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Draft Environmental Assessment for the Proposed Amendment of Source Material License SUB–1435 Jefferson Proving Ground, Southeastern Indiana (Jefferson, Ripley, and Jennings Counties)

U.S. Department of the Army
Docket No. 040-08838

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

On December 21, 2016, the U.S. Department of the Army (Army) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) to amend Source Material License SUB–1435 from “possession only for decommissioning” to “possession only” and exempt the Army from the decommissioning timeliness requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) 40.42(d). Source Material License SUB–1435 currently authorizes possession only by the Army of up to 80,000 kilograms (kg) [176,370 pounds (lb)] of depleted uranium (DU) metal, alloy, and/or other forms, kept onsite, for the purpose of decommissioning, in the restricted area known as the “Depleted Uranium Impact Area” (DU Impact Area) at the Jefferson Proving Ground (JPG) in southeastern Indiana. If the NRC grants the amendment and the exemption requests, the NRC staff anticipates establishing a license condition that would exempt the Army from the need to submit a decommissioning plan for 20 years, at which time the Army would be required to submit a license amendment request and provide a basis for continuing the exemption. The proposed action analyzed in this environmental assessment (EA) accounts for a possession-only license and decommissioning timeliness exemption term of 20 years.

JPG was used by the Army between 1941 and 1994 for the test-firing of a wide variety of conventional explosive munitions. During that time, more than 24 million rounds were fired. Approximately 1.5 million rounds did not detonate upon impact, remaining as unexploded ordinance (UXO) on or beneath the ground surface, along with an additional 3 to 5 million rounds with live detonators, primers, or fuses. As part of its munitions testing program, the Army also test-fired DU projectiles (also known as DU penetrators) into the 8.4-square kilometers (km^2) [2,080-acres (ac)] DU Impact Area, which is located within the 224-km^2 [55,265-ac] JPG installation. The DU test firings began on March 18, 1984, and concluded on May 2, 1994.

The Army estimates that a “very high” density of high-explosive UXO (i.e., 85 UXO/ac) is present in the DU Impact Area. The hazard associated with the UXO has been the principal factor affecting the Army’s decisions concerning the status of Source Material License SUB–1435 and management of the DU Impact Area. The purpose of the proposed action is to allow the Army to delay decommissioning until the UXO in the vicinity of DU within the DU Impact Area can be considered inert, or until technology becomes available that would make it economically feasible to safely remove the DU from the site. The need for NRC action is to ensure the safe use (in this case, possession) of radioactive materials. The Army needs to delay remediation of the DU Impact Area because remediation is complicated by the presence of UXO and the associated risk of potential explosions. Further, the Army estimates that the cost to clean up the DU Impact Area to unrestricted use conditions using current technology is $3.2 billion, which the Army states is prohibitively expensive.

If the NRC approves the license amendment and exemption requests as proposed, (i) the licensed DU material would remain onsite in the DU Impact Area; (ii) institutional controls that the Army has established under a Memorandum of Agreement with the U.S. Fish and Wildlife Service and U.S. Air Force would remain in effect to maintain legally enforceable access controls and land use restrictions over areas of JPG, including the DU Impact Area; and (iii) an Environmental Radiation Monitoring Program would be implemented by the Army for detecting DU leaving the DU Impact Area.

Based on its review of the proposed action relative to the requirements set forth in 10 CFR Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions,” that implement the National Environmental Policy Act of 1969 (NEPA), as amended, the NRC staff has preliminarily determined that amending Source Material License

SUB–1435 to possession-only and granting an exemption to NRC's decommissioning timeliness requirements for a period of 20 years will not significantly affect the quality of the human environment. Based on this preliminary assessment and in accordance with 10 CFR 51.31, the NRC staff has concluded that the proposed action does not warrant the preparation of an Environmental Impact Statement, and, pursuant to 10 CFR 51.32, a Finding of No Significant Impact is appropriate.

ABBREVIATIONS AND ACRONYMS

ac	acre
ACHP	Advisory Council on Historic Preservation
ALARA	as low as reasonably achievable
Army	U.S. Department of the Army
BONWR	Big Oaks National Wildlife Refuge
BMPs	Best Management Practices
BRAC	Base Realignment and Closure
CAA	Clean Air Act
CCP	Comprehensive Conservation Plan
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CNWRA	Center for Nuclear Waste Regulatory Analyses
CRMP	Cultural Resources Management Plan
DEGDN	diethylene glycol dinitrate
DERP	Defense Environmental Restoration Program
DFW	Division of Fish and Wildlife
DHPA	Division of Historic Preservation and Archaeology
DNP	Division of Nature Preserves
DO	dissolved oxygen
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DP	decommissioning plan
DU	depleted uranium
E. coli	Escherichia coli
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ER	environmental report
ERMP	Environmental Radiation Monitoring Plan
ESA	Endangered Species Act
FMP	fire management plan
ft	feet
ft/s^2	feet per second squared
GHG	Greenhouse Gases
Gpm	gallons per minute
ha	hectares
HMX	Her Majesty's Explosive
IAEA	International Atomic Energy Agency
IBCs	impaired biotic communities
ICCP	Interim Comprehensive Conservation Plan
ICRMP	Integrated Cultural Resources Management Plan

ICRP	International Commission on Radiological Protection
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
in	inch
INANG	Indiana Air National Guard
INDOT	Indiana Department of Transportation
INRMP	Integrated Natural Resource Management Plan
JPG	Jefferson Proving Ground
kg	kilograms
km	kilometers
km^2	square kilometers
L/min	liters per minute
lb	pound
LLRW	low-level radiological waste
m/s^2	meters per second squared
m	meter
m^2	square meters
MCs	munitions constituents
MCL	maximum contaminant level
MEC	munitions and explosives of concern
mi	mile
mg/L	milligrams per liter
mm	millimeter
MMRP	Military Munitions Response Program
MOA	Memorandum of Agreement
mrem/yr	millirem per year
mSv/yr	millisieverts per year
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act of 1966
NLEB	Northern long-eared bat
NOAA	National Oceanic and Atmospheric Administration
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
PA	Programmatic Agreement
pCi/L	picocuries per liter
PGM	Precision-Guided Munitions
ppb	parts per billion
ppm	parts per million
RDX	Royal Demolition Explosive

SEIRD	Southeastern Indiana Recycling District
SER	Safety Evaluation Report
SHPO	State Historic Preservation Officer
SIRPC	Southeastern Indiana Regional Planning Commission
TDS	total dissolved solids
TEDE	total effective dose equivalent
THPO	Tribal Historic Preservation Officer
TNT	trinitrotoluene
ug/L	micrograms per liter
USAF	U.S. Air Force
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGCRP	U.S. Global Change Research Program
USGS	United States Geological Survey
UXO	unexploded ordinance

1 INTRODUCTION

The U.S. Nuclear Regulatory Commission (NRC) staff prepared this Environmental Assessment (EA) in response to the December 21, 2016, request (U.S. Army, 2016) submitted by the U.S. Department of the Army (Army) to amend NRC Source Material License SUB–1435 from “possession only for decommissioning” to “possession only” and exempt the Army from the decommissioning timeliness requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) 40.42(d). The NRC staff was assisted in this effort by the NRC’s contractor, the Center for Nuclear Waste Regulatory Analyses (CNWRA®), San Antonio, Texas. Source Material License SUB–1435 currently authorizes possession only by the Army of up to 80,000 kilograms (kg) [176,370 pounds (lb)] of depleted uranium (DU) metal, alloy, and/or other forms, kept onsite, for the purpose of decommissioning, in the restricted area known as the “Depleted Uranium Impact Area” (DU Impact Area) at the Jefferson Proving Ground (JPG) in southeastern Indiana (NRC, 2013a) (Figure 1-1).

> Depleted uranium (DU) is a byproduct of uranium enrichment. DU is uranium with a percentage of the uranium-235 isotope lower than 0.7 percent (by mass) contained in natural uranium. The normal residual uranium-235 content in DU is 0.2–0.3 percent, with the uranium-238 isotope composing 98.7–98.8 percent. Because of its high density (1.7 times that of lead), DU is used by the U.S. military as penetrators in armor-piercing, anti-tank projectiles.

Under the “proposed action” that is evaluated in detail in this EA, residual radioactive material (i.e., all DU material remaining in the DU Impact Area at JPG) would remain in place and institutional controls would be maintained by the Army to minimize exposure to the public and the environment. The proposed action is further described in Sections 1.2 and 2.1 of this EA. Another alternative evaluated in detail in this EA is the no-action alternative (described in Section 2.2).

> *Institutional controls* are defined in NUREG–1757, Vol. 1, Rev. 2 (NRC, 2006), as measures to control access to a site and minimize disturbances to engineered measures established by the licensee to control the residual radioactivity. Institutional controls include administrative mechanisms (e.g., land use restrictions) and may include, but are not limited to, physical controls (e.g., signs, markers, landscaping, and fences).

This EA was prepared in accordance with applicable requirements in the NRC’s regulations under Title 10, Energy, of the 10 CFR Part 51 (“Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions”). The NRC regulations under 10 CFR Part 51 implement the requirements of the National Environmental Policy Act of 1969 (NEPA), as amended (P.L. 91-190). NEPA requires Federal agencies to assess the potential environmental impacts of Federal actions affecting the quality of the human environment.

On August 28, 2013, the Army submitted a license amendment application requesting termination of Source Material License SUB–1435 and release of the DU Impact Area at JPG under restricted conditions, in accordance with NRC regulations in 10 CFR 20.1403 (“Criteria for license termination under restricted conditions”) (U.S. Army, 2013a–c). The information and assessments presented in this EA were adapted from an environmental impact statement (EIS) that was being prepared for this previously proposed Federal action. Because much of the information from that EIS remains applicable to the current proposed action, the NRC staff has determined that it would be in the public interest to retain and publish that information in the EA. Therefore, the format and length of this EA do not specifically conform to the guidelines for format and length for EAs outlined in NRC staff guidance in NUREG–1748, Environmental Review Guidance for Licensing Actions Associated with NMSS Programs (NRC, 2003).

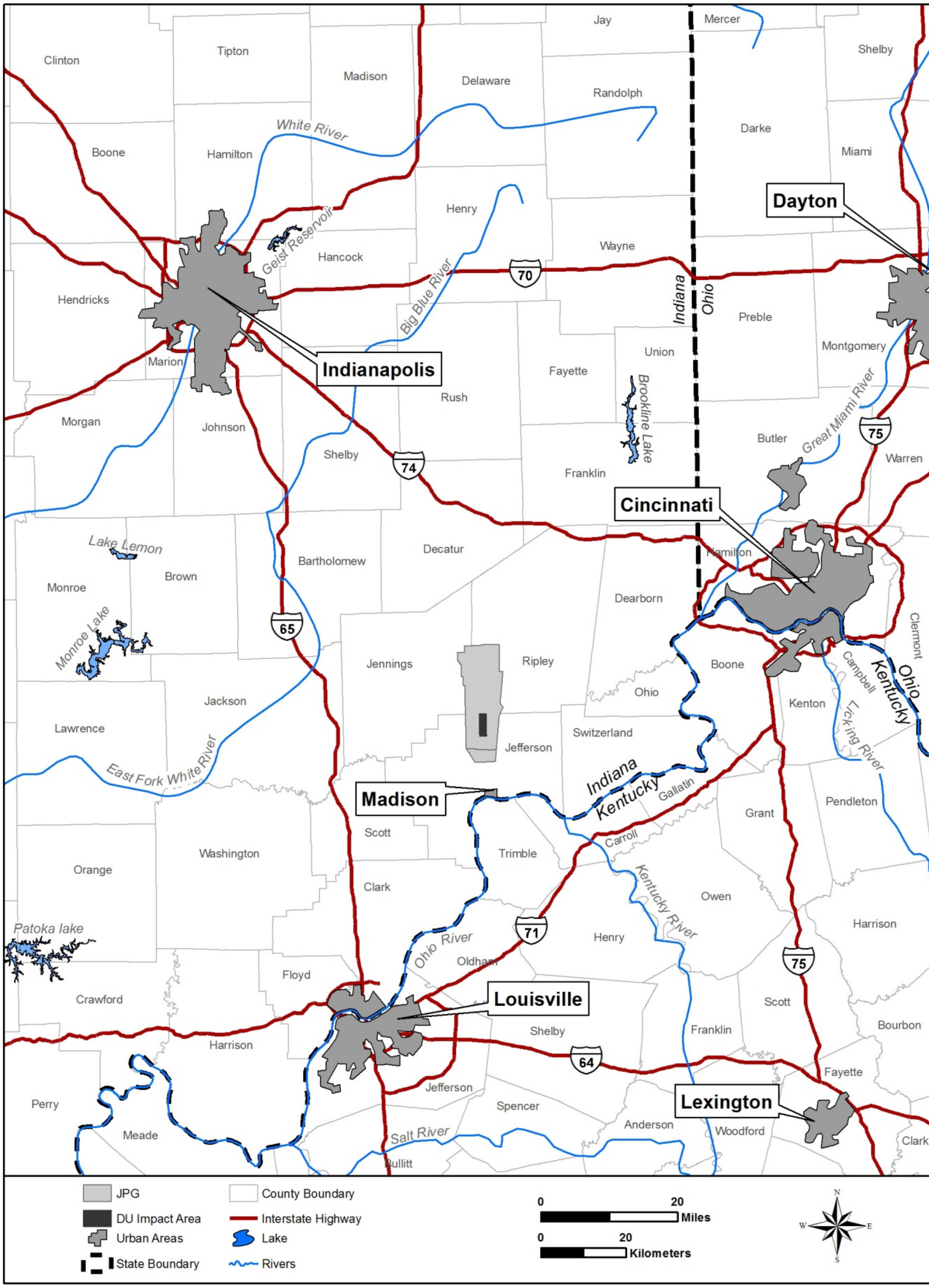

Figure 1-1. Location of JPG and the DU Impact Area in Southeastern Indiana

1.1 Background

JPG was established in 1940 on 224 square kilometers (km^2) [55,265 acres (ac)] in parts of Jefferson, Ripley, and Jennings counties in southeastern Indiana (see Figure 1-1) for the purpose of production and specification testing of conventional ammunition components (U.S. Army, 2013a). The nearest population center is Madison, Indiana, located approximately 8 kilometers (km) [5 miles (mi)] south of JPG. Major metropolitan areas near JPG include Indianapolis, Indiana, to the north-northwest; Louisville, Kentucky, to the southwest; and Cincinnati, Ohio, to the northeast (see Figure 1-1).

A firing line with 268 fixed-gun positions separated JPG into two areas: a 17.5-km^2 [4,314-ac] southern portion (commonly referred to as the "Cantonment Area") and a 206-km^2 [50,950-ac] northern portion (Figure 1-2). Currently, the Army owns all property north of the firing line. Property south of the firing line has been or is in the process of being transferred from Army control to public and private ownership (see Section 3.2.2). Pursuant to the "Jefferson Proving Ground Firing Range Memorandum of Agreement (MOA)," entered into by the Army, the U.S. Air Force (USAF), and the U.S. Fish and Wildlife Service (USFWS), dated May 2000, the Army granted real estate permits transferring the Army's administrative control over all property north of the firing line to the USFWS, except for two discrete areas that were transferred to the USAF (U.S. Army, 2000). Under the terms of the MOA, the USFWS operates the Big Oaks National Wildlife Refuge (BONWR) on approximately 206 km^2 [50,950 ac] in the northern part of JPG (including the DU Impact Area) and the Indiana Air National Guard (INANG) operates two bombing practice ranges for the USAF on 4.2 km^2 [1,038 ac] within the BONWR (see Figure 3-3 for location of bombing training ranges within BONWR), both under 25 year leases with 10-year renewal options. However, as specified under the terms of the MOA, the Army remains responsible for remediation of all contamination resulting from Army activities, including the ultimate remediation and control of all DU in the NRC-licensed DU Impact Area (U.S. Army, 2000).

JPG was used by the Army between 1941 and 1994 for the test firing of a wide variety of conventional explosive munitions into the area north of the firing line. During that time, more than 24 million rounds were fired. The types of munitions tested varied from 20-millimeter (mm) [0.8-inch (in)] small-caliber projectiles to 0.9-metric ton [2,000-pound (lb)] bombs. Approximately 1.5 million rounds did not detonate upon impact, remaining as unexploded ordnance (UXO) on or beneath the ground surface, along with an additional 3 to 5 million rounds with live detonators, primers, or fuses.

> Unexploded ordnance (UXO) refers to explosive weapons (bombs, shells/artillery projectiles, grenades, missiles, etc.) that did not explode when they were fired or dropped and still pose a risk of detonation, even many decades after they were used or discarded. Most UXO in the United States is the result of weapons systems testing and troop training activities conducted by the Department of Defense. Property containing UXO includes active military sites, land already transferred to private ownership, such as formerly used defense sites, and land that is no longer being used for military purposes but is still under the ownership of the U.S. Government, such as Base Realignment and Closure (BRAC) sites.

As part of its munitions testing program, the Army also test-fired DU projectiles (also known as DU penetrators) into the 8.4-km^2 [2,080-ac] DU Impact Area, which is located north of the firing line (see Figure 1-2). The DU test firings began on March 18, 1984, and concluded on May 2, 1994.

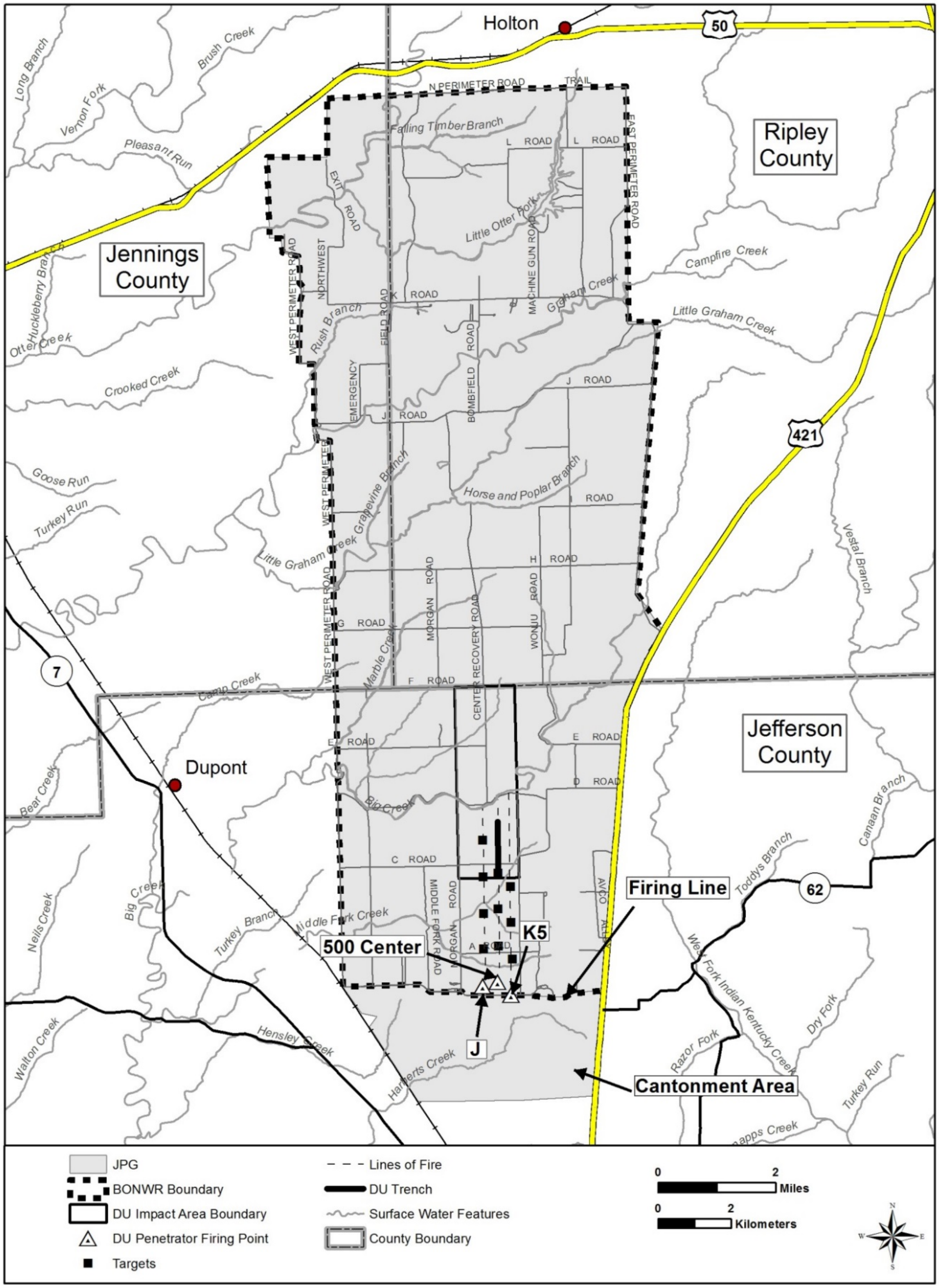

Figure 1-2. **Map Showing JPG Site Features, Including the DU Impact Area, Firing Line, Cantonment Area, and BONWR Boundary (Modified from U.S. Army, 2013a)**

The DU penetrators were fired at stationary cloth targets from three fixed-gun positions: the 500 Center, J, and K5 firing positions shown in Figure 1-2. The cloth targets were spaced at 1,000-meter (m) [305-feet (ft)] intervals starting at 1,000 m [3,281 ft] and extending as far as 4,000 m [13,124 ft] downrange of the gun positions. The DU penetrators fired at JPG were composed of a DU body with aluminum nose cone and tail fins to stabilize the round in flight (Figure 1-3). The DU penetrators were fired from either 105-mm [4.1-in] or 120-mm [4.7-in] tank guns into the DU Impact Area (U.S. Army, 2013b). Figure 1-4 shows the dimensions and weights of the DU penetrators fired into the DU Impact Area. DU penetrators fired from 105-mm [4.1-in] tank guns weighed approximately 3.9 kg [8.5 lb] and penetrators fired from 120-mm [4.7-in] tank guns weighed approximately 4.9 kg [10.7 lb].

Once fired, the DU penetrators traveled through the cloth targets and continued to travel downrange until losing kinetic energy and falling to the ground in the DU Impact Area. The penetrators tended to skip and ricochet upon impact with the ground, which allowed them to travel considerable distances downrange even after impact (U.S. Army, 2013b). The majority of the DU penetrators remained intact after being fired; however, some broke into pieces upon ground impact.

Approximately 100,000 kg [220,462 lb] of DU projectiles were fired into the DU Impact Area. Approximately 89 percent {65,415 kg [144,214 lb]} of DU penetrators were fired from the 500 Center firing position, 7 percent {5,145 kg [11,343 lb]} were fired from the J firing position, and 4 percent {2,940 kg [6,482 lb]} were fired from the K5 firing position (U.S. Army, 2013a). Because DU penetrator firing occurred from three specific fixed-gun positions and the penetrators were fired at stationary targets within a relatively narrow area at JPG (see Figure 1-2), the DU penetrators impacted the ground in nearly the same areas in narrow corridors along their respective lines of fire. Repeated impacts along the line of fire of the 500 Center firing position, from which 89 percent of the test firing occurred, resulted in the formation of a trench (shown as the "DU Trench" in Figure 1-2 and labeled as the "DU Trench" in the photograph in Figure 1-5). A second smaller trench was identified for the J firing position (labeled as the "DU Trench" in the photograph in Figure 1-6), from which 7 percent of the penetrator test firing occurred.

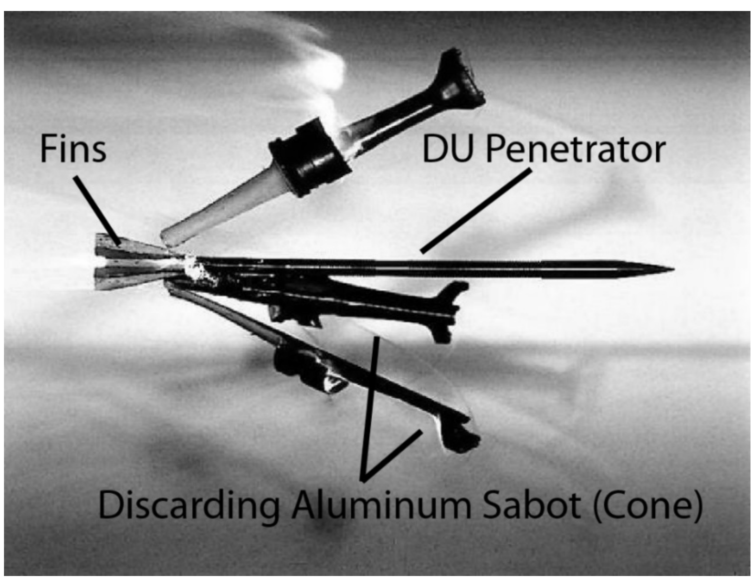

Figure 1-3. Photograph of DU Penetrator Fired at JPG (Modified from U.S. Army,2013b)

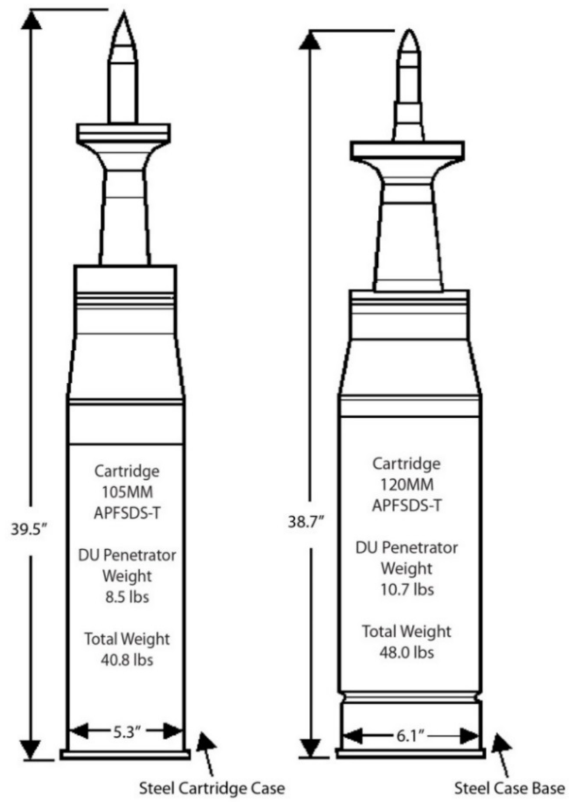

Figure 1-4. Dimensions and Weights of DU Penetrators Fired at JPG (U.S. Army, 2013b)

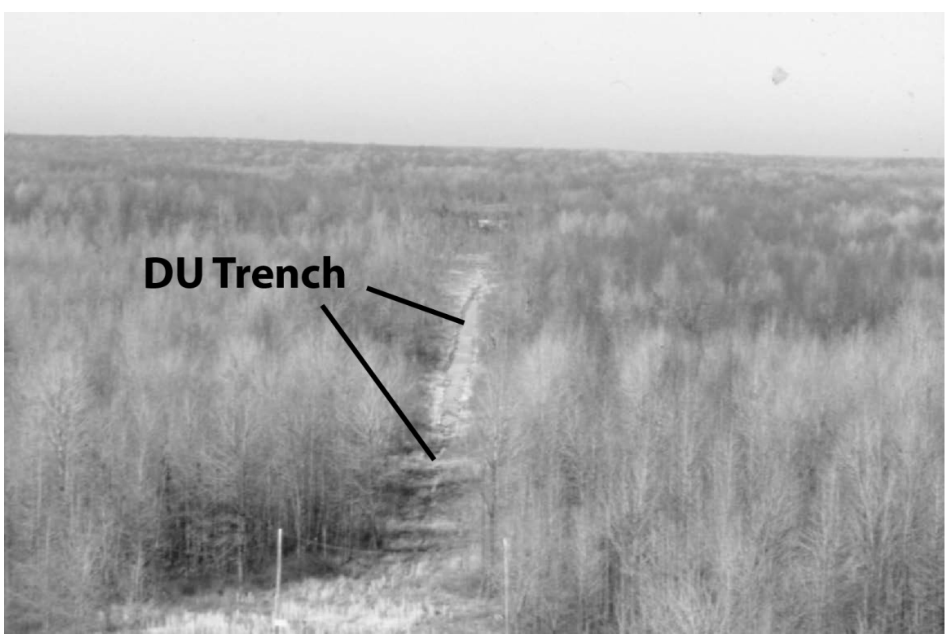

Figure 1-5. 500 Center Firing Position DU Trench (U.S. Army, 2013a)

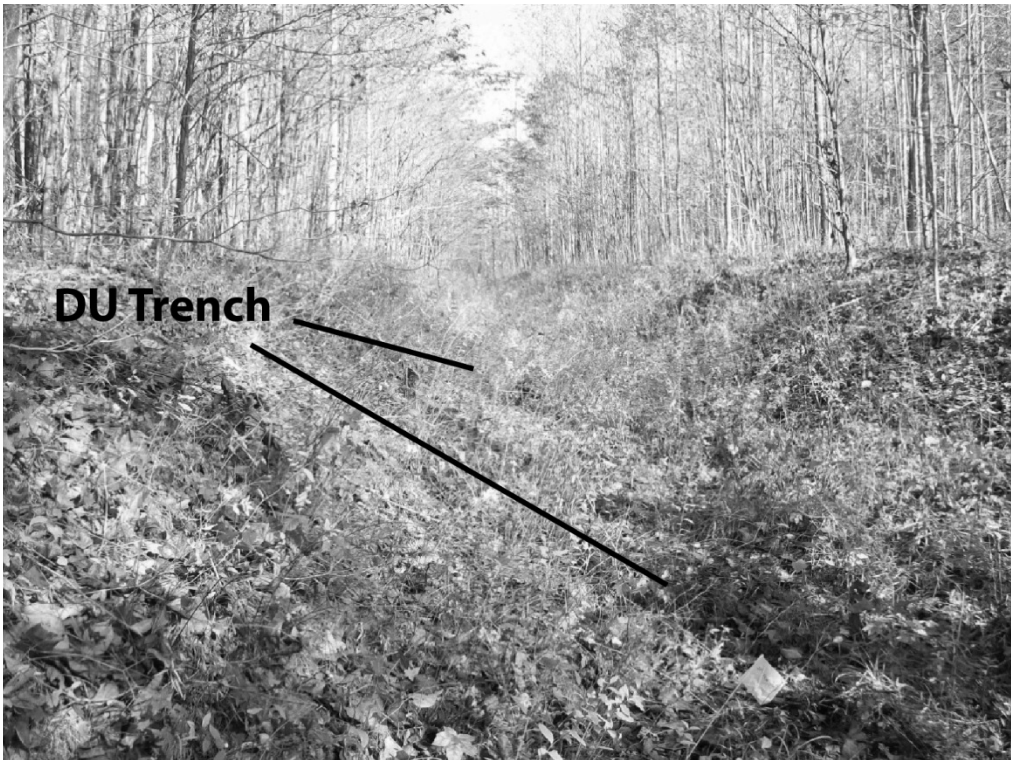

Figure 1-6. J Firing Position DU Trench (U.S. Army, 2013a)

Approximately 26,500 kg [58,423 lb] of DU penetrators and penetrator fragments on or near the ground surface were recovered during periodic collection events by the Army (U.S. Army, 2013b). Approximately 73,500 kg [162,040 lb] of DU remain in the DU Impact Area as DU penetrators, penetrator fragments, and degradation (i.e., corrosion) products (Figure 1-7). Based on the penetrator weights shown in Figure 1-4 and the approximately 73,500 kg [162,040 lb] of residual DU, approximately 15,000 to 19,000 penetrators could be present in the DU Impact Area (U.S. Army, 2013b). In addition, the Army estimates that a “very high” density of high-explosive UXO {i.e., 85 UXO/ac [1 ac = 4,047 m^2]} is present in the DU Impact Area (U.S. Army, 2013a, b). The UXO is a hazard that has been a major factor in the Army’s decisions concerning management of the area of JPG north of the firing line (U.S. Army, 2013b).

In 1989, JPG was identified for base closure under the *Base Realignment and Closure Act* (P.L. 100-256). Base Realignment and Closure (BRAC) was established to identify military installations that should be realigned or closed as a means of realizing long-term defense budget savings while not impairing the ability of the various branches of the military to carry out their respective missions. As a result of BRAC, the Army’s testing mission at JPG was realigned to Yuma Proving Ground in Arizona (U.S. Army, 1991). Operational closure of JPG occurred on September 30, 1994, and final closure of JPG occurred on September 30, 1995 (U.S. Army, 1991). Following closure, areas south of the firing line, including buildings and facilities where DU was stored, were surveyed and decontaminated. After resurveying to verify compliance with NRC decommissioning criteria, the total area south of the firing line was released for unrestricted use by NRC in May 1996 (NRC, 1996a). Source Material License SUB–1435 was also amended in May 1996 for possession only of up to 80,000 kg [176,370 lb] of DU in the DU Impact Area, for the purpose of decommissioning (U.S. Army, 2013b).

Figure 1-7. Photograph of Excavated DU Penetrator at JPG

Since permanent closure and cessation of DU munitions testing at JPG, the Army has sought to comply with NRC requirements for decommissioning of the DU Impact Area, in accordance with regulations in 10 CFR 40.42 ("Expiration and termination of licenses and decommissioning of sites and separate buildings or outdoor areas"). However, the presence of UXO, the associated risk of potential explosions, and the high cost for cleanup complicate remediation activities at the DU Impact Area and in other areas of JPG north of the firing line. The Army submitted a decommissioning plan (DP) in 1999 (U.S. Army, 1999) but withdrew that DP and submitted a new DP in 2001 (U.S. Army, 2001). The NRC did not accept the 2001 DP. The Army submitted a revised DP in 2002 (U.S. Army, 2002), but in 2003 withdrew the revised DP and requested that the possession-only license be issued for a 5-year renewable period indefinitely. Subsequently, the Army withdrew the 2003 request and began various studies aimed towards decommissioning the DU Impact Area. These studies included leachate/corrosion studies; groundwater age dating; aquifer parameters; electrical imaging; radiation monitoring; computer modeling; and soil, groundwater, surface water, and sediment analyses.

In 2013, the Army submitted a revised environmental report (ER) (U.S. Army, 2013a) and DP (U.S. Army, 2013b), which documented these studies, as part of its request to terminate Source Material License SUB–1435 and release the DU Impact Area under restricted conditions in accordance with NRC regulations in 10 CFR 20.1403 ("Criteria for License Termination Under Restricted Conditions") (U.S. Army, 2013c). To meet its obligations under NEPA, the NRC announced its intent to begin preparing an EIS and conduct scoping (79 FR 65256; November 3, 2014). The NRC held a public meeting, gathered public comments, conducted a site visit, conducted information-gathering meetings, and initiated interagency consultations.

Relevant information from these efforts is contained in a publicly available scoping summary report (NRC, 2015a) and site visit and information-gathering report (NRC, 2015b). The Army withdrew its 2013 license amendment application in 2015 (U.S. Army, 2015a), and NRC ceased EIS development efforts.

In December 2016, the Army submitted a request to amend Source Material License SUB–1435 from "possession only for decommissioning" to "possession only" and to grant an exemption from the decommissioning timeliness requirements in 10 CFR 40.42(d) (U.S. Army, 2016). The NRC has determined that developing an EA is appropriate for assessing the potential impacts of this proposed license amendment and exemption (NRC, 2017a). Because no ground-disturbing activities would occur as a result of this proposed action, most of the potential impacts are very similar to the potential impacts from the previously proposed release of the site under restricted conditions. Therefore, as applicable to this proposed action, the NRC has used information that was developed for the previously proposed license termination request to prepare this EA. This includes information related to scoping and other initial EIS development efforts, as well as site characterization information contained in the Army's ER (U.S. Army, 2013a) and DP (U.S. Army, 2013b).

1.2 The Proposed Action

The proposed action is for the NRC to (i) amend Condition 9 of Source Material License SUB–1435 to change the authorized use of licensed material from "possession only for decommissioning" to "possession only," and (ii) grant an exemption from the NRC's decommissioning timeliness requirements in 10 CFR 40.42(d). Under the proposed action and in accordance with current license conditions, the licensed DU material would remain onsite in the restricted area known as the DU Impact Area at JPG. In accordance with the MOA established in 2000 with the USFWS and USAF (U.S. Army, 2000), the Army would continue to maintain institutional control and implement land use restrictions over the approximately 206-km^2 [50,950-ac] area north of the firing line, including the DU Impact Area. Under the terms of the MOA, the Army would remain responsible for remediation of all contamination resulting from Army activities, including the ultimate remediation and control of all DU in the NRC-licensed DU Impact Area. In addition, the Army would modify its Environmental Radiation Monitoring Plan (ERMP) to focus on effluent monitoring rather than site characterization. The revised ERMP includes sampling of surface water and sediment on two creeks (Middle Fork Creek and Big Creek) at locations where flowing water in these creeks exits the DU Impact Area and JPG installation and at four groundwater monitoring wells upgradient, within, and downgradient of the DU Impact Area (U.S. Army, 2018, 2016).

The various components of the proposed action (i.e., institutional controls and land use restrictions, revised ERMP, and exemption from decommissioning timeliness requirements) are discussed in detail in Section 2.1 of this EA.

1.3 Purpose and Need for the Proposed Action

The purpose of the proposed action is to allow the Army to delay decommissioning until the UXO in the vicinity of DU within the DU Impact Area can be considered inert, or until technology becomes available that would make it economically feasible to safely remove the DU from the site. The need for NRC action is to ensure the safe use (in this case, possession) of radioactive materials. The Army needs to delay remediation of the DU Impact Area because remediation is complicated by the presence of UXO, the associated risk of potential explosions, and the associated cleanup cost. Decommissioning of the DU Impact Area to unrestricted release conditions would be unduly hazardous to workers and prohibitively expensive (estimated at $3.2 billion) (U.S. Army, 2016). A possession-only license that requires institutional controls and continued environmental monitoring would ensure the maintenance of worker and public safety and land use restrictions until technology becomes available to address the UXO.

1.4 Basis for Review

To fulfill its responsibilities under NEPA, the NRC has prepared this EA to analyze the potential environmental impacts (i.e., direct, indirect, and cumulative impacts) of the proposed action and reasonable alternatives to the proposed action. The EA includes consideration of both radiological and nonradiological impacts. The NRC staff performed this review in accordance with the requirements of 10 CFR Part 51 and staff guidance in NUREG–1748 (NRC, 2003).

The NRC staff reviewed and considered the following documents in the development of this EA:

- Army license amendment request dated December 21, 2016 (U.S. Army, 2016)
- Previous Army license amendment application dated August 28, 2013 (U.S. Army, 2013a-c) and Army responses to NRC requests for additional information (RAIs) (U.S. Army, 2018, 2015b-c)
- Information gathered from the EIS-related scoping process and associated public participation activities (NRC, 2015a)
- Information gathered from previous NRC site visits, including information provided by the public, organizations, and municipal, State, and Federal agencies (including the Army) (NRC, 2015b)
- Information from ERMP reports for 2004 through 2016 (U.S. Army, 2013a, 2017)
- NRC's consultation with Federal agencies, Indian tribes, and State and local government agencies (see Chapter 6)

In addition, the development of this EA was closely coordinated with the development of the NRC's Safety Evaluation Report (SER), which is the outcome of the NRC staff's safety review of the Army's license amendment and exemption request. The SER evaluates the radiological consequences of the Army's proposed action to determine if that action can be accomplished safely and in compliance with applicable NRC regulations.

1.5 Issues Addressed in Detail

Considering the proposed action, as described in Section 1.2, and issues and concerns raised by the public, agencies, and organizations during past scoping and information-gathering activities (NRC, 2015a,b), the NRC staff identified areas to be addressed in detail in this EA. As stated in Section 1.1, most of the potential impacts from the proposed action are the same as or very similar to the potential impacts from the previously proposed license termination under restricted release conditions. Areas and issues identified by the NRC staff that need to be conducted as part of the NEPA process evaluated in the EA and/or could be subject to short- or long-term impacts resulting from implementation of the proposed action are as follows:

- Agency consultations
- Regulatory issues and requirements
- Alternatives

- Land use
- Geology and soils
- Water resources (groundwater and surface water)
- Ecological resources
- Meteorology, climatology, and air quality (including climate change)
- Public and occupational health
- Environmental justice
- Cumulative impacts

1.6 Issues Eliminated From Detailed Study

The NRC staff has determined that detailed analyses associated with transportation, minerals, noise, historic and cultural resources, visual and scenic resources, socioeconomics, and waste management are not necessary, because these resource areas would not be affected by the proposed action (see Section 1.2) or the no-action alternative (see Section 2.2). The reasons for eliminating these issues from detailed study are discussed in Appendix A of this EA.

2 PROPOSED ACTION AND ALTERNATIVES

This chapter describes the proposed action and no-action alternative to the proposed action that are evaluated in detail in this Environmental Assessment (EA). The proposed action is described in Section 2.1, and the no-action alternative is described in Section 2.2. Consideration of the no-action alternative is required under the National Environmental Policy Act of 1969 (NEPA), as amended, and serves as a baseline for comparing alternatives.

The U.S. Nuclear Regulatory Commission (NRC) staff identified no other reasonable alternatives to the proposed action for detailed evaluation. In the NRC staff's guidance in NUREG–1748, "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs" (NRC, 2003), the NRC defines *reasonable alternatives* as those alternatives that meet the proposal objectives and applicable environmental standards and are technically feasible. NRC staff considered license termination and decommissioning under unrestricted conditions as an alternative to the proposed action. Under this alternative, the U.S. Department of Army (Army) would remove the depleted uranium (DU) in the DU Impact Area to meet the radiological criteria for unrestricted use specified in Title 10 of the *Code of Federal Regulations* (10 CFR) 20.1402 ("Radiological Criteria for Unrestricted Use"), and the NRC would terminate the license. However, as discussed in Section 2.3, the NRC staff has eliminated this alternative from detailed consideration in the EA.

2.1 <u>The Proposed Action</u>

As described in Section 1.2 of this EA, the proposed action is for the NRC to amend Source Material License SUB–1435 from "possession only for decommissioning" to "possession only" and to grant an exemption from the decommissioning timeliness requirements in 10 CFR 40.42(d). The material currently in the DU Impact Area at Jefferson Proving Ground (JPG) would remain in place. This material would be subject to the Army's commitments for institutional controls that the Army has established under the Memorandum of Agreement (MOA) with the U.S. Fish and Wildlife Service (USFWS) and U.S. Air Force (USAF) to maintain legally enforceable access controls and land use restrictions over the DU Impact Area and other areas of JPG north of the firing line {approximately 206 square kilometers (km^2) [50,950 acres (ac)]} (U.S. Army, 2000). If the NRC grants the amendment and exemption, the NRC staff would establish a license condition that would exempt the Army from the need to submit a decommissioning plan for 20 years, at which time the Army would be required to submit a license amendment request and provide a basis for continuing the exemption. The proposed action analyzed in this EA accounts for a possession-only license and a decommissioning timeliness exemption term of 20 years. The NRC staff would re-evaluate the terms of the license in light of site conditions and technological developments available at the time of any future review for license renewal or an extension of the exemption.

As part of the proposed action, the Army would modify its Environmental Radiation Monitoring Plan (ERMP). The current ERMP was designed for site characterization and includes sampling of surface soil, sediment, groundwater, and surface water inside and at the boundary of the DU Impact Area and at the boundary of the JPG installation (U.S. Army, 2004, 2003a). The proposed revised ERMP is designed for effluent monitoring (i.e., detecting DU leaving the DU Impact Area) and includes sampling surface water and sediment on two creeks (Big Creek and Middle Fork Creek) at locations where flowing water in these creeks exits the DU Impact Area and JPG installation and groundwater at four wells upgradient, within, and downgradient from the DU Impact Area (U.S. Army, 2018, 2016).

The components of the proposed action include the maintenance of institutional controls and monitoring under the conditions of the possession-only license and an exemption from the decommissioning timeliness requirement. These elements are discussed in the sections below.

2.1.1 Institutional Controls and Land Use Restrictions

Because the Army owns the land and UXO is present, the Army would continue to maintain institutional control of the approximately 206-km^2 [50,950-ac] area north of the firing line, including the DU Impact Area (U.S. Army, 2016). Institutional controls that have been implemented by the Army include (i) physical access restrictions to prevent unauthorized entry (e.g., perimeter chain-link fence with pad locked chain-link fence gates, security warning signs placed around the property to caution persons not to enter); (ii) legal controls (e.g., the Army as an agency of the Federal Government and an enduring entity retains property ownership of JPG north of the firing line); and (iii) administrative controls (e.g., restricted and limited public access and hunting prohibitions) over the JPG site, including the DU Impact Area (U.S. Army, 2016, 2013a).

As described in Section 1.1, under an MOA established in 2000 between the Army, the USFWS, and the USAF, the USFWS operates the Big Oaks National Wildlife Refuge (BONWR) on the approximately 206-km^2 [50,950-ac] area north of the firing line (including the DU Impact Area) and the Indiana Air National Guard (INANG) operates a bombing practice range for the USAF on 4.2 km^2 [1,038 ac] within the BONWR, both under 25-year leases with 10-year renewal options (U.S. Army, 2000). The bombing practice range includes an approximate 0.2 km^2 [50 ac] laser bombing range and an approximately 4 km^2 [983 ac] conventional bombing range. When in use, the bombing ranges have large safety fans (see Figure 3-3) that are off limits to BONWR personnel and visitors during flight operations involving laser energy or munitions training (U.S. Army, 2000).

Under the 2000 MOA, INANG, and USFWS were assigned infrastructure maintenance and site access responsibilities for the area north of the firing line (U.S. Army, 2000). INANG is responsible for patrolling, inspecting, and maintaining the perimeter fence and related infrastructure to ensure the overall security at JPG. In addition to the fencing materials and gates, the perimeter fence infrastructure includes security warning signs (“No Trespassing” and “Warning”) as well as the road system associated with the perimeter fence. INANG is required to inspect the perimeter fence weekly and repair damaged gates and holes in the fence within 72 hours of being documented (U.S. Army, 2000). INANG is also responsible for maintenance of locked road barricades north of the firing line.

USFWS is responsible for controlling public access to BONWR. As a requirement of the 2000 MOA, USFWS developed a public access plan (USFWS, 2012a) that identifies appropriate public uses of BONWR and ensures all visitors are provided unexploded ordinance (UXO), DU, and environmental contamination safety/awareness training. Visitors to the BONWR must check in and out and receive a safety briefing from the USFWS before being issued a public access permit. Public access to the refuge is controlled at a single gate and is limited to two areas: the limited day-use recreation area and special controlled hunting zones (see Figure 3-3 for the locations of these areas within JPG).

In 2016, the Army, in coordination with the USFWS and USAF, redrafted the 2000 MOA to clarify roles and responsibilities. This MOA is currently in draft form, but the Army has stated that “it is similar in content to the original MOA, with the exception that the land use permits will be granted for 99-year leases, with 9-year required reviews of the MOA (U.S. Army, 2016).”

2.1.2 ERMP for the DU Impact Area

Under the proposed action, the Army would modify its ERMP for the DU Impact Area. The current ERMP was designed to characterize the effects on human health and the environment of potential radiological releases from the DU Impact Area. The current ERMP includes semi-annual sampling of surface soil, sediment, groundwater, and surface water inside and at the boundary of the DU Impact Area and at the boundary of the JPG installation (U.S. Army, 2004, 2003a). The current ERMP sampling locations for surface soil, surface water, sediment, and groundwater are shown in Figure 2-1.

The proposed revised ERMP is designed for effluent monitoring (i.e., detecting DU leaving the DU Impact Area) and includes semi-annual collection of collocated surface water and sediment samples from four locations downstream of the DU Impact Area where surface water flows throughout the year and groundwater samples from four monitoring wells upgradient, within, and downgradient of the DU Impact Area (U.S. Army, 2018, 2016). Flowing surface water traversing the DU Impact Area and water infiltrating into the soil and overburden and reaching the water table are potential pathways for mobilization and transport of DU. DU has been detected in surface water and groundwater samples at JPG; however, DU concentrations have always been well within NRC effluent limits and U.S. Environmental Protection Agency (EPA) drinking water standards (see Sections 4.4.1.1 and 4.4.1.2) (U.S. Army, 2017, 2013a). Water flowing out of the DU Impact Area could carry DU in suspended sediment. Sediment sampling at JPG has on occasion detected small amounts of DU inside the DU Impact Area but never outside the DU Impact Area (see Section 4.4.1.1) (U.S. Army, 2017, 2013a).

All four surface water and sediment sampling locations in the Army's revised ERMP are current monitoring locations along Big Creek and Middle Fork Creek. These streams flow through the JPG site in a northeast to southwest direction. Two sampling locations (SW–DU–007/SD–DU–007 and SW–DU–008/SD–DU–008) are close to the DU Impact Area boundary (see Figure 2-1) and were selected for detecting any DU that might be entering areas at JPG open to the public. The other two sampling locations (SW–DU–001/SD–DU–001 and SW–DU–002/SD–DU–002) are at the JPG installation boundary (see Figure 2-1) and were selected for detecting any DU that might be exiting the JPG property.

All four groundwater sampling locations in the Army's revised ERMP are current monitoring wells and were selected based on the prevailing west-southwest groundwater flow direction at the JPG site and potential for DU contribution (U.S. Army, 2018). These wells include MW–DU–001, MW–DU–005, MW–DU–006, and MW–DU–011 (see Figure 2-1). MW–DU–001 is located on the eastern (upgradient) boundary of the DU Impact Area and has exhibited elevated U–238/U–234 ratios in groundwater during previous ERMP sampling events (see Section 4.4.1.2). MW–DU–005 is located in the western portion of the DU Impact Area near the boundary where Big Creek exits the DU Impact Area. MW–DU–006 is located outside of and downgradient of the DU Impact Area and has exhibited total uranium concentrations exceeding that of other wells during previous ERMP sampling events (U.S. Army, 2018). MW–DU–001 is located in the central part of the DU Impact Area in close proximity to Big Creek and downgradient of the DU trenches.

2.1.3 Exemption from Decommissioning Timeliness Requirements

In accordance with 10 CFR 40.14 ("Specific exemptions"), the Army requests an exemption from the decommissioning timeliness requirements specified in 10 CFR 40.42(d). The Army has stated that removal of DU would be unduly hazardous and prohibitively expensive. The Army's opinion is based on the need for UXO clearance, radiological soil treatment, and offsite

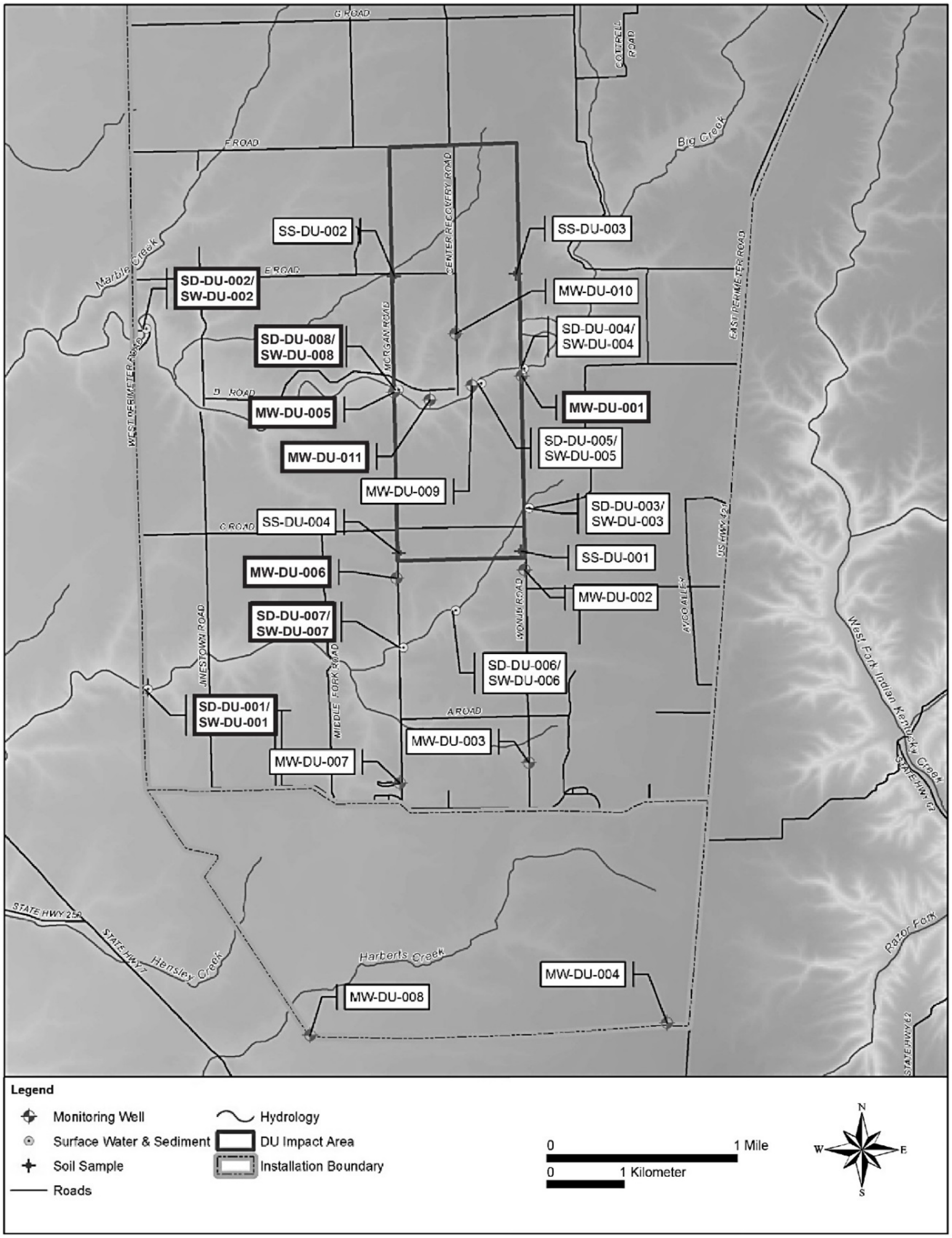

Figure 2-1. Current ERMP Sampling Locations. Water in Streams Traversing the JPG Site Flows from Northeast to Southwest. The Four Surface Water (SW), Sediment (SD), and Monitoring Well (MW) Sample Locations for the Army's Revised ERMP are in Bold Print (modified from U.S. Army, 2016)

transportation and disposal of the DU and DU-contaminated soil as low-level radioactive waste (U.S. Army, 2016). Using currently available technology, the Army estimates that decommissioning the DU Impact Area to meet NRC's unrestricted release requirements would cost an estimated $3.2 billion (U.S. Army, 2016). Based on these safety and economic considerations, the Army has stated that it is in the public's best interest to continue the possession of DU at JPG under a possession-only license and delay decommissioning until technology becomes available to economically and safely remove the DU from the site.

Under 10 CFR 40.14, the NRC can grant exemptions from the requirements of the regulations in 10 CFR Part 40 ("Domestic Licensing of Source Material") "as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest." The Army's justification for its request for an exemption from the decommissioning timeliness rule is based on the following considerations (U.S. Army, 2016):

- Under Condition H of Source Material License SUB–1435 (NRC, 2013a), the Army's Radiation Safety Plan for the DU Impact Area, which includes periodic NRC onsite inspections, would remain in place and therefore procedures for radiological safety and security would be maintained.
- As described in Section 2.1.1, the Army would continue to maintain institutional control of the area north of the firing line, including the DU Impact Area, based on Army ownership of the land and the presence of UXO (U.S. Army, 2016). In addition, the Army would maintain its MOA with the USFWS and USAF to continue infrastructure maintenance, security, and site access responsibilities for the management of the area north of the firing line (U.S. Army, 2000).
- As described in Section 2.1.2, effluent monitoring to detect DU leaving the DU Impact Area would be performed in accordance with the Army's revised ERMP.
- Current radiological exposure risks are small and well below the 1 millisievert per year (mSv/yr) [100 millirem per year (mrem/yr)] dose limit for individual members of the public specified in 10 CFR 20.1301 ("Dose limits for individual members of the public"). The Army conducted dose modeling for the situation where institutional controls are no longer in place. Loss of institutional controls implies the failure of physical and administrative access control to the JPG area north of the firing line. Modeled exposure scenarios included a subsistence farmer, industrial worker, sportsman or other visitor, and souvenir hunter (U.S. Army, 2018, 2013b). The modeled exposure scenarios considered information on the known nature and distribution of DU penetrators and DU contamination and site-specific information on DU transport mechanisms and exposure pathways. The analysis calculated an annual total effective dose equivalent (TEDE) of 0.673 mSv/yr [67.3 mrem/yr] and 0.263 mSv/yr [26.3 mrem/yr] for the souvenir hunter and subsistence farmer scenarios, respectively. The sportsman/visitor and industrial worker annual TEDE results of 0.033 to 0.059 mSv, respectively [3.3 and 5.9 mrem, respectively], were also well below the public dose limit of 1 mSv [100 mrem] in 10 CFR 20.1301.
- The DU penetrators at JPG have no strategic value. The DU is depleted of fissile isotope U-235 and therefore poses no criticality risks. Moreover, the DU is commingled with a high density of UXO {85 UXO/ac [1 ac = 4,047 square meters (m^2)]}, which precludes the intentional collection and removal of large quantities.

Based on the above considerations, the Army stated that there would be very little risk that life, property, and common defense and security would be endangered under a possession-only license (U.S. Army, 2016). In addition, based on safety and economic considerations, the Army stated that an exemption from the decommissioning timeliness requirements is otherwise in the public interest.

2.2 No-Action Alternative

Under the no-action alternative, the NRC would not grant the requested license amendment and exemption from the timeliness requirement. NRC Source Material License SUB–1435 (NRC, 2013a) for the JPG DU Impact Area, with all its provisions, would remain in effect. The Army would continue to conduct its present semi-annual ERMP (U.S. Army, 2004, 2003a). As described previously, the current ERMP includes sampling of surface soil, sediment, groundwater, and surface water. In addition, periodic NRC inspections and enforcement, which includes evaluation of the Army's site-security program and ERMP, would continue. The Army would continue to maintain and implement the restricted area identified in the NRC license as the DU Impact Area and institutional control of the approximately 206-km^2 [50,950-ac] area north of the firing line, based on Army ownership of the land and the presence of UXO.

In accordance with Source Material License SUB–1435, Condition 13 (NRC, 2013a), the Army would proceed with preparations for decommissioning the DU Impact Area, in accordance with NRC requirements for license termination and timely decommissioning as defined in 10 CFR 40.42 ("Expiration and termination of licenses and decommissioning of sites and separate buildings or outdoor areas"). Under these requirements, the Army would have to submit a timely decommissioning plan for NRC review and approval prior to the start of site decommissioning activities. As discussed in Section 1.3, the Army has stated that decommissioning of the DU Impact Area to unrestricted release conditions in the near term would be unduly hazardous and prohibitively expensive because of the need for UXO clearance, radiological soil treatment, and offsite disposal of DU and DU-contaminated soil. As further discussed in Section 1.2, the Army previously submitted a license amendment application to decommission the DU Impact Area by way of NRC termination of Source Material License SUB–1435 under restricted conditions, in accordance with criteria specified in 10 CFR 20.1403 ("Criteria for license termination under restricted conditions") (U.S. Army, 2013c). Therefore, the NRC staff assumes that the Army would propose to decommission the site by leaving the residual radioactivity in the DU Impact Area in place and demonstrating compliance with the criteria for license termination under restricted conditions specified in 10 CFR 20.1403. In accordance with 10 CFR 20.1403, one of the requirements for license termination under restricted conditions is that the licensee provide institutional controls that limit the calculated residual radiation dose (i.e., the TEDE from residual radioactivity at a site under the licensee's control) distinguishable from background to an average member of the critical group to 0.25 mSv/yr [25 mrem/yr]. Further, the licensee must reduce residual radioactivity so that if institutional controls fail, the calculated dose distinguishable from background to an average member of the critical group would not exceed 1 mSv/yr [100 mrem/yr], or if the licensee satisfies certain strict conditions, 5 mSv/yr [500 mrem/yr].

2.3 License Termination and Decommissioning Under Unrestricted Conditions

As required by NEPA and NRC regulations, NRC staff considered alternatives to the proposed action of amending Source Material License SUB–1435 from "possession only for decommissioning" to "possession only" and granting an exemption from the decommissioning timeliness requirements in 10 CFR 40.42(d). The range of alternatives to the proposed action was determined by considering other ways for the Army to comply with the NRC requirements for license termination and timely decommissioning of the DU Impact Area defined in 10 CFR 40.42. As discussed in Section 1.3, the purpose and need for the proposed action is to enable the Army to delay decommissioning until the UXO in the vicinity of DU within the DU Impact Area is inert, or until technology becomes available that would make it economically feasible to safely remove the DU from the site. Nevertheless, NRC staff determined that it would be appropriate to consider alternatives to the proposed action, in which license termination and decommissioning would occur under the NRC's unrestricted release conditions (pursuant to 10 CFR 20.1402, "Radiological criteria for unrestricted use"). This alternative is discussed in the following paragraphs but was eliminated from further study in this EA based on economic, environmental, and current technological factors.

Under this alternative, the Army would terminate Source Material License SUB–1435 and clean up residual radioactivity in the DU Impact Area to meet the radiological criteria for unrestricted use specified in 10 CFR 20.1402. In accordance with 10 CFR 20.1402, a site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 0.25 mSv [25 mrem] per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels, which are ALARA, must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal.

Remediation of the DU Impact Area to meet unrestricted use conditions would require (i) UXO and DU detection, (ii) UXO surface clearance and DU penetrator retrieval; (iii) excavation and sifting of subsurface materials to remove UXO and DU penetrators; (iv) radiological screening and soil washing of the excavated/sifted materials; (v) and the transportation and offsite disposal of nonhazardous and low-level radiological waste (LLRW) (U.S. Army, 2016). In addition, liquid waste generated from soil washing would require onsite treatment and transportation to an offsite disposal facility. The Army estimates the remediation costs associated with this alternative to be $3.2 billion using currently available technology (U.S. Army, 2016). This cost is about three times the enacted U.S. Department of Defense Environmental Restoration budget for fiscal year 2016.

For safety reasons, the UXO removal process would require the in-place detonation of the high-explosive UXO {estimated 85 high-explosive UXO rounds per ac [1 ac = 4,047 m^2]}. The detonation of UXO within the DU Impact Area could irreparably damage the habitat of the Indiana Bat, a federally endangered species, and the Northern long-eared bat, a federally threatened species, which are known to exist within the BONWR, including within the DU Impact Area (see Section 3.5.3). In addition, DU removal would require land within the DU Impact Area to be excavated and vegetation removed, resulting in adverse impacts on the habitat of many other Federal and State-threatened and endangered plant and animal species that have the potential to occur within the BONWR (see Section 3.5), as well as increased soil erosion, runoff, and disturbance of stream sediment. Moreover, explosions resulting from the in-place detonation of UXO could scatter DU penetrators, DU penetrator fragments, and DU-contaminated soil beyond the DU Impact Area. Explosions could also entrain DU corrosion products and soil-bound DU into the atmosphere, contributing to the inhalation pathway and residual radiation doses. Furthermore, there would be additional exposure to workers during DU removal and handling onsite and to the public and workers during offsite transport and disposal of the DU.

The DU Impact Area is surrounded on all sides by areas of restricted access north of the firing line because of the presence of UXO (see Figure 3-3). Therefore, even if the DU in the DU Impact Area could be cleaned-up to meet the unrestricted release criteria specified in 10 CFR 20.1402, unrestricted use of the DU Impact Area (i.e., commercial or residential development) would be greatly hampered, if not impossible, due to the great difficulty or inability to access the area via the surrounding areas of restricted access. Based on the need to mitigate explosive hazards associated with UXO in these areas of JPG, land use restrictions and security measures (as described in Section 2.1.1) would need to remain in place, regardless of the radiological status of the DU Impact Area.

Considering (i) the existing UXO hazards north of the firing line at JPG; (ii) the high and uncertain costs of identifying, treating, and disposing of UXO, DU penetrators, and DU-contaminated soil; and (iii) the environmental harm and worker and public health hazards associated with UXO and DU removal, handling, transportation, and disposal, remediation of the DU Impact Area would have little to no beneficial impact on the future use of the DU Impact Area and the JPG installation north of the firing line as a whole. Therefore, the NRC has eliminated this alternative from further consideration in the EA.

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Introduction

This chapter describes the affected environment at and near Jefferson Proving Ground (JPG) in southeastern Indiana and the depleted uranium (DU) Impact Area at JPG. The location of JPG and the DU Impact Area in southeastern Indiana is shown in Figure 3-1. Several small and rural towns are located around the JPG installation, including Madison, Versailles, Dupont, North Vernon, and Vernon. Population in these towns ranges from about 300 people in Vernon and Dupont to about 12,000 people in Madison. Descriptive and historical information on munitions testing at JPG, including the test firing of DU penetrators into the DU Impact Area, is presented in Section 1.1.

The Council on Environmental Quality (CEQ) defined *affected environment* as the environment of the area(s) to be affected or created by the alternatives under consideration [Title 40 of the *Code of Federal Regulations* (40 CFR) 1502.15]. The description of the affected environment focuses on baseline conditions (i.e., existing regional and local environmental conditions). As discussed in Section 1.2, the proposed action -- as requested by the U.S. Department of Army (Army) in its December 21, 2016, license amendment request (U.S. Army, 2016) -- is for the U.S. Nuclear Regulatory Commission (NRC) to amend Source Material License SUB–1435 for the JPG DU Impact Area from “possession only for decommissioning” to “possession only” and to grant an exemption from the decommissioning timeliness requirements in 10 CFR 40.42(d). The affected environment described in this chapter is used as the baseline to assess the potential environmental impacts of the proposed action and the no-action alternative in Chapter 4 (Environmental Impacts) of this environmental assessment (EA).

This chapter presents information on baseline conditions for the following resource areas: land use; geology and soils; water resources (surface water and groundwater); ecological resources; climatology, meteorology, and air quality; public and occupational health; and environmental justice. As discussed in Section 1.6, the NRC staff has determined that detailed descriptions of the baseline conditions for other resource areas, which are transportation, noise, historic and cultural resources, visual and scenic resources, socioeconomics, and waste management, do not need to be included in this chapter, because these resource areas would not be affected by the proposed action or the no-action alternative. Appendix A explains the reasons for eliminating these resource areas from detailed study in this EA.

3.2 Land Use

This section describes existing and planned land uses at the JPG site and vicinity, including the DU Impact Area, that are relevant to the assessment of potential impacts from the proposed action and the no-action alternative. This land use discussion focuses on the area shown in Figure 3-2 that is within 8 kilometers (km) [5 miles (mi)] of the JPG DU Impact Area boundary. The DU Impact Area is located entirely within Jefferson County, in the northern part of the county. The area within 8 km [5 mi] of the DU Impact Area boundary encompasses portions of Jefferson County, Jennings County to the northwest, and Ripley County to the north and northeast (see Figure 3-2). Since JPG was closed in 1995, there have been no military uses of the facility by the Army, and the land areas within JPG, both north and south of the firing line, have reverted to other uses.

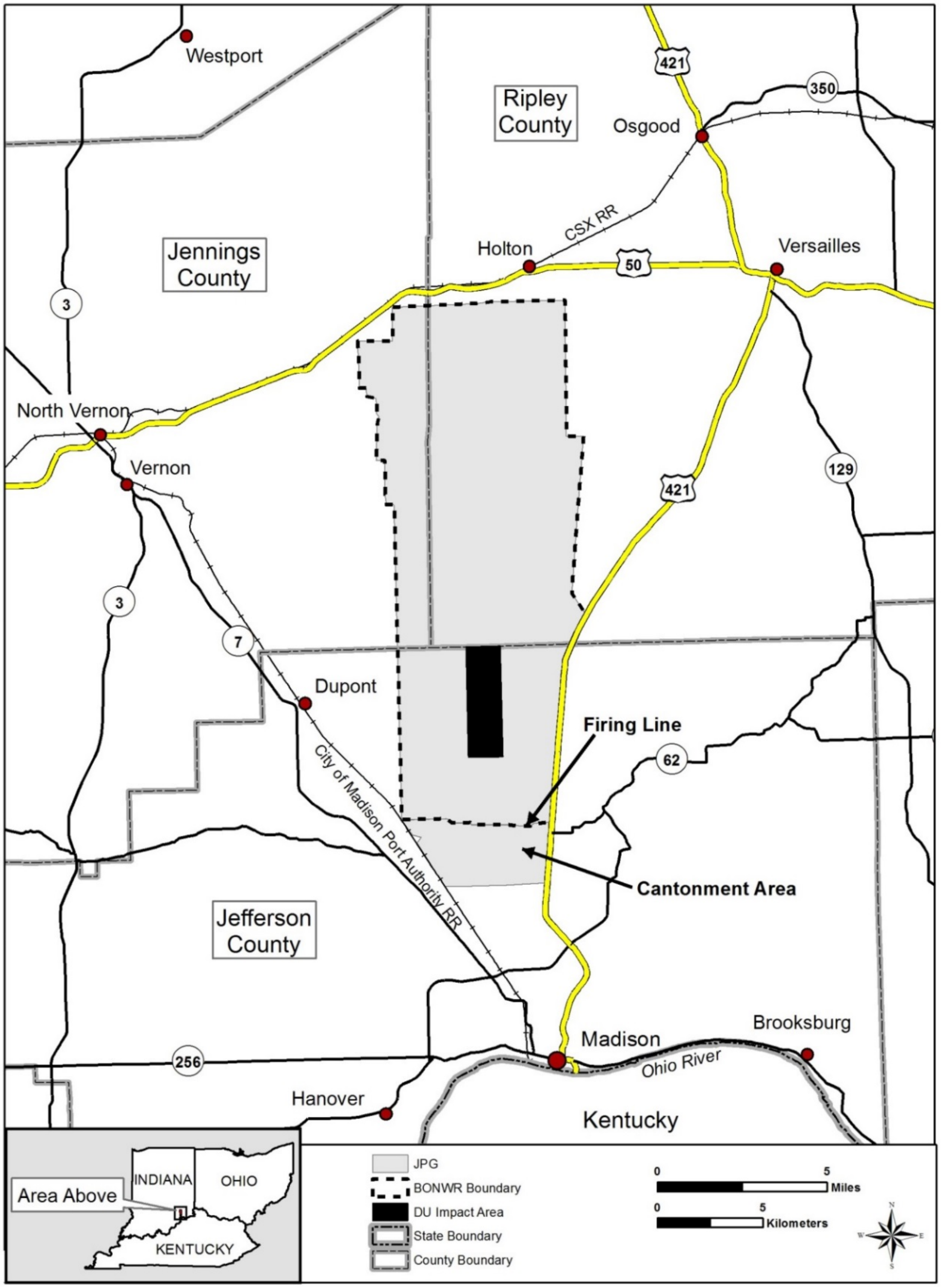

Figure 3-1. Map Showing Location of JPG and the DU Impact Area in Southeastern Indiana

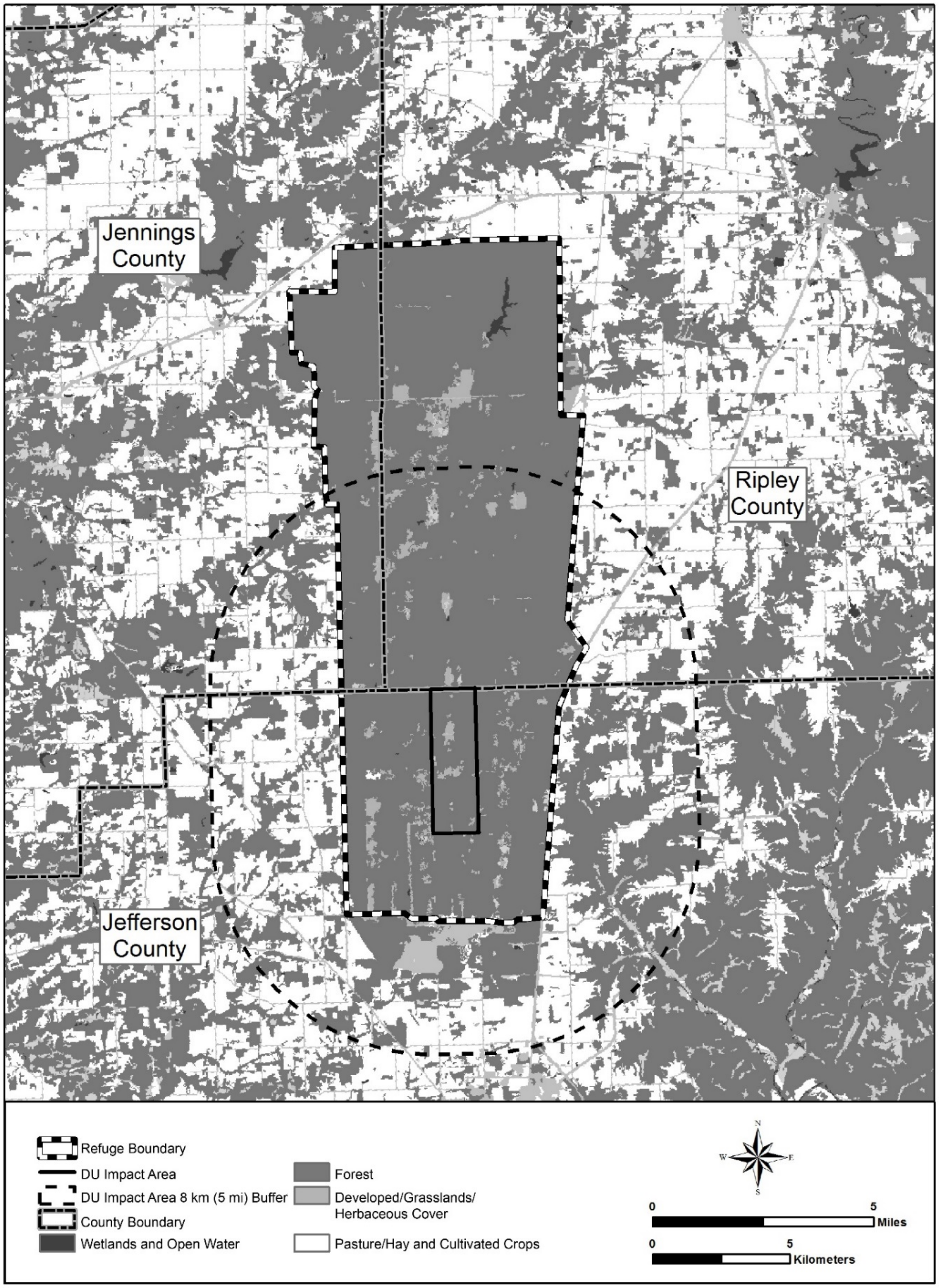

Figure 3-2. Land Cover and Land Use Within 8 km [5 mi] of the DU Impact Area Boundary (USGS, 2006)

As shown in Figure 3-2, most of the land within 8 km [5 mi] of the DU Impact Area boundary is densely forested (approximately 63 percent). Deciduous forests account for approximately 62 percent of all forests, and evergreen and mixed forests cover an additional 1 percent of the forest land. Cultivated crops and pasture/hay cover approximately 30 percent of land, and shrub or scrub cover approximately 2 percent. Open developed land (i.e., land used for residential, commercial, and recreational purposes) covers approximately 4 percent of the land. The remaining land uses and land covers include land with grassland and herbaceous cover, emergent herbaceous land, and open water, and represent approximately 1 percent of the total of land uses and covers (USGS, 2006).

The land north of the firing line within JPG, including the DU Impact Area, contains one of the largest contiguous forest blocks and grassland complexes in southeast Indiana, and contrasts somewhat with the land uses and covers surrounding JPG (see Figure 3-2) (U.S. Army, 2013a). The land south of the firing line and surrounding JPG is used predominantly for agricultural, commercial, light industrial, recreational, and residential purposes (U.S. Army, 2013a).

3.2.1 Land Use Within JPG North of the Firing Line

As described in Section 1.1, in 2000, the U.S. Fish and Wildlife Service (USFWS) established the Big Oaks National Wildlife Refuge (BONWR) on the 206-square kilometers (km^2) [51,000-acre (ac)] portion of JPG north of the firing line, under a Memorandum of Agreement (MOA) between the Army, the USFWS, and the U.S. Air Force (USAF) (U.S. Army, 2000). In accordance with the MOA, the Army retains ownership of all real property north of the firing line, and the USFWS operates the BONWR under a 25-year lease with 10-year renewal options. The BONWR boundary is shown in Figures 3-1, 3-2, and 3-3. Also under the MOA, the Indiana Air National Guard (INANG) operates two bombing training ranges [Precision-Guided Munitions (PGM) range and a conventional bombing range] for the USAF, covering approximately 4.2 km^2 [1,032 ac] of the BONWR area (see Figure 3-3), also under a 25-year lease with 10-year renewal options. When in use, these bombing ranges have large buffer areas of associated land, called safety fans, where access is restricted to all persons other than INANG personnel. During flight operations involving training munitions or laser energy, USFWS personnel and visitors to the BONWR are excluded from the bombing ranges and areas within the safety fan for the range in use (U.S. Army, 2000). When the INANG is not using the bombing ranges, the USFWS has access to the safety fan areas. Access to the ranges is controlled through pad locked metal swing gates on roads that lead to the ranges.

The MOA included a Public Access Plan, which was updated in 2012 (USFWS, 2012a) and outlines Army, USFWS, and USAF (including INANG) responsibilities regarding safety briefings, entry procedures, public use types, accessibility areas, public use monitoring, and controlling procedures. The plan also identifies requirements and protocols for public access to the BONWR. Visitors to the BONWR must check in and out and receive a safety briefing from the USFWS before being issued a public access permit. Public access to the refuge is controlled at a single gate and is limited to two areas: the limited day-use recreation area and special controlled hunting zones (see Figure 3-3). Public use areas are delineated by maps provided to visitors and by signs placed at strategic locations within the BONWR. Access to approximately 97 km^2 [24,000 ac] of land within the BONWR is restricted primarily because of the occurrence of high levels of unexploded ordinance (UXO), and both DU and UXO in the DU Impact Area and surrounding vicinity (see Figure 3-3).

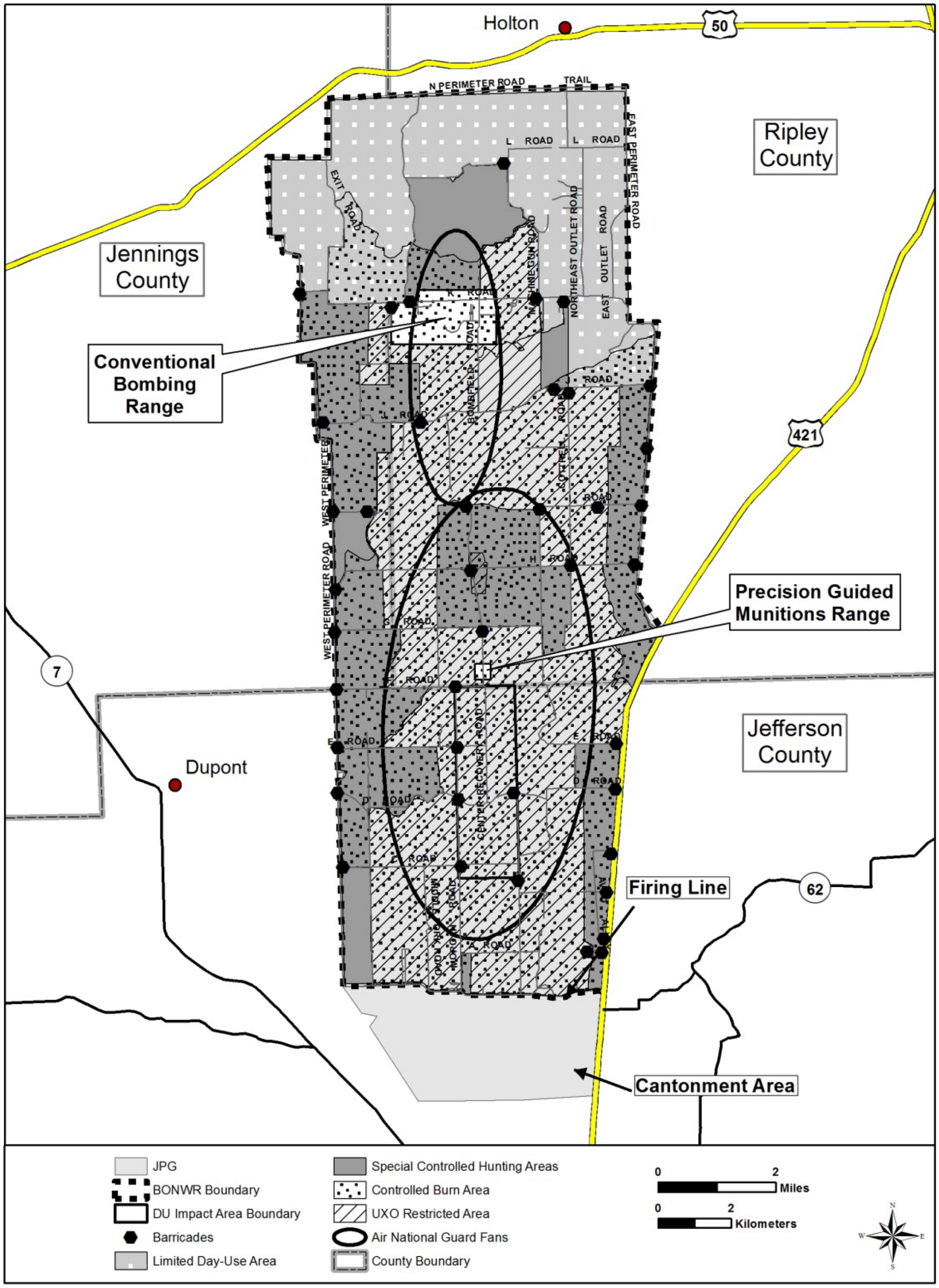

Figure 3-3. Land Use Within JPG North of the Firing Line (modified from U.S. Army, 2013a)

3.2.2 Land Use Within JPG South of the Firing Line

As described in Section 1.1, land south of the firing line at JPG totals 17.5 km^2 [4,314 ac] and is commonly referred to as the “Cantonment Area” (see Figure 3-3). All property south of the firing line has been transferred from Army control to private ownership (U.S. Army, 2018). This property is being used for light industrial, commercial, agricultural, recreational, and residential purposes (NRC, 2015b; U.S. Army, 2013a). Building 216 and approximately 27 km [17 mi] of railroad tracks were sold under the Defense Authorization Amendments and Base Realignment and Closure (BRAC) program after base closure to the Madison Railroad, a division of the City of Madison Port Authority. Currently, Madison Railroad uses 16 km [10 mi] of track at JPG for short- and long-term railcar storage. Parcels of land totaling approximately 2.56 km^2 [635 ac] (including Krueger Lake Park) were given to the Jefferson County Park System. The Indiana Department of Transportation (INDOT) owns about 0.12 km^2 [30 ac] of the land south of the firing line. The Southeastern Indiana Recycling District (SEIRD) owns and operates a regional recycling center in Building 534.

3.3 Geology and Soils

A description of the geology and soils within and in the vicinity of JPG is presented in this section that is relevant to the assessment of potential impacts from the proposed action and the no-action alternative. The geology of the JPG site in southeastern Indiana, including the DU Impact Area, is characterized by mostly glacial deposits that overlie bedrock composed of interbedded carbonates and shale. Glacial deposits formed from glacial ice and consist of a mixture of undifferentiated material ranging from clay-sized particles to boulders.

3.3.1 Regional Geology

Rocks from the Devonian, Silurian, and Ordovician Periods, which formed in the Paleozoic Era (approximately 350 to 450 million years ago), are found in southeastern Indiana (IGS, 2015a). The youngest rocks are from the Devonian Period, and the oldest rocks are from the Ordovician Period. Underlying the Paleozoic rocks are igneous rocks from the Precambrian Eon that form some of the basement rocks of the North American continent. No Precambrian rocks are exposed at the ground surface. The general stratigraphy of Paleozoic rocks in Indiana is shown in Figure 3-4.

During most of the Ordovician Period, Indiana was covered by a shallow ocean and was located south of the equator (Paleoportal, 2015a). In areas where the younger rocks were removed by erosion, Ordovician-aged rocks underlie glacial-related deposits or are exposed at the surface. In southern Indiana, Ordovician-aged rocks consist of sequences of limestone and shale. Ordovician-aged rocks of the Maquoketa Group crop out in southeastern Indiana (IGS, 2015b). Component formations of the Maquoketa Group in descending order are the Whitewater Formation (limestone with minor amounts of shale), the Dillsboro Formation (shale with lesser amounts of limestone), and the Kope Formation (principally shale) (see Figure 3-4).

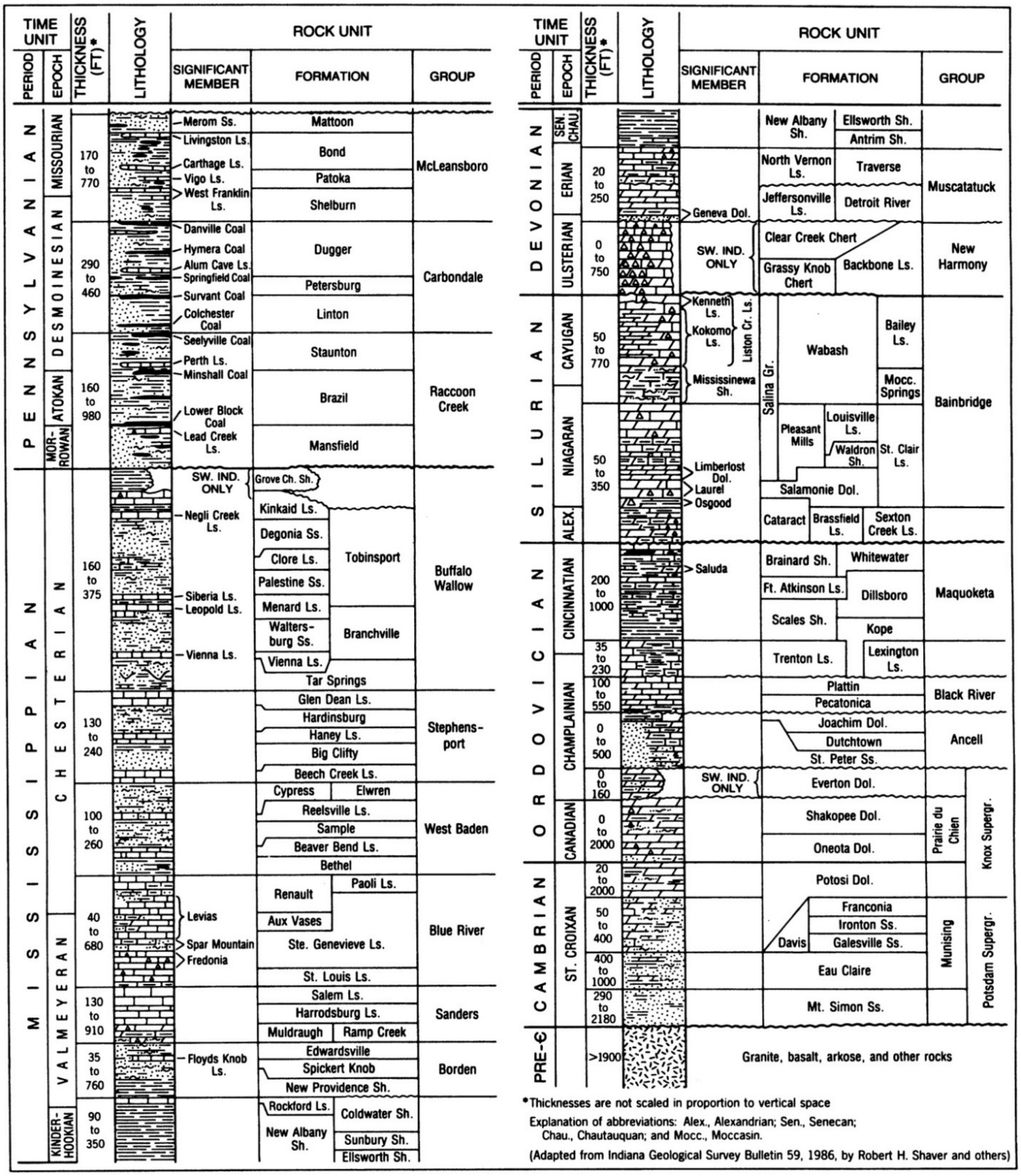

Figure 3-4. General Stratigraphic Column of Paleozoic Rocks in Indiana (modified from Thompson et al., 2016)

During the Silurian Period, southeastern Indiana was located near the equator and covered by a shallow sea that contained abundant marine organisms (Paleoportal, 2015b). In some areas, large reefs existed. The rocks formed in southern Indiana during the Silurian Period consist primarily of interbedded limestone and shale of the Louisville limestone (IGS, 2015c) and the

Waldron shale (IGS, 2014). In Jefferson County, Louisville limestone, which contains minor amounts of dolomite and shale, is more prevalent.

During the Devonian Period, southeastern Indiana was still a shallow sea that contained abundant marine organisms (Paleoportal, 2015c). Typically, Devonian rocks in southeastern Indiana are limestones with smaller amounts of shale and dolomite. The Jeffersonville and North Vernon limestones (IGS, 2013a) are common in Jefferson County as well as some New Albany shale (IGS, 2013b). The Muscatatuck Plateau in southeastern Indiana has karst features in both Devonian and Silurian age formations (IGS, 2011a) from the dissolution of the carbonate rocks. The features include sinkholes, caves, and underground drainage channels.

Following the Paleozoic Era, Indiana was above sea level and there was no rock formation other than limited areas near streams and lake beds that were later removed by erosion. The advancement and recession of glaciers in Indiana resulted in much of the Paleozoic bedrock being covered by unconsolidated materials. The Illinoian glaciation during the Pleistocene Epoch affected southeastern Indiana near JPG (IGS, 2015d). The event deposited glacial till, which is a homogeneous and unsorted mixture of clay- to boulder-sized particles, over the bedrock. The later Wisconsin glaciation did not extend to southeastern Indiana (IGS, 2015d); however, the resulting large volume of meltwater from the retreat of the glaciation produced outwash deposits.

About 0.6 to 1.2 meters (m) [2 to 4 feet (ft)] of windblown sand, silt, and clay from flood plains along the Ohio River and other major rivers covers the Illinoian till (Nickell, 1985). These windblown (aeolian) deposits are called loess. During the retreat of the Illinoian and Wisconsin glaciers, bare flood plains developed from the melting of the glaciers. The resulting outwash was transported by the winds in drier periods and deposited in southeastern Indiana. The amount of sand, silt, and clay in the loess deposits is a function of wind velocity and the distance to which particles traveled.

3.3.2 Site Geology

The ability to conduct onsite investigations north of the firing line at JPG is limited because of the presence of UXO. Therefore, although the bedrock and glacial geology north of the firing line is relatively well-known, there are uncertainties at any specific location.

In general, the bedrock surfaces at the JPG site formed during the Paleozoic Era were eroded during the Pennsylvanian Period (IGS, 2015a). The resulting bedrock consists of layers of uplifted sedimentary rocks of the Silurian Period with some areas from the Devonian Period and stringers from the Ordovician Period (Figure 3-5). The older Ordovician rocks are exposed in areas where greater erosion occurred. The Army stated that the upper 12 to 18 m [40 to 60 ft] of the bedrock is more permeable than the deeper bedrock (U.S. Army, 2013c).

The bedrock stratigraphy of Silurian and Devonian formations at JPG is summarized in the stratigraphic column shown in Figure 3-6. The bedrock stratigraphy is based on lithologic information from cores collected during drilling of monitoring wells in the area south of the firing line (MWH, 2002). The bedrock at JPG consists of interbedded limestone, dolomite, and shale. The thickness of individual bedrock formations is variable, as illustrated in the stratigraphic column in Figure 3-6.

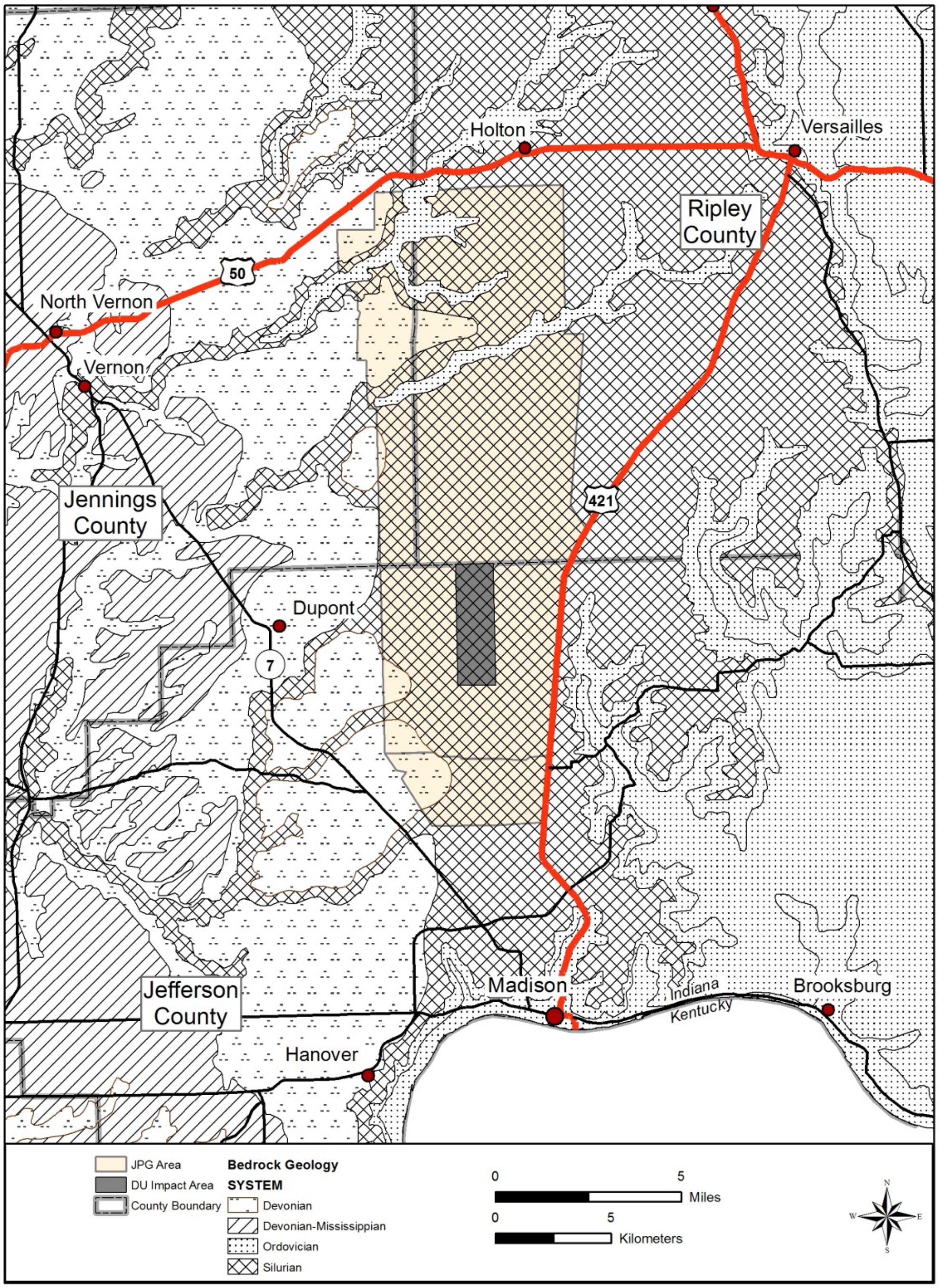

Figure 3-5. Bedrock Geology of JPG [modified from Indiana Map (IGS, 1987)]

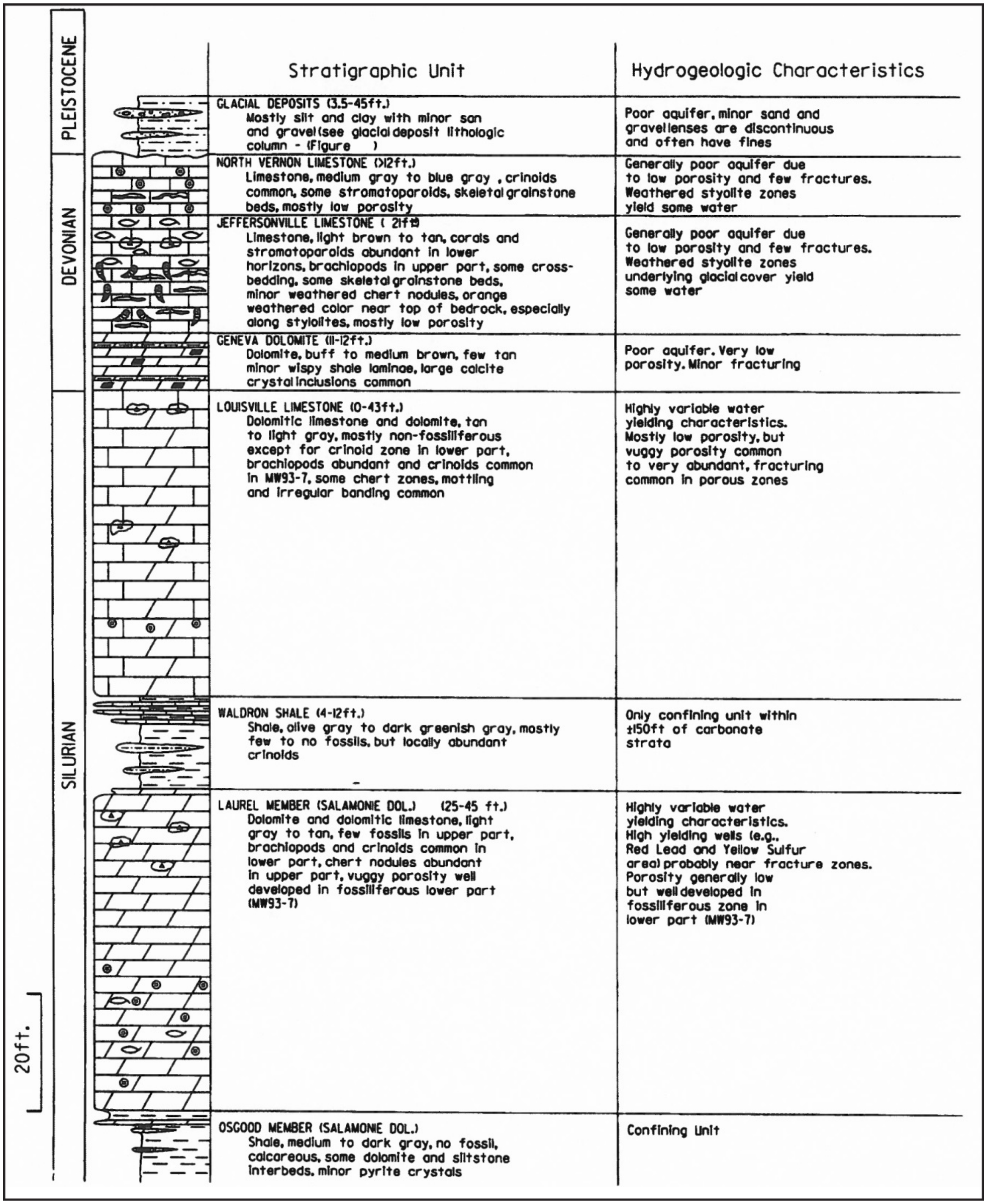

Figure 3-6. Stratigraphic Column for JPG South of the Firing Line (modified from MWH, 2002)

The Ordivician Dillsboro, Saluda, and Whitewater formations and the Silurian Brassfield Limestone were not encountered during drilling of monitoring wells in the area south of the firing line but are exposed along stream drainages north of the firing line (MWH, 2002). The Dillsboro Formation consists of calcareous shale with thin limestone interbeds. The Dillsboro Formation is overlain by the Saluda Formation, which comprises silty dolomite with limestone interbeds.

The uppermost Ordivician formation at JPG is the Whitewater Formation, which consists of limestone interbedded with thin shales and dolomites.

The lowermost Silurian formation at JPG is the Brassfield Limestone, which ranges in thickness from 0 to 3 m [0 to 10 ft]. The Brassfield Limestone is a dolomite containing clasts and fossils reworked from the underlying Whitewater Formation. The Silurian Osgood Member of the Salamonie Dolomite was the deepest formation penetrated by the monitoring wells (MWH, 2002). The Osgood Member is shale with some dolomite and siltstone interbeds. The Osgood Member is overlain by the Laurel Member of the Salamonie Dolomite and consists of dolomite and dolomitic limestone with some thin shale beds in the upper part, especially near the contact with the overlying Waldron Shale. The Waldron Shale consists of calcareous shale with thin siltstone and limestone interbeds. The Louisville limestone is the uppermost Silurian formation at JPG and consists of dolomitic limestone and dolomite.

The Geneva Dolomite is the oldest Devonian formation at JPG and consists of dolomite with minor shale laminae. The Jeffersonville Limestone overlies the Geneva Dolomite and consists of fossiliferous limestone with minor chert nodules. The North Vernon Limestone is the uppermost Devonian formation present south of the firing line. The North Vernon Limestone is a fossiliferous limestone.

Pleistocene glacial till deposits overlay the bedrock in the JPG area. The glacial till thickness from the Illinoian glaciation varies over JPG from approximately 0.2 to 22 m [0.7 to 72.5 ft], as determined from well installations and well logs (U.S. Army, 2013c). These deposits consist of interbedded silts and clays and silts with gravel. Near the bedrock contact, the glacial deposits contain chert, dolomite, and limestone rock fragments overlain by silt and clay layers that contain discontinuous gravel lenses (MWH, 2002). Glacial till deposits adjacent to streams within JPG (such as Big Creek) are thin because of erosion adjacent to the stream drainages. Within the DU Impact Area, the glacial deposits range from 0.6 to more than 5.8 m [2 to more than 19 ft], based on stratigraphic information from groundwater monitoring wells in this area (U.S. Army, 2002). The glacial deposits within the DU Impact Area are described as brown, silty clay containing some black gravel/rock fragments and some chalky white rock fragments (U.S. Army, 2002). The deeper loess deposits at JPG are relatively higher in sand content, which suggests that the deeper loess came from closer areas and, therefore, was from the Illinoian glacier (Nickell, 1985). The shallower loess is relatively higher in silt content, which suggests that this loess came from more distant areas and, therefore, was from the Wisconsin glacier (Nickell, 1985). Both deposits also contain an appreciable amount of clay.

3.3.3 Seismology

Seismic activity has occurred in southeastern Indiana, but the main area of seismic activity in Indiana is in the southwestern part of the state. According to the IGS, most of the faults in Indiana are within 1 km [0.6 mi] of the ground surface (IGS, 2015e). However, earthquakes in Indiana in the last 200 years have generally occurred from movement of faults at 10 or more km [6.2 or more mi] below the surface (IGS, 2015e). Seventy earthquakes between July 5, 1827, and December 30, 2010, were identified as occurring within 200 km [124 mi] of JPG (U.S. Army, 2013a). Of the 70 earthquakes, one occurred close to the western boundary of JPG on March 3, 1886, with a moment magnitude of 4 (U.S. Army, 2013a). The largest moment magnitude of the 70 earthquakes was 6, which occurred in 1827 and 1887. The effect of an earthquake with a moment magnitude of 4 would correlate to a Modified Mercalli Intensity Scale of III. A Modified Mercalli Scale III would slightly shake a building similar to when a heavy truck passes by a house. A moment magnitude of 6 would correlate to a Modified Mercalli Intensity Scale of IV, which would cause pictures to fall off walls and furniture to move. The 2014

U.S. Geological Survey (USGS) National Seismic Hazard Map (Figure 3-7) shows earthquake ground motions for a probability of 10 percent in the next 50 years (USGS, 2014). For southeastern Indiana, Figure 3-7 shows that there is a 10 percent probability that an earthquake will occur with a ground motion of 0.03 to 0.05 standard gravity in the next 50 years, which means that there is a 10 percent probability that an earthquake will occur in the next 50 years that will cause the ground to move at a rate of 0.29 meter per second squared (m/s^2) [0.96 feet per second squared (ft/s^2)] to 0.49 m/s^2 [1.6 ft/s^2], which correlates to a Modified Mercalli Intensity Scale of IV.

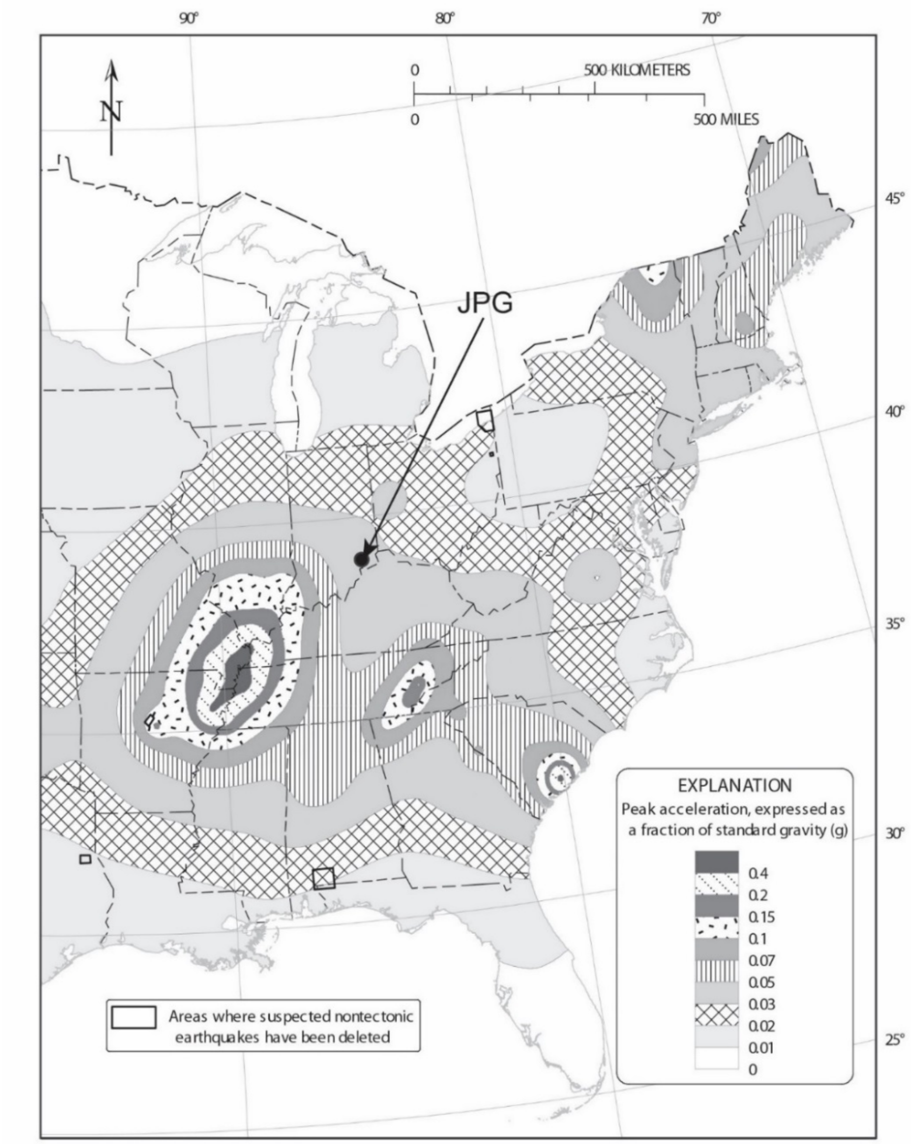

Figure 3-7. 2014 Modified Map of the National Seismic Hazard Showing the 10 Percent Probability of Exceeding a Peak Ground Acceleration (PGA) in 50 Years (USGS, 2014)

3.3.4 Site Soils

Soil development at JPG, including the DU Impact Area, began soon after deposition and exposure of bedrock, glacial till, and loess. Soil development occurred on the loess after it was deposited on older soil development from the glacial till. Consequently, the soils at JPG may contain buried old soil remnants, or paleosols. At locations where the glacial till and loess have been removed along drainages by erosion, soil formation occurred directly from weathering of exposed bedrock.

Based on soil survey mapping conducted by the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) (USDA, 2015), six soil series compose approximately 99 percent of the DU Impact Area. These six soil series areas are the Cincinnati, Rossmoyne, Cobbsfork, Avonburg, Grayford, and Ryker series.

The Cincinnati and Rossmoyne soil series occupy approximately 20 and 13 percent of the DU Impact Area, respectively. Both soil series have a loess mantle over glacial till that are generally less than 59 centimeters (cm) [23 inches (in)] thick. A paleosol exists in the upper glacial till. Both soil series also have an argillic horizon, which is an accumulation layer of clay particles that have moved downward from overlying horizons and coated soil structural units with clay particles. An argillic horizon has at least 20 percent more clay than an overlying horizon. Below the interface between the loess and the glacial till, there is a fragipan, which is a firm, brittle soil layer more than 15 cm [6 in] thick in which water moves downward slowly and plant roots do not easily penetrate, because it is dense or compacted. Structurally, fragipans are prism-shaped and are typically elongated vertically. Both the Cincinnati and Rossmoyne soils also are very deep {i.e., deeper than 150 cm [59 in]}. The Cincinnati soil series is well drained and the Rossmoyne soil series is moderately well drained.

The Cobbsfork and Avonburg soil series occupy approximately 39 and 15 percent of the DU Impact Area, respectively. Both soil series are poorly drained and have a seasonally high water table during the late fall to early spring. It is common to see water ponded on the surface of these soils in late fall and early spring, especially following precipitation events. Both the Cobbsfork and Avonburg soils also have a mantle of loess overlying glacial till. The loess mantle may be as thick as 89 cm [35 in], which is thicker than in the Cincinnati and Rossmoyne soil series {less than 59 cm [23 in] thick}. Both soils are very deep and have an argillic horizon but do not have fragipans.

The Grayford and Ryker soil series occupy approximately 7 and 5 percent of the DU Impact Area, respectively. Both soil series have loess over till over residuum from limestone. The depth to a bedrock contact is from 102 to 152 cm [40 to 60 in] for the Grayford soil series and from 152 to more than 203 cm [60 to more than 80 in] for the Ryker soil series. The loess mantle is 0 to 56 cm [0 to 22 in] thick on the Grayford series and 51 to 102 cm [20 to 40 in] on the Ryker series.

NRC staff discussions with soil scientists from the NRCS in January 2015 to inquire about possible information additions to the NRCS soil mapping survey revealed that the Blocher soil series might be found intermingled with the Cincinnati soil series (Dena Anderson, Resource Soil Scientist, personal communication, January 12, 2015). The main differences between the two soil types are that the Blocher series is moderately well drained, whereas the Cincinnati soil series is well drained. Both have seasonal perched water tables. It was also noted that the Rossmoyne soil series may be replaced by the Nabb soil series in any updating of the NRCS soil survey (NRC, 2015b). The primary reason for this is that the depth to the till (i.e., the thickness of the loess) in the local soils is greater than 102 cm [40 in], which is the upper limit in the description for the Rossmoyne soil series. The Nabb soil series has a greater depth to the till but is similar in other properties to the Rossmoyne series.

As discussed in Section 1.1, the Army estimates that the DU Impact Area contains approximately 85 high-explosive UXO rounds per acre and approximately 73,500 kilograms (kg) [162,040 pounds (lb)] of DU penetrators, DU penetrator fragments, and DU corrosion products (U.S. Army 2013a). The UXO and the DU penetrators and fragments exist as point sources of contamination and, consequently, the soils at the DU Impact Area and nearby adjacent areas within the JPG are contaminated with radiological constituents of the DU and nonradiological constituents of both the UXO and DU. Information on both radiological and nonradiological soil contamination and public health and safety can be found in Section 3.7 (Public and Occupational Health).

3.4 <u>Water Resources</u>

This section describes water resources at the JPG site and vicinity that are relevant to the assessment of potential impacts from the proposed action and the no-action alternative. These water resources include regional surface water downstream from the JPG and local water resources on and near the JPG site and the DU Impact Area. The local water resources primarily consist of surface water in perennial streams and groundwater in bedrock aquifers.

3.4.1 Surface Water Resources

Surface water features at JPG consist of streams or creeks and ponds, lakes, and wetlands. Descriptions of each of these features are provided next. Surface water use and surface water quality are also discussed.

3.4.1.1 Streams

The JPG site is drained by the streams shown in Figure 3-8, which from north to south are: Otter Creek, Graham Creek, Little Graham Creek, Marble Creek, Big Creek, Middle Fork Creek, and Harberts Creek. All these streams flow in a northeast to southwest direction. The DU Impact Area is within the watersheds of Big Creek and Middle Fork Creek. The Big Creek watershed is the main watershed draining from the DU Impact Area. The Big Creek watershed area is approximately 102 km^2 [25,160 ac] at its confluence with Middle Fork Creek. Big Creek exits JPG about 4.8 km [3 mi] from the boundary of the DU Impact Area. The Middle Fork Creek watershed area is approximately 44 km^2 [10,890 ac] at its confluence with Big Creek. Middle Fork Creek exits JPG about 6.6 km [4 mi] downstream from the DU Impact Area.

Big Creek and Middle Fork Creek merge about 11.2 km [7 mi] downstream from the DU Impact Area. Big Creek ultimately flows into the Muscatatuck River at its confluence with Graham Creek approximately 16 km [10 mi] west of JPG. The drainage area of Big Creek at its confluence with the Muscatatuck River is about 490 km^2 [176 mi^2] (Hoggatt, 1975). Flow in the Muscatatuck River near its confluence with Big Creek has averaged 10.5 cubic meters per second (m^3/s) [373 cubic feet per second (ft^3/s)], since measurements began in 1949 (USGS Station 03366500) (USGS, 2015). The Muscatatuck River drains over 2,590 km^2 [1,000 mi^2] of southeastern Indiana and is a major tributary to the East Fork of White River (IDNR, 2015a). The White River flows into the Wabash River and the Wabash River ultimately flows into the Ohio River approximately 200 km [120 mi] west of JPG.

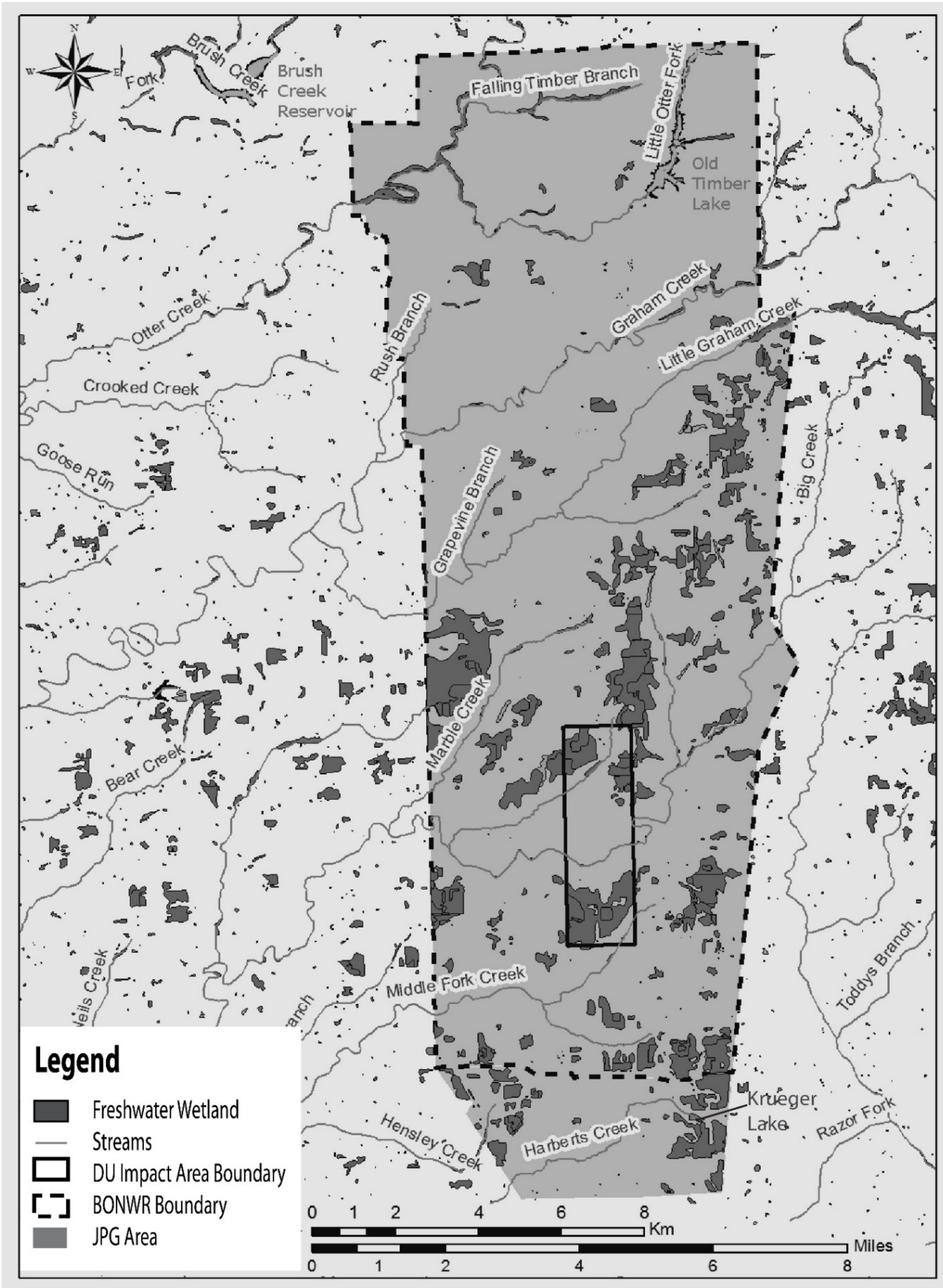

Figure 3-8. Streams and Distribution of Wetland Types On JPG and the Surrounding Area (modified from USFWS, 2014a)

Stream flow in Big Creek and Middle Fork Creek is not gaged (measured) by the USGS or the State of Indiana in the vicinity of JPG. The Army has been gaging stream flow since 2006, as part of a monitoring plan for decommissioning of the DU Impact Area (U.S. Army, 2013a). The Army described stream flow in Big Creek and Middle Fork Creek as “extremely flashy,” meaning rapid increases in flow shortly after precipitation events followed by periods with low or no flow (U.S. Army, 2013a). Based on data collected and reported by the Army, flow in Big Creek at the western boundary of the DU Impact Area ranged from practically zero to as much as 100 m^3/s [3,500 ft^3/s]. Based on the Big Creek drainage area at the western boundary of the DU Impact Area (92.7 km^2 [35.8 mi^2]), the Army reported median flow in Big Creek at the western boundary of DU Impact Area of 1.5×10^{-3} to 2.3×10^{-3} $m^3/s\text{-}km^2$ [0.14 to 0.22 $ft^3/s\text{-}mi^2$] (U.S. Army, 2013a).

3.4.1.2 Ponds, Lakes, and Wetlands

Other surface water features located at JPG include Old Timbers Lake, Krueger Lake, several ponds, and seasonal wetlands (Pruitt et al., 1994) (Figure 3-8). Old Timbers Lake, a 0.7-km^2 [165-ac] surface impoundment, is located in the northeast corner of JPG and was constructed in 1973. Krueger Lake, a 0.035-km^2 [8.8-ac] surface impoundment, is located in the southeast corner of JPG (in the former Cantonment Area) and was constructed in 1967. Several ponds scattered over the JPG site, including Gate 3 Pond, Gate 8 Pond, Gate 19 Pond, and Hydes Pond, existed on JPG at the time the installation was acquired and are presumed to be abandoned quarry sites. These ponds range from 0.004 to 0.012 km^2 [1 to 3 ac] in surface area.

The National Wetlands Inventory (NWI) identifies over 2,428 hectares (ha) [6,000 ac] of wetlands in the BONWR, including portions of the DU Impact Area (USFWS, 2014a), as shown in Figure 3-8. This wetland area, as designated under the NWI system, constitutes approximately 12 percent of the BONWR land area. In the USFWS initial management plan for the BONWR, the USFWS indicated that palustrine forested and shrub wetlands (see Freshwater Wetland in Figure 3-8) occupy approximately 16.2 km^2 [4,004 ac] or 8 percent of the BONWR and are the most abundant wetland type at the refuge (Pruitt et al., 1994). Minimal jurisdictional determinations have been conducted at the BONWR under Section 404 of the Clean Water Act. According to the Army, wetlands north of the firing line at JPG have not been surveyed because of the presence of UXO, and a jurisdictional determination letter has neither been requested from nor issued by the U.S. Army Corps of Engineers for that area (NRC, 2015b). However, the USFWS indicated in its Interim Plans that over 60.7 km^2 [15,000 ac] or 30 percent of the BONWR contain hydric soils, a strong wetland indicator (USFWS, 2000a). Thus, wetlands likely constitute a higher percentage of land at JPG and the BONWR than what is estimated using the NWI system.

3.4.1.3 Surface Water Use

The current uses of surface water in streams draining the DU Impact Area include water for wildlife and livestock and for recreational fishing, swimming, and wading. Surface water in streams on and immediately downstream of the JPG is not used as a source of drinking water, because most residences are connected to public water supplies sourced from the City of Madison (NRC, 2015b).

With a few exceptions, all waters in Indiana are designated for warm water aquatic life use, full body contact recreational use, public water supply (where there are drinking water intakes from surface waters), industrial uses, and agricultural uses (IDEM, 2017). These designations apply to the streams draining JPG and to the Muscatatuck River upstream and downstream of its confluence with Big Creek. Big Creek from the east side of JPG to its confluence with the Muscatatuck River is included on the State of Indiana's Outstanding Rivers as having "outstanding ecological, recreational, or scenic importance," as is the Muscatatuck River (INRC, 1997). The Muscatatuck River is also used for recreational boating (INRC, 1997). Within the BONWR, fishing is allowed only in Old Timbers Lake (USFWS, 2012b). Fishing is also allowed in Krueger Lake, outside the BONWR in the former Cantonment Area (Pruitt et al., 1994).

3.4.1.4 Surface Water Quality

Water samples analyzed by the Army from Big Creek and Middle Fork Creek upstream and downstream of the DU Impact Area for site characterization purposes indicate that surface water quality is generally good (U.S. Army 2003b). The only regulated, nonradiological constituent exceeding ambient water quality criteria was manganese. Concentrations of metals exceeding background levels in sediment have been detected in Harberts Creek within JPG at the downstream boundary of the Cantonment Area (MWH, 2002). These metals were attributed to discharges from an on site sewage treatment plant and sewage sludge application areas within the Cantonment Area (MWH, 2002). No suspended sediment data have been collected and reported for Big Creek or Middle Fork Creek.

Several watersheds having streams that either flow through or receive water flowing through the JPG are listed by the State of Indiana as having impaired water quality (IDEM, 2017). The watersheds, streams, and impairments identified are listed in Table 3-1. The nature of the impairments include elevated Escherichia coli (E. coli), low dissolved oxygen (DO), elevated or low pH, impaired biotic communities (IBCs), and, in one case, elevated total mercury in fish tissue. The finding of elevated total mercury was on the Vernon Fork of the Muscatatuck River that is downstream of the northern portion of JPG. Except for mercury, similar impairments have been identified in watersheds upstream of JPG and in other parts of southern Indiana (U.S. Army 2015c).

With respect to radiological constituents, the Army has analyzed surface water and sediment samples for uranium content from upstream and downstream of the DU Impact Area and at locations within the DU Impact Area since1984, as part of its longstanding monitoring program, which is reflected in the latest version of the Army's Environmental Radiation Monitoring Plan (ERMP) (U.S. Army, 2013a). ERMP sampling locations are shown in Figure 2-1. The results of the Army's ERMP show no increasing trends in the concentration of uranium in surface water and sediment samples (U.S. Army, 2013a, 2017). From 2004 to 2016, the average total uranium concentration in surface water samples is 0.72 picocuries per liter (pCi/L) [1.06 parts per billion (ppb)] (U.S. Army, 2017), which is well below the primary drinking water standard maximum contaminant level (MCL) of 30 micrograms per liter (µg/L) [30 ppb] for uranium as provided by U.S. Environmental Protection Agency (EPA) regulations at 40 CFR 141.66 (maximum contaminant levels for radionuclides). Based on the mass of U-238, U-235, and U-234 in natural uranium and DU, the EPA primary drinking water standard MCL of 30 µg/L [30 ppb] for uranium converts to 20.3 pCi/L [30 ppb] for natural uranium and 10.8 pCi/L [16 ppb] for DU. From 2004 to 2016, the average total uranium activity-concentration in sediment samples was 0.95 picocuries per gram (pCi/g) [1.43 parts per million (ppm)] (U.S. Army, 2017). The results of the Army's ERMP are further described in Section 3.7.2.1 (DU Impact Area Radiological Survey Results).

Table 3-1. List of Watersheds and Streams Identified by IDEM as Having Impaired Water Quality (IDEM, 2017).			
Watershed	**Stream**	**County(s)**	**Cause of Impairment**
Big Creek	Big Creek	Jefferson, Ripley	IBC, E. coli
Big Creek	Big Creek – Unnamed Tributary	Jefferson, Ripley	IBC
Big Creek	Marble Creek	Jefferson	IBC
Big Creek	Middle Fork Creek	Jefferson	IBC, E. coli
Big Creek	Middle Fork Creek – Unnamed Tributary	Jefferson	IBC, E. coli
Big Creek	Harberts Creek	Jefferson	IBC
Graham Creek	Graham Creek	Ripley	DO
Graham Creek	Little Graham Creek	Ripley, Jennings	pH, DO, IBC, Nutrients
Graham Creek	Hungry Hollow	Jennings	DO
Graham Creek	Rush Branch	Jennings	DO
Otter Creek	Otter Creek	Ripley, Jennings	IBC, DO
Otter Creek	Falling Timber Branch	Ripley	IBC, DO
Otter Creek	Crooked Creek	Jennings	IBC
Otter Creek	Crooked Creek – Unnamed Tributary	Jennings	IBC
Otter Creek	Goose Run	Jennings	IBC
White Oak Branch – Muscatatuck River	Big Creek	Jefferson	E. coli
White Oak Branch – Muscatatuck River	Walton Creek	Jefferson	E. coli
Vernon Fork – Muscatatuck River	Vernon Fork – Muscatatuck River	Jennings	DO, IBC, Nutrients, pH, Total Mercury

3.4.2 Groundwater Resources

This section describes groundwater resources in the vicinity of JPG along with site-specific hydrogeologic conditions that are relevant to the assessment of potential impacts to groundwater resources from the proposed action and the no-action alternative. Groundwater resources in the area consist of water-bearing geologic formations that may act as aquifers supplying water to wells.

3.4.2.1 Regional Hydrogeology

JPG is located in an area of southern Indiana described as having limited groundwater supplies due to the low yield of local geologic units (approximately 38 liters per minute (L/min) [10 gallon per minute (gpm)]) (IDNR, 2015b). Groundwater occurs in saturated loess and till soils overlying predominately carbonate bedrock beneath JPG and the surrounding area. The Indiana Department of Natural Resources (IDNR) describes the saturated loess/till as the Dissected Till and Residuum Aquifer. The bedrock aquifers in the vicinity of JPG are the Silurian and Devonian Carbonate Aquifer System and the Ordovician–Maquoketa Group Aquifer System (Herring, 2004a; Schrader, 2004a,b). Figure 3-9 shows the general hydrostratigraphy at JPG.

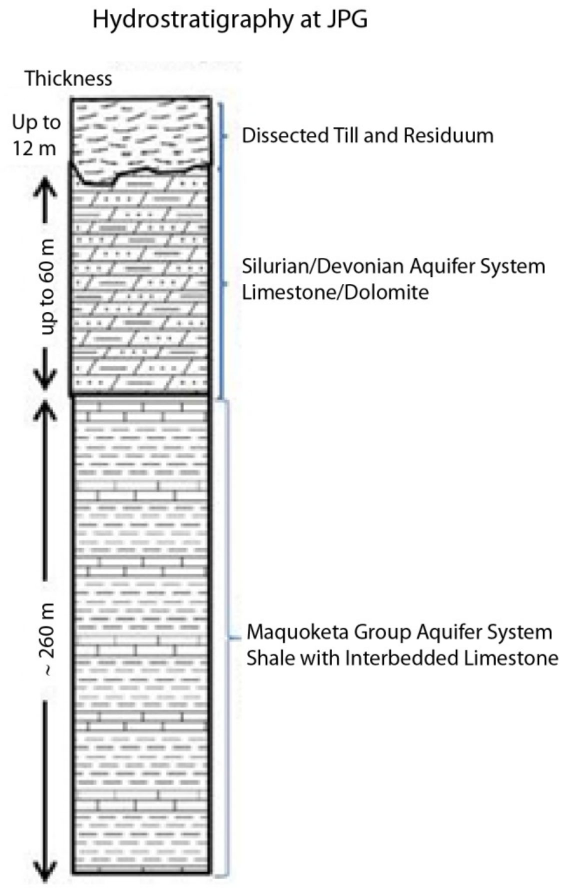

Figure 3-9. Schematic Diagram Showing Generalized Hydrostratigraphy at JPG

The Dissected Till and Residuum Aquifer is present throughout JPG and surrounding areas, except where stream channels are incised into bedrock (Herring, 2003; Schrader, 2004c,d). The groundwater table in the Dissected Till and Residuum Aquifer ranges from less than a meter to tens of meters [a few feet to tens of feet] in depth, depending on local drainage conditions, and generally parallels surface topography (Herring, 2003; Schrader, 2004c,d). The materials comprising the Dissected Till and Residuum Aquifer are generally fine-grained silt and clay with sand lenses; thus, the permeability of the Dissected Till and Residuum Aquifer is relatively low.

The Silurian and Devonian Carbonate Aquifer System and the Ordovician–Maquoketa Group Aquifer System are present beneath JPG and adjacent portions of Jefferson, Jennings, and Ripley counties. The Silurian and Devonian Carbonate Aquifer System is the uppermost bedrock aquifer in the southern half of JPG and west of JPG where it is exposed in incised stream channels. The uppermost bedrock aquifer east of JPG in Jefferson County, where the rocks of the Silurian and Devonian Carbonate Aquifer System have been eroded away, is the Ordovician–Maquoketa Group Aquifer System. The Silurian and Devonian Carbonate Aquifer System is also the uppermost bedrock aquifer near and beneath JPG in Jennings and Ripley counties, except where the Ordovician–Maquoketa Group Aquifer System has been exposed along incised stream channels. Monitoring wells installed by the Army and described as “deep bedrock” wells are completed in the Silurian and Devonian Carbonate Aquifer System (U.S. Army, 2013a).

The rocks comprising these bedrock aquifers consist of hard limestone and dolomite layers with thin clay interbeds. Groundwater in the bedrock aquifers flows primarily through fractures and solution cavities in the upper 30 m [100 ft] of the aquifer units. Herring (2004b) describes the occurrence of karst features as follows, "…the majority of sinkholes or depressions occur along the larger stream valleys (especially Big Creek)…," "…water well records…indicate a few feet of crevices, broken limestone, or mud seams within the limestone bedrock, generally at depths less than 50 feet below land surface…," and "…The Silurian carbonates…show limited karst development in Jefferson County. These rocks contain thinner limestones and more layers of shale, conditions that significantly limit karst development." More recent observations by the Army confirm this finding (U.S. Army, 2013a).

3.4.2.2 Site Hydrogeology

The Army has described the site hydrogeology, from top to bottom, in terms of three stratigraphic layers: (i) overburden, (ii) shallow/intermediate bedrock, and (iii) deep bedrock (U.S. Army, 2013a). As explained in Section 3.4.2.1, the overburden corresponds to the Dissected Till and Residuum Aquifer defined by the IDNR. The shallow and deep bedrock units correspond to the Silurian and Devonian Carbonate Aquifer System, at least in the DU Impact Area and southern portion of JPG. A conceptualization of the three hydrogeologic units is shown in Figure 3-10, along with the components of a water balance for the DU Impact Area estimated by the Army (U.S. Army 2013a). Based on the Army's estimates, approximately 8 percent of the precipitation falling in the area (including rainfall and snow) reaches the water table. Based on groundwater flow modeling by the Army (U.S. Army, 2013a), the majority of the water reaching the water table ultimately discharges to streams within the JPG.

The overburden ranges in thickness from 0.2 to 22.1 m [0.65 to 72.5 ft], with an average depth to bedrock of 6.3 m [20.8 ft] in areas investigated by the Army (U.S. Army, 2013a), except near creeks that have incised into the bedrock. The overburden is composed of loess and glacial till with loess covering the surface over most of the site. The loess is a fine-grained material with a generally low hydraulic conductivity, but the glacial till contains sand and gravel lenses in addition to finer grained silt and clay. Based on well tests performed by the Army, the hydraulic conductivity of the overburden ranged from 4×10^{-4} to 0.2 meters per day (m/d) [0.0013 to 0.71 feet per day (ft/d)] with a geometric mean of 0.03 m/d [0.11 ft/d] (U.S. Army, 2013a). The water table depth in the overburden varies from <0.6 to 12 m [<2 to 40 ft]. The permeability of the shallow overburden may be locally modified by the presence of terrestrial crayfish burrows. Based on a study by Thoma and Armitage (2008), the depth of crayfish burrows in Indiana ranged from approximately 20 cm [7.9 in] to as much as 200 cm [79 in] and could extend to the water table.

The shallow bedrock unit consists of fractured, weathered carbonate rocks that contain karst features, such as caves and enlarged fractures formed by dissolution of the carbonate. The Army has defined the shallow bedrock unit as the upper 12 to 18 m [40 to 60 ft] of the bedrock (U.S. Army, 2013a). Based on well tests performed by the Army, the hydraulic conductivity of the shallow bedrock varies between 0.15 to 0.91 m/d [0.5 to 3 ft/d] with a geometric mean of 0.24 m/d [0.8 ft/d]. Groundwater flow in the shallow bedrock is controlled by the karst features, fractures, and bedding planes. The hydraulic conductivity of the shallow bedrock may be much higher where these karst features are present.

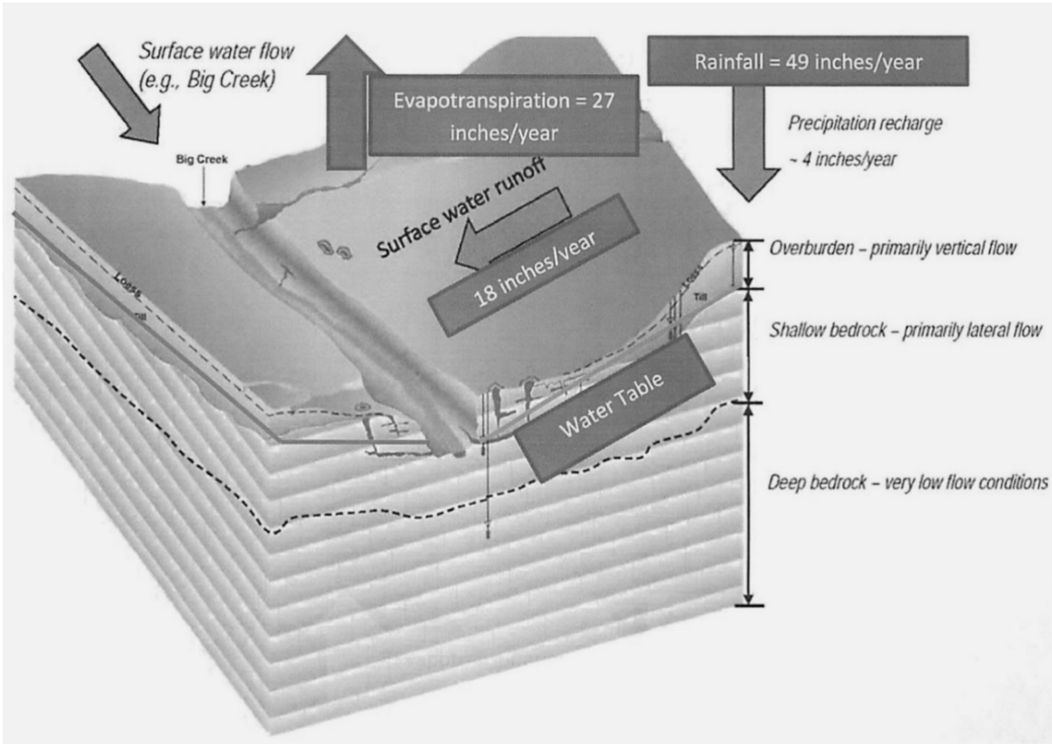

Figure 3-10. Hydrogeologic Units and Water Balance at JPG (modified from U.S. Army, 2013a)

A hydraulic connection exists between the overburden and the shallow bedrock with a small downward hydraulic gradient, although the water travels slowly through the overburden. The karst features in the shallow bedrock drain groundwater to the surface streams (U.S. Army, 2013a). An example is shown in the photograph in Figure 3-11. A karst study of JPG conducted by Sheldon (1997) observed 19 caves with an average cave length of 49.4 m (162 ft) along Big Creek. The karst study concluded that karst activity within and close to the DU Impact Area is confined to depths above the water table (Sheldon, 1997).

The deep bedrock unit is the bedded limestone below the shallow bedrock, which extends to an undetermined depth. The distinction between the shallow and deep bedrock zones used by the Army is based on the general absence of weathered fractures in the deep bedrock zone, which results in a much lower hydraulic conductivity (U.S. Army, 2013a). The average hydraulic conductivity of the deep bedrock is smaller than that of the shallow bedrock and is estimated to be on the order of 9×10^{-4} m/d [3×10^{-3} ft/d] (U.S. Army, 2013a).

Groundwater elevations in the overburden and shallow bedrock units are interpreted to generally parallel topography, although site-specific groundwater elevation contour maps have not been developed due to the widely spaced locations of the monitoring wells. This interpretation is supported by groundwater flow modeling (U.S. Army, 2013a) that indicates that water in the overburden and shallow bedrock flows from topographically high areas between the major surface water features and then discharges into the major streams through cave springs and smaller seeps in the bedrock and seeps at the overburden-bedrock interface within JPG, as illustrated in Figure 3-11. Groundwater elevations in wells completed in the deep bedrock are

Figure 3-11. Photograph of Groundwater Discharging from Seeps at the Overburden/Bedrock Contact and from the Shallow Bedrock at JPG (NRC Site Visit January 12, 2015)

much lower than those in the shallow bedrock wells (U.S. Army 2013a) indicating limited hydraulic connection between the shallow and deep bedrock, despite a potential for flow from the shallow to deep bedrock. The direction of groundwater flow in the deep bedrock cannot be determined from the limited geographical extent of monitoring wells tapping the deep bedrock.

3.4.2.3 Groundwater Use

Review of the IDNR water well database for Jefferson, Jennings, and Ripley counties revealed 61 recorded water wells within approximately 8 km [5 mi] of the perimeter of JPG (IDNR, 2015c). The locations of these wells and their depths are shown in Figure 3-12. Of these, five are test wells drilled by the Army in the Cantonment Area of JPG in a failed effort to obtain an onsite water supply. As shown in Figure 3-12, the majority of the wells in the IDNR water well database are less than 30 m [100 ft] deep, indicating that they are completed in the upper portion of either the Silurian and Devonian Carbonate Aquifer System and the Ordovician–Maquoketa Group Aquifer System, or the shallow and intermediate bedrock in the terminology of the Army (U.S. Army, 2013a). Reported yields are highly variable for wells with depths between 15 and 30 m [50 and 100 ft], ranging from a high of 113 L/min [30 gpm] to only a few L/min [gpm]. The majority of the wells in the database are described as “home use,” but no current use information is available for these wells. Many were drilled during the 1960s at a time when public water service may not have been available.

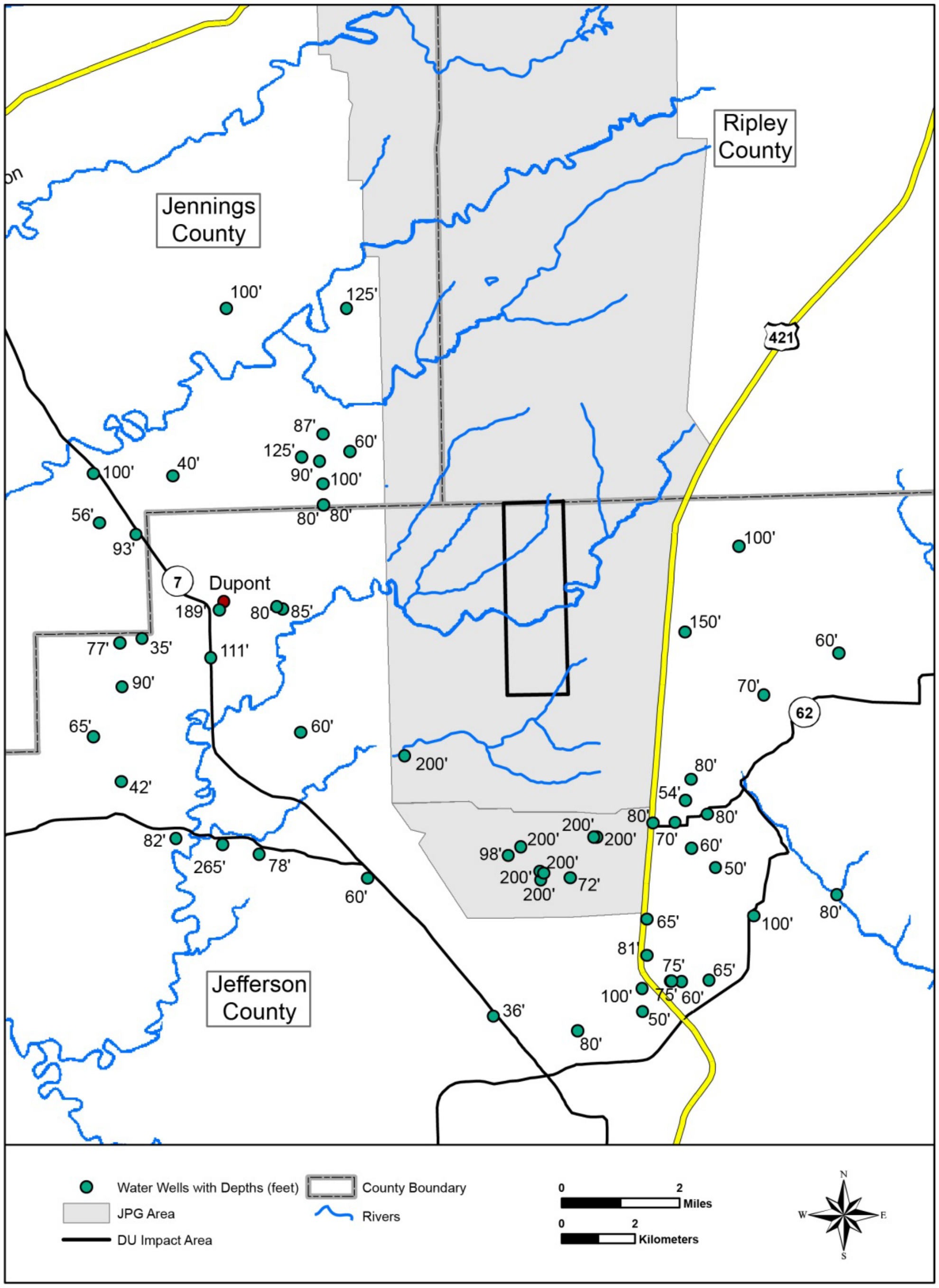

Figure 3-12. Water Wells and Well Depths Reported in the Vicinity of JPG Based on Records from IDNR (2015c|Well database)

The drinking water at JPG is obtained from the city of Madison Municipal Supply Systems and is derived from the Canaan Deposits in the Ohio River Valley, approximately 8 km [5 mi] south of JPG (U.S. Army, 2013a). Most residences surrounding JPG are also connected to public water supplied by Madison Water Supply Systems or by those of smaller towns, such as Dupont (NRC, 2015b). A few of the more remote residences around JPG may still use water from the bedrock aquifers. Herring (2003) states that “a few dug wells are likely still used” in the

Dissected Till and Residuum Aquifer and that the IDNR has records of three drilled wells with yields of 1.9 to 3.8 L/min [0.5 to 1 gpm]. A review of the IDNR water well database did not reveal any wells within 8 km [5 mi] of JPG that, based on their depth, appeared to be completed in the Dissected Till and Residuum Aquifer. No sole-source aquifers have been identified that might be affected by activities related to the DU Impact Area or other actions at JPG (EPA, 2012a).

3.4.2.4 Groundwater Quality

Little information is available on the quality of groundwater in the Dissected Till and Residuum Aquifer and bedrock aquifers outside of JPG. Schrader (2004b) and Herring (2004a) state that the water in the bedrock aquifers in Jennings and Jefferson counties is generally suitable for domestic use. However, water quality data provided by the Army from deep bedrock monitoring wells on the JPG indicates that groundwater in at least the upper portion of the deep bedrock is brackish {total dissolved solids (TDS) 1,000 to 10,000 milligrams per liter (mg/L) [1,000 to 10,000 ppm]) to saline (TDS 10,000 to 100,000 mg/L [10,000 100,000 ppm]} (U.S. Army, 2015b). Samples from all of the deep bedrock monitoring wells exceeded the EPA secondary MCL for TDS (500 mg/L [500 ppm]), as well as chloride (250 mg/L [250 ppm]), as provided by EPA regulations at 40 CFR Part 141. All samples also exceeded the secondary MCL for manganese [0.05 mg/L [0.05 ppm]), and many samples exceeded the secondary MCLs for iron (0.3 mg/L [0.3 ppm]. The high TDS, manganese, and iron concentrations in the deep bedrock water appear to be of natural origin because high concentrations occur in both background wells and wells on and near the DU Impact Area.

The quality of water from monitoring wells in the overburden and shallow bedrock on the JPG was generally much better than that in deep bedrock, with a median TDS of 253 mg/L [253 ppm] (U.S. Army, 2015b). However, the TDS of samples from five shallow bedrock monitoring wells (MW-5, JPG-DU-1i, JPG-DU-7i, and JPG-DU-8i) exceeded 1,000 mg/L [1,000 ppm]. Sodium and chloride were the dominant ions in these samples. Samples from a number of the monitoring wells also exceeded the secondary MCLs for iron and manganese. The source of the high TDS water in the shallow bedrock water samples is unclear. However, the shallow bedrock samples with high TDS have sodium/chloride ratios similar to those of the deep bedrock samples. Thus, the shallow bedrock wells with elevated TDS likely tap into the same source of groundwater as the deep bedrock wells, and the elevated TDS is likely to be of natural origin.

Shallow groundwater contamination from past waste handling practices at JPG was identified during the Army's Remedial Investigation of the Cantonment Area, which is south of the firing line (MWH, 2002). Metals detected in groundwater above background levels included aluminum, arsenic, barium, beryllium, mercury, molybdenum, manganese, and zinc. Volatile and semi-volatile organic compounds were also detected, including chlorinated organic compounds and organic chemicals associated with explosives (MWH, 2002).

As part the ERMP discussed previously, the Army has analyzed uranium in groundwater samples from upgradient and downgradient of the DU Impact Area and at locations within the DU Impact Area since 1984 (U.S. Army, 2013a). The results of the Army's ERMP show no increasing trends in the concentration of uranium in groundwater samples (U.S. Army, 2017, 2013a). As described in Section 3.7.2.1, from 2004 to 2016, uranium concentrations in groundwater collected from all groundwater monitoring wells ranged from 0.11 to 5.7 pCi/L [0.16 to 8.4 ppb]. All the groundwater uranium concentrations were below the primary drinking water standard MCL of 30 μg/L [30 ppb] {20.3 pCi/L [30 ppb] for natural uranium and 10.8 pCi/L [16 ppb] for DU} as provided by EPA regulations at 40 CFR 141.66.

3.5 <u>Ecological Resources</u>

This section contains an overview and description of the habitat types and species that may be found within and in the vicinity of the DU Impact Area at JPG and that are relevant to the assessment of potential impacts to ecological resources from the proposed action and the no-action alternative. The Army did not conduct wildlife surveys to specifically support its license amendment request; however, NRC staff reviewed a number of surveys and reports from the IDNR Division of Fish and Wildlife (DFW), IDNR Division of Nature Preserves (DNP), and USFWS documenting observed and potential wildlife species at and around the BONWR and JPG, which have the potential to exist within the DU Impact Area.

The USFWS began to manage the natural resources at JPG in October 1996 under a 3-year MOA with the Army (USFWS, 2006). The USFWS expanded its role to make the area north of the JPG firing line a national wildlife refuge through an MOA signed on May 19, 2000, with both the Army and the USAF (U.S. Army, 2000). Under the 2000 MOA, the Army authorized the issuance of a real estate permit (effective Summer 2000) that allowed the USFWS to establish the 206-km^2 [51,000-ac] BONWR north of the JPG firing line (U.S. Army, 2000). In July 2000, the USFWS combined three plans into what is hereafter referred to as the Interim Plan (USFWS, 2000a). The three plans that compose the Interim Plan include an Interim Comprehensive Conservation Plan (ICCP), an Interim Hunting and Fishing Plan, and an Interim Compatibility Determination. The ICCP was developed as a general guideline for how the proposed BONWR could be managed over the course of the next several years until a final Comprehensive Conservation Plan (CCP) can be completed (USFWS, 2000a). A final CCP is currently being developed (78 FR 3909) but has not been issued for public review.

3.5.1 Vegetation and Habitat Types

The EPA, through its Western Ecology Region and in cooperation with the U.S. Forest Service (USFS) and the NRCS, has developed a common framework for describing, classifying, and mapping ecological regions of the United States for environmental resource management purposes. The DU Impact Area is located in EPA's Level IV Pre-Wisconsinan Drift Plains ecoregion (EPA, 2010). The EPA describes the Pre-Wisconsinan Drift Plains ecoregion as having deeply leached, acidic, pre-Wisconsinan till and thin loess surface material that overlies Paleozoic carbonates. Large areas within this ecoregion are characterized as nearly flat, with very poorly drained soils with altered subsurface soil layers that restrict water flow and root penetration. Beech forests and elm-ash swamp forests were common in this ecoregion before the establishment of modern dairy and livestock farming and corn, tobacco, soybean crops, and developed areas.

The most recently available assessment of vegetation types is provided in the 2000 USFWS Interim Plans for the BONWR (USFWS, 2000a). Figure 3-13 shows the habitat types and management areas at the BONWR, and Figure 3-2 shows the general land uses (e.g., forests, croplands, wetlands, and open water) on and around the DU Impact Area. The BONWR contains one of the largest contiguous forest blocks and grassland complexes in southeast Indiana (USFWS, 2015a).

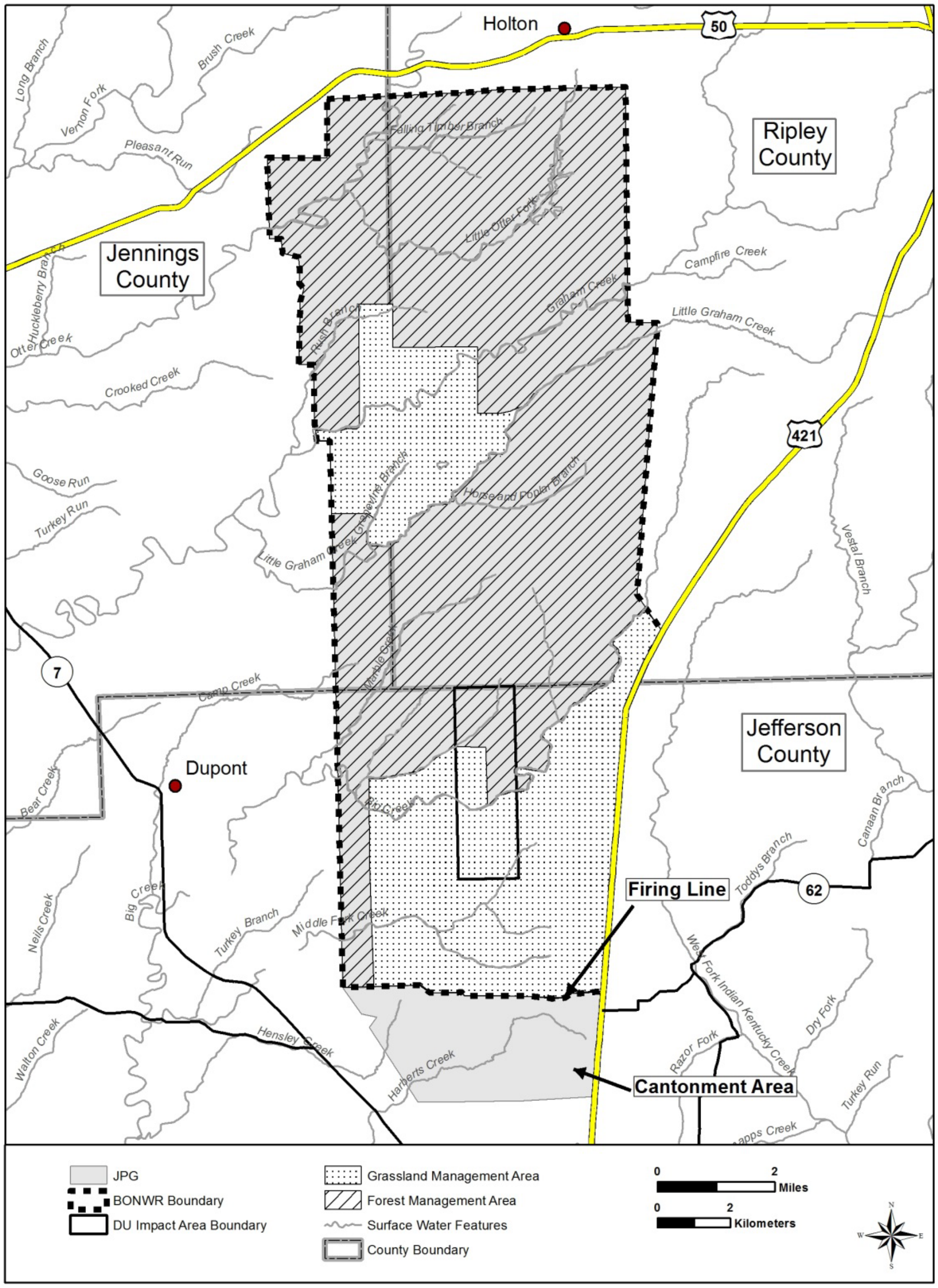

Figure 3-13. Habitat Types and Management Areas at the Big Oaks National Wildlife Refuge (Source: USFWS, 2000a)

The Interim Plans provided habitat classifications for the BONWR using photo interpretation from 1995 and 1997 aerial photographs with a minimum detection size of 202 square meters (m^2) [0.05 ac]. The USFWS classified 109 km^2 [27,000 ac] (54 percent) of the refuge as dominant upland forest habitat followed by 34 km^2 [8,500 ac] (17 percent) of grassland habitat. Figure 3-13 shows the forest management area (the entire refuge) and two grassland management areas at the refuge. About half of the DU Impact Area is located within a grassland management area.

Evergreen and deciduous species within the upland forest habitat range in age from young (approximately 15–30 years) to mature (>50 years). Eastern red cedar (*Juniperus virginiana*) is the dominant evergreen species at the refuge. Dominant deciduous trees on poorly drained upland depressions include sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), and black gum (*Nyssa sylvatica*). Tulip poplar (*Liriodendron tulipifera*) and white ash (*Fraxinus americana*) make up the majority of the young upland forests in well drained areas. Dominant species on intermediate and some mature upland forests include white oak (*Quercus alba*), red oak (*Quercus rubra*), and shagbark hickory (*Carya ovata*). American beech (*Fagus grandifolia*) and sugar maple (*Acer saccharum*) dominate the remainder of the mature upland forests. The dominant grassland species at the refuge appears to be broomsedge (*Andropogon* sp.). Plant species located within the woodland habitats are similar to those species found in the upland forest habitat (USFWS, 2000a).

The IDNR DNP conducted a survey of special plants in 1992, which identified 29 species of vascular plants at the JPG site that were listed as State-endangered, State-threatened, or rare, or which were on the State of Indiana's watch list (Hedge et al., 1993). A second survey was conducted by the DNP in 1998 covering areas that had not been visited during the field studies in 1992 and revisiting especially productive sites. This survey identified 17 additional species (46 species total) of vascular plants that were designated as state-endangered, state-threatened, rare, or on the State of Indiana's watch list species at that time (Hedge et al., 1999). No federally listed plants were found at the JPG site during either survey; however, it was noted that excellent habitat was present at JPG for the federally endangered running buffalo clover (*Trifolium stoloniferum*) (Hedge et al., 1999). A plant species inventory of the DU Impact Area was not conducted during the 1992 or 1998 surveys, and the occurrence of listed plants within the DU Impact Area is unknown.

However, as part of the previous environmental review activities conducted in 2014, NRC staff reviewed listed species within 1.6 km [1 mi] of the JPG site because these species could potentially occur within the DU Impact Area. NRC staff obtained a list of State-listed species from the IDNR DNP in December 2014 (Minor, 2014). NRC staff also requested information from the USFWS regarding federally listed threatened and endangered species and critical habitat that may occur at JPG (NRC, 2014; Lemont, 2015). The USFWS responded that JPG is within the range of running buffalo clover, a federally endangered plant species found in disturbed bottomlands; however, the running buffalo clover is not known to occur at JPG (Clark, 2018; Reed, 2014). The USFWS further stated that no critical habitat for federally listed threatened or endangered species is present in the JPG area. Protected species are further discussed in Section 3.5.3.

There are six areas at JPG that are classified as IDNR high quality natural communities (Clark, 2018; Hedge et al., 1999; Hellmich, 2015). Also called natural areas, high quality natural communities are undisturbed, large-tree canopies with good structure and composition that lack exotic species. Five of the six natural areas/high quality natural communities at JPG are located in the far northwest corner of JPG, and one is located in the central portion of JPG north of the DU Impact Area (Hedge et al., 1993). These communities consist of mesic upland forest, dry-mesic upland forest, limestone cliff, dry upland forest, and bluegrass till plain flatwoods.

3.5.2 Wildlife

The BONWR's continuous forest blocks and grassland complexes provide diverse, productive habitats for hundreds of animal species. USFWS surveys indicate that the BONWR is used by over 200 species of birds, 46 species of mammals, 24 species of amphibians, 41 species of fish, 8 species of freshwater mussels, and 18 species of reptiles (USFWS, 2000b; U.S. Army, 1995). The BONWR staff manages the large blocks of forest, grassland, and early successional schrubland habitats that are necessary to ensure healthy wildlife populations (USFWS, 2000a).

Mammals

The BONWR and JPG are home to white-tailed deer (*Odocoileus virginianus)*; river otters (*Lutra canadensis)*; raccoon (*Procyon lotor*); coyote (*Canis latrans*); Virginia opossum (*Didelphis virginiana*); bobcat (*Felis rufus*); gray and fox squirrel (*Sciurus carolinensis* and *S. niger*); Eastern cottontail (*Sylvilagus floridanus*); striped skunk (*Mephitis mephitisl)*; beaver (*Castor canadensisl)*; red fox (*Vulpes vulpesl);* gray fox (*Urocyon cinereoargenteus*); weasel (*Mustela* spp.); mink (*Mustela vison*); muskrat (*Ondatra zibethicus*); and large populations of small mammals, including mice, shrew, and moles (U.S. Army, 2013a, 1995; USFWS, 2006; Pruitt et al., 1994). River otters, aquatic mammals formerly extirpated in Indiana, were reintroduced to BONWR in 1996 and 1999. Breeding otter populations are now established and are seen frequently at the refuge, including in streams that cross the DU Impact Area. They benefit fisheries by eating mostly slow-swimming fish, rather than game fish, and crayfish. Annual squirrel and deer hunting is managed at the BONWR to control population size. No hunting is permitted within the DU Impact Area. Hunting areas at the BONWR are shown in Figure 3-3.

The Northern long-eared bat (NLEB) (*Myotis septentrionalis*), a federally threatened species, and the Indiana bat (*Myotis sodalist)*, a federally endangered species, are both present at the BONWR and JPG (Clark, 2018; Reed, 2017, 2014) and could be present in the DU Impact Area. Bats roost and forage in the summer along the forested stream corridors in the area and use dead tree bark, cracks, splits, or hollows (called snags) to rear their young (USFWS, 2006). Initial USFWS surveys reported several maternity colonies of Indiana bats located within the BONWR (USFWS, 2000b). Protected species are further discussed in Section 3.5.3.

Birds

JPG lies within the Atlantic and Mississippi flyways, which include the majority of the eastern and mid-western states (36 states and the District of Columbia) and the Great Lakes (USGS, 2013). Migrating birds have highly variable flight paths within and around these flyways that cover the migratory range of many bird species. In addition to migratory bird use, the BONWR is also used by many breeding birds considered rare in the surrounding landscape that flourish in the BONWR's large and diverse habitats. Examples of interior forest species that require large forest blocks of the types present at BONWR include cerulean warblers (*Dendroica cerulean)*, wood thrush (*Hylocichla mustelina)*, worm-eating warblers (*Helmitheros vermivorus)*, and wild turkey (*Meleagris gallopavo)* (USFWS, 2000a). The BONWR has been named a Globally Important Bird Area by the American Bird Conservancy for its importance to grassland birds (e.g., Henslow's sparrow) and forest birds (e.g., cerulean warbler) (USFWS, 2000a, 2012b). Bald eagles are frequently sighted near Old Timbers Lake at the BONWR, approximately 11.3 km [7 mi] north of the DU Impact Area (USFWS, 2015a). No federally listed threatened, endangered, or proposed bird species are known to occur, or are expected to occur at the BONWR, including the DU Impact Area (Clark, 2018; Reed, 2017, 2014; USFWS 2018). Protected species are further discussed in Section 3.5.3.

Other Terrestrial Wildlife

Other terrestrial wildlife at BONWR and JPG include reptiles, insects, and spiders. Surveys of the BONWR and JPG report several snake species occurring in the area, especially in wetland or other areas near water. These species include Kirtland's snake *(Clonophis kirtlandii)* (Clark, 2018; U.S. Army, 1995; Hellmich, 2015), a State-endangered species. Very little data is available regarding insects at the BONWR and JPG. One limited study conducted as part of a local college entomology course collected and documented 96 families of terrestrial and aquatic insects at JPG (Pruitt et al., 1994).

Aquatic Species

Section 3.4.1 describes the surface water features and characteristics of streams, ponds, lakes, and wetlands at JPG. A fish survey was conducted in 1993 by the USFWS in Otter Creek, Little Otter Creek, Graham Creek, Little Graham Creek, and Big Creek at JPG. The most common fish type surveyed was minnows. In their 1993 Preliminary Concept Report, the USFWS described the quality of the aquatic habitat and fish communities in the streams at JPG as high and unusually rich in diversity of reptiles and amphibians due to the relatively undisturbed state of the stream channels and watersheds. The USFWS did not perform a comprehensive mussel survey but stated that freshwater mussels have been observed in all the major streams at JPG (U.S. Army, 1995). JPG is within the range of the federally endangered sheepnose mussel *(Plethobasus cyphyus),* but occurrences have not been reported at BONWR and JPG. The USFWS informed NRC staff that the sheepnose mussel is limited to the Ohio River, which is approximately 6.4 km [4 mi] south of JPG (Reed, 2017, 2014).

A variety of amphibians, including frogs and salamanders, have been reported at JPG (Hellmich, 2015; Pruitt et al., 1994; U.S. Army, 1995). Ruts and pits in the ground are common at JPG in the areas that are treated with controlled burns. Craters are also present from previous ordnance testing. These ruts, pits, and crater areas fill with water and provide an abundance of amphibian breeding habitat (Pruitt et al., 1994). The Northern crawfish frog, a State-endangered species, has been reported at JPG (Clark, 2018; Hellmich, 2015). Protected species are further discussed in Section 3.5.3.

3.5.3 Protected Species

The BONWR is within the known range of several State and Federal species of concern. BONWR staff manages natural resources at the refuge to preserve sensitive and protected wildlife species. The protection of federally endangered or threatened species is carefully reviewed by BONWR staff and as part of the recreational hunting and fishing that occur at the BONWR to eliminate conflict with the recovery of these species (USFWS, 2000a). The NRC staff reviewed information from the Army, USFWS, Indiana National Heritage Data Center, as well as surveys conducted to inform the USFWS of the wildlife resources present at the BONWR prior to its establishment, to determine which State and federally listed or proposed species could occur there. The NRC staff also reviewed a 2006 USFWS fire management plan (FMP) for BONWR, which identified Federal and State species of concern that could potentially occur or are suspected to occur at the BONWR (USFWS, 2006).

As discussed in Section 3.5.2, one federally endangered species, the Indiana bat, and one federally threatened species, the Northern long-eared bat, are present at the BONWR. Four federally endangered species [Kirtland’s warbler (*Dendroica kirtlandii),* grey bat (*Myotis grisescens)*, running buffalo clover (*Trifolium stoloniferum*and), and American burying beetle (*Nicrophorus americanus*)*,* and one federally threatened species [Northern copperbelly water snake (*Nerodia erythrogaster neglecta*)] were identified in the FMP as having the potential to occur within the BONWR based on their current ranges but are not known to occur at BONWR, including the DU Impact Area (Clark, 2018; USFWS, 2006). No critical habitat is present within BONWR and JPG for any wildlife species (Reed, 2017, 2014; USFWS, 2018). Appendix B lists animal and plant species that have been reported at or within 1.6 km [1 mi] of the BONWR and JPG or that could occur at the BONWR and that are either federally listed or Federal species of concern, State-endangered, State-threatened, State rare species, or State species of special concern, or on the State watch list.

3.5.4 Biological Studies

Uranium concentration data in animals, mostly deer, at JPG, including the DU Impact Area, was collected for several studies between 1984 and 2006 to determine the human health effects from consuming animals exposed to DU (U.S. Army, 2013a). Deer tissue samples collected prior to 2006 for total uranium concentrations for isotopes U-234 to U-238 were less than 0.42 pCi/g [0.63 ppm] and did not indicate the presence of DU in deer tissue. Results of a more robust deer tissue sampling effort conducted in 2006 indicated that total uranium isotope concentrations ranged from 0.0017 to 0.074 pCi/g [0.0026 to 0.111 ppm], and that deer tissue does not appear to be a potential significant exposure pathway for DU at JPG.

Between 2006 and 2007, the USFWS and the Indiana Department of Environmental Management (IDEM) Biological Studies Section conducted a study of streams and rivers focused on metal contaminants and nutrient impacts and other land use stressors (USFWS, 2008). Fish, macroinvertebrates, and crayfish sampling within JPG was conducted, including sample locations both upstream and downstream of the DU Impact Area, as part of the 2-year study. The Army conducted an additional evaluation of macroinvertebrates and fish in 2006 on Big Creek upstream and downstream from the DU Impact Area. Based on the results of the USFWS and IDEM study and the additional study conducted by the Army in 2006, the Army interprets the results to indicate that the stream water and stream conditions at JPG are of a relatively high quality compared to other streams in Southern Indiana (U. S. Army, 2015b).

An ecological risk assessment was conducted at JPG by the U. S. Army (2003b) titled, "*Training Range Site Characterization and Risk Screening*." The dominant JPG ecosystem (in this case, wet meadow) was selected for the analysis and included the assessment of selected plants and rodents. Soil, surface water, sediment, benthic invertebrate, groundwater, plants, and rodents were sampled for constituents of concern attributable to test artillery range operations other than uranium in three areas at JPG: a high-explosive impact area west of the DU Impact Area, the northern portion of the DU Impact Area, and at a comparison site on the east central boundary of JPG that was not used for munition testing. The results of the ecological risk assessment indicated that small mammal populations and aquatic benthic macroinvertebrate at JPG were not affected by munition constituents attributable to test range operations. The assessment also concluded that there were no estimated risks to raptors, which consume rodents in the JPG area and thus were assumed to bear some risk of exposure to munitions constituents (U.S. Army, 2015b, 2003b).

Other ecological risk assessments were conducted as part of the BRAC program remedial investigation activities at JPG south of the firing line (MWH, 2002). These assessments are not discussed in this EA, because they were conducted under a narrow scope at specific locations, such as disposal sites and burn areas with known contaminants, and are not representative of the ecological conditions north of the firing line or within the DU Impact Area.

No plant or animal sampling has occurred in the vicinity outside of JPG and no ecological risk assessments have been conducted for ecological resources that occur outside of JPG (e.g., plants and animals that are exposed to water and sediment downstream of JPG) (U.S. Army, 2015b, 2013a).

3.6 Meteorology, Climatology, and Air Quality

This section describes the meteorology, climatology, and air quality conditions of the environment at and surrounding JPG that are relevant to the assessment of the potential impacts associated with the proposed action and the no-action alternative.

3.6.1 Meteorology and Climatology

Indiana has an active and lively climate with distinct seasons. Southerly winds from the Gulf of Mexico transport warm, moisture-laden air to Indiana, while the jet stream transports continental polar air from central and western Canada. Interactions between these two air masses typically drive Indiana's weather as surges of polar air move to the south and tropical air moves to the north. Winters are sometimes bitterly cold while summers are characterized by high temperatures and humidity levels. The transition between winter and summer can result in an active spring with thunderstorms and tornadoes (NOAA, 1960).

The USFWS operates a weather station at JPG located off East Perimeter Road near the intersection of Route 421 and Old Michigan Road, which is about 4.0 km [2.5 mi] northeast of the DU Impact Area. This station collects temperature, precipitation, and wind data, which is presented in Table 3-2. At the JPG weather station, winds are predominately from the south-southwest.

Temperature and precipitation are two parameters that can be used to characterize climate change. Average U.S. temperatures have increased between 0.72 to 1.06 °C [1.3 to 1.9 °F] since 1895, and temperatures in the U.S. are expected to continue to rise (USGCRP, 2014). From 1991 to 2012, the average temperature in the region where JPG is located increased by up to 0.55 °C [1.0 °F] when compared to the 1901 to 1960 baseline (USGCRP, 2014). The average temperature in this region is projected to increase between 2.22 to 5.00 °C [4 and 9 °F] by the latter part of this century (USGCRP, 2014).

Average U.S. precipitation has increased since 1990; however, some areas in the U.S. experienced increases greater than the national average, while other areas experienced decreased precipitation levels. From 1991 to 2012, the annual precipitation totals in the region where JPG is located increased between 5 to 15 percent when compared to the 1901 to 1960 baseline (USGCRP, 2014). By the latter part of this century, U.S. Global Change Research Program (USGCRP) forecasts a 0 to 10 percent decrease in precipitation during the summer and a 0 to 10 percent increase in precipitation for the fall, winter, and spring for this region (USGCRP, 2014). The USGCRP predicts increases in the frequency and intensity of extreme

Table 3-2. Temperature, Precipitation, and Wind Data from the JPG Weather Station

Time Period	Temperature (°C)*	Precipitation (cm)†	Wind (km/hr)‡
Annual§	10.7	137.41	9.17
Monthly‖ Low	-4.78 (January)	5.28 (February)	5.31 (August)
Monthly High	22.2 (August)	20.1 (July)	12.5 (April)

Source: Weather Underground, 2014
* To convert Celsius (°C) to Fahrenheit (°F), multiply by 1.8 and add 3.2.
† To convert centimeters (cm) to inches (in), multiply by 0.3937.
‡ To convert kilometers per hour (km/hr) to miles per hour (mi/hr), multiply by 0.6214.
§ The annual temperature and wind values are means. The annual precipitation value is the total.
‖ The monthly temperature value is the mean daily temperature over a month. The monthly precipitation value is the total over a month. The monthly wind speed is the average over a month.

precipitation events for all regions of the U.S., particularly in the Northeast and in the Midwest where JPG is located. From 1958 to 2012, the amount of rain falling during the most intense 1 percent of storms increased by 37 percent in the Midwest where JPG is located (USGCRP, 2014). These increases in the amount of rain during extreme precipitation events result in an increase in the number of floods. River flood magnitudes in the part of the Midwest where JPG is located increased about 9 percent per decade from the 1920s through 2008 (USGCRP, 2014).

3.6.2 Air Quality

Non-Greenhouse Gases

In 40 CFR Part 50, “National Primary and Secondary Ambient Air Quality Standards,” the EPA established the National Ambient Air Quality Standards (NAAQS) to promote and sustain healthy living conditions. The EPA requires States to monitor ambient air quality and evaluate compliance with the NAAQS. Based on the results of these evaluations, EPA designates areas into various NAAQS compliance classifications (e.g., attainment, nonattainment, or maintenance) for each of the six NAAQS primary criteria air pollutants. An attainment area is defined as a geographic region that EPA designates meets the primary or secondary NAAQS for a pollutant. A nonattainment area is defined as a geographic region that EPA designates does not meet the primary or secondary NAAQS for a pollutant or that contributes to the ambient pollutant levels in a nearby area that does not meet the NAAQS. A maintenance area is defined as any geographic area previously designated nonattainment and subsequently redesignated by EPA to attainment. These EPA classifications characterize the air quality within a defined area, which can range in size from portions of cities to large Air Quality Control Regions comprising many counties. An Air Quality Control Region is a federally designated area for air quality management purposes.

The JPG DU Impact Area is located in the Southern Indiana Intrastate Air Quality Control Region, which comprises 23 counties in Indiana, including Jefferson, Jennings, and Ripley Counties. Areas within the Southern Indiana Intrastate Air Quality Control Region are classified as an attainment area for each criteria pollutant, with one exception. Veale Township, located in Daviess County about 145 km [90 mi] to the west of JPG, is a nonattainment area for the sulfur dioxide 1-hour standard. From 2005 to 2016, the Madison Township portion of this Air Quality Control Region was classified as nonattainment for the particulate matter $PM_{2.5}$ annual standard (70 FR 944 and 81 FR 62390). Madison Township is located in the southern part of Jefferson County and is currently classified as a maintenance area for this pollutant. As depicted in Figure 3-14, some of the JPG Cantonment Area (i.e., the area south of the JPG firing line) is located in Madison Township. Other areas in Indiana outside of the Southern Indiana Intrastate Air Quality Control Region are classified as nonattainment, including Clark and Floyd Counties, which are nonattainment areas for the particulate matter $PM_{2.5}$ annual standard. These two counties are to the southwest of JPG with Clark County sharing a border with Jefferson County (see Figure 1-1). At the closest point, Clark County is about 25 km [15.5 mi] from JPG.

Air quality within Madison Township was recently classified as nonattainment and is now classified as maintenance. EPA designates an area as nonattainment if it has an air quality monitoring site that is violating a standard or if it has emission sources that contribute to a NAAQS violation in a nearby area. Madison Township was previously classified as a nonattainment area for the particulate matter $PM_{2.5}$ annual standard because EPA determined that the Clifty Creek Power Plant, which is located in Madison Township, contributed to the NAAQS violations in the Louisville, Kentucky-Indiana Area (i.e., Clark and Floyd Counties in Indiana and Jefferson and Bullitt Counties in Kentucky). In 2014, EPA stated that Clifty Creek

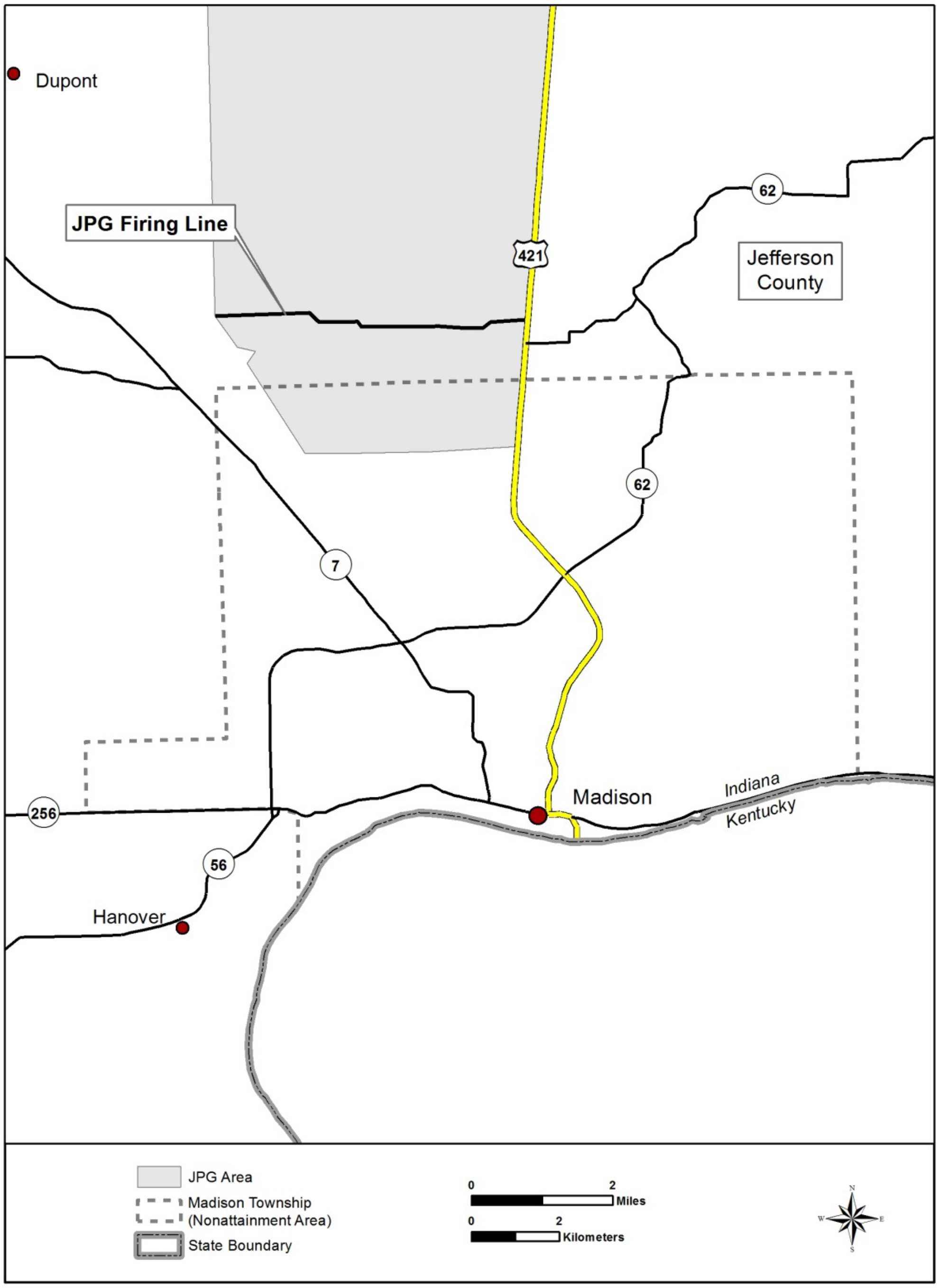

Figure 3-14. Madison Township Maintenance Area for Particulate Matter (PM)$_{2.5}$ Annual Standard (Source: 40 CFR 81.315)

no longer contributed to the NAAQS violation in the Louisville-Indiana Area, because of the lower facility emission levels resulting from the installation of new pollution abatement equipment, the distance between the facility and the Louisville-Indiana Area, and the low frequency of winds blowing from the facility to the Louisville-Indiana Area (EPA, 2015).

Under the Clean Air Act (CAA), the EPA developed the Prevention of Significant Deterioration Program (40 CFR 52.21), which places limits on the allowable increases in ambient pollutant levels for nitrogen dioxide, particulate matter PM_{10}, and sulfur dioxide. Under the regulations for this program, certain national park and wilderness areas are designated as Class I areas and provided the highest levels of protection. The rest of the country is designated as Class II area and provided a lower level of protection. The nearest Class I area to JPG is Mammoth Cave National Park in Kentucky, located about 209 km [130 mi] south of JPG.

Table 3-3 presents the annual mass flow rates (i.e., the amount of a pollutant generated in a year) for various pollutants for Jefferson, Jennings, and Ripley Counties. Table 3-4 presents the area emissions by the following five different types of sources: on-road, non-road, point, area, and electricity-generating units (i.e., power plants). In Jefferson County, power plants such as Clifty Creek generate 85.6 percent of the particulate matter $PM_{2.5}$, 95.4 percent of the nitrogen oxides, and 99.8 percent of the sulfur oxide emissions.

Greenhouse Gases

Greenhouse Gases (GHGs), which can trap heat in the atmosphere, include carbon dioxide, methane, nitrous oxide, and certain fluorinated gases. These gases vary in their ability to trap heat and in their atmospheric longevity. GHG emission levels are expressed as carbon dioxide (CO_2) equivalents (CO_2e), which is an aggregate measure of total GHG global warming potential described in terms of CO_2, and accounts for the heat-trapping capacity of different gases. Long-term CO_2 levels extending back 800,000 years have ranged between 170 and 300 parts per million (USGCRP, 2014). Present-day CO_2 concentrations are about 400 parts per million, and USGCRP estimates that at the end of the century these levels will range somewhere between 420 and 935 parts per million (USGCRP, 2014).

As described in Section 5.4.5.2, climate change impacts are considered the result of overall GHG emissions from numerous sources rather than an individual source, and there is no strong relationship between the locations of GHGs emissions and the locations of impacts. The EPA has promulgated rules to address GHG emissions under its CAA permitting programs. The EPA finalized a rule that focused on the nation's largest stationary source GHG emitters and established thresholds for greenhouse gas emissions that define whether sources are subject to EPA air permitting (EPA, 2012b). For new sources, the threshold was 90,718 metric tons [100,000 short tons] of carbon dioxide equivalents per year and for modified existing sources the threshold was 68,039 metric tons [75,000 short tons] of carbon dioxide equivalents per year.

Table 3-3. Emission Mass Flow Rates (Metric Tons* Per Year) for Various Pollutants for Jefferson, Jennings, and Ripley Counties

	Pollutant					
County	Carbon Monoxide	Nitrogen Dioxides	Particulate Matter $PM_{2.5}$	Particulate Matter PM_{10}	Sulfur Dioxide	Volatile Organic Compounds
Jefferson	4,280	9,412	1,805	3,698	27,315	1,430
Jennings	2,513	569	672	2,780	347	1,237
Ripley	3,748	711	806	3,299	356	2,710
Total	10,541	10,692	3,283	9,777	28,018	5,377

Sources: IDEM, 2012 a,b

*To convert metric tons to short tons, multiply by 1.10231

Table 3-4. Percent of Area Emissions by Various Source Types

Pollutant	Area*	Source Type					
		On-Road	Non-Road	Electric Generating Unit†	Point	Area	Total
Carbon Monoxide	Jefferson County	na‡	na	na	na	na	na
	Southeast Indiana	61	18	2	3	16	100
	Central Southeast Indiana	63	17	1	4	15	100
Nitrogen Oxides	Jefferson County	1.9	2.0	95.4	0	0.7	100
	Southeast Indiana	15	23	53	7	2	100
	Central Southeast Indiana	23	15	34	21	7	100
Particulate Matter $PM_{2.5}$	Jefferson County	3.4	7.8	85.6	2.5	0.7	100
	Southeast Indiana	2	4	27	21	46	100
	Central Southeast Indiana	2	2	15	23	57	100
Particulate Matter PM_{10}	Jefferson County	na	na	na	na	na	na
	Southeast Indiana	1	1	10	18	70	100
	Central Southeast Indiana	1	1	4	14	80	100
Sulfur Dioxide	Jefferson County	0	0	99.8	0	0.2	100
	Southeast Indiana	0	1	92	6	1	100
	Central Southeast Indiana	0	1	79	17	3	100
Volatile Organic Compounds	Jefferson County	na	na	na	na	na	na
	Southeast Indiana	18	8	1	10	63	100
	Central Southeast Indiana	17	8	1	20	55	100

Sources: IDEM, 2011, 2012 a,b
*Central Southeast Indiana consists of the following nine counties: Bartholomew, Brown, Dearborn, Decatur, Franklin, Jackson, Jennings, Lawrence, and Ripley. Southeast Indiana consists of the following ten counties: Clark, Crawford, Floyd, Harrison, Jefferson, Ohio, Orange, Scott, Switzerland, and Washington. Jefferson County data from 2008. Central Southeast Indiana and Southeast Indiana data are 5-year averages from 2005-2009.
†An electricity-generating unit (i.e., power plant) is one specific type of point source.
‡na is not available.

3.7 Public and Occupational Health

This section describes the existing conditions of the environment within and surrounding JPG and the DU Impact Area that are relevant to the assessment of potential impacts to public and occupational health from the proposed action and the no-action alternative. This includes general descriptions of background radiation exposure, the background radiation exposure level within the DU Impact Area, and the potential health effects from exposure to radiation. In addition, results of various Army site characterization studies are summarized to describe current conditions regarding sources and levels of exposure to radioactive materials and chemicals in the DU Impact Area. In these studies, the Army surveyed various environmental media within and around the DU Impact Area, including soil, surface water, sediment, and groundwater, for the presence of natural uranium, depleted uranium, and munitions constituents.

3.7.1 Background Radiological Exposure

Humans are exposed to ionizing radiation from many sources in the environment, including natural sources and sources resulting from human activities. The average total annual background radiation dose received by the general public in the U.S. is approximately 6.2 mSv [620 mrem]. Natural background radiation contributes 50 percent of this average total radiation dose, or 3.1 mSv [310 mrem] (NCRP, 2009). Radioactivity from naturally occurring elements in the environment is present in soil, rocks, and living organisms.

Locations in the U.S. that have specific types of soils or bedrock have higher radon levels (EPA, 2005a). The background radiation dose from natural sources in Indiana is 4.57 mSv [457 mrem] (EPA, 2005a), which is higher than the national average of 3.1 mSv [310 mrem], as described previously. This is the result of above-average natural concentrations of uranium in Indiana. When the Indiana natural background radiation dose of 4.57 mSv [457 mrem] is added to the general 3.1 mSv [310 mrem] background dose from medical and industrial sources, the total annual background for a resident of Indiana is approximately 7.67 mSv [767 mrem].

In 1994, the Army conducted a scoping survey that involved taking gamma radiation measurements at 1 m [3.3 ft] above the ground surface every 10 m [3.3 ft] while walking across gridlines within the DU Impact Area parallel to the lines of fire and spaced 50 m [165 ft] apart (SEG, 1995). This survey also included a background study that took similar measurements outside of the DU Impact Area. Thirty-five locations south of the firing line were measured to determine an average background exposure rate of 12 microroentgen per hour (μR/hr). The Army scoping survey found these results were consistent with the site background levels determined by the Army in 1983 prior to test firing DU. For comparison purposes, the NRC staff converted this measure to an annual dose based on an individual being exposed to this level of gamma radiation for 8 hours per day, 5 days per week, 52 weeks per year, and a conservative assumption that 1R gamma exposure equals a 1 rem dose. The resulting annual dose is 0.25 mSv/yr [25 mrem/yr], which is 25 percent of the 10 CFR Part 20 annual public dose limit of 1 mSv/yr [100 mrem/yr]. The NRC staff notes that this level of estimated dose is comparable to the national background terrestrial radiation exposure, which is approximately 0.19 mSv/yr [19 mrem/yr].

To support previous decommissioning proposals for the DU Impact Area at JPG, the Army has conducted site surveys of various environmental media to establish background activity concentrations (e.g., radioactivity per unit volume) of uranium. These surveys include taking measurements of soil, surface water, sediment, and groundwater at locations that are up-gradient from any known sources of DU from past Army DU penetrator test firing.

Additionally, the ratio of uranium isotopes (isotopes are different forms of uranium atoms) that are present in sampled media provide a means to determine whether any uranium detected in samples came from natural sources or from DU penetrators.

The following sections summarize the results of the Army's background characterization studies within and beyond the DU Impact Area. This information supports the analysis of environmental impacts to public and occupational health documented in Section 4.7.

3.7.1.1 Soils

The 1996 Army characterization survey (SEG, 1996) included soil background measurements on surface soils and at various depths below the ground surface. For the depth 0 to 15 cm [0 to 5.9 in], the total uranium concentration ranged from 1.52 to 2.53 pCi/g [2.28 to 3.8 ppm], with an average of 1.97 pCi/g [2.96 ppm]. For the depth 15 to 30 cm [5.9 to 11.8 in], the total uranium concentration ranged from 1.33 to 2.59 pCi/g [2.0 to 3.89 ppm] and averaged 1.84 pCi/g [2.76 ppm]. For the depth 30 to 45 cm [11.8 to 17.7 in], the concentration of total uranium ranged from 1.33 to 2.76 pCi/g [2.0 to 4.14 ppm] and averaged 1.95 pCi/g [2.92 ppm]. The ratio of concentration of U-238 to U-234 ranged from 0.7 to 1.3, which is within the range that indicates the uranium is from natural background (U.S. Army, 2013b). The Army also conducted soil sampling in 2008 and 2012 to assess the presence of uranium in the DU Impact Area. Based on 127 background samples analyzed for uranium, the average background soil concentration was 1.5 ± 0.2 pCi/g [2.25 ± 0.3 ppm] (U.S. Army, 2013a). These levels of uranium in soil are within the range of values expected by the NRC staff for background natural uranium soil concentrations.

3.7.1.2 Surface Water and Sediments

The Army also surveyed surface water and sediments in the scoping survey (SEG, 1995) at various locations within and in the vicinity of the DU Impact Area. Samples collected from Big Creek upstream from the DU Impact Area had a total uranium concentration of 0.27 pCi/L [0.40 ppb] (SEG, 1995). All surface water samples in that survey showed low concentrations and isotopic ratios of U-238 to U-234, indicating that the uranium was from natural sources. The survey sampled sediments at the same locations. The location upstream from the DU Impact Area with the highest value showed a total uranium concentration of 1.36 pCi/g [2.04 ppm], and isotopic ratios indicated natural uranium. The site characterization survey produced comparable results at locations upstream from the DU Impact Area (SEG, 1996).

3.7.1.3 Groundwater

Groundwater was sampled by the Army for uranium isotopes at 11 background wells, as part of the scoping and characterization surveys and in the ERMP. The scoping and characterization survey samples were collected in 1994 and 1995. The total uranium concentration in groundwater samples collected ranged from 0.33 to 5.09 pCi/L [0.49 to 7.52 ppb]. The activity ratio of U-238 and U-234 in groundwater samples indicated that the uranium was naturally occurring (U.S. Army, 2013b).

During the most recent site characterization program in 2008 and 2009, the Army sampled groundwater for total and isotopic uranium in nine background wells (upgradient of the DU Impact Area) that drew water from various strata, including the overburden (two wells), shallow bedrock (six wells), and deep bedrock (one well). Uranium reported for the unfiltered and filtered background groundwater samples ranged from 0.11 to 6.4 pCi/L [0.16 to 9.45 ppb] with the highest mean at 2.5 pCi/L [3.69 ppb] in the overburden wells (unfiltered samples). For context, all mean values were below the 40 CFR 141.66 EPA MCL for uranium of 30 μg/L [30 ppb] {20 pCi/L [30 ppb] for natural uranium}.

3.7.2 Sources and Levels of Exposure to Radioactive Material in the DU Impact Area

DU at JPG originated from Army test firings of armor penetrators fired at targets within the DU Impact Area. As described in Section 1.1, the Army estimates that during the period of DU penetrator test firing (1984–1994), approximately 100,000 kg [220,500 lb] of DU rounds were fired into the DU Impact Area at cloth targets, so that the DU penetrators remained intact. Approximately 89 percent {65,415 kg [144,214 lb]} of DU penetrators were fired from the 500 Center firing position, 7 percent {5,145 kg [11,343 lb]} were fired from the J firing position, and 4 percent {2,940 kg [6,482 lb]} of the DU projectiles were fired from the K5 firing position (U.S. Army, 2013a). See Figure 1-2 for the locations of these firing positions. The Army recovered a portion of this material and estimates that approximately 73,500 kg [162,040 lb] of DU penetrators, DU penetrator fragments, and DU corrosion products presently remain in the DU Impact Area (U.S. Army, 2013a).

The DU penetrators consist of a DU-titanium alloy metal (0.75 percent titanium) (U.S. Army, 2013a). According to a past Army assessment, the DU in the DU Impact Area, which occurs primarily in the form of solid metal rods, corrodes in the presence of oxygen and water and would corrode completely over a period of time ranging from approximately 65 to 182 years (U.S. Army, 2013a). The Army describes the isotopic composition of the DU (based on mass) as U-238 (99.7990 percent), U-235 (0.200 percent), and U-234 (0.0010 percent) (U.S. Army, 2013a). The chemical and physical properties of DU are the same as natural uranium; however, the mixture of the three uranium isotopes is different than natural uranium because some U-235 and U-234 was removed during the uranium enrichment process that produced the DU. For reference, the isotopic composition of natural uranium is U-238 (99.3 percent), U-235 (0.72 percent), and U-234 (0.006 percent) (U.S. Army, 2013a). Additionally, based on the ratio of specific activities of uranium isotopes, a unit mass of U-235 has 6.43 times the radioactivity of U-238 and a unit mass of U-234 has 18,500 times the radioactivity. As a result, DU, with lower proportions of U-235 and U-234 is less radioactive than natural uranium per unit mass. Additionally, in natural uranium, the ratio of measured U-238 to U-234 radioactivity should be approximately one but can range from 0.025 to 2.0 in water and 0.83 to 2.0 in soil due to disequilibrium facilitated by both physical and chemical processes (U.S. Army, 2013a). In DU, this ratio can also vary with details of the uranium enrichment process from approximately 5 to 11 (based on reported ranges for each isotope) (U.S. Army, 2013a). This elevated U-238 to U-234 ratio allows DU to be detected in the environment in the presence of natural uranium (U.S. Army, 2013a). For mixtures of natural uranium and DU that are typical of JPG environmental samples, the Army considers U-238 to U-234 ratios below two as indicative of natural uranium and above three as potentially containing DU.

The historical methods used to produce some depleted uranium from spent reactor fuel has resulted in the introduction of additional radiological impurities not normally associated with depleted uranium into DU armor and DU penetrators (U.S. Army, 2002). This is described in U.S. Department of Energy (DOE) documentation that states "…some of the uranium feed material that was handled at DOE facilities had been reclaimed or recycled from reprocessed, spent reactor fuel. The chemical processes by which recycled uranium was purified left trace amounts of transuranic elements (e.g., neptunium, americium, plutonium) and fission products [mainly technetium-99 (Tc-99)]. The recycled uranium also contained trace amounts of uranium isotopes not found in nature, such as U-236. At the minute concentration levels in uranium from fuel reprocessing facilities, the radiological impact of these impurities was negligible in most cases. However, there were many routine chemical processes that tended to concentrate these impurities, either in the uranium product or in reaction by-products" (DOE, 2009). The potential impacts of these suspected impurities are addressed in the NRC radiological impact analysis in Section 4.7.1.1.

The following subsections summarize the results of radiological surveys and describe historical exposure to radioactive material in the DU Impact Area.

3.7.2.1 DU Impact Area Radiological Survey Results

To support the previous decommissioning proposal for the DU Impact Area, the Army described the results of past surveys and monitoring of various environmental media to determine if DU is present and if so, at what concentrations (U.S. Army, 2013b). These surveys include walkover gamma radiation measurements of the land and sampling and laboratory analysis of soil, surface water, sediment, and groundwater at locations throughout and outside the DU Impact Area. As described in Section 3.7.1, the ratio of uranium isotopes that are present in sampled media provide a means to determine whether any uranium detected in samples came from natural sources or from the DU.

Soil

Scoping and characterization surveys (SEG, 1996, 1995) were performed by the Army to estimate the extent of the area contaminated by DU. The scoping survey included gamma radiation measurements in the DU Impact Area along grid lines at 50-m [164-ft] intervals from the northern to southern boundaries of the survey area, following the J, 500 Center, and K5 firing lines, and laterally at distances of 50 m [164 ft] on either side of each firing line. The Army took gamma radiation measurements at 1 m [3.28 ft] above the surface soil at 10-m [32.8-ft] intervals along each grid line for a total of 25,098 measurements. The majority of measurements were below 15 μR/hr with an average exposure rate of 10.2 μR/hr and maximum of approximately 44 μR/hr (SEG, 1995). For context, continuous exposure of an individual to gamma radiation at these exposure rates for the number of hours in a working year (2,080 hrs) would produce an annual effective dose below the NRC 10 CFR Part 20 public dose limit of 1 mSv/yr [100 mrem/yr]. The most likely exposure rate that an onsite individual would experience is the average that is comparable to the background soil radiation measurements described in Section 3.7.1.

The Army also sampled soil on a 150-m [490-ft] grid and analyzed samples by alpha spectroscopy to determine activity concentrations for U-238, U-235, and U-234. The Army's statistical analysis of the gamma radiation survey results (SEG, 1995) initially identified land areas impacted by DU testing as those areas within the DU Impact Area that had radiation exposure rates significantly different than the average of all exposure rates measured within the DU Impact Area (i.e., greater than or equal to 13.3 μR/hr, which is the upper bound of a 95 percent confidence interval of the mean exposure rate of 10.2 μR/hr). These areas of elevated gamma radiation are shown in Figure 3-15. These results show locations of elevated DU penetrator impact densities and the resulting spatial extent of the most concentrated areas of DU contamination within the impact area. The NRC staff notes that the site characterization survey report (SEG, 1996) further refined and limited the spatial extent of the impacted area, based on prior values of NRC soil guidelines for unrestricted use of 35 pCi/g [52.5 ppm] (46 FR 52061; October 23, 1981). However, these results are not described further, because the NRC license termination standards have since been revised in 10 CFR Part 20, Subpart E (62 FR 39088; July 21, 1997).

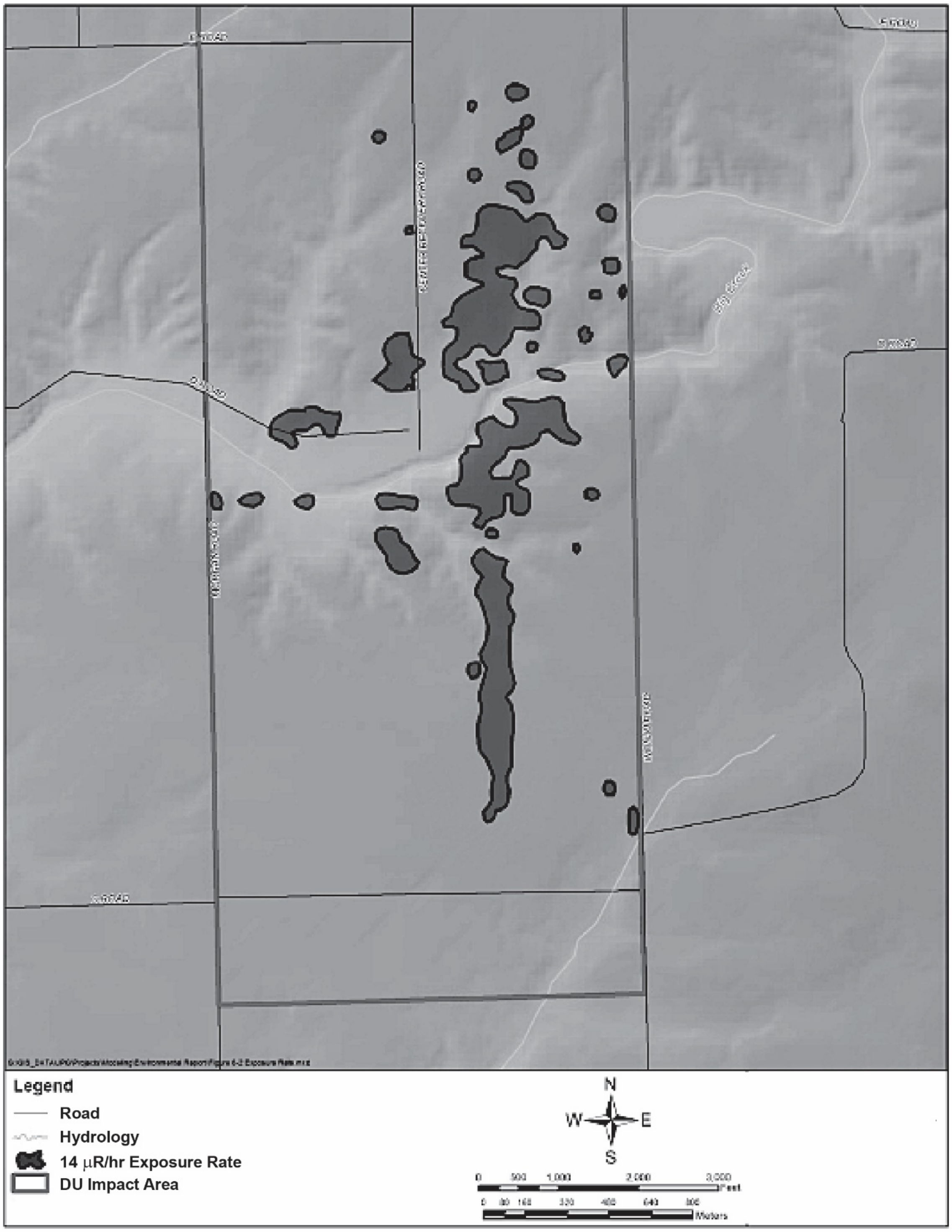

Figure 3-15. Locations Within the DU Impact Area With Measured Dose Rates Above the Average for the Area (SEG, 1995)

The soil sampling results from the 1996 characterization survey (SEG, 1996) conducted at penetrator locations showed total uranium concentrations in the top 15 cm [5.9 in] of soil that ranged from 2.9 to 12,319 pCi/g [4.35 to 18,478 ppm] with an average of 2,881 pCi/g [4,321 ppm]. Additional soil sampled at various depths below 15 cm [5.9 in] showed decreasing uranium concentrations with depth. Random soil samples showed much lower uranium concentrations with the highest values from 1.51 to 6.91 pCi/g [2.26 to 10.4 ppm] at 15 to 30 cm [15.9 and 11.8 in] depth, with a mean of 2.4 pCi/g [3.6 ppm], which was slightly above the average measured background outside the DU Impact Area. The surveys concluded that the most affected areas were along the 500 Center firing line, which is where the most DU test firing occurred.

The Army's ERMP included surface soil sampling semiannually since 1984 and has revealed no increasing trends in soil concentrations of uranium (U.S. Army, 2013a, 2017). Uranium concentrations in surface soil collected semiannually from two locations at the eastern boundary of the DU Impact Area (SS–DU–001 and SS–DU–003 in Figure 2-1) and two locations at the western boundary of the DU Impact Area (SS–DU–002 and SS–DU–004 in Figure 2-1) ranged from 0.36 to 2.2 pCi/g [0.54 to 3.3 ppm] (U.S. Army, 2017, 2013a). The mean uranium concentrations in surface soil from the four sampling locations ranged from 1.4 to 1.7 pCi/g [2.1 to 2.6 ppm] (U.S. Army, 2017, 2013a) and are well below the 14 pCi/g [21 ppm] soil surface contamination screening level for U-238 provided in NRC decommissioning guidance in NUREG–1757, Vol. 1, Rev. 2 (NRC, 2006).

The Army conducted additional soil sampling in 2008 and 2012 to further characterize DU contamination in the DU Impact Area by collecting samples within and outside of the three DU penetrator firing lines (i.e., the 500 Center, J, and K5 firing lines) and directly over or under DU penetrators, respectively (U.S. Army, 2013a). The mean radioactivity of soil samples collected outside the three DU penetrator firing lines ranged from 1.5 to 1.8 pCi/g [2.25 to 2.7 ppm] and are similar in magnitude to background levels outside the DU Impact Area {1.5 pCi/g [2.25 ppm]}. The mean radioactivity of samples collected within the three DU penetrator firing lines range from 1.9 to 26 pCi/g [2.85 to 39 ppm] and decrease with depth. The mean radioactivity of samples collected directly over or under DU penetrators ranged from 208 to 13,729 pCi/g [312 to 20,593 ppm] and also decrease with depth.

Overall, the soil sampling results confirm that DU in soil is above background concentrations in the areas along the firing lines. Within these areas, the most elevated soil concentrations are in close proximity to the penetrators, with highest concentrations at the surface and decreasing with depth below the penetrators.

Surface Water and Sediment

As described in Section 3.4.1.4, the Army has analyzed surface water and sediment samples for uranium content from upstream and downstream of the DU Impact Area and at locations within the DU Impact Area since1984, as part of its longstanding monitoring program, which is reflected in the latest version of the Army's ERMP (U.S. Army, 2013a). ERMP sampling locations are shown in Figure 2-1. From 2004 to 2016, uranium concentrations in surface water and sediment samples have ranged from 0.04 to 19 pCi/L [0.06 to 28 ppb] and 0.19 to 2.4 pCi/g [0.28 to 3.6 ppm], respectively, and were highly variable at each sample location (U.S. Army, 2017, 2013a). Mean uranium concentrations in surface water samples from each sample location ranged from 0.29 to 2.4 pCi/L [0.43 to 3.5 ppb], which are well below the 40 CFR 141.66 EPA MCL of 30 μg/L [30 ppb] {which converts to 20.3 pCi/L [30 ppb] for natural uranium and 10.8 pCi/L [16 ppb] for DU}. Mean uranium concentrations in sediment samples from each sample location ranged from 0.57 to 1.5 pCi/g [0.86 to 2.25 ppm]. The maximum U-238/U-234 ratio in surface water and sediment samples at each ERMP sampling location ranged from 1.25 to 7.8 and 1.01 to 3.13, respectively (U.S. Army, 2017, 2013a). The highest U-238/U-234 ratios in both surface water (7.8 and 6.7) and sediment (3.13 and 2.9) were measured in the samples from location SW–DU–005 on Big Creek within the DU Impact Area and location SW–DU–004 on Big Creek at the upstream boundary of the DU Impact Area, respectively (see Figure 2-1).

The Army collected additional surface water and sediment samples at 20 locations in 2008 and 2009 to further characterize DU contamination within and surrounding the DU Impact Area (U.S. Army, 2013a). Uranium concentrations ranged from 0.03 to 22 pCi/L [0.045 to 33 ppb] in surface water samples and 0.25 to 7.4 pCi/g [0.37 to 10.9 ppm] in sediment samples. The Army stated that samples with the highest uranium concentrations were collected from a standing pool of water at a sampling location where overland flow from the DU trench associated with the 500 Center firing line intersects Big Creek (U.S. Army, 2013a). Many of the surface water and sediment samples had elevated U-238/U-234 ratios (i.e., ratios exceeding 3.0), indicating the presence of DU. The majority of the surface water samples with elevated U-238/U-234 ratios were collected from Big Creek in close proximity to the DU trench associated with the 500 Center firing line (U.S. Army, 2013a). All sediment samples with elevated U-238/U-234 ratios were collected from Big Creek in close proximity to the DU trench associated with the 500 Center firing line.

Groundwater

As described in Section 3.4.2.4, the Army has also analyzed uranium in groundwater samples from upgradient and downgradient of the DU Impact Area and at locations within the DU Impact Area since 1984 as part of its ERMP at JPG (U.S. Army, 2013a). From 2004 to 2016, uranium concentrations in groundwater collected from all groundwater monitoring wells (see Figure 2-1 for monitoring well locations) ranged from 0.11 to 5.7 pCi/L [0.16 to 8.4 ppb]. Mean uranium concentrations in groundwater samples from each monitoring well location ranged from 0.26 to 3.8 pCi/L [0.38 to 5.6 ppb] and were below the 40 CFR 141.66 EPA MCL of 30 μg/L [30 ppb] {which converts to 20.3 pCi/L [30 ppb] for natural uranium and 10.8 pCi/L [16 ppb] for DU}. One U-238/U-234 ratio in groundwater from one well (MW–DU–001 located near Big Creek at the eastern boundary of the DU Impact Area), with a ratio of 5.99, exhibited a U-238/U-234 ratio exceeding 3.0 (U.S. Army, 2013a).

The Army collected additional groundwater samples in 2008 and 2009 from wells completed in the overburden, shallow bedrock, and deep bedrock, to further characterize DU contamination within and surrounding the DU Impact Area (U.S. Army, 2013a). Excluding background well sample results, uranium concentrations ranged from 0 to 47 pCi/L [0 to 70 ppb] in overburden wells, 0 to 5.0 pCi/L [0 to 7.5 ppb] in shallow bedrock wells, and 0.04 to 21 pCi/L [0.06 to 31.5 ppb] in deep bedrock wells (U.S. Army, 2013a). The 40 CFR 141.66 EPA MCL of 30 μg/L [30 ppb] {which converts to 20.3 pCi/L [30 ppb] for natural uranium and 10.8 pCi/L [16 ppb] for DU} was exceeded in two wells. Well MW–RS–7, located just outside the southwestern boundary of the DU Impact Area and completed in the overburden, had measured uranium concentrations up to 47 pCi/L [70 ppb]. Well JPG–DU–02D, located near Big Creek at the western boundary of the DU Impact Area and completed in the deep bedrock, had measured uranium concentrations up to 21 pCi/L [31.5 ppb]. The elevated uranium concentration in groundwater from MW-RS-7 likely resulted from documented high turbidity and emptying of the well during pre-sampling purging (U.S. Army, 2018). The U-238/U-234 ratios in groundwater from MW-RS-7 have never exceeded 3.0, suggesting uranium in the well is of natural origin. Evidence also indicates that uranium in groundwater from JPG-DU-02D is of natural origin. For example, water in deep wells completed in the deep bedrock at JPG, including JPG–DU–02D, did not substantially recover after groundwater was withdrawn during initial well development

(U.S. Army, 2018). A U.S. Geological Survey (USGS) study (Buszka et al., 2010) of the relative age of groundwater in and near the DU Impact Area stated that, "The slow rate of water levels in most wells in the deep carbonate unit is consistent with slow rates of groundwater flow and very old groundwater age in that unit." The USGS study categorized wells in the deep carbonate bedrock in and near the DU Impact Area as "submodern," indicating groundwater in the wells is predominantly composed of 1953 or earlier recharge (Buszka et al., 2010). Considering that DU was first fired at JPG in 1984, uranium in groundwater from JPG–DU–02D is likely to represent natural uranium.

3.7.2.2 Historical Exposure to Radioactive Materials in the DU Impact Area

NRC oversight of licensed activities at JPG provides reasonable assurance that the health and safety of site personnel and members of the public are protected from radiological hazards. Recent NRC inspection of licensed activities affirmed that historical exposures to radioactive materials in the DU Impact Area have been limited, based on the low overall radiation safety hazard of solid DU material, the limited scope and extent of activities in the DU Impact Area, and access and other controls required by either the NRC license or Army plans and agreements (NRC, 2013b).

Important aspects of maintaining radiological safety are addressed in the NRC Source Material License SUB–1435 (NRC, 2013a). In particular, the license requires an NRC-approved radiation safety plan. The current radiation safety plan was approved by NRC in 2013 (NRC, 2013c). This radiation safety plan was designed to satisfy the NRC radiation protection requirements in 10 CFR Part 20 that address, for example, radiation safety standards, personnel and their responsibilities, training requirements, authorized activities, access controls, monitoring, and reporting.

The Army radiation safety plan also incorporates the ERMP that has been in effect since 1984 (U.S. Army, 2013a). The ERMP provides data about the potential for migration of DU to areas that are publicly accessible. The ERMP groundwater sampling results (Section 3.7.2.1) have not detected DU in samples downgradient of the DU Impact Area. The ERMP surface water sampling results (Section 3.7.2.1) have indicated the downstream presence of DU at locations near the western boundary of the DU Impact Area and near the JPG western boundary; however, the total measured uranium concentrations at these locations have been below the EPA maximum contaminant level (MCL). These monitoring results indicate a potential for migration of DU in surface water beyond the JPG boundary, though the measured uranium concentrations were below levels of concern for public health impacts.

Prior to 2013, the Army had implemented radiological controls through the MOA (U.S. Army, 2000), the JPG Security Plan (Mullins, 2003), the Field Sampling Plan for site characterization (Wilson, 2005), and the Health and Safety Plan for site characterization (Wilson, 2005). In 2013, an NRC inspection of licensed activities at JPG revealed a minor violation of NRC requirements in that the Army did not have a documented radiation protection program (NRC, 2013b). However, based on the controls in place prior to 2013, the type and form of radioactive material present at the site (DU in solid form) and the limited "possession-only for decommissioning" license in effect at the time, the NRC staff concluded from the inspection that it was unlikely that any of the 10 CFR Part 20 radiation protection provisions would have been violated by the licensee because of the lack of a documented radiation protection program. The current radiation safety plan referenced in NRC Source Material License SUB–1435 was revised to address the NRC inspection observations and findings.

3.7.3 Sources and Levels of Chemical Exposure in the DU Impact Area

This section summarizes available information on the potential sources and levels of chemical exposure within the DU Impact Area and elsewhere within JPG north of the firing line. The summary emphasizes information that is relevant to the evaluation of cumulative impacts in Chapter 5. Therefore, the focus is on sources of chemical exposure at JPG that could lead to future actions that could impact the DU Impact Area or that present potential health hazards that overlap and accumulate with the assessed impacts from exposure to depleted uranium that will be evaluated in Chapter 4. Detailed information is provided in the referenced source documents.

The Army munitions testing at JPG deposited unexploded ordnance and munitions constituents (e.g., nonradiological chemical constituents from military munitions) within the DU Impact Area and elsewhere within JPG north of the firing line. The inventory of munitions constituents within the watershed of the DU Impact Area is a function of the types and quantities of munitions that were tested and their final resting locations (U.S. Army, 2015c). The total inventory of munitions constituents in the DU Impact Area and elsewhere within JPG north of the firing line is unknown because the historical records of ordnance testing are limited and detailed characterization of these site areas was deferred indefinitely by the Army based on the explosive hazards to personnel from UXO (U.S. Army, 1997). Within the JPG installation north of the firing line (including the DU Impact Area), the Army refers to the potential for approximately 1.5 million rounds of high-explosive UXO, plus an estimated 3 to 5 million rounds with live detonators, primers, or fuses, to exist from Army military munitions testing conducted between 1941 and 1994 (U.S. Army, 2013a). The Army estimates the density of UXO within the DU Impact Area is approximately 85 rounds per acre.

Constituents and by-products of the various munitions constituents, including propellants and explosives, that have been used at JPG have been described by the Army (ASI, 1993). These constituents include perchlorate, lead, mercury, and explosive compounds such as TNT (trinitrotoluene), RDX (Royal Demolition Explosive), and HMX (Her Majesty's Explosive). Some of these munitions constituents are considered potentially harmful to human health and the environment (DOD, 2002; EPA, 2005b).

The Army states that the quantity of munitions constituents released from munitions during their use is based on the degree of detonation {i.e., high-order detonation, low-order detonation, or duds [UXO]} (U.S. Army, 2015c). They further note that high-order detonations (the intended result) occur 96 to 97 percent of the time, but a higher failure rate is possible at JPG, based on the nature of proof testing. High-order detonations are known to consume more than 99.99 percent of the high explosives and release airborne gases that quickly dissipate. Of greater concern for release of munitions constituents are (i) low-order detonations that can disperse unburned constituents into the surrounding environment and (ii) munitions that are damaged on impact but do not explode and can leak munitions constituents into the surrounding environment. The Army estimates that low-order detonations occur much less frequently (0.06 percent of the time), and the dud rate across multiple munition types is 3.45 percent (U.S. Army, 2015c).

The Army considers the potential for UXO to be damaged on impact to be low based on the strength of canisters, which are designed to penetrate hardened targets and generate shrapnel. Undamaged UXO would have reached its final resting place with intact casings. The casings would have to fail (e.g., by corrosion) for a release of munitions constituents to occur. In response to NRC requests for additional information on the Army's previous decommissioning proposal, the Army provided available corrosion estimates for half-inch casings ranging from

320 to 4,200 years, depending on the environment (U.S. Army, 2015c). From this available information, the NRC concludes that the greatest source of existing and future environmental contamination involving munitions constituents at JPG (within the next several hundred to possibly thousands of years) is likely from low-order detonations. Additionally, the greatest overall inventory of munitions constituents is contained within intact UXO casings that would need to be perforated by corrosion over a period of hundreds to thousands of years before constituents could be released to the environment.

Previous early studies conducted under the JPG environmental restoration program identified the entire area north of the firing line as an area requiring environmental evaluation to further characterize the hazards and determine what actions should be taken (U.S. Army, 1990). The Army's enhanced preliminary assessment (U.S. Army, 1990) suggested that corrosion or cracking of UXO and subsequent transport of contaminants in groundwater or surface water to offsite locations is a potential pathway that should be evaluated.

A subsequent study evaluated groundwater in and around the DU Impact Area for the presence of explosive constituents (SEC Donohue, Inc., 1992). The study detected HMX at 0.779 microgram per liter (μg/L) [0.779 ppb] and RDX at 0.452 μg/L [0.452 ppb] in one monitoring well (MW-2, located a few hundred meters south of the southeast corner of the DU Impact Area); however, the authors reported that these concentrations were low and exposure pathways were limited, so the study concluded that further investigation was not necessary. While not available at the time of the study, EPA risk assessments have indicated that the drinking water concentration representing a 1×10^{-6} (1 in 1,000,000) cancer risk level for RDX is 0.3 μg/L [0.3 ppb] (EPA, 1993). Additionally, the current Agency for Toxic Substances and Disease Registry profile for HMX notes that EPA recommended a drinking water concentration of 0.4 mg/L [0.4 ppm] to protect human health from a lifetime exposure (Sciences International, Inc., 1997).

In 2003, an additional site investigation for munitions constituents in areas north of the firing line, including the DU Impact Area, was documented (U.S. Army, 2003b). The study involved sampling soil, groundwater, surface water, and sediments for various munitions constituents and conducting human health and ecological risk assessments, based on the results of the environmental sampling. The study found no explosive compounds or perchlorate in groundwater. Other constituents sampled, such as metals, were detected in some samples but were below EPA MCLs or background concentrations. An exception was manganese, which exceeded the EPA secondary MCL and the average background concentration in several overburden wells but was suspected to originate from natural overburden material. RDX and perchlorate were the only explosives found in soil samples; however, the levels were below human health risk screening criteria. Surface water samples for explosives in Middle Fork and Big Creeks showed no adverse effects on water quality of these streams. Both streams showed elevated metals mid-stream that returned to background concentrations upon exiting the JPG site. Risks calculated from measured concentrations of explosives and metals were low.

In 2001, the U.S. Congress established the Military Munitions Response Program (MMRP) under the Defense Environmental Restoration Program (DERP) to address UXO and munitions constituents (MCs) located on current and former defense sites. MMRP-eligible sites include nonoperational ranges where UXO and MCs are known or suspected to be present. The Army has indicated that in accordance with a U.S. Department of Defense (DOD) and EPA Memorandum, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is the DOD-preferred response mechanism for addressing UXO on other than operational ranges (U.S. Army, 2015c). The Army also noted that if JPG were eligible for inclusion in the MMRP, the CERCLA response process would have been followed to address munitions and explosives of concern (MEC) at JPG. However, since INANG's operational bombing training ranges (see PGM range and conventional bombing range in Figure 3-3) cover a large portion of JPG property north of the firing line, the UXO and MCs from previous Army activities are currently ineligible for funding under the MMRP. When the bombing training ranges eventually close, the DERP would require INANG or the Army to add JPG to the inventory of MMRP-eligible sites. Based on this information, the NRC staff concludes that the Army has not yet begun the MMRP CERCLA process that would eventually lead to a remedial action decision on the area north of the firing line. Until a remedial action decision is made, the final status of JPG with regard to residual chemical hazards remains uncertain; however, based on the high cost and hazards associated with removal of UXO, the analysis of potential cumulative impacts in this EA (see Chapter 5) assumes UXO will be left in place for an indeterminate period.

3.7.4 Health Effects Associated with Exposure to DU

The radiological properties of uranium are based on the three isotopes of uranium and short-lived decay products. The three isotopes of uranium emit alpha radiation. The radioactivity of DU is about 40 percent less than that of natural uranium per unit mass (U.S. Army, 2013b). Because alpha radiation does not penetrate skin, the primary radiation exposure pathway is through ingestion or inhalation. Like other radioactive materials, as uranium decays, the material is slowly transformed to other radioactive materials known as decay products. Short-lived uranium decay products Th-234, Pa-234m, and Th-231 are beta and gamma radiation emitters that have short half-lives and quickly reach secular equilibrium (the decay product decays at the same rate as it is produced). As a result, these additional radionuclides are present at the same activity as the parent uranium isotopes in DU at JPG (U.S. Army, 2013a). These decay products contribute an additional external radiation dose to the body and also provide a means to detect DU using gamma radiation detectors (U.S. Army, 2013a).

As with all radioactive materials, both natural uranium and DU present an additional risk within a person's lifetime of developing cancer from exposure to the radiation that is emitted. The annual dose limit set by the International Atomic Energy Agency (IAEA) as well as the NRC to protect members of the public from the harmful effects of radiation is 1 mSv/yr [100 mrem/yr]. The additional risk of fatal cancer associated with a dose of 1 mSv [100 mrem] calculated using the scientific methods of the International Commission on Radiological Protection (ICRP, 2007) is 1 in 20,000. This small increase in lifetime risk can be compared to the baseline lifetime risk of 1 in 5 for a person to develop a fatal cancer.

Uranium that is ingested or inhaled can be harmful because of its chemical characteristics. These characteristics are described in NRC (2017b). Like mercury, cadmium, and other heavy-metal ions, excess uranyl ions affect kidney function. High concentrations in the kidney can cause damage and, in extreme cases, renal failure. The EPA has established an oral reference dose for soluble uranium salts at 0.003 milligram per kilogram per day (mg/kg/day) (EPA, 1989). This value was based on a lowest observed adverse effect level of 2.8 mg/kg/day from available scientific studies divided by an uncertainty factor of 1,000. This reference dose, when applied to an average 70 kg [154 lb] person, would result in an annual exposure of 77 milligram (mg) [0.0027 ounce (oz)] of uranium.

3.7.5 Health Effects Associated with Exposure to UXO and Munitions Constituents

The greatest hazard from exposure to UXO is the physical hazard from explosion and the resulting potential for injury or death. Additionally, some of the munitions constituents in the

UXO are considered potentially harmful to human health and the environment (EPA, 2005b; DOD, 2002). If explosive constituents contained within the UXO are released into the environment, there is a potential for human exposure to these materials. While a wide variety of explosive compounds have been used in the munitions tested at JPG, a subset of these constituents have potential toxicity effects on human receptors that are similar to the effects of DU and could present the potential for cumulative effects from exposure to both materials. The EPA *Handbook on the Management of Munitions Response Actions* (EPA, 2005b) identifies TNT and RDX as possible human carcinogens. The handbook also describes renal effects associated with exposure to munitions constituents, including diethylene glycol dinitrate (DEGDN), lead azide, lead styphnate, and mercury fulminate.

3.8 <u>Environmental Justice</u>

This section describes the affected environment with respect to environmental justice impacts that may occur due to implementation of the proposed action and the no-action alternative. Under Executive Order 12898 (59 FR 7629), Federal agencies are responsible for identifying and addressing potential disproportionately high and adverse human health and environmental impacts on minority and low-income populations. Environmental justice refers to a Federal policy implemented to ensure that minority, low-income, and tribal communities historically excluded from environmental decision-making are given equal opportunities to participate in decision-making processes. In 2004, the Commission issued a Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions (69 FR 52040), which states, "The Commission is committed to the general goals set forth in Executive Order 12898, and strives to meet those goals as part of its National Environmental Policy Act review process."

3.8.1 Overview

The CEQ provides the following definitions to consider when conducting environmental justice reviews within the framework of the National Environmental Policy Act of 1969 (NEPA), as amended (CEQ, 1997a):

- Disproportionately High and Adverse Human Health Effects—Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant (as employed by NEPA) and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group.

- Disproportionately High and Adverse Environmental Effects—A disproportionately high environmental impact that is significant (as employed by NEPA) refers to an impact or risk of an impact on the natural or physical environment in a low-income, minority, or Indian tribe community that appreciably exceeds the environmental impact on the larger community. Such effects may include ecological, cultural, human health, economic, or social impacts. An adverse environmental impact is an impact that is determined to be both harmful and significant (as employed by NEPA). In assessing whether potential environmental effects could occur in minority or low-income populations or American Indian tribe, cumulative and multiple exposures are considered.

- Minority individuals—Individuals who identify themselves as members of the following population groups: Hispanic or Latino, American Indian or Alaskan Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races meaning individuals who identified themselves on a Census form as being a member of two or more races, for example, Hispanic and Asian.

- Minority populations—Minority populations are identified when (i) the minority population of an affected area exceeds 50 percent or (ii) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. In identifying minority communities, groups of individuals living in geographic proximity to one another, or a geographically dispersed/transient set of individuals (such as migrant workers or Native Americans), are considered.

- Low-income populations—Low-income population is defined as individuals or families that fall below the poverty level, as identified by the U.S. Census Bureau (USCB), which varies by family size and composition. If the total income for a family or unrelated individual falls below the relevant poverty threshold, then the family or unrelated individual is classified as being "below the poverty level." Low-income populations may be communities of individuals living in close geographic proximity to one another, or they may be a set of individuals, such as migrant workers, who, as a group, experience common conditions.

The CEQ states that, "for an environmental justice analysis, agencies may select the appropriate geographic unit of analysis, which may be a political jurisdiction, county, region, or state, or some other similar unit that is chosen so as not to artificially dilute or inflate the affected population" (CEQ, 1997a). Consistent with NRC guidance in Appendix C (Environmental Justice Procedures) of the NRC's *Environmental Review Guidance for Licensing Actions Associated with NMSS Programs* (NUREG–1748) (NRC, 2003), if a facility is located outside the city limits or in a rural area, a radius of approximately 6.4 km [4 mi] should be used for the environmental justice analysis. For this environmental justice analysis, because the DU Impact Area is located in an area that is not considered an urban area, potentially affected populations who reside within a 6.4-km [4-mi] radius of the DU Impact Area boundary are considered. Data on low-income and minority individuals were collected and analyzed at the census tract or census block group level within this study area (NRC, 2003).

As shown in Figure 3-16, seven census block groups are partly located within a 6.4-km [4-mi] radius of the DU Impact Area boundary and are included in the environmental justice analysis. As further explained in Sections 3.8.2 and 3.8.3, none of the populations in these seven block groups require a detailed environmental justice analysis for minority or low-income populations, pursuant to the NRC guidance in NUREG–1748 (NRC, 2003).

3.8.2 Low-Income Populations

As previously noted, low-income populations are those that fall below the poverty level identified by the USCB, including variations by family size and composition (CEQ, 1997a). If the total income for a family or unrelated individual falls below the relevant poverty threshold, then the family or unrelated individual is classified as being "below the poverty level." For example, in 2015, for the most recent data available in the 2011 to 2015 American Community Survey 5-year estimates used for this assessment, the poverty threshold for a family of five with three children below the age of 18 was $28,410. For any given family below the poverty line, all family members are considered as being below the poverty line for the purposes of analysis. Table 3-5 shows the percentages of low-income populations for the seven block groups within 6.4 km [4 mi] of the DU Impact Area boundary (as shown in Figure 3-16). Table 3-6 shows the percentages of low-income populations for the State of Indiana and the three counties within 6.4 km [4 mi] of the DU Impact Area boundary. The percent of families living below the poverty

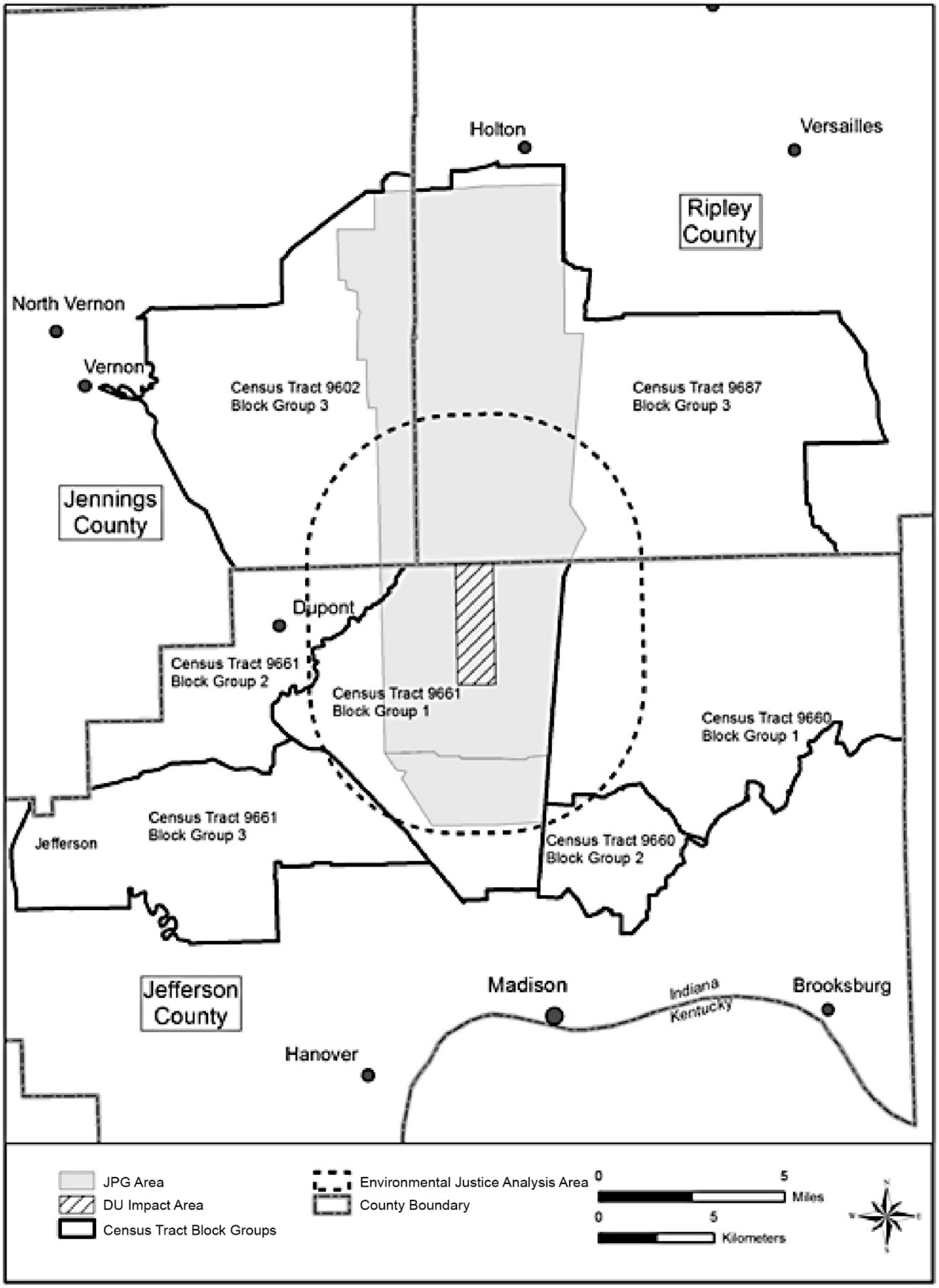

Figure 3-16. 2011-2015 Block Groups within 6.4 km [4 mi] of the DU Impact Area Boundary at Jefferson Proving Ground (USCB, 2014)

Table 3-5. 2011–2015 Demographic Profile of Block Groups Within 6.4 km [4 mi] of the DU Impact Area Boundary

	Census Tract 9660, Block Group 1 (Jefferson County)	Census Tract 9660, Block Group 2 (Jefferson County)	Census Tract 9661, Block Group 1 (Jefferson County)	Census Tract 9661, Block Group 2 (Jefferson County)	Census Tract 9661, Block Group 3 (Jefferson County)	Census Tract 9602, Block Group 3 (Jennings County)	Census Tract 9687, Block Group 3 (Ripley County)
Total Population	1,329	1,309	1,455	1,240	962	1,629	1,288
Race—Total Population, not Hispanic or Latino (Percent of Total Population, where applicable)							
White (not Hispanic or Latino)	1,329 (100)	1,264 (96.6)	1,387 (95.3)	1,238 (99.8)	944 (98.1)	1,629 (100)	1,284 (99.7)
Black or African American	0	45 (3.4)	0	0	0	0	4 (0.3)
American Indian and Native Alaskan	0	0	0	0	0	0	0
Asian	0	0	0	0	13 (1.4)	0	0
Native Hawaiian and Other Pacific Islander	0	0	0	0	0	0	0
Some other race	0	0	0	0	0	0	0
Two or more races	0	0	68 (4.7)	1 (0.1)	5 (0.5)	0	0
Ethnicity							
Hispanic or Latino of any race (Percent)	0	0	0	1 (0.1)	0	0	0
Minority Population (Including Hispanic and Latino Ethnicity)*							
Total minorities	0	45	68	2	18	0	4
Percent minority	0.0	3.4	4.7	1.2	1.9	0.0	0.3

Source: USCB, 2015.
*Minority population includes persons of Hispanic/Latino origin who are considered an ethnic minority and may be of any race (USCB, 2001).

Table 3-6. 2011–2015 5-yr American Community Survey Estimates of the Demographic Profile of the State of Indiana and Counties within 6.4 km [4 mi] of the DU Impact Area Boundary

	Indiana	Jefferson County	Jennings County	Ripley County
Total Population	6,568,645	32,453	28,113	28,612
Race—Total Population, not Hispanic or Latino (Percent of Total Population, where applicable)				
White (not Hispanic or Latino)	5,288,121 (80.5)	30,322 (93.4)	26,837 (95.5)	27,500 (96.1)
Black or African American	594,251 (9.0)	629 (1.9)	401 (1.4)	136 (0.5)
American Indian and Native Alaskan	11,827 (0.2)	53 (0.2)	22 (0.1)	68 (0.2)
Asian	120,961 (1.8)	271 (0.8)	65 (0.2)	308 (1.1)
Native Hawaiian and Other Pacific Islander	1,774 (0.03)	0	0	0
Some other race	8,829 (1.3)	8 (0.03)	0	3 (0.01)
Two or more races	121,676 (1.9)	382 (1.2)	153 (0.5)	111 (0.4)
Ethnicity				
Hispanic or Latino of any race (percent)	421,206 (6.4)	788 (2.4)	635 (2.3)	486 (1.7)
Minority Population (Including Hispanic and Latino Ethnicity)*				
Total minorities	1,280,524	2,131	1,276	1,112
Percent minority	19.5	6.7	4.5	3.9

Source: USCB, 2015.

*Minority population includes persons of Hispanic/Latino origin who are considered an ethnic minority and may be of any race (USCB, 2001).

level in the seven block groups within 6.4 km [4 mi] of the DU Impact Area boundary ranges from 3.8 to 16.9 percent. The percent of families living below the poverty level in these block groups does not exceed 50 percent. When compared to the percent of families living below the poverty level in the State of Indiana (11.1 percent), Jefferson County (11.1 percent), Jennings County (12.3 percent), and Ripley County (5.8 percent), the percent of families living below the poverty level in the seven block groups (3.8 to 16.9 percent) is not more than 20 percentage points higher (USCB, 2015).

The percent of individuals living below the poverty level in the seven block groups within a 6.4-km [4-mi] radius of the DU Impact Area boundary ranges from 6.5 to 21.0 percent (see Table 3-7). The percent of individuals living below the poverty level in these block groups does not exceed 50 percent. When compared to individuals living below the poverty level in the

Table 3-7. 2011–2015 Income Profile of BlockGroups Within 6.4 km [4 mi] of the DU Impact Area Boundary							
	Census Tract 9660, Block Group 1 (Jefferson County)	**Census Tract 9660, Block Group 2 (Jefferson County)**	**Census Tract 9661, Block Group 1 (Jefferson County)**	**Census Tract 9661, Block Group 2 (Jefferson County)**	**Census Tract 9661, Block Group 3 (Jefferson County)**	**Census Tract 9602, Block Group 3 (Jennings County)**	**Census Tract 9687, Block Group 3 (Ripley County)**
Median Household Income (Annual Dollars)	42,384	35,263	34,773	53,318	60,083	47,768	41,392
Per Capita Income (Annual Dollars)	24,616	21,760	17,978	23,850	22,012	21,529	18,314
Percent of Families Living Below the Poverty Level	5.5	6.5	7.5	16.9	3.8	15.7	16.9
Percent of Persons Below the Poverty Level	6.5	7.6	10.0	21.0	7.0	11.1	18.5
Source: USCB, 2015.							

State of Indiana (15.4 percent), Jefferson County (14.5 percent), Jennings County (15.9 percent), and Ripley County (8.6 percent) (see Table 3-8), the percentage of families living below the poverty level in the seven block groups (6.5 to 21 percent) is not more than 20 percentage points higher.

Although low-income individuals reside within the seven block groups within 6.4 km [4 mi] of the DU Impact Area, because the percentage of low-income populations in these seven block groups does not significantly exceed the percentage of low-income populations at the State or county level, and the low-income population does not exceed 50 percent of any block group, the NRC staff determined that a detailed environmental justice analysis is not required (NRC, 2003).

3.8.3 Minority Populations

As discussed previously, the CEQ guidelines for environmental justice analyses define "minority" to include individuals that are Hispanic or Latino, American Indian or Alaskan Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races (CEQ, 1997a). Beginning with the 2000 Census, individuals are allowed the option of identifying themselves in one or more race categories, thereby creating the multiracial Census category of "two or more races." They are generally counted as part of the minority group they identified. Minority populations can be determined by subtracting "White, Not Hispanic or Latino" populations from the total population. Once the minority population is determined, the percent of minority populations can be determined by dividing the number of minority individuals by the total population. As shown in Table 3-5, using this method, the minority population in each of the seven block groups that lie within a 6.4-km [4-mi] radius of the DU Impact Area boundary constitutes between 0.0 percent and 4.7 percent of those block groups. The NRC environmental justice guidance in NUREG–1748 (NRC, 2003) states, "[i]f the percentage in the block groups significantly exceeds that of the state or county percentage for either minority or low-income population, environmental justice will have to be considered in greater detail. As a general matter, and where appropriate, staff may consider differences greater than 20 percentage points to be significant. Additionally, if either the minority or low-income population percentage exceeds 50 percent, environmental justice will have to be considered in greater detail." As further described next, none of the minority populations in the seven block groups analyzed exceeds 50 percent of the population.

Table 3-8. 2011–2015 5-yr American Community Survey Estimates of the Income for the State of Indiana and Counties Within 6.4 km [4 mi] of the DU Impact Area Boundary

	Indiana	Jefferson County	Jennings County	Ripley County
Median Household Income (Annual Dollars)	49,255	45,718	44,736	51,170
Per Capita Income (Annual Dollars)	25,346	22,139	21,434	23,534
Families Living Below the Poverty Level (Percent)	11.1	11.1	12.3	5.8
Persons Below the Poverty Level (Percent)	15.4	14.5	15.9	8.6

Source: USCB, 2015.

Minority populations for the State of Indiana and the three counties (Jefferson, Jennings, and Ripley counties) within 6.4 km [4 mi] of the DU Impact Area boundary are provided in Table 3-6. The NRC staff used the same method described previously to determine the percent of minority population at the State and county level. The percent of minority populations in the seven block groups within 6.4 km [4 mi] of the DU Impact Area boundary is between 0 and 4.7 percent, which is not more than 20 percentage points higher than the minority populations for the State of Indiana (19.5 percent), Jefferson County (6.7 percent), Jennings County (4.5 percent), or Ripley County (3.9 percent) (USCB, 2015). Because the percentage of minority populations in the seven block groups do not significantly exceed the percentage of minority populations at the State or county level and the minority population does not exceed 50 percent of any block group within the environmental justice study area, the NRC staff determined that a detailed environmental justice analysis is not required (NRC, 2003).

3.8.4 Potentially Unique Characteristics of Minority and Low-Income Populations

Executive Order 12898, Section 4-4 (59 FR 7629) directs Federal agencies, whenever practical and appropriate, to collect and analyze information on the consumption patterns of populations that rely principally on fish and/or wildlife for subsistence and to communicate the risks of these consumption patterns to the public. In some cases, minority and low-income groups may rely on natural resources for their subsistence and to support unique cultural practices. Differential patterns of consumption of natural resources should be considered (i.e., differences in rates and/or patterns of fish, vegetable, water, and/or wildlife consumption among groups defined by demographic factors, such as socioeconomic status, race, ethnicity, and/or cultural attributes). In some circumstances, these groups could be unusually vulnerable to impacts from the proposed action. In particular, higher participation in outdoor recreation, farming, and subsistence fishing may increase exposure risk to minority and low-income groups through inhalation or ingestion through various environmental pathways. In this environmental justice analysis, NRC staff considered whether there are any means or pathways for minority or low-income individuals to be disproportionately affected by the proposed action. Staff considered the levels of radiological and nonradiological contaminants in native vegetation, crops, soils and sediments, surface water, fish, and game animals on or near the DU Impact Area. For example, Section 3.5.4 provides information on ecological risk assessments conducted on plants and animals at JPG, and Section 3.7 provides information on radiological and nonradiological contaminants in soils, surface water, sediments, and groundwater at JPG. In addition, the NRC staff considered public access and land use restrictions in the area north of the firing line at JPG as established by the Army's MOA with the USFWS and USAF (U.S. Army, 2000). Section 3.2.1 provides information on these public access and land use restrictions, which include limited day-use recreation areas and special controlled hunting zones.

Concerns from stakeholders were sought in the course of the NRC's public scoping activities related to the Army's 2013 license amendment application to terminate Source Material License SUB–1435 and decommission the DU Impact Area under restricted conditions (see Section 1.1) (NRC, 2015a | scoping summary report). Some of these stakeholders were local residents with concerns that health effects from offsite transport of DU and UXO constituents may already be affecting those living close to JPG (NRC, 2015a).

The NRC staff examined data concerning the health status of the general population in Jefferson, Jennings, and Ripley Counties (Table 3-9). In 2015, the three leading causes of death were diseases of the heart, cancer, and chronic lower respiratory diseases (CDC, 2015). Based on the data reviewed, NRC staff found no exceptional incidences or death rates for these three causes of death among residents in the three counties within 6.4 km [4 mi] of the

Table 3-9. Selected Health Statistics for Jefferson, Jennings, and Ripley Counties and the State of Indiana (per 100,000 population)

	Jefferson County	Jennings County	Ripley County	Indiana
Annual Average Age-Adjusted Number Of Cases, 2010–2014				
All cancer	187	147	150	32,312
Cancer of lung and bronchus	34	30	27	5,318
Annual Average Age-Adjusted Incidence Rate, 2010–2014				
All cancer	470.9	464.2	430.6	445.2
Cancer of lung and bronchus	84.5	93.5	72.8	72.8
Annual Average Age-Adjusted Death Rate, 2010–2014				
All cancer	183.2	202.5	200.7	183.2
Cancer of lung and bronchus	65.5	67.0	59.6	55.1
Annual Average Age-Adjusted Death Rate, 2005-2011				
Chronic lower respiratory disease*	64.5	74.0	33.5	63.6
Coronary heart disease†	222.0	240.8	173.6	118.6

Sources: CDC, 2015; CDC, 2014a, b, c, d; CDC, 2011a, b.

*Chronic lower respiratory disease includes asthma, emphysema, chronic bronchitis, bronchiectasis, and chronic obstructive pulmonary disease.

†Coronary heart disease refers to ischemic heart diseases (acute myocardial infarction, or heart attack, other acute ischemic heart disease, and other forms of chronic ischemic heart disease). Ischemic heart disease is heart problems caused by narrowed heart arteries.

DU Impact Area boundary (see Table 3-9). It was not possible to identify any unusual incidences of birth defects or cancer clusters at the county level, the smallest area for which published health information is available.

4 ENVIRONMENTAL IMPACTS

4.1 Introduction

This chapter presents the potential environmental impacts of the proposed action and the no-action alternative. As described in Section 1.2, the proposed action is for the U.S. Nuclear Regulatory Commission (NRC) to amend Condition 9 of NRC Source Material License SUB–1435 for the depleted uranium (DU) Impact Area at Jefferson Proving Ground (JPG) (NRC, 2013a) to change the authorized use of licensed material from “possession only for decommissioning” to “possession only” and to grant an exemption from the NRC’s decommissioning timeliness requirements in Title 10 of the *Code of Federal Regulation* (10 CFR) 40.42(d). In accordance with current license conditions, the DU material in the DU Impact Area at JPG would remain onsite. As described in Section 2.1, the DU material would be subject to the U.S. Department of the Army (Army) commitments for institutional controls that the Army has established under a Memorandum of Agreement (MOA) with the U.S. Fish and Wildlife Service (USFWS) and U.S. Air Force (USAF) to maintain legally enforceable access controls and land use restrictions over the DU Impact Area and other areas of JPG north of the firing line {approximately 206 square kilometers (km^2) [50,950 acre (ac)]} (U.S. Army, 2000). In addition, the Army would reduce the scope of its Environmental Radiation Monitoring Plan (ERMP), to include only semi-annual sampling of surface water and sediment on two creeks (Middle Fork Creek and Big Creek) at four locations where flowing water in these creeks exits the DU Impact Area and the JPG installation and groundwater at four wells upgradient, within, and downgradient from the DU Impact Area (see Section 2.1.2). The proposed action analyzed in this environmental assessment (EA) accounts for a possession-only license and a decommissioning timeliness exemption term of 20 years.

Under the no-action alternative, NRC Source Material License SUB–1435 with all its provisions would remain in effect (NRC, 2013a). The Army would continue semi-annual sampling of surface soil, sediment, groundwater, and surface water under its current ERMP (U.S. Army, 2004, 2003a). The Army would continue to maintain the restricted area identified in the NRC license as the DU Impact Area and implement institutional control of the approximately 206 km^2 [50,950 ac] area north of the firing line through Army ownership of the land and because of the presence of unexploded ordinance (UXO). The Army would proceed with preparations for decommissioning the DU Impact Area, in accordance with NRC requirements for license termination and timely decommissioning defined in 10 CFR 40.42, “Expiration and Termination of Licenses and Decommissioning of Sites and Separate Buildings and Outdoor Areas.” As described in Chapter 2, consideration of the no-action alternative is required under the National Environmental Policy Act of 1969, as amended (NEPA), and serves as a baseline for comparing alternatives.

As discussed in Section 1.3 and 2.2.1, decommissioning of the DU Impact Area to unrestricted release conditions in the near term would be unduly hazardous and prohibitively expensive (on the order of billions of dollars) due to the need for UXO clearance, radiological soil treatment, and offsite disposal of DU and DU-contaminated soil. Therefore, under the no-action alternative, the NRC staff expects that the Army would submit a decommissioning plan proposing to decommission the site by leaving DU in place and demonstrating compliance with the criteria for license termination under restricted conditions pursuant to NRC requirements at 10 CFR 20.1403, “Criteria for License Termination Under Restricted Conditions.” While the NRC staff considers restricted release a viable option that the Army could pursue for decommissioning the DU Impact Area, the analyses in this chapter do not evaluate or make any conclusions regarding the suitability of the site for restricted release or the general acceptability of any prior Army analyses related to the restricted release option. Because restricted release decommissioning is a complex regulatory process and licensing action (relative to the proposed action) and, if proposed by the Army, would be supported by detailed site characterization and modeling analyses described in a future decommissioning plan, the NRC impact analysis of the no-action alternative was conducted at a general and qualitative level of detail for the 20-year period addressed in this EA (i.e., a possession-only license and decommissioning timeliness exemption term of 20 years).

The NRC has established a standard of significance for assessing environmental impacts. According to the Council on Environmental Quality (CEQ), the significance of impacts is determined by examining both context and intensity (40 CFR 1508.27). Context is the geographic, biophysical, and social setting in which environmental effects may occur. Intensity refers to the severity of impact, in whatever context it occurs. The NRC uses a three-level standard of significance, based on CEQ regulations described in NRC guidance in NUREG–1748 (NRC, 2003). The three significance levels are:

- SMALL: The environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource considered.
- MODERATE: The environmental effects are sufficient to alter noticeably but not destabilize important attributes of the resource considered.
- LARGE: The environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource considered.

As described in Section 3.1, this EA only addresses the potential environmental impacts for resource areas that would be affected by implementation of the proposed action. The resource areas addressed in this chapter are: land use; geology and soils; water resources; ecological resources; air quality, including greenhouse gases; public and occupational health; and environmental justice.

4.2 <u>Land Use Impacts</u>

The potential environmental impacts on land use from the proposed action and the no-action alternative are evaluated in this section. Under both alternatives, existing DU and UXO within the DU Impact Area would be left in place and would be subject to institutional controls to maintain legally enforceable access controls and land use restrictions over the DU Impact Area.

4.2.1 Proposed Action

As described in Section 1.1, approximately 73,500 kilograms (kg) [162,000 pounds (lb)] of DU, consisting of approximately 15,000 to 19,000 DU penetrators, DU penetrator fragments, and DU corrosion products, are estimated by the Army to be present in the DU Impact Area (U.S. Army, 2013b). Under the proposed action, no activities that would directly or indirectly disturb the land to reduce the amount of residual DU penetrators, DU penetrator fragments, or DU corrosion products (and, therefore, the residual radioactivity) within the DU Impact Area would be conducted, such as the in-place detonation of comingled UXO to facilitate removal of DU from the site. Therefore, no land disturbance would be associated with the proposed action.

In addition, the Army will continue to maintain all the provisions needed to legally enforce access controls and land use restrictions over the DU Impact Area. As described in Section 2.1.1, the Army has established an MOA with the USFWS for establishment and management of the Big Oaks National Wildlife Refuge (BONWR) and with the USAF for use of designated portions of JPG as an air-to-ground bombing training range (U.S. Army, 2000). Under this MOA, the USFWS manages JPG's natural resources on the approximately 206-km^2 [50,950-ac] area of JPG north of the firing line and the Indiana Air National Guard (INANG) operates an air-to-ground bombing range on approximately 4.2 km^2 [1,038 ac] north of the firing line, both under 25-year leases with 10-year renewal options. As described in Section 3.2.1, public access to the BONWR is limited to two areas: the limited day-use recreation area and special controlled hunting zones (see Figure 3-3). Public access to other areas in the BONWR {approximately 97 km^2 [24,000 ac]} is restricted due to the occurrence of high levels of UXO and of both DU and UXO in the DU Impact Area (see Figure 3-3). When in use, the bombing ranges also have large safety fans (i.e., buffer areas) and are restricted to all persons other than INANG personnel (U.S. Army, 2000).

In summary, no aspect of the proposed action—which includes amending NRC Source Material License SUB–1435 to possession-only, granting the Army an exemption from NRC's decommissioning timeliness requirements (see Section 2.1.3), reducing the scope of the Army's semi-annual ERMP (see Section 2.1.2), and continuing the implementation and maintenance of institutional controls to enforce access controls and land use restrictions (see Section 2.1.1)—would result in direct or indirect impacts on land use. No activities are planned that would result in land disturbance or alter the current land use, as described in Section 3.2. The BONWR would continue to sustain vegetation communities and wildlife habitat, in accordance with USFWS management goals and objectives. Therefore, the NRC staff concludes that potential impacts to land use as a result of the proposed action would be SMALL.

4.2.2 No-Action Alternative

Until the NRC approves a decommissioning plan for restricted release of the DU Impact Area, pursuant to 10 CFR 20.1403 requirements, all provisions of NRC Source Material License SUB–1435 would remain in effect. The Army would continue to conduct its present semi-annual ERMP (U.S. Army, 2004, 2003a) and the NRC would continue to conduct periodic onsite inspections. The DU material would continue to be subject to the Army's commitments for institutional controls established under the MOA with the USFWS and USAF (U.S. Army, 2000). No additional activities would occur that would result in land disturbance or that would alter current land use. Therefore, potential impacts to land use would be similar to the proposed action (SMALL).

Should the NRC approve a decommissioning plan within the 20-year timeframe analyzed in this EA, the NRC would ultimately terminate the license to possess DU, and institutional controls and access restrictions would continue to be maintained and implemented. The level of continued radiological monitoring and NRC oversight (e.g., onsite inspections), if any, would be established as part of the license termination process. Therefore, assuming the Army would have satisfactorily demonstrated compliance with NRC decommissioning criteria for restricted use at 10 CFR 20.1403, the NRC staff concludes that potential impacts on land use under the no-action alternative for the timeframe analyzed in this EA (20 years) would be SMALL.

4.3 Geology and Soils Impacts

The potential environmental impacts on geology and soils resulting from the proposed action and the no-action alternative are evaluated in this section. Under these alternatives, existing DU within the DU Impact Area would be left in place; therefore, there would be no ground-disturbing activities that would impact geologic and soil resources within the DU Impact Area. As described in Section 3.7.2.1, soils in close proximity to DU penetrators are contaminated with uranium, and continued dissolution of DU penetrators and DU penetrator corrosion products would result in additional uranium soil contamination.

4.3.1 Proposed Action

Other than the occasional maintenance and repair of fences, gates, and signs, no activities (such as excavation or construction of new facilities) would be conducted that would directly or indirectly disturb geology and soils. Because no activities are planned to reduce the amount of DU within the DU Impact Area, natural vegetation would not be disturbed or destroyed within the area. Therefore, the potential for increased soil loss is not likely, because vegetation acts to reduce wind and water erosion.

As discussed in Section 3.3, soils at JPG developed from the weathering of loess (windblown deposits) and glacial till deposits and consist of predominantly clay and silt particles. As further described in Section 3.7.2.1, the results of radiological sampling of soils at JPG over a period of 28 years (from initiation of DU penetrator test firing in 1984 to 2012) indicate that migration of DU through the soil column has been limited to several meters [feet]. Based on the radiological sampling results, NRC concludes that the properties of the soils at JPG are effective in limiting the migration of DU in the soil.

As described in Section 3.3.3, the 2014 USGS National Seismic Hazard Map (see Figure 3-7) shows that for southeastern Indiana, where JPG is located, there is a 10 percent probability that an earthquake will occur in the next 50 years with a ground motion of 0.03 to 0.05 standard gravity, which correlates to a moment magnitude of 6. As further described in Section 3.3.3, an earthquake with a moment magnitude of 4 would slightly shake a building, while an earthquake with a moment magnitude of 6 would cause pictures to fall off walls and furniture to move. Therefore, the risk of seismic activity (i.e., earthquakes) impacting geologic and soil resources within the DU Impact Area is low.

In summary, no activities are planned that would physically disturb geology and soils within the DU Impact Area; results of radiological sampling of soils at JPG indicate that migration of DU in soil is limited; and the DU Impact Area is situated in an area with historically low seismic potential. Therefore, NRC staff concludes that the potential impacts to geology and soil resources as a result of the proposed action would be SMALL.

4.3.2 No-Action Alternative

Until the NRC approves a decommissioning plan for restricted release of the DU Impact Area, pursuant to 10 CFR 20.1403 requirements, all provisions of NRC Source Material License SUB–1435 would remain in effect. The Army would continue to conduct semi-annual sampling of soils, as outlined in its present ERMP (U.S. Army, 2004, 2003a), and the NRC would continue to conduct periodic onsite inspections. No additional activities would occur that would result in the disturbance of geologic and soil resources, and related potential impacts on geology and soils would be similar to the impacts under the proposed action. Impacts to soil quality associated with in-place degradation of existing DU material within the DU Impact Area would also be similar to those under the proposed action.

Should the NRC approve a decommissioning plan within the 20-year timeframe analyzed in this EA, the NRC would terminate the license to possess DU and establish requirements for any continued soil radiological monitoring and NRC oversight. Therefore, assuming the Army would have satisfactorily demonstrated compliance with NRC decommissioning criteria for restricted use at 10 CFR 20.1403, the NRC staff concludes that potential impacts on geology and soils under the no-action alternative for the timeframe analyzed in this EA (20 years) would be SMALL.

4.4 Water Resources Impacts

Under both the proposed action and no-action alternative, existing DU penetrators and fragments and their corrosion products would be left in place in the DU Impact Area. Because neither alternative involves activities that would disturb the hydrologic properties of the DU Impact Area, BONWR, or the surrounding environment in terms of the quantity of streamflow or groundwater, the impacts are evaluated in terms of their effect on surface water and groundwater quality. Adverse impacts to surface water or groundwater quality could affect the availability of these water resources for beneficial use.

A conceptual model of the environmental pathways by which uranium leached from DU penetrators and their corrosion products in the DU Impact Area can move through the environment and impact surface water and groundwater is illustrated in Figure 4-1. Based on site-specific hydrogeologic conditions described in Section 3.4, uranium leached from the DU penetrators and fragments and their corrosion products would (i) move laterally as uranium dissolved in surface water runoff or as uranium adsorbed onto soil eroded from the DU Impact Area (sediment) or (ii) move downward through the soil (overburden) in the DU Impact Area as uranium dissolved in infiltrating water. A portion of the water infiltrating into the soil and overburden (termed “interflow”) flows rapidly back into the streams before reaching the water table. The remaining water infiltrating into the soil and overburden reaches the water table and then flows more slowly in groundwater that discharges locally to streams.

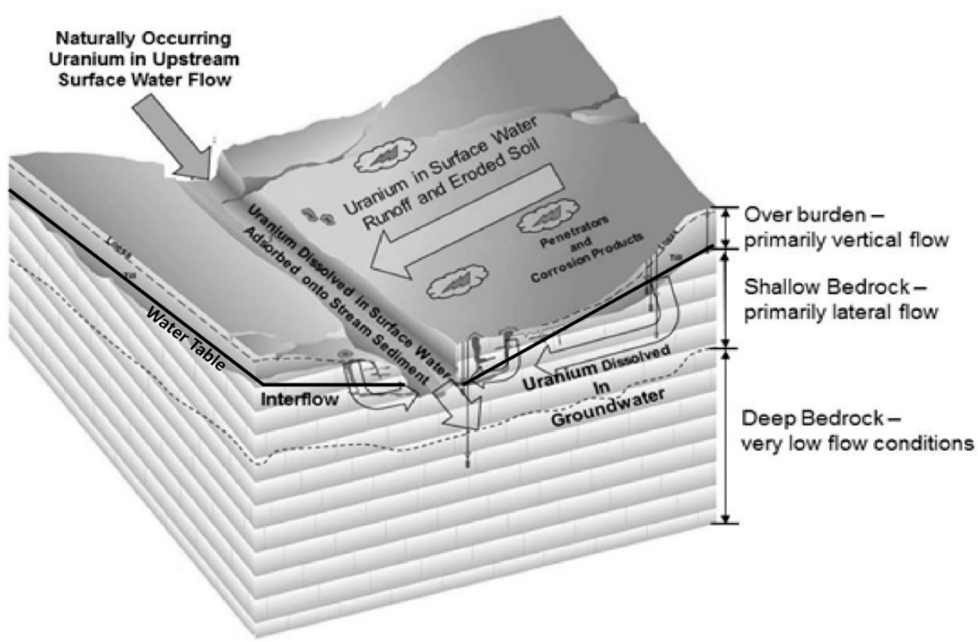

Figure 4-1. Conceptual Model of Uranium Transport Pathways at JPG (modified from U.S. Army 2013a)

4.4.1 Proposed Action

4.4.1.1 Surface Water and Sediment Impacts

As described in Section 3.4.1.1, the DU Impact Area is within the Big Creek and Middle Fork Creek watersheds. As illustrated in Figure 4-1, uranium leaving the DU Impact Area in surface runoff would increase the dissolved uranium concentration in surface water and the uranium concentration in suspended and bed-load sediment in Big Creek and Middle Fork Creek, both within JPG and downstream of JPG. Uranium-bearing suspended sediment and bed-load sediment in these streams would move downstream into the lower reach of Big Creek and ultimately into the Muscatatuk River and the White River.

As described in Section 3.7.1.2, the maximum total uranium concentration in background surface water and sediment samples collected from Big Creek upstream of the DU Impact Area were 0.27 picocuries per liter (pCi/L) [0.4 parts per billion (ppb)] and 1.36 pCi/g [2.04 ppm], respectively (SEG, 1995). All of the background surface water and sediment samples had isotopic ratios of U-238 to U-234 that occur naturally (i.e., measured U-238 to U-234 ratios of approximately 1 or less), indicating that the uranium was from natural sources (i.e., the source of uranium was not from DU) (see Section 3.7.2).

As part of the Army's current ERMP, surface water and sediment samples have been collected at locations along Big Creek and Middle Fork upstream, downstream, and within the DU Impact Area since 1984 (see Sections 3.4.1.4 and 3.7.2.1). ERMP sampling locations are shown in Figure 2-1. From 2004 to 2016, uranium concentrations in surface water have ranged from 0.04 to 19 pCi/L [0.05 to 28 ppb] and have been highly variable at each sample location (U.S. Army, 2017, 2013a). Mean uranium concentrations in surface water samples from each sample location ranged from 0.29 to 2.4 pCi/L [0.43 to 3.6 ppb]. The mean uranium concentrations in surface water are above the previously described maximum uranium background concentration in surface water {i.e., 0.27 pCi/L [0.4 ppb]} but are well below the U.S. Environmental Protection Agency (EPA) primary drinking water standard maximum contaminant level (MCL) of 30 micrograms per liter (µg/L) [30 ppb] {which converts to 20.3 pCi/L [30 ppb] for natural uranium and 10.8 pCi/L [16 ppb] for DU} as specified in 40 CFR 141.66 (Maximum Contaminant Levels for Radionuclides). Two surface water samples exceeded the EPA primary drinking water standard MCL for uranium sourced from DU {19 pCi/L [28 ppb] at sample location SW–DU–005 on Big Creek within the DU Impact Area and 16 pCi/L [24 ppb] at sample location SW–DU–004 on Big Creek at the upstream boundary of the DU Impact Area (see Figure 2-1)} (U.S. Army, 2013a).

The ERMP surface water monitoring data are based on samples collected at relatively low flows in Big Creek and Middle Fork Creek (U.S. Army, 2013a). Based on the drainage areas of the watersheds upstream of the DU Impact Area (U.S. Army, 2013a) relative to the drainage area within the DU Impact Area, at least 90 percent of the surface water flow leaving the DU Impact Area would originate from upstream of the DU Impact Area at higher flows resulting from surface runoff. Thus, the uranium concentrations indicated in the ERMP samples that result from surface water leaving the DU Impact Area would typically be diluted by a factor of at least 9 under the more common high-flow conditions.

As described in Section 3.7.2, an elevated U-238 to U-234 ratio allows DU to be detected in environmental samples. In natural uranium, the measured U-238 to U-234 radioactivity should be approximately 1 but can range from 0.025 to 2.0 in water due to disequilibrium facilitated by both physical and chemical processes (U.S. Army, 2013a). In DU, this ratio can also vary with details of the uranium enrichment process from approximately 5 to 11. As part of its ERMP, the

Army has measured U-238 and U-234 radioactivity in environmental samples and used a U-238/U-234 ratio below 2 as indicative of natural uranium and above 3 to identify uranium that may have originated from DU (U.S. Army, 2013a). In surface water samples collected from 2004 to 2016, maximum U-238/U-234 ratios ranged from 1.25 to 7.8 from each ERMP sample locations (U.S. Army, 2013a). U-238/U-234 ratios have exceeded 3 in samples collected upstream, within, and downstream of the DU Impact Area, which makes distinguishing between naturally occurring uranium and DU uncertain. The highest U-238/U-234 ratios were measured in the samples from location SW–DU–005 on Big Creek within the DU Impact Area (with a U-238/U-234 ratio of 7.8) and location SW–DU–004 on Big Creek at the upstream boundary of the DU Impact Area (with a U-238/U-234 ratio of 6.7) (see Figure 2-1). These samples also had the highest total uranium concentration {19 and 16 pCi/L [28.1 and 23.7 ppb], respectively}, which indicates that at least some of the uranium in surface water at JPG originates from DU.

As discussed in Section 3.7.2.1, uranium concentrations in sediment samples have ranged from 0.19 to 2.4 pCi/g [0.28 to 3.6 ppm] and, like the surface water sample analysis results described previously, were highly variable at each sampling location (U.S. Army, 2017, 2013a). Mean uranium concentrations in sediment samples from each sample location ranged from 0.57 to 1.5 pCi/g [0.85 to 2.25 ppm]. The mean uranium concentrations in sediments are below or slightly above the maximum uranium sediment background levels described previously {i.e., 1.36 pCi/g [2.04 ppm]}. No clear difference exists between the total uranium activity in bed-load sediment between sediment sample locations upstream of the DU Impact Area {highest mean concentration of 1.5 pCi/g [2.25 ppm] in sediment sample location SD–DU–003} and downstream of the DU Impact Area {highest mean concentration of 1.2 pCi/g [1.8 ppm] in sediment sample location SD–DU–007}. As with uranium in surface water, sediment in Big Creek and Middle Fork Creek originates not only from the DU Impact Area but also from upstream and downstream watersheds. Thus, the overall uranium concentration in the stream sediment would be diluted by uncontaminated sediment from outside the DU Impact Area.

The maximum U-238/U-234 ratio in sediment samples at each ERMP sampling location ranged from 1.01 to 3.13. Like the surface water samples, the highest U-238/U-234 ratios in sediment samples (3.13 and 2.90) were measured in the samples from location SW–DU–005 on Big Creek within the DU Impact Area and location SW–DU–004 on Big Creek at the upstream boundary of the DU Impact Area, respectively (see Figure 2-1). This result indicates that at least some of the uranium in sediments from these two locations originates from DU.

In summary, ERMP monitoring data indicate that the DU Impact Area is contributing DU to surface water and sediments and that the highest concentrations are in Big Creek within and at the upstream boundary of the DU Impact Area. Mean uranium concentrations in surface water samples from each ERMP sample location ranged from 0.29 to 2.4 pCi/L [0.43 to 3.6 ppb]. These mean uranium activity concentrations are well below the EPA primary drinking water standard MCL of 30 μg/L [30 ppb] {which converts to 20.3 pCi/L [30 ppb] for natural uranium and 10.8 pCi/L [16 ppb] for DU} as specified in 40 CFR 141.66. Mean uranium concentrations in sediment samples from each ERMP sample location ranged from 0.57 to 1.5 pCi/g [0.85 to 2.25 ppm]. These mean uranium concentrations are below or slightly greater than the maximum uranium sediment background concentrations {1.36 pCi/g [2.04 ppm]} measured in Big Creek upstream of the DU Impact Area (SEG, 1995). Although surface runoff from the DU Impact Area could contribute to increased uranium to surface water and sediments in Big Creek and Middle Fork Creek, significant dilution is likely to occur due to flow from the watersheds upstream of the DU Impact Area. Furthermore, as described in Section 3.4.1.4, surface water in streams on and immediately downstream of the JPG is not used as a source of drinking water, because most residences are connected to public water supplies sourced from the City of Madison (NRC, 2015b). In addition, under the proposed action, the Army would continue semi-annual sampling of surface water and sediments at a reduced level (as described in Section 2.1.2) to detect uranium leaving the DU Impact Area and the JPG installation. Therefore, the NRC staff concludes that environmental impacts to surface water and sediment from the proposed action would be SMALL.

4.4.1.2 Groundwater Impacts

As discussed in Section 3.4.2.2, the Army described the hydrogeology of JPG in terms of three stratigraphic layers: (i) overburden; (ii) shallow bedrock; and (iii) deep bedrock, as illustrated in Figure 4-1 (U.S. Army, 2013a). As further described in Section 3.7.1.3, in 2008 and 2009, the Army sampled groundwater for total and isotopic uranium in nine background wells upgradient of the DU Impact Area. The background wells drew water from various strata, including the overburden (two wells), shallow bedrock (six wells), and deep bedrock (one well). Uranium concentrations in the nine wells ranged from 0.11 to 6.4 pCi/L [0.16 to 9.5 ppb], with the highest mean at 2.5 pCi/L [3.7 ppb] in the overburden wells.

As part of the Army's ERMP, groundwater samples have been collected at 11 locations within and outside the DU Impact Area since 1984 (U.S. Army, 2013a). The ERMP groundwater sampling locations are shown in Figure 2-1. From 2004 to 2016, uranium concentrations in groundwater samples ranged from 0.11 to 5.7 pCi/L [0.16 to 8.4 ppb] (U.S. Army, 2017, 2013a). Mean uranium concentrations in groundwater samples from each sample location ranged from 0.26 to 3.8 pCi/L [0.38 to 5.6 ppb]. The mean concentrations and ranges of uranium in the ERMP groundwater samples are within the previously described concentration range of uranium measured in background wells {i.e., 0.11 to 6.4 pCi/L [0.16 to 9.5 ppb]} and are well below the primary drinking water standard MCL of 30 microgram per liter (μg/L) [30 ppb] {which converts to 20.3 pCi/L [30 ppb] for natural uranium and 10.8 pCi/L [16 ppb] for DU} as provided by EPA regulations at 40 CFR 141.66.

The maximum U-238/U-234 ratio in groundwater samples at each ERMP sampling location ranged from 0.47 to 5.99 (U.S. Army, 2013a). Well MW–DU–001, located along the western boundary of the DU Impact Area, was the only well from which a sample exceeded a U-238/U-234 ratio of 3. This groundwater sample was collected in October 2008 and had a U-238/U-234 ratio of 5.99. The other samples collected from well MW–DU–001 had U-238/U-234 ratios of 1.5 or lower. Excluding the U-238/U-234 ratio of 5.99 in well MW–DU–001 (based on the assumption that it is anomalous due to sampling or measurement error), the maximum U-238/U-234 ratio in groundwater samples at each ERM sampling location ranged from 0.47 to 1.77 (U.S. Army, 2013a), which indicates that the uranium in groundwater did not originate from DU.

In summary, ERMP monitoring data indicate that, approximately 30 years after the introduction of DU into the DU Impact Area, the DU Impact Area is not contributing DU to groundwater (i.e., DU leached from penetrators and infiltrating through the soil overburden has not reached the water table). ERMP monitoring data indicate that total uranium concentrations in groundwater are within the range expected for non-impacted, background groundwater and are also well below the EPA primary drinking water standard MCL of 30 μg/L [30 ppb] specified in 40 CFR 141.66. The NRC staff does not expect that the historical data trends would change during the course of the 20-year timeframe assessed in this EA. In addition, under the proposed action, the Army would continue semi-annual sampling of groundwater at a reduced level (as described in Section 2.1.2) to detect uranium leaving the DU Impact Area. Furthermore, groundwater is not used as a source of drinking water at JPG and areas surrounding JPG (U.S. Army, 2013a). As described in Section 3.4.2.3, drinking water at JPG is obtained from the City of Madison Municipal Supply Systems wells approximately 8 kilometers (km) [5 miles (mi)] south of JPG (U.S. Army, 2013a). Most residences surrounding JPG are also connected to public water supplied by Madison Water Supply Systems or to public water supplied by smaller towns, such as Dupont (NRC, 2015b). Therefore, the NRC staff concludes that environmental impacts to groundwater from the proposed action would be SMALL.

4.4.2 No-Action Alternative

Until the NRC approves a decommissioning plan for restricted release of the DU Impact Area, pursuant to 10 CFR 20.1403 requirements, all provisions of NRC Source Material License SUB–1435 would remain in effect. The Army would continue to conduct semi-annual sampling of surface water, sediments, and groundwater, as outlined in its present ERMP (U.S. Army, 2004, 2003a), and the NRC would continue to conduct periodic onsite inspections. No additional activities would occur that would disturb the hydrologic properties of the DU Impact Area, BONWR, or the surrounding environment in terms of quantity of streamflow or groundwater. Surface water, sediment, and groundwater quality impacts associated with in-place degradation of existing DU material within the DU Impact Area would be similar to those under the proposed action.

Should the NRC approve a decommissioning plan within the 20-year timeframe analyzed in this EA, the NRC would terminate the license to possess DU and may establish requirements for continued surface water, sediment, and groundwater radiological monitoring and NRC oversight (e.g., onsite inspections). Therefore, assuming the Army would have satisfactorily demonstrated compliance with NRC decommissioning criteria for restricted use at 10 CFR 20.1403, the NRC staff concludes that potential impacts to surface water, sediments, and groundwater under the no-action alternative for the timeframe analyzed in this EA (20 years) would be SMALL.

4.5 Ecological Resources Impacts

The potential environmental impacts on ecological resources from the proposed action and the no-action alternative are evaluated in this section. Both the proposed action and the no-action alternative would have no effect on federally threatened and endangered species, because no activities would occur that would disturb or harm these species or their habitats within the DU Impact Area.

4.5.1 Proposed Action

Vegetation and Habitats

Beyond the continued, occasional maintenance of fencing and signs, no activities are planned that would directly or indirectly disturb or harm vegetation or habitat within the DU Impact Area, such as land disturbance, DU penetrator removal, or tree removal. The NRC staff anticipates that potential direct and indirect impacts on vegetation and habitats from the activities planned under the proposed action for 20 years would be negligible.

Current institutional controls effectively restrict access and would continue to restrict access to the JPG Site and DU Impact Area under the proposed action (see Section 2.1.1). Institutional controls include physical access restrictions to prevent unauthorized entry into JPG and the DU Impact Area (e.g., JPG perimeter chain-link fence; security warning signs around JPG and the DU Impact Area to caution persons not to enter; and locked road barricades to prevent entry into restricted areas north of the firing line, including the DU Impact Area) (U.S. Army, 2013a). Institutional controls significantly reduce the potential for direct impacts to vegetation outside the

DU Impact Area and for unplanned activities to occur within the DU Impact Area, such as members of the public conducting unauthorized vegetation removal.

As a result of the reduced scope of the ERMP associated with the proposed action, fewer disturbances to vegetation and habitats, including aquatic habitats, would occur because of the reduction of vehicles and foot traffic needed to complete the sampling. Direct effects to vegetation, including the clearing of vegetation to access sample locations, would also decrease.

As explained in Section 2.1.1, under the MOA between the Army, USFWS, and USAF (U.S. Army, 2000), the USFWS manages JPG's natural resources on the approximately 206-km^2 [50,950-ac] BONWR north of the firing line, including the DU Impact Area. The USFWS conducts wildlife population monitoring within the BONWR (e.g., for birds, crayfish, frogs) but does not conduct environmental sampling of water, soil, sediment, air, or plant or animal tissue. During NRC consultations with USFWS staff, the USFWS stated no concerns regarding endangered species at JPG (or their habitat), as long as the DU remains in the DU Impact Area and no remediation activities occur. The USFWS staff is not aware of any adverse effects on wildlife from DU and UXO at JPG (see Chapter 6). Thus, the NRC staff concludes that the BONWR would continue to sustain vegetation communities and wildlife habitat in accordance with USFWS management goals and objectives. USFWS management of existing vegetation that supports sensitive species, particularly the grassland communities, would continue.

Wildlife

For the reasons explained under the vegetation and habitats discussion, compared to the current direct and indirect impacts on wildlife within the DU Impact Area, fewer direct and indirect impacts to terrestrial and aquatic wildlife would occur from the proposed action because of the planned reduction of vehicles and clearing of vegetation needed to collect ERMP samples. The NRC staff also expects fewer potential direct impacts to animals from vehicle collisions to occur due to the reduced traffic. The NRC staff also anticipates that the proposed action would reduce indirect impacts currently experienced by wildlife because the noise produced by driving over unpaved roads would occur less frequently.

Protected Species

As discussed in Section 3.5, the NRC staff obtained a list of federally listed species and critical habitats that could occur at JPG from USFWS (Lemont, 2015; NRC, 2014; Reed, 2017; USFWS, 2018). JPG is within the range of the federally endangered Indiana bat (*Myotis sodais*), federally endangered sheepnose mussel (*Plethobasus cyphyus*), federally endangered running buffalo clover (*Trifolium stoloniferum)*, and the federally threatened northern long-eared bat (*M. septentrionalis*) (Reed, 2017; USFWS 2018). No critical habitat occurs within JPG (Reed, 2017; USFWS, 2018).

As part of the establishment of the BONWR, the USFWS conducted an Intra-Service Section 7 Consultation (USFWS, 2000a) under the *Endangered Species Act* for those listed species that may occur or be affected by the establishment, management, or public use (including hunting and fishing) of the BONWR to ensure that those species would be protected. The Section 7 consultation conducted in 2000 included review of the Indiana bat and its summer habitat and the bald eagle and its stop-over habitat. Indiana bats have been captured during several bat surveys at JPG (Reed, 2017, 2014). The bald eagle was delisted from the Federal list of Endangered and Threatened Wildlife in July 2007 (72 FR 37346) but remains an Indiana State species of concern (see Appendix B). Bald eagles tend to use BONWR habitats during migration periods (USFWS, 2000a); however, a bald eagle nest was reported at Big Timbers Lake in March 2013 (Hellmich, 2015). As a result of the Intra-Service Section 7 Consultation, the USFWS determined that the establishment of the BONWR would have a positive impact on Indiana bat and bald eagle habitats by continuing to provide habitats suitable for these species, and that refuge management and public recreation activities would not adversely impact these species (USFWS, 2000a). No new activities are planned under the proposed action and none of the continued or amended activities would disturb Indiana bats or bald eagles or their habitats beyond what is currently experienced at JPG. For these reasons, the NRC staff determined that the proposed action would have no effect on the Indiana bat or the bald eagle.

The sheepnose mussel and running buffalo clover, both federally endangered species (see Section 3.5), were not considered at the time of the 2000 Intra-Service Section 7 Consultation. As explained in Section 3.5, the sheepnose mussel and running buffalo clover are not known to be present at JPG (Reed, 2017, 2014; U.S. Army, 2013a) and have not been documented either at JPG or within 1.6 km [1 mi] of JPG (see Appendix B). No activities under the proposed action are expected to disturb the ground surface where running buffalo clover could potentially occur or impact the creeks where the sheepnose mussel could potentially occur. Therefore, the NRC staff determined that the proposed project would have no effect on the sheepnose mussel or running buffalo clover.

The USFWS listed the Northern long-eared bat as a federally threatened species on April 2, 2015 (80 FR 17974). Northern long-eared bats have been captured during several bat surveys at JPG (Reed, 2017, 2014). These bats are similar to the Indiana bat and roost singly or in colonies in cavities, crevices, or underneath bark and in hollows of both live and dead trees (USFWS, 2014b). Their habitat may also include some adjacent and interspersed non-forested habitats, such as emergent wetlands and adjacent edges of agricultural fields, old fields, and pastures, as well as linear features such as fencerows, riparian forests, and other wooded corridors. Breeding occurs in late summer and fall (August to November) when the bats swarm at entrances of winter hibernation areas, which also are typically located in large underground openings where they spend the rest of the winter (USFWS, 2014b). For the same reasons explained previously for the Indiana bat, the NRC staff determine that the proposed action would have no effect on the Northern long-eared bat.

In addition to the Indiana bat, sheepnose mussel, running buffalo clover, and Northern long-eared bat, three other species listed as federally endangered [Gray bat (*Myotis grisescens)*, Kirtland's warbler (*Dendroica kirtlandii)*, American burying beetle (*Nicrophorus americanus)*] and one federally threatened species [Northern copperbelly water snake, (*Nerodia erythrogaster neglecta)]* identified in Appendix B, have the potential to occur within JPG, based on their current habitat ranges. Although JPG is within their range of existence, these species are not known to occur at JPG (Clark, 2018; USFWS, 2006) and; therefore, they would not be affected by the proposed action.

Further, several State-listed species (i.e., birds, insects, snakes, small mammals) identified in Appendix B could potentially occur at JPG. As previously explained in this section for other wildlife, the proposed action is not expected to disturb or harm individual State-listed animals or habitat, including state listed species in Appendix B, beyond what is currently experienced at the JPG site.

<u>Ecological Risks from DU</u>

As described in Section 3.5.4, (i) ecological data collected between 1984 and 2006 shows that DU concentrations are not present in deer tissue at levels to be a significant exposure pathway to humans (U.S. Army, 2013a), (ii) prior ecological risk assessments indicate that there are no apparent ecological risks to raptor and small mammal populations at JPG and that aquatic habitats at JPG are considered high quality (U.S. Army, 2015b, 2003b), and (iii) evidence from the ERMP sampling results show abiotic DU is not expected to be transported off of JPG (U.S. Army, 2017, 2013a). Therefore, over the timeframe analyzed in this EA (20 years), the NRC staff concludes that the impacts of the continued presence of DU in the environment and releases from the DU penetrators would likely not be detectable in plants (other than at penetrator resting locations) or animal populations and would not noticeably alter wildlife populations or habitats.

Summary of Potential Ecological Impacts from the Proposed Action

In summary, no activities are planned that would directly or indirectly impact ecological resources greater than those impacts that vegetation and habitat and wildlife currently experience at the JPG site. As discussed previously in this section, there would be no additional land disturbances or vegetation removal planned within the DU Impact Area that could impact vegetation or wildlife populations. Institutional controls at the JPG site and the DU Impact Area would remain in place to limit unauthorized activities. Fences, gates, and signs would continue to be repaired and replaced as needed, resulting in minor impacts on vegetation and soil. The proposed action would result in reduced environmental monitoring, which would reduce associated direct and indirect impacts associated with vehicles, foot traffic, and foliage removal. As discussed previously in this section, no critical habitat is present at JPG. The BONWR would continue to manage vegetation communities and wildlife habitat in accordance with USFWS management goals and objectives. USFWS management of existing vegetation that supports sensitive species, particularly the grassland communities, would continue. There would be no change of impacts to ecological resources, and there would be no effect on Federal- or State-listed species from the proposed action. Finally, over the 20-year timeframe analyzed in this EA, the presence of DU in the DU Impact Area and throughout JPG does not appear to create a potential significant exposure pathway for DU from animals to humans, and the continued presence of DU during this timeframe does not appear to pose risks for aquatic, terrestrial plant, and animal species, including federally threatened or endangered species. Therefore, the NRC staff concludes that the potential impacts to ecological resources resulting from the proposed action would be SMALL.

4.5.2 No-Action Alternative

Until the NRC approves a decommissioning plan for restricted release of the DU Impact Area, pursuant to 10 CFR 20.1403 requirements, all provisions of NRC Source Material License SUB–1435 would remain in effect. The Army would continue to conduct semi-annual sampling of soils, surface water, sediments, and groundwater, as outlined in its present ERMP (U.S. Army, 2004, 2003a), and the NRC would continue to conduct periodic onsite inspections. No additional activities would occur that would disturb vegetation or wildlife populations within the DU Impact Area beyond those disturbances that currently occur as a result of activities associated with the existing NRC Source Material License SUB–1435. Clearing vegetation away in order to access sample locations would continue, as well as the continued use of vehicles and foot traffic associated with the ERMP and NRC's periodic site inspections. The BONWR would continue to manage vegetation communities and wildlife habitat, in accordance with USFWS management goals and objectives. USFWS management of existing vegetation that supports sensitive species, particularly the grassland communities, would continue. There would be no change of impacts to ecological resources, and there would be no effect on Federal- or State-listed species from the continuation of NRC Source Material License SUB–1435. Therefore, potential impacts to ecological resources would be similar to the proposed action.

Should the NRC approve a decommissioning plan within the 20-year timeframe analyzed in this EA, the NRC would terminate the license to possess DU and may establish requirements for continued monitoring and NRC oversight (e.g., onsite inspections). Based on existing biological studies, the impacts of the continued presence of DU in the environment and releases from the DU penetrators would likely not be detectable in plants (other than at penetrator resting locations) or animal populations over the 20-year timeframe analyzed in this EA (see Section 4.5.1). Additionally, assuming the Army would have satisfactorily demonstrated compliance with NRC decommissioning criteria for restricted release at 10 CFR 20.1403, the NRC staff concludes that the Army also would have demonstrated that the DU would not exceed the applicable NRC human dose limits for restricted release. The NRC staff assumes that compliance with these dose limits, combined with the limited extent of DU contamination relative to available habitat at JPG, would be protective of ecological resources. Therefore, the potential impacts to ecological resources under the no-action alternative for the timeframe analyzed in this EA (20 years) would be SMALL.

4.6 Air Quality

This section describes activities that generate air emissions, characterizes their emission levels, and analyzes the associated impacts for both the proposed action and no-action alternative for the 20-year timeframe analyzed in this EA. Under both alternatives, existing DU and UXO within the DU Impact Area would be left in place and subject to institutional controls. Note that many of the activities considered in this section, such as those related to maintenance of institutional controls, are evaluated differently than in other resource areas in this EA because the locations where the air emissions occur are not confined to the DU Impact Area.

4.6.1 Proposed Action

Under the proposed action, activities generating air emissions would include the following:

- Institutional controls, as outlined in the 2000 MOA among the Army, USFWS, and USAF (U.S. Army, 2000)
  - DU Impact Area Gate Inspection
  - JPG Perimeter Fence Inspection
  - JPG Perimeter Fence Repair
  - JPG Perimeter Mowing
  - JPG Road Maintenance (both perimeter and within JPG)
  - JPG Signage Monitoring and Replacement (both perimeter and within JPG)
  - Personal Vehicle Use (direct support of institutional control activities)
- Periodic NRC onsite inspections
- Sampling of surface water and sediment, as outlined in the Army’s revised ERMP (see Section 2.1.2)

All emissions are attributed to mobile sources, and the only activity that would occur more than three times in a year is the JPG perimeter fence inspection, which would continue to occur on a weekly basis (U.S. Army, 2000). Emissions from these activities are nonradiological in nature. The estimated mass flow rates (i.e., the estimated mass of pollutants generated annually) for the proposed action are presented in Table 4-1.

Table 4-1. Estimated Pollutant* Mass Flow Rates (Metric Tons† per Year) for the Proposed Action‡						
CO_2	CO	NOx	$PM_{2.5}$	PM_{10}	SOx	VOC
509	7.40	1.14	0.03	0.07	0.01	0.37

Sources: U.S. Army, 2015b, 2015c
* CO_2 = Carbon Dioxide, CO = Carbon Monoxide, NOx = Nitrogen Oxides, $PM_{2.5}$ = Particulate Matter 2.5 micrometers, PM_{10} = Particulate Matter 10 micrometers, SOx = Sulfur Oxides, and VOC = Volatile Organic Compounds
†To convert metric tons to short tons, multiply by 1.10231.
‡Emission levels for vehicles visiting the BONWR were used to estimate emission levels for some of the proposed action activities (e.g., commuting). The NRC staff determined that this estimation is appropriate because emission levels are proportional to the distance vehicles travel, and the distance traveled by the BONWR visitors are considered bounding.

Combustion emissions compose most of the anticipated air emissions, although some activities, such as road maintenance, would generate fugitive dust. The Army implements Best Management Practices (BMPs) designed to ensure that activities comply with requirements of the Indiana Department of Environmental Management (IDEM) rules pertaining to fugitive dust. These BMPs include (i) applying water to reduce dust; (ii) suspending soil-disturbing activities during periods of high wind or when visible dust plumes emanate from the JPG site; and (iii) limiting traffic speeds on unpaved roads. Air quality impacts from non-greenhouse gas emissions are addressed in Section 4.6.1, and air quality impacts from greenhouse gas emissions are addressed in Section 4.6.2.

<u>Non-Greenhouse Gases</u>

The nature of the air emissions associated with the proposed action is important when analyzing potential impacts. The proposed action would periodically generate air emissions from mobile sources over a large area (i.e., around the JPG perimeter) rather than continuously generating emissions from discrete stationary locations. The periodic and widespread nature of the emissions generated by institutional control and ERMP sampling activities reduces potential impacts.

The existing air quality where the emissions are generated is another important factor when analyzing potential impacts. As discussed in Section 3.6.2, Madison Township is currently classified as a maintenance area (i.e., formerly a nonattainment area) for the particulate matter $PM_{2.5}$ annual standard (see Figure 3-14). As depicted in Figure 3-14, the southern part of the JPG Cantonment Area (i.e., the area south of the JPG firing line) is located in Madison Township. However, all of the activities associated with the proposed action would occur north of the firing line—which is not within Madison Township and is within an attainment area—because the Army's revised ERMP would eliminate sampling at the two groundwater monitoring wells (MW–DU–004 and MW–DU–008, as shown in Figure 2-1) that are located in Madison Township. Some of the emissions associated with the proposed action occur along the JPG firing line (i.e., the southern boundary of the northern portion of the JPG) located about 1.3 km [0.81 mi] north of Madison Township (see Figure 3-14). However, only a small portion of the air emissions associated with the proposed action would occur along the JPG firing line in close proximity to the maintenance area. In addition, the prevailing winds are from the south-southwest (see Section 3.6.1.3), which would transport the emissions away from the maintenance area.

The quantity of air pollutants generated by the proposed action is also important when analyzing potential impacts. The proposed action would generate low pollutant levels. The only non-greenhouse gas with an estimated annual mass flow rate greater than about one metric ton

[1.10 short ton] per year is carbon monoxide at 7.40 metric tons [8.16 short tons] per year (see Table 4-1). To provide a perspective on how low the proposed actions emission levels are, the non-greenhouse gas annual mass flow rates for the combined Jefferson, Jennings, and Ripley Counties range between 3,283 and 28,018 metric tons [3,619 and 30,884 short tons] (see Table 3-3). The NRC staff expects that potential impacts to air quality from the proposed action would be minimal, both in the immediate vicinity and in regions farther away where dispersion reduces pollutant concentrations.

In summary, implementation of the proposed action would lower the amount of emissions generated from JPG, because the proposed modified ERMP reduces the number of sampling locations (see Section 2.1.2), which reduces the amount of travel and associated emissions from mobile sources. The proposed action would generate low levels of air emissions within an attainment area with good existing air quality. Therefore, the NRC staff concludes that potential impacts to air quality as a result of the proposed action would be SMALL.

Greenhouse Gases

The same mobile sources that generate the non-greenhouse gases also generate carbon dioxide (CO_2). For this EA, the NRC staff is limiting the discussion of greenhouse gases to CO_2 because it is the primary greenhouse gas emitted by the proposed action (see Table 4-1). As described above, combustion emissions compose most of the anticipated air emissions; therefore, emissions of greenhouse gases other than CO_2 (e.g., methane, nitrogen oxides, and fluorinated gases) would be minimal and their impact not detectable. The Army does not implement mitigation measures to reduce CO_2 emissions generated by mobile sources at JPG.

NRC addresses the contribution of CO_2 from the proposed action and no-action alternative to the overall atmospheric greenhouse gas (GHG) levels, as well as the relevant climate change impacts as part of the cumulative impacts analysis in Section 5.4.5, because climate change impacts are considered the result of overall GHG emissions from numerous sources rather than an individual source. Further, there is no strong relationship between where the GHGs are emitted and where the impacts occur.

4.6.2 No-Action Alternative

Until the NRC approves a decommissioning plan for restricted release of the DU Impact Area, pursuant to 10 CFR 20.1403 requirements, all provisions of NRC Source Material License SUB–1435 would remain in effect. The Army would continue to conduct its present semi-annual ERMP (U.S. Army, 2004, 2003a), and the NRC would continue to conduct periodic onsite inspections. The DU material would continue to be subject to the Army's commitments for institutional controls established under the MOA with the USFWS and USAF (U.S. Army, 2000). No additional activities would occur that would generate new or increased air emissions. Therefore, potential impacts to air quality would be similar to the proposed action.

Should the NRC approve a decommissioning plan within the 20-year timeframe analyzed in this EA, the NRC would terminate the license to possess DU and may establish requirements for continued monitoring and NRC oversight (e.g., onsite inspections). Therefore, assuming the Army would have satisfactorily demonstrated compliance with NRC decommissioning criteria for restricted use at 10 CFR 20.1403, the NRC staff concludes that potential impacts to air quality under the no-action alternative for the timeframe analyzed in this EA (20 years) would be SMALL.

4.7 Public and Occupational Health

This section analyzes the potential impacts on public and occupational health from the proposed action and the no-action alternative. Both alternatives involve leaving the DU in place within the DU Impact Area but represent distinctly different options available to the Army to comply with NRC requirements applicable to the continued possession of the DU material.

The impacts to public and occupational health from the alternatives are based on the potential for human exposure to unsafe levels of DU or associated radiation for the applicable duration of each action. The impact analysis addresses both radiological and nonradiological impacts and considers the potential impacts to workers engaged in activities within or around the DU Impact Area and the potential impacts to members of the public that could be exposed. Additionally, because the proposed action is mostly a passive action that involves no facilities or operations, no plausible accident scenarios are expected or evaluated by the NRC staff in this section.

4.7.1 Proposed Action

Under the proposed action, the Army would leave the licensed DU material in the DU Impact Area and retain existing radiation safety controls (radiation safety plan) other than the proposed modifications to the ERMP (see Section 2.1.2). Therefore, the NRC staff's evaluation of the potential impacts to public and occupational health considers whether the existing controls and site characteristics and the proposed modifications to the ERMP would continue to maintain safety for the duration of the proposed license term (20 years).

As described in Section 3.7.2, the existing NRC oversight of licensed activities at JPG provides reasonable assurance that the health and safety of site personnel and members of the public are protected from radiological hazards. In particular, the license requires an NRC-approved radiation safety plan. The current radiation safety plan was approved by NRC in 2013 (NRC, 2013a). This radiation safety plan was designed to satisfy the NRC radiation protection requirements in 10 CFR Part 20. These requirements address, for example, radiation safety standards with radiation dose limits, personnel and their responsibilities, training requirements, authorized activities, access controls, monitoring, and reporting. As described in Section 3.7.1.1, the average radiation dose measured within the DU Impact Area is comparable to background radiation at approximately 0.19 millisievert per year (mSv/yr) [19 millirem per year (mrem/yr)]. This level of radiation dose does not present a safety hazard to Army personnel engaged in typical activities within or near the DU Impact Area and following applicable radiation safety practices. Similarly, this level of radiation dose presents no safety hazard for publicly accessible areas within the JPG site and beyond the site boundary.

Institutional controls currently effectively restrict access and would continue to restrict access to the JPG site under the proposed action (see Section 2.1.1). Additionally, the DU Impact Area would continue to be designated a restricted area by license condition and marked with radiation warning signs. Therefore, the potential for members of the public to be exposed to DU is limited to scenarios where DU migrates to offsite areas.

As described in Section 3.7.2, based on a past Army assessment, the DU in the DU Impact Area, which occurs primarily in the form of solid metal rods, corrodes in the presence of oxygen and water, and would corrode completely over a period of time ranging from approximately 65 to 182 years (U.S. Army, 2013a). While evidence of DU corrosion has been observed on penetrators in the DU Impact Area (U.S. Army 2013a) (thereby making the material available for potential dissolution in rainwater and subsequent environmental transport), the average concentrations of uranium measured in groundwater and in surface water have been below EPA MCLs (see Sections 4.4.1.1 and 4.4.1.2). Additionally, the distance to offsite locations provides a buffer between the DU Impact Area and areas of uncontrolled public access, including nearby communities outside the western boundary of the site (the direction of surface water flow and the expected direction of some groundwater flow). For over three decades, the Army's environmental monitoring has not detected any significant migration of DU to offsite locations (U.S. Army, 2013a). While site conditions appear to have limited the migration of DU, the proposed monitoring programs provide additional safety assurance by preferentially collecting environmental samples in areas expected to be potential transport pathways to offsite locations (including Big Creek) (U.S. Army, 2016).

The NRC staff have reviewed the proposed modifications to the Army's ERMP and conclude that the proposed approach is adequate to identify whether DU is migrating from the DU Impact Area to offsite locations over the proposed license term and subsequent renewal.

Based on the preceding analysis, the NRC staff concludes that the Army's continued possession of DU material in the DU Impact Area under the proposed action is unlikely to present a public or worker health and safety concern, provided that the Army maintains the required access restrictions and JPG institutional controls, continues to comply with license conditions (including sufficient monitoring to detect offsite migration of DU), and maintains safety practices in accordance with the NRC-approved radiation safety plan. Therefore, the NRC staff concludes that the radiological public and occupational health impacts of the proposed action would be SMALL.

As described in Section 3.7.4 of this EA, DU poses potential chemical toxicity hazards, in addition to its radiological hazards. The chemical hazards associated with uranium are based on the mass of uranium that enters the body either by inhalation or ingestion. EPA MCLs for uranium in water (considered in the preceding radiological impact analysis) are derived considering both chemical and radiological hazards of uranium exposure. Because the NRC-approved radiation safety plan and access controls required by the license effectively limit the potential for inhalation or ingestion of DU, the NRC staff concludes that the nonradiological public and occupational health and safety impacts of the proposed action would also be SMALL.

4.7.2 No-Action Alternative

Until the NRC approves a decommissioning plan for restricted release of the DU Impact Area pursuant to 10 CFR 20.1403 requirements, all provisions of NRC Source Material License SUB–1435 would remain in effect. The Army would continue to conduct its present semi-annual ERMP (U.S. Army, 2004, 2003a), conduct periodic onsite inspections, and maintain safety practices in accordance with the NRC-approved radiation safety plan. The DU material would continue to be subject to the Army's commitments for institutional controls established under the MOA with the USFWS and USAF (U.S. Army, 2000). The physical environment of the DU and surrounding area would be essentially the same as the environment under the proposed action. Therefore, potential radiological and nonradiological public and occupational health and safety impacts would be similar to the proposed action.

Should the NRC approve a decommissioning plan within the 20-year timeframe analyzed in this EA, the NRC would terminate the license to possess DU and may establish requirements for continued radiological monitoring and NRC oversight (e.g., onsite inspections). Therefore, assuming the Army would have satisfactorily demonstrated compliance with NRC decommissioning criteria for restricted use at 10 CFR 20.1403, the NRC concludes that under the no-action alternative for the timeframe analyzed in this EA (20 years), the radiological and nonradiological impacts to public and occupational health would be SMALL.

4.8 Environmental Justice

The NRC addresses environmental justice matters for license reviews through (i) identifying minority and low-income populations that may be affected by the proposed action and alternatives, and (ii) examining any potential human health or environmental effects on these populations to determine whether these effects may be disproportionately high and adverse (NRC, 2003). Disproportionately high effects may include biological, cultural, economic, or social impacts (CEQ, 1997a). Some of these potential effects (e.g., ecological and public health impacts) are discussed in previous sections of this chapter. For this environmental justice analysis, minority and low-income populations are subsets of the general public residing within 6.4 km [4 mi] of the DU Impact Area boundary. For the majority of this evaluation, the NRC staff used data from the U.S. Census Bureau (USCB), as reported in Sections 3.8.2 and 3.8.3.

4.8.1 Proposed Action

For the NRC to fulfill its obligation to evaluate potential environmental justice impacts from the proposed action, the NRC staff evaluated whether the minority and low-income populations evaluated could experience disproportionately high and adverse human health and environmental effects. As described in Section 3.8.2, the NRC environmental justice guidance in NUREG–1748, "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs" (NRC, 2003) states, "[i]f the percentage in the block groups significantly exceeds that of the state or county percentage for either minority or low-income populations, environmental justice will have to be considered in greater detail. As a general matter, and where appropriate, staff may consider differences greater than 20 percentage points to be significant. Additionally, if either the minority or low-income population percentage exceeds 50 percent, environmental justice will have to be considered in greater detail." Based on USCB data reported in Sections 3.8.2 and 3.8.3, the NRC staff concluded that minority and low-income individuals reside within the seven block groups within 6.4 km [4 mi] of the DU Impact Area. However, the percentage of minority and low-income populations in the seven block groups do not significantly exceed the percentage of minority and low-income populations at the State or county level (i.e., are not greater than 20 percent), and the minority and low-income populations do not exceed 50 percent of any block group. Therefore, based on the environmental justice guidance in NUREG–1748 (NRC, 2003), the NRC staff determined that a detailed environmental justice analysis is not required and that minority and low-income populations would not experience disproportionately high and adverse human health and environmental effects from the proposed action. However, as discussed in this section and Section 5.2.7, the NRC staff conservatively looked at other potentially unique characteristics that could result in a disproportionate impact on minority and low-income populations or to the general population.

As described in Section 3.8.4, the NRC staff considered the results of ecological risk assessments; the results of radiological sampling of soils, surface water, sediments, and groundwater; and public access and land use restrictions at JPG, to identify means or pathways for minority or low-income populations to be disproportionately affected by the proposed action. The results of ecological risk assessments indicate that the continued presence of DU in the DU Impact Area and throughout JPG does not appear to be a potentially significant exposure pathway for DU from animals to humans at JPG, and the continued presence of DU does not appear to have ecological risks for aquatic and terrestrial plant and animal species (see Section 4.5.1). As discussed in Section 4.7.1, while evidence of DU corrosion has been observed on penetrators in the DU Impact Area (U.S. Army, 2013a), the average concentrations of uranium measured in groundwater and in surface water have been below EPA MCLs (e.g., see Sections 4.4.1.1 and 4.4.1.2). In addition, the results of radiological sampling of soils at JPG, as described in Section 3.7.2.1, indicates that soils in close proximity to DU penetrators are contaminated with DU but that migration of DU in soil is limited. For over three decades, the Army's ERMP has not detected any significant migration of DU to offsite locations (U.S. Army, 2017, 2013a). Furthermore, the distance to offsite locations provides a buffer between the DU Impact Area and areas of uncontrolled public access, including nearby communities outside the western boundary of the site (the direction of surface water flow and the expected direction of some groundwater flow). As discussed in Section 4.2.1, public access to the BONWR is limited to two areas: the limited day-use recreation area and special controlled hunting zones (see Figure 3-3). Public access to other areas in the BONWR {approximately 97 km^2 [24,000 ac]} is restricted primarily because of the occurrence of high levels of UXO and both UXO and DU in the DU Impact Area.

In summary, no means or pathways have been identified for minority or low-income populations to be disproportionately affected by the proposed action. Moreover, adverse health effects to all populations, including minority and low-income populations, are not expected under the proposed action, because the Army would maintain current access restrictions and institutional controls (see Section 2.1.1); continue to comply with license conditions, including sufficient monitoring to detect offsite migration of DU (see Section 2.1.2); and maintain safety practices, in accordance with the NRC-approved radiation safety plan (see Section 4.7.1). Furthermore, the NRC staff has not identified any potential impacts on the natural or physical environment that would significantly and adversely affect a particular population group. Therefore, the NRC staff concludes that the proposed action would have no disproportionately high and adverse impacts on any group, including minority and low-income populations.

4.8.2 No-Action Alternative

Until the NRC approves a decommissioning plan for restricted release of the DU Impact Area, pursuant to 10 CFR 20.1403 requirements, all provisions of NRC Source Material License SUB–1435 would remain in effect. The Army would continue to conduct semi-annual sampling of soils, surface water, sediments, and groundwater, as outlined in its present ERMP (U.S. Army, 2004, 2003a), and the NRC would continue to conduct periodic onsite inspections. The Army would continue to maintain required institutional controls. The physical environment of the DU and surrounding area would be essentially the same as the environment described under the proposed action, although it would continue to evolve over the longer timeframe associated with a decommissioning action, as would the population groups within the seven block groups that are within 6.4 km [4 mi] of the DU Impact Area boundary. Therefore, potential impacts to any group, including minority and low-income populations, would be similar to the proposed action.

Should the NRC approve a decommissioning plan within the 20-year timeframe analyzed in this EA, the NRC would terminate the license to possess DU and may establish requirements for continued monitoring and NRC oversight (e.g., onsite inspections). As described in Section 2.2, maintaining institutional controls and conducting dose modeling analyses are required for demonstrating that decommissioning would not exceed the applicable NRC dose limits for restricted release, pursuant to 10 CFR 20.1403. Assuming the Army would have satisfactorily demonstrated compliance with NRC decommissioning criteria for restricted use at 10 CFR 20.1403, no disproportionately high and adverse environmental or health impacts would be experienced by any group, including minority and low-income populations. Therefore, the NRC staff concludes that potential impacts to any group, including minority and low-income populations, under the no-action alternative for the timeframe analyzed in this EA (20 years) would be SMALL.

5 CUMULATIVE IMPACTS

The Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act of 1969 (NEPA), as amended, define a cumulative impact as "the impact on the environment that results from the incremental impact of [an] action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions" [Title 40 of the *Code of Federal Regulations* (40 CFR) 1508.7]. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time.

This chapter provides an assessment of the cumulative impacts that could be associated with the proposed action and the no-action alternative evaluated in this environmental assessment (EA). Section 5.1 summarizes the past, present, and reasonably foreseeable future actions considered in the cumulative impact analysis. Section 5.2 describes the cumulative impact analyses for each resource area that was selected for detailed impact analysis. The U.S. Nuclear Regulatory Commission (NRC) methodology for assessing the cumulative impacts of the proposed action and the no-action alternative in this EA is described in Appendix C.

As stated in Chapter 1, the information and analysis presented in this EA were adapted from an environmental impact statement (EIS) that was being prepared for a previously proposed Federal action (decommissioning and license termination under restricted release conditions). Much of the information from that preliminary draft EIS is applicable to the current proposed action because the potential impacts from the currently proposed license amendment and exemption would be very similar to the potential impacts that were being evaluated in the EIS. This includes information supporting the assessment of cumulative impacts below, and the NRC staff has determined that it would be in the public interest to publish that information in this EA.

5.1 <u>Past, Present, and Reasonably Foreseeable Future Actions</u>

This section describes the NRC's methodology for identifying past, present, and reasonably foreseeable future actions for the cumulative impact analysis. As described by CEQ (1997b), identifying past, present, and reasonably foreseeable future actions is a critical component of a cumulative impact analysis. However, the CEQ also recognizes that agencies should not engage in speculation in an effort to identify all actions that could contribute to overall potential cumulative effects. Accordingly, reasonably foreseeable future actions that are considered in this cumulative impact analysis include the following:

- General trends or activities in the region of southeastern Indiana where the Jefferson Proving Ground (JPG) site is located that have been documented in available information sources, such as applicable Federal, State, and local studies, including NEPA assessments and planning documents.
- Actions and activities documented in the Army's environmental report (ER) (U.S. Army, 2013a) and decommissioning plan (DP) (U.S. Army, 2013b) for the Army's 2013 license amendment application to terminate Source Material License SUB–1435 and decommission the Depleted Uranium (DU) Impact Area under restricted conditions (U.S. Army, 2013c) that have been determined to be pertinent to this EA (see Sections 1.1 and 1.4).
- Actions and activities identified during the NRC's prior EIS scoping process (NRC, 2015a) and information-gathering meetings with Federal, State, and local officials and interested stakeholders (NRC, 2015b) for the Army's 2013 license amendment

application to terminate Source Material License SUB–1435 and decommission the DU Impact Area under restricted conditions (U.S. Army, 2013c) that have been determined to be pertinent to this EA (see Sections 1.1 and 1.4).

The NRC staff considered including the possibility of the Army proposing a future decommissioning action for unrestricted release of the site (see Section 2.3) because this possibility was included as part of the Army's rationale for its current proposal for exemption from the NRC timely decommissioning requirements (stating that the delay in decommissioning would allow time for technology to be developed that would allow more efficient site-cleanup for unrestricted release) (U.S. Army, 2016). However, the NRC has not included this potential future action in the cumulative impact analysis, because (i) the Army has not provided firm plans regarding which decommissioning option it would pursue in the future; (ii) any consideration of undeveloped technology would be speculative and not informative; (iii) the NRC expects that the Army would not pursue a decommissioning action until after the 20-year timeframe of the cumulative impact analysis; and (iv) the potential for significant accumulation of future decommissioning impacts, with the residual impacts of the proposed action, is unlikely when considering the currently low-level of impacts in the DU Impact Area that have been observed several decades after licensed DU testing operations ended. Additionally, the NRC would evaluate, in detail, the environmental impacts of any decommissioning action the Army proposes in the future.

The following sections summarize the past, present, and reasonably foreseeable future actions considered in this cumulative analysis, including actions within the DU Impact Area or JPG, general trends and activities in the region, other proposed projects, and other potential sources of radiological or uranium exposure in the region.

5.1.1 Actions and Activities at the DU Impact Area or JPG Site

Actions and activities within the DU Impact Area or the broader JPG site have created current conditions that could contribute to cumulative impacts and are likely to persist and continue to contribute to cumulative impacts into the indefinite future. These actions and activities include the following, and are described in other sections of the EA as identified in the bullets that follow:

- Historical explosive ordnance testing at JPG that has deposited unexploded ordinance (UXO) on large tracts of land at the JPG site north of the firing line (including the DU Impact Area), described in Sections 1.1, 3.2.1, 3.7.3, and 3.7.5.
- JPG site-wide land use and access restrictions, described in Sections 2.1.1 and 3.2.1.
- Federal land management actions and activities associated with operating the Big Oaks National Wildlife Refuge (BONWR), described in Sections 2.1.1 and 3.2.1. The U.S. Fish and Wildlife Service (USFWS) manages grasslands within the BONWR to enhance habitat for species of concern that may be present at the BONWR. As part of grassland management, BONWR staff conducts controlled burns two or three times per year. Some controlled burns conducted by BONWR staff extend into the DU Impact Area. Details of the prescribed burn activities are described in the USFWS "*Wildlife Fire Management Plan"* (USFWS, 2006).
- Activities associated with the Indiana Air National Guard (INANG) bombing testing ranges, described in Sections 2.1.1 and 3.2.1. An Integrated Natural Resource Management Plan (INRMP) was developed by INANG, in cooperation with the USFWS and Indiana Department of Natural Resources (IDNR) for the conservation, protection,

and management of natural resources on the training range areas at JPG (INANG, 2013).

5.1.2 General Trends and Activities in the Region

JPG occupies approximately 224 square kilometers (km^2) [55,264 acres (ac)] in parts of Jefferson, Jennings, and Ripley Counties in southeastern Indiana (Figure 3-1). The DU Impact Area consists of approximately 8.4 km^2 [2,080 ac] in the south-central part of JPG (Figure 3-1), and is situated entirely in Jefferson County.

5.1.2.1 Characteristics of the DU Impact Area and Region

As described in Section 3.2, land within 8 kilometers (km) [5 miles (mi)] of the DU Impact Area boundary is covered by forests (approximately 63 percent); cultivated crops and pasture/hay (approximately 30 percent); shrub or scrub cover (approximately 2 percent); and open residential, commercial, and recreational land (approximately 4 percent). The land south of the firing line (i.e., in the Cantonment Area) is used for agricultural, commercial, light industrial, recreational, and residential purposes (U.S. Army, 2013a). Overall, the area surrounding the DU Impact Area beyond the boundary of the JPG site can be characterized as rural and agricultural. Several small rural towns are located around the JPG area, including Madison, Dupont, Vernon, North Vernon, and Versailles (see Figure 3-1).

5.1.2.2 General Economic and Planning Trends in the Region

To understand the general trends in the region, the NRC staff surveyed the areas surrounding JPG; talked with local government representatives and other stakeholders; and reviewed planning documents for Jefferson, Jennings, and Ripley counties and the city of North Vernon (NRC, 2015b; SDG Inc., 2012; planning NEXT, 2014; EGT, 2009; SIRPC, 2010). Of the planning documents reviewed, regional planning information was available for all adjacent counties (SIRPC, 2010), detailed comprehensive plans were available for Jennings County (SDG Inc., 2012) and the city of North Vernon (EGT, 2009), and a draft community assessment was available for Jefferson County (planning NEXT, 2014).

The Southeastern Indiana Regional Planning Commission (SIRPC) serves a region that includes Jefferson, Jennings, and Ripley counties. SIRPC planning information indicates that no economic growth centers have been identified in the areas outside the JPG boundary that are nearest to the DU Impact Area, to the west, south, or east (SIRPC, 2010). The nearest economic growth centers were identified along Highway 62 to the northeast and west of Madison and to the west and north of JPG from North Vernon to Versailles (see Figure 3-1) (SIRPC, 2010). The NRC staff heard similar descriptions of potential growth areas in discussions with local officials and stakeholders during an information-gathering visit to the region (NRC, 2015b).

According to the Jennings County comprehensive plan, new commercial, industrial, and residential subdivision growth would occur in areas served by municipal water and sewer systems (SDG Inc., 2012). The rural areas beyond the JPG boundary that are west and southwest of the DU Impact Area are outside of the service areas for the small town of Dupont and the city of Madison. These areas do not have municipal water or sewer service, and the NRC staff identified no plans to develop such services. Additionally, the planning documents noted economic challenges, such as low population growth, an aging population base, and a stagnant housing market (both sales and new construction were significantly affected by the recent recession) (planning NEXT, 2014; SDG Inc., 2012). Overall, the available information suggests the rural agricultural character of the region immediately surrounding the JPG site is likely to remain similar to current conditions into the foreseeable future, and specifically within the next 20 years.

5.1.2.3 Coal Fired Power Plant

Other activities in the region that are expected to continue into the future include the operation of the Clifty Creek generating station, a 1,300-megawatt coal fired power plant in Madison, approximately 14 km [9 mi] southwest of the DU Impact Area. Built in the early 1950s, this generating station burns 11,000 metric tons [12,000 short tons] of coal per day, has the capacity to store over 910,000 metric tons [1 million short tons] of coal (OVEK-IKEC, 2015), and stores its fly ash in a lagoon. The plant recently installed additional pollution control equipment (OVEK-IKEC, 2015).

5.1.2.4 Proposed or Planned Projects in the Region

NRC staff reviewed available information to identify other potential projects that might be planned for the region. NRC staff consulted the U.S. Environmental Protection Agency's (EPA) EIS database (EPA, 2017) to locate any recent EISs for projects in Indiana but found none. NRC staff also reviewed the Indiana Department of Transportation (INDOT) future transportation needs report (INDOT, 2013) for any large transportation projects that might be planned for the region. The staff identified no large transportation projects in the vicinity of the site that would have impacts that overlap with the projected impacts from the proposed action or no-action alternative. Information the staff obtained from the prior scoping efforts (see Section 1.1) and from the information-gathering meetings with Federal, State, and local officials and stakeholders also did not reveal any proposed or planned projects that would generate environmental impacts that would overlap or interact with the impacts from the proposed action or the no-action alternatives (NRC, 2015b).

5.1.3 Other Potential Sources of Radiation or Uranium Exposure in the Region

NRC staff also considered whether there are other potential sources of radiation exposure in the region surrounding JPG that would add to the radiation exposure from the proposed action and the no-action alternative. The NRC website at www.nrc.gov provides the locations of licensed facilities that possess radioactive materials, such as operating power reactors, operating research and test reactors, fuel cycle facilities (e.g., that produce fuel for commercial power reactors), low-level radioactive waste disposal sites, and any of the preceding types of facilities that are undergoing decommissioning following the end of operations. Existing analyses of nuclear power plants indicate that a large majority (although not all) of early health effects from a severe accident release would occur within 80 km [50 mi] of the plant site (NRC, 1996b). None of these other potential sources of radiation exposure are located within an 80 km [50 mi] radius of the DU Impact Area at JPG.

5.2 Resource-Specific Cumulative Impact Analysis

This section includes the cumulative impact analyses for each resource area that was analyzed in Chapter 4 of this EA.

5.2.1 Land Use

This section evaluates the direct and indirect effects of the proposed action and no-action alternative on land use (i.e., the incremental impacts) when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. The geographic area considered in the cumulative land use analysis includes the area within 8 km [5 mi] of the JPG DU Impact Area boundary, because it is unlikely that any past, present, or reasonably foreseeable future actions beyond this distance (e.g., agricultural activities and economic growth in surrounding towns) would impact current land use.

The direct and indirect impacts on land use from the proposed action are described in detail in Section 4.2.1. Under the proposed action, no activities are planned that would disturb the land or alter the dimensions of the land use restrictions that are currently in place (NRC, 2013a). Although the land use restrictions for the 8.4 km^2 [2,080 ac] DU Impact Area would continue for the duration of the license term under the proposed action, the overall impact of these restrictions is limited because of the much larger area of land use restrictions surrounding the DU Impact Area because of the presence of UXO {97 km^2 [24,000 ac]}, or the even larger restricted area of the JPG site north of the firing line {206-km^2 [51,000-ac]}. Therefore, the NRC staff concluded that potential incremental impacts to land use would be SMALL.

The direct and indirect impacts to land use under the no-action alternative are described in detail in Section 4.2.2. The BONWR would continue to sustain vegetation communities and wildlife habitat, in accordance with the USFWS management goals and objectives. No additional activities would occur that would alter existing land use, and the Army would have made provisions for continued implementation and maintenance of legally enforceable institutional controls and access restrictions over the site. Therefore, the NRC staff concluded that the impacts to land use in the 20-year analysis timeframe from the continuation of NRC Source Material License SUB–1435 under the no-action alternative would be SMALL.

Past, present, and reasonably foreseeable future actions exist in the geographic region of the proposed action (Section 5.1) that contribute to cumulative impacts on land use, including: (i) the continued predominance of agricultural activities in the region surrounding JPG (Section 5.1.2); (ii) management actions for BONWR (Section 5.1.1), including access for recreational hunting, fishing, collecting, and wildlife observation; and (iii) JPG land access restrictions (Section 5.1.1). All of these actions are currently in place, as described in Section 3.2, and are expected to continue into the reasonably foreseeable future. These actions would not result in changes to land use impacts from those described in the baseline conditions (i.e., controlled public access to the entire range area north of the firing line with access limitations and restrictions for specific areas). The NRC staff concludes that the impact from these baseline actions is noticeable but not destabilizing (MODERATE), because the land use restrictions have been in place for a sufficiently long period of time for the region to adapt to their presence.

In conclusion, the cumulative impacts on land use are the incremental impacts from the proposed action when added to the aggregate impacts of other past, present, and reasonably foreseeable future actions. As described in Section 4.2.1, the incremental impact from the proposed action on land use would be SMALL. In addition, the NRC staff identified past, present, and reasonably foreseeable future actions in the geographic area of interest that could contribute MODERATE impacts to land use cumulative impacts. Therefore, the cumulative impacts, which are the incremental impacts from the proposed action when added to other past, present, and reasonably foreseeable future actions, such as agricultural activities in the region surrounding JPG, management of BONWR, and JPG land access restrictions, are MODERATE. Additionally, the NRC staff determined that the cumulative impacts would remain MODERATE, whether or not the proposed action occurs.

Furthermore, because the direct and indirect impacts to land use would be the same for the no-action alternative and for the proposed action, and the applicable past, present, and reasonably foreseeable future actions also would be the same, the cumulative impacts for the no-action alternatives would be MODERATE, as determined in the preceding impact analysis for the proposed action.

5.2.2 Geology and Soils

This section evaluates the direct and indirect environmental effects of the proposed action and the no-action alternative on geology and soils (incremental impacts) when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. The geographic area considered in the cumulative analysis includes the geology and soils of the DU Impact Area and vicinity at JPG where DU penetrators and UXO rounds may occur. As discussed in Sections 1.4.2.2 and 4.3, no known mineral deposits or petroleum resources are present within the JPG site and vicinity, and the JPG site is situated in an area with historically low seismic potential. Consequently, the NRC staff has identified no cumulative impacts to geologic resources, and this section focuses on cumulative impacts to soils.

The direct and indirect environmental impacts on soils from the proposed action are described in detail in Section 4.3.1. The primary impact to soils under the proposed action is potential contamination from the gradual degradation of DU penetrators. There are no planned activities that would directly or indirectly disturb the soil resource and promote soil loss. The analysis in Section 4.3.1 characterized the potential environmental impacts to soils as SMALL, based on the lack of soil disturbance and the limited potential for DU contaminant migration in soils within the 20-year timeframe of this analysis. The potential environmental impacts from the no-action alternative are similar to those expected under the proposed action during the time period of analysis (20 years), as stated in Section 4.3.1. Under both alternatives, minimal soil disturbance would occur and the DU would remain in place, resulting in SMALL impacts.

Past, present, and reasonably foreseeable future actions exist in the geographic region of the proposed action (Section 5.1) that could contribute to cumulative environmental impacts on soils. These actions include the continued presence of UXO from past Army munitions testing at JPG, including in the DU Impact Area, and continued controlled burning as part of the USFWS management program of BONWR.

Regarding UXO, as described in Section 3.7.3, the Army has not yet begun the Military Munitions Response Program (MMRP) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process that would eventually lead to a remedial action decision on the area north of the firing line that includes the DU Impact Area. Until a remedial action decision is made, the final status of JPG with regard to residual chemical hazards remains uncertain; however, based on the high cost and hazards associated with removal of UXO, the analysis of potential cumulative impacts in this EA assumes UXO would be left in place for an indeterminate period. The Army previously evaluated the potential impacts of munitions constituents measured in soils at JPG on public and occupational health and stated that the risks are low (see Section 3.7.3) (U.S. Army, 2003b). The NRC staff reviewed and verified this analysis and has determined that its conclusions are reasonable. Additionally, as described in Section 3.7.3, the greatest overall inventory of munitions constituents is contained within intact UXO casings that would need to be perforated by corrosion over a period of hundreds to thousands of years before constituents could be released to the soil. Based on the preceding analysis of existing information, the NRC staff concludes that the impacts to soils from UXO at JPG over the timeframe of analysis (20 years) would be negligible.

The continued controlled burning, as part of the USFWS management program of the BONWR, is not likely to present a detrimental impact to soils. Controlled burns would be conducted to limit temperature extremes that would adversely affect soil properties (USFWS, 2006).

Furthermore, controlled burning is not expected to expose large areas of soil that would then be subject to potential wind or water erosion (U.S. Army, 2013a).

In conclusion, the cumulative environmental impacts on soils are the incremental impacts from the proposed action when added to the aggregate impacts of other past, present, and reasonably foreseeable future actions. As described in Section 4.3.1, the incremental impacts from the proposed action on soils would be SMALL, based on the lack of soil disturbance and the limited potential for DU contaminant migration in soils over the time period of analysis (20 years). In addition, past, present, and reasonably foreseeable future actions, such as the continued presence of UXO and continued controlled burning, take place in the geographic area of interest but would contribute minor cumulative impacts to soils. Therefore, the cumulative impacts, which are the incremental impacts from the proposed action when added to other past, present, and reasonably foreseeable future actions, such as the continued presence of UXO and controlled burns, would be SMALL.

Additionally, because the direct and indirect environmental impacts to soils would be the same for the proposed action and the no-action alternative during the analysis time period (20 years), and the applicable past, present, and reasonably foreseeable future actions also would be the same for each alternative, the cumulative impacts for the no-action alternative would be SMALL, as determined in the preceding impact analysis for the proposed action.

5.2.3 Water Resources

This section evaluates the direct and indirect effects of the proposed action and no-action alternative on water resources, surface water, and groundwater, when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. The geographic area considered in the cumulative water resource analysis includes JPG and watersheds of Big Creek and Middle Fork Creek, upstream and downstream of JPG.

The direct and indirect impacts on water resources from the proposed action are described in detail in Section 4.4. The impacts to water resources under the proposed action include (i) the potential for contamination of groundwater beneath and in the vicinity of the DU Impact Area by dissolved uranium, (ii) contamination of surface water within and downstream of the DU Impact Area by dissolved uranium and uranium adsorbed onto suspended sediment, and (iii) contamination of the bed sediment in Big Creek and Middle Fork Creek within and downstream of the DU Impact Area. The NRC staff characterized the significance of potential impacts to groundwater as SMALL, because impacts have not been identified in 30 years of monitoring. Although DU has been detected in surface water, the levels have been below EPA Maximum Contaminant Levels, the water in Big Creek downstream from the JPG site is not and likely would not be used as a primary source of drinking water, and there is significant dilution of surface water from the watershed of Big Creek and Middle Fork Creek upstream and downstream of the DU Impact Area. Based on the Army’s estimated corrosion rate of DU penetrators and site characteristics, the NRC staff expects the conditions leading to the currently low levels of surface water contamination would not change significantly over the analysis time period of 20 years. Therefore, the overall impact to surface water quality due to dissolved uranium or uranium adsorbed onto suspended sediment would be local and continue to be SMALL.

The potential impacts to water resources under the no-action alternative during the 20-year time period of analysis would be the same as under the proposed action (SMALL), because the physical conditions of the DU and the environment would be the same.

Past, present, and reasonably foreseeable future actions in the geographic region of the proposed action (Section 5.1) that could contribute to cumulative impacts on surface water include (i) the continued presence of UXO in the DU Impact Area and JPG in general, (ii) continued agricultural land use upstream and downstream of the DU Impact Area, and (iii) continued use of onsite septic systems by residents upstream and downstream of the DU Impact Area. The continued presence of UXO in the DU Impact Area and eventual release of hazardous constituents from the UXO to the environment could contribute to impacts to groundwater in the vicinity of the DU Impact Area and throughout JPG.

With respect to the cumulative impacts from UXO, releases of hazardous constituents from UXO may have occurred in the past due to partial explosions and cracked canisters and could continue or increase for an indefinite period due to corrosion of the canisters. However, the NRC staff expects that corrosion-related releases would occur well beyond the time period of analysis (20 years), based primarily on the Army's estimated corrosion rate of UXO shell casings (hundreds to thousands of years) (U.S. Army, 2013a).

Drainage from agricultural land may have impacted surface water quality due to the presence of nitrate from fertilizer use and may continue to do so into the foreseeable future (Section 3.4.1.4). The results of surface water monitoring conducted by the Army (U.S. Army, 2013a, Appendix F) indicate the nitrate concentration was consistently below the EPA maximum contaminant level (MCL) of 10 milligrams per liter (mg/L) [10 parts per million (ppm)], despite the presence of extensive agricultural activity in the watersheds of Big Creek upstream of JPG. Assuming fertilizer use does not increase in the future, the additive effect of agricultural use of fertilizers to the potential impacts from the proposed action would be minor.

Big Creek and Middle Fork Creek are listed by the Indiana Department of Environmental Management (IDEM) as impaired streams due to elevated Escherichia coli (E. coli) bacteria (see Table 3-1). Sources of E. coli in natural waters include runoff from livestock areas and sewage effluent, possibly from domestic septic tanks in the case of Big Creek and Middle Fork Creek. As discussed in Section 5.1.2, the current patterns of land use around JPG are expected to remain stable. Future residential development, at least in Jennings County, would occur in areas with municipal water and sewage. Thus, the NRC staff does not expect an increase in livestock or the number of onsite septic systems, and the additive effect of E. coli contamination to the impacts from the proposed action would be no greater than current effects.

In conclusion, the cumulative impacts on water resources are the incremental impacts from the proposed action when added to the aggregate impacts of other past, present, and reasonably foreseeable future actions. As described in Section 4.4, the incremental impacts from the proposed action on surface water and groundwater would be SMALL. In addition, past, present, and reasonably foreseeable future actions take place in the geographic area of interest that could contribute to the cumulative impacts to water resources. The cumulative impacts, which are the incremental impacts from the proposed action when added to other past, present, and reasonably foreseeable future actions, such as continued presence of UXO, agricultural land use, and the presence of onsite septic systems, would be SMALL.

Additionally, because the direct and indirect impacts to water resources would be the same for the no-action alternative as for the proposed action, and the applicable past, present, and reasonably foreseeable future actions also would be the same, the cumulative impacts for the no-action alternative would be SMALL, as determined in the preceding impact analysis for the proposed action.

5.2.4 Ecology

This section evaluates the direct and indirect effects of the proposed action and no-action alternative on ecological resources when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. The geographic area considered in the cumulative impacts ecological resources analysis includes habitats and species (both plants and animals) at JPG and BONWR and adjacent to JPG and BONWR that are closely interconnected by the movement or migration patterns of certain species.

The direct and indirect impacts on ecological resources from the proposed action are described in detail in Section 4.5.1. The NRC staff does not expect potential impacts to vegetation and wildlife from the proposed action, because no activities are planned that would affect vegetation or wildlife, in addition to the disturbances currently occurring under NRC Source Material License SUB–1435, such as minimal human disturbances from continued implementation of institutional controls and controlled burns. The NRC staff characterized the significance of potential impacts to terrestrial and aquatic vegetation and wildlife from the proposed action as SMALL. The NRC staff also determined that the proposed action would have no effect on Federal- or State-listed species, because no activities are planned that would disturb or harm habitat on which listed species depend.

The direct and indirect impacts to terrestrial and aquatic vegetation and wildlife under the no-action alternative are described in detail in Section 4.5.2. The potential incremental impacts to ecological resources under the no-action alternative during the time period of analysis (20 years) would be the same as under the proposed action and would be SMALL, because there would be no land disturbance from the proposed action beyond those disturbances that currently occur from activities associated with the existing NRC Source Material License SUB–1435 that could impact either vegetation or wildlife populations.

Past, present, and reasonably foreseeable future actions exist in the geographic region of the proposed action (Section 5.1) that could contribute to cumulative impacts on terrestrial and aquatic vegetation and wildlife, including the continued presence of UXO in the DU Impact Area and JPG in general, the continued agricultural land use upstream of the DU Impact Area, increased flooding events, and the continued management of BONWR (prescribed burns, habitat management, hunting, fishing, and other recreational activities).

With respect to the potential ecological impacts of UXO, releases of munitions constituents from UXO have occurred in the past at low levels (see Section 3.7.3). This may be due to partial explosions and cracked canisters, and could continue, and possibly increase, in the future for an indefinite period due to corrosion of the canisters. However, as noted previously, corrosion of canisters leading to releases of munitions constituents is not likely to occur during the time period of analysis (20 years). If munitions constituents contained within UXO are released into the environment, there is a potential for plant and animal exposure to these materials. While a wide variety of munitions constituents have been used at JPG (see Section 3.7.5), a subset of these constituents presents the potential for toxic effects on ecological receptors, including plants and animals (EPA, 2005b). To support its previous decommissioning proposal, the Army conducted an analysis of previously measured environmental concentrations of munitions constituents at JPG, including within the DU Impact Area, and conservatively compared the results with risk-based ecological screening values (U.S. Army, 2015c). The ecological screening values were derived from scientific studies that determined environmental concentrations below which no ecological effects would be expected. The Army analysis evaluated concentrations of several munitions constituents, including explosive compounds and metals in environmental media, such as soils, surface water, and sediments. The Army analysis concluded that no cumulative effects concerns were identified regarding the effects of most munitions constituents and DU on ecological receptors; these conclusions were based on either the levels of measured constituents or their location. The Army analysis identified a potential concern regarding accumulated concentrations of arsenic, manganese, and DU in Big Creek sediments. The Army further evaluated this issue, taking into account that a prior USFWS assessment of actual biological conditions in the creek stated that the conditions are indicative of high quality habitat and water (USFWS, 2008). The NRC staff reviewed and verified the USFWS assessment and has determined that its conclusions are reasonable. Considering the preceding analysis, the NRC staff concludes that the additive impacts of releases from the UXO would likely not be detectable or noticeably alter wildlife populations or habitat, based on the low levels of most munitions constituent measurements, the existing high quality of the habitat, the dispersed spatial distribution of UXO, and the NRC staff's expectation that concentrations of munitions constituents in the environment at JPG at locations where DU also exists would remain at or below current levels, because of the continued containment provided by UXO canisters over the time period of analysis.

Drainage from agricultural land upstream from the DU Impact Area may impact surface water due to the presence of nitrate from fertilizer use, and this impact may continue into the foreseeable future (U.S. Army, 2013a). The buildup of bacteria and fertilizer chemicals from farm runoff may potentially impact the water at JPG used by plants and animals and may affect habitats as a result of the nutrient load (e.g., changes to plant types and growth rates along stream banks). Current conditions indicate that the impacts from agricultural runoff are minor (see Section 5.2.3) and unlikely to change significantly over the time period of analysis.

The USFWS BONWR management activities (prescribed burns, habitat management, hunting, fishing, and other recreational activities) would have overlapping impacts on ecological resources in the geographic area considered in this cumulative analysis. The USFWS is in the process of developing a final Comprehensive Conservation Plan (CCP) (78 FR 3909) but has not yet issued the plan for public review. The CCP would provide BONWR managers with a 15-year strategy, including sound principles of fish and wildlife management, conservation, legal mandates, and service policies. In addition, the CCP would identify recreational opportunities available to the public, including opportunities for hunting, fishing, wildlife observation and photography, and environmental education and interpretation (78 FR 3909). USFWS is aware of the development of this EA and the Army's proposed action. NRC staff concludes that the USFWS would continue to manage BONWR in such a manner as to sustain vegetation communities and wildlife habitat, in accordance with the USFWS management goals and objectives. Therefore, the NRC staff expects that adverse impacts from BONWR management activities would be minor, and beneficial impacts would be noticeable.

In conclusion, the cumulative impacts on ecological resources are the incremental impacts from the proposed action when added to the aggregate impacts of other past, present, and reasonably foreseeable future actions. As described in Section 4.5, the incremental impacts from the proposed action on ecological resources, both terrestrial and aquatic resources, would be SMALL. In addition, past, present, and reasonably foreseeable future actions take place in the geographic area of interest that could contribute to cumulative impacts to ecological resources. The cumulative adverse impacts, which are the incremental impacts from the proposed action when added to other past, present, and reasonably foreseeable future actions, such as the presence of UXO, increased flooding events, agricultural runoff, and management of BONWR during the time period of analysis, would be SMALL. Additionally, MODERATE cumulative beneficial ecological impacts would occur from continued management of BONWR under the proposed action or the no-action alternative.

Because the direct and indirect impacts to ecological resources would be similar for the no-action alternative over the time period of analysis compared to the proposed action, and the applicable past, present, and reasonably foreseeable future actions would also be the same, the cumulative adverse impacts for the no-action alternative would be SMALL, as determined in the preceding impact analysis for the proposed action.

5.2.5 Air Quality

The cumulative impact analyses in this section address the potential impacts to air quality from nonradiological air emissions of commonly regulated air pollutants referred to as non-greenhouse gases (Section 5.2.5.1). Additionally, this section also addresses the cumulative effects of greenhouse gas emissions on the global climate (Section 5.2.5.2), as well as the potential for climate change to affect any resource area impacts of the proposed action or the no-action alternative (EA Section 5.2.5.3).

5.2.5.1 Non-Greenhouse Gas

This section evaluates the direct and indirect effects of non-greenhouse gas emissions from the proposed action and no-action alternative on air quality when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. The geographic area considered in the cumulative air quality analysis, hereafter called the region of influence, includes the portions of the Southern Indiana Intrastate Air Quality Control Region located within an 80-km [50-mi] radius of JPG. The region of influence primarily covers the portions of the Air Quality Control Region east of Brown, Jackson, and Washington Counties (see Figure 1-1).

The direct and indirect impacts on air quality from the proposed action and no-action alternative are described in detail in Section 4.6. The proposed action would periodically generate low levels of air emissions within an attainment area with good existing air quality. Therefore, the NRC staff concluded that potential impacts to air quality as a result of the proposed action would be SMALL.

The potential impacts to air quality under the no-action alternative would be similar to impacts under the proposed action during the time period of analysis (20 years). The only distinction is that until site decommissioning is complete, the no-action alternative would generate a very minor amount of additional emissions from environmental monitoring activities, and these additional emissions would occur in the Madison Township air quality maintenance area. Although the no-action alternative would generate a slightly greater amount of pollutants than the proposed action, the difference in emission levels between these two alternatives is not appreciable. Overall, the impacts of the no-action alternative would be SMALL.

Past, present, and reasonably foreseeable future actions exist in the region of influence, including several of the actions identified in Section 5.1 that contribute to the cumulative impacts on air quality by generating emissions that increase the overall pollutant levels in the atmosphere. Table 3-4 identifies the types of sources responsible for generating the majority of the pollutants in the area. Electricity-generating units, such as the Clifty Creek coal fired power plant in Madison, generate about 86 percent of the particulate matter $PM_{2.5}$, 95 percent of the nitrogen oxides, and 99 percent of the sulfur dioxide within Jefferson County. Area sources generate around 70 percent of particulate matter PM_{10} in the region of influence. An example of an area source is the controlled burns conducted by the USFWS within BONWR. Around 80 percent of the carbon monoxide generated in the region of influence is attributed to on-road and non-road combustion emissions. Examples of non-road sources include construction equipment and agricultural machinery.

The effects of past and present activities on the air quality in the region of influence are represented in the National Ambient Air Quality Standards (NAAQS) compliance status. EPA evaluates the NAAQS compliance status of an area on an ongoing basis. As described in Section 3.6.2, EPA designates all of the area within the region of influence as in attainment for all pollutants, with one exception. Currently a maintenance area, Madison Township in Jefferson County was classified as a nonattainment area for the particulate matter $PM_{2.5}$ annual standard from 2005 to 2016 (70 FR 944 and 81 FR 62390). This previous classification was not associated with violations of NAAQS (i.e., high ambient pollutant concentrations) within Jefferson County but rather with the emission of a specific source located in Madison that EPA believed contributed to an NAAQS violation elsewhere.

The primary source for this analysis of impacts from reasonably foreseeable future actions is the report that IDEM prepared for EPA requesting the re-designation of the Madison Township nonattainment area (IDEM, 2011). This report estimated the 2025 emission levels for particulate matter $PM_{2.5}$, nitrogen oxides, and sulfur dioxide in Jefferson County. Table 5-1 presents these estimates and includes the same types of sources and actions considered earlier in this section for determining the NAAQS compliance status resulting from past and present activities. Overall, the trends in the county are for decreasing pollutant levels. Total emission levels are projected to decrease between 8 and 58 percent, depending on the pollutant. This trend holds true for the individual source types, with one exception: a 2 percent increase in nitrogen dioxide emissions is estimated for point sources. The NRC staff is not aware of any reason why the general trends for all of the NAAQS pollutants in the entire region of influence would be substantially different than the trends identified in Table 5-1 for the Jefferson County portion of the region of influence.

The region of influence contains no Class I areas (that is, specific areas identified for additional protection against deterioration in air quality, including visibility); therefore, the analyses do not include air quality issues associated with Class I areas. The nearest Class I area is Mammoth Cave National Park, located about 209 km [130 mi] south of JPG. Because of the low emission levels of the proposed action and distance from these areas, the NRC staff does not expect the impacts from the proposed action to overlap with impacts from other sources at this Class I location to an extent that warrants further consideration in this EA.

Table 5-1. Comparison of 2008 and 2025 Projected Emission Estimates for Jefferson County

Pollutant	Source					
	On-Road	Non-Road	Area	Electric Generating Unit*	Point	Total
Nitrogen Dioxide	73% decrease	63% decrease	3% decrease	38% decrease	2% increase	38% decrease
Particulate Matter $PM_{2.5}$	76% decrease	64% decrease	6% decrease	0%	30% decrease	8% decrease
Sulfur Dioxide	4% decrease	99% decrease	5% decrease	58% decrease	0%	58% decrease

Source: Appendix E of IDEM, 2011
*An electric generating unit (i.e., a power plant) is one specific type of point source.

The NRC staff concludes that the impact from past, present, and reasonably foreseeable future actions in the region of influence have noticeably altered but not destabilized important attributes of the resource. The NAAQS status with the region of influence indicates overall good air quality. Based on the predicted pollutant level trends for Jefferson County, the region of influence should experience similar or reduced ambient pollutant levels in the future, relative to current levels.

In conclusion, the cumulative impacts on air quality from non-greenhouse gases are the incremental impacts from the proposed action when added to the aggregate impacts of other past, present, and reasonably foreseeable future actions. As described in Section 4.6.1, the incremental impacts from the proposed action on air quality would be SMALL. In fact, the proposed action would slightly reduce the amount of JPG emissions when compared to the current levels emitted from the site. In addition, past, present, and reasonably foreseeable future actions contribute to the cumulative impacts on air quality by generating emissions that increase the overall pollutant levels in the atmosphere. The cumulative impacts, which are the incremental impacts from the proposed action, when added to other past, present, and reasonably foreseeable future actions, would be MODERATE.

The magnitude of the direct and indirect impacts to air quality from non-greenhouse gases for the no-action alternative would be SMALL. The no-action alternative would generate the same or lower annual emissions during the time period of analysis (20 years) as currently experienced for NRC-licensed activities at the site. Emissions generated in the maintenance area are minimal, and the air quality within the maintenance area is considered good. Therefore, based on the preceding cumulative impact analysis for the proposed action, the NRC staff concludes the cumulative impacts from the no-action alternative would also be MODERATE.

5.2.5.2 Contribution to Atmospheric Greenhouse Gas Levels

This section evaluates the contribution of carbon dioxide from the proposed action and no-action alternative to atmospheric greenhouse gas levels.

The proposed action would generate low levels of greenhouse gases relative to other sources. The NRC-licensed activities would generate an estimated 509 metric tons [560 short tons] of carbon dioxide (see Table 4-1). The EPA established thresholds for greenhouse gas emissions that define whether sources are subject to EPA air permitting (EPA, 2012b). For new sources, the threshold is 90,718 metric tons [100,000 short tons] of carbon dioxide equivalents per year, and for modified existing sources, the threshold is 68,039 metric tons [75,000 short tons] of carbon dioxide equivalents per year. Because emission estimates are well below the EPA thresholds, the NRC staff concludes that the proposed action would generate low levels of greenhouse gases relative to other sources and would have a SMALL impact on air quality in terms of greenhouse gas emissions.

The no-action alternative would also generate low levels of greenhouse gases, also below the EPA threshold, relative to other sources. The NRC staff concludes that the no-action alternative would not be considered a large emitter or source of greenhouse gases and would have a SMALL impact on air quality in terms of greenhouse gas emissions.

5.2.5.3 Potential Effect of Climate Change on the Two Alternatives

The NRC acknowledges that climate change may have impacts across a wide variety of resource areas, including air, water, ecological, and human health. These potential impacts are described in U.S. Global Change Research Program [USGCRP (2014)]. However, this section of the EA focuses on interactions between climate change impacts and the proposed action and comparing the resilience of the proposed action and no-action alternative to climate change impacts.

During the time period of analysis (20 years) under both the proposed action and no-action alternative, the DU within the DU Impact Area would continue to slowly corrode and release DU corrosion products to soil and surface water. Although climate changes are projected on a longer timescale than the time period of analysis, available information provided by the USGCRP indicates a potential for increased frequency and intensity of storms in the future (USGCRP, 2014). Because the Army has indicated that most of the remaining DU penetrators in the DU Impact Area are below the ground surface, the soil overburden is expected to provide some level of protection against the potential effects of increased storm activity. Nevertheless, the NRC staff expects that increased rainfall could accelerate surface soil erosion that could expose more DU to oxidation and further facilitate DU corrosion and transport to surface water bodies, such as Big Creek.

Both the proposed action and no-action alternative include monitoring programs designed to detect an increase in DU material migrating to offsite locations. The monitoring programs would be sufficient to detect changes in the presence of DU in environmental media, such as Big Creek surface water and sediments, at levels that would trigger an elevated concern for public health and safety and, if necessary, corrective actions. Therefore, for the 20-year analysis timeframe, both the proposed action and no-action alternative would be unaffected by potential changes in climate resulting in more frequent and intense storm events that could affect the release and migration of DU to offsite locations.

5.2.6 Public and Occupational Health

This section evaluates the direct and indirect effects of the proposed action and no-action alternative on public and occupational health when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. The geographic area considered in the cumulative public and occupational health analysis includes the DU Impact Area and communities beyond the western boundary of the JPG site along Big Creek and in the general path of groundwater transport. Additionally, the assessment of the potential impacts from airborne transport of DU during controlled burns considers the potential impacts to any individuals within or beyond the JPG site boundary.

The direct and indirect impacts on public and occupational health from the proposed action and no-action alternative are described in detail in Sections 4.7.1 and 4.7.2, respectively. The impacts from the proposed action and no-action alternative would be the same because the DU would remain onsite indefinitely and the exposure scenarios and resulting estimated DU exposures and doses applicable to each alternative are the same. The NRC staff concluded that the Army’s continued possession of DU material in the DU Impact Area for the time period of analysis (20 years) is unlikely to present a public or worker health and safety concern, provided the Army maintains the required access restrictions and JPG institutional controls; continues to comply with license conditions, including sufficient monitoring to detect offsite migration of DU; and maintains safety practices, in accordance with the NRC-approved radiation safety plan. Therefore, the NRC staff concludes that the public and occupational health impacts of the proposed action and the no-action alternative for the time period of analysis (20 years) would be SMALL.

<u>Other Past, Present, and Reasonably Foreseeable Future Actions (Radiological)</u>

Past, present, and reasonably foreseeable future actions exist in the geographic region of the proposed action (Section 5.1) that could contribute to radiological cumulative impacts on public and occupational health, including controlled burns (Section 5.1.1) and climate change (Section 5.1.2). The potential effects of climate change on the release and transport of DU that could affect public and occupational health are evaluated in the preceding climate impact analysis (Section 5.2.5.3). That analysis concludes that monitoring programs would aid in the detection of changes in migrating DU concentrations, allowing early detection and corrective action, if necessary.

Controlled burns were historically used by the Army during the operational period at JPG to limit the potential for wildfires and to keep operational areas clear. In 1998, the USFWS began controlled burns at JPG to maintain habitat (USFWS, 2006). Concerns about the potential for controlled burns to mobilize DU were raised during the NRC's scoping process for evaluating the Army's 2013 decommissioning proposal (NRC, 2015a). In 2007, the NRC staff evaluated this aspect of DU mobilization during a JPG licensing proceeding (i.e., the Army's request for a 5-year extension for submittal of its decommissioning plan to allow additional site characterization, in accordance with a proposed Army field sampling plan) (NRC, 2007). For the proposed 2013 decommissioning action, the Army concluded in the ER (U.S. Army, 2013a) that the risks associated with the mobilization of DU from controlled burns is negligible, based on the 2007 NRC licensing hearing on the 5-year extension (NRC, 2008) that considered the available supporting information and studies applicable to controlled burns at JPG.

The NRC staff evaluation in 2007 for the 5-year extension found the principal mechanism for human exposure to DU from controlled burns would be by transfer of DU in soil to plants and from plants to air during a controlled burn (NRC, 2007). These pathways and potential radiation doses were evaluated by NRC staff in 2007 by reviewing the available information and studies provided by the Army (SAIC, 2005). The information provided by the Army included (i) previous air monitoring results during a controlled burn at JPG (Abbott, 1988); (ii) a plume transport modeling analysis of DU from controlled burns conducted at Aberdeen Proving Ground, another range where DU penetrators were previously tested (Williams et al., 1998); (iii) a subsequent air monitoring study of DU from controlled burns at Aberdeen Proving Ground (GPC, 2001); and (iv) an evaluation of dose impacts from uranium released to air by a wildfire at the Los Alamos National Lab (Kraig et al., 2001). Based on its review of this information, the NRC staff concluded that the studies demonstrated that workers and the public were protected from radiological doses because of air dispersion and that the risk presented by the mobilization of DU from fires is extremely small (NRC, 2007). After hearing testimony on controlled burns from all parties, the NRC Atomic Safety and Licensing Board found the referenced studies indicated that the potential radiation dose to the public from the controlled burns at JPG was minimal and that air sampling at JPG was unnecessary during the site characterization period proposed at that time (NRC, 2008).

NRC staff also considered how the safety measures applied by the USFWS in managing the controlled burns at JPG provide additional confidence that public and worker exposures to concentrated smoke during controlled burns would be limited. Smoke management measures are emphasized in the USFWS Fire Management Plan (USFWS, 2006) and include (i) verifying meteorological conditions are favorable for plume rise, plume dispersion, and direction of plume travel prior to starting a burn; (ii) using test fires to verify smoke dispersion conditions; (iii) verifying minimum wind speed and plume mixing height conditions are met before starting a burn; and (iv) burning small parcels of land at a time. Additionally, USFWS has stated that UXO hazards limit the proximity of staff to burns and that fire personnel leave the area following ignition and only return on a periodic basis for monitoring the burn (USFWS, 2006). The NRC staff note that the USFWS smoke management and UXO avoidance measures would limit worker and public exposures to smoke, and therefore also would limit associated exposures to any DU that may be mobilized to air during burns from the combustion of contaminated vegetation.

Based on the preceding information and studies, including the previous NRC staff review of DU risks from controlled burns at JPG and the safety measures applied by the USFWS in managing controlled burns, the NRC staff concludes that the potential radiological impacts to workers and the public from similar controlled burns would be SMALL. Additionally, the NRC staff considered other potential mechanisms of exposure, such as the potential for fire to enhance the breakdown and mobilization of DU by fire (NRC, 2015a) but considered these other scenarios unlikely, because most DU penetrators are resting below the surface and most controlled burns are of low intensity and temperature, as described by the USFWS (2006). The Army has explained that a penetrator requires a temperature of 700 to 1,000 °C [1,292 to 1,892 °F] to ignite (SAIC, 2005). USFWS stated JPG controlled burns usually have limited effects on the surface litter and rarely transfer significant heat for an extended time (USFWS, 2006).

Other Past, Present, and Reasonably Foreseeable Future Actions (Nonradiological)

Past, present, and reasonably foreseeable future actions (Section 5.1) exist in the geographic region of the proposed action that also could contribute to nonradiological cumulative impacts on public and occupational health, including the presence of UXO (Section 5.1.1), and the use of controlled burns (Section 5.1.1).

Regarding UXO, as described in Section 3.7.3, the Army has not yet begun the MMRP CERCLA process that would eventually lead to a remedial action decision on the area north of the firing line that includes the DU Impact Area. Until a remedial action decision is made, the final status of these areas with regard to residual chemical hazards remains uncertain; however, based on the high cost and hazards associated with removal of UXO, this analysis of potential cumulative impacts assumes UXO would be left in place for an indefinite period. The Army previously evaluated the impacts of measured concentrations of munitions constituents at JPG on public and occupational health and concluded the risks were low (see Section 3.7.3) (U.S. Army, 2003). Additionally, as described in Section 3.7.3, the greatest overall inventory of munitions constituents is contained within intact UXO casings that would need to be perforated by corrosion over a period of hundreds to thousands of years before constituents could be released to the environment. The NRC staff expects that this containment would provide resiliency against the effects of climate change, including the increased frequency and intensity of storm events. Based on the preceding analysis of available information, the NRC staff concludes that the nonradiological impacts to public and occupational health from UXO at JPG over the timeframe of analysis (20 years) would be negligible.

The potential nonradiological impacts to public and occupational health from controlled burns include the toxicological effects from exposure to DU that may be mobilized during the burns. The studies that were considered in the 2007 radiological impact analysis of controlled burns also included comparisons with uranium toxicity thresholds and found that measured or estimated air concentrations were well below levels of toxicological concern (Williams et al., 1998; GPC, 2001; Kraig et al., 2001). Additionally, as previously described in the preceding radiological impact analysis, the safety measures applied by the USFWS in managing the controlled burns at JPG provide additional confidence that public and worker exposures to concentrated smoke during controlled burns would be limited. Therefore, based on the information and studies reviewed in the preceding radiological impact analysis, the NRC staff concludes that the toxicological impacts of DU exposure from similar controlled burns in the future also would be SMALL.

Cumulative Impacts

In conclusion, the cumulative impacts on public and occupational health include the incremental impacts from the proposed action when added to the aggregate impacts of other past, present, and reasonably foreseeable future actions. As described in Section 4.7, the incremental impacts from the proposed action on public and occupational health would include SMALL radiological and nonradiological impacts. In addition, past, present, and reasonably foreseeable future actions take place in the geographic area of interest that could contribute to cumulative impacts to public and occupational health. The cumulative radiological and nonradiological impacts, which are the incremental impacts from the proposed action when added to the impacts of other past, present, and reasonably foreseeable future actions involving controlled burns and UXO during the time period of analysis (20 years), would be SMALL.

Additionally, because the direct and indirect impacts on public and occupational health are the same for the no-action alternative and the proposed action over the time period of analysis, and the applicable past, present, and reasonably foreseeable future actions also would be the same for the no-action alternative as for the proposed action, the cumulative impacts for the no-action alternative would therefore be SMALL, as determined in the preceding impact analysis for the proposed action.

5.2.7 Environmental Justice

This section evaluates the potential for direct and indirect disproportionately high and adverse human health or environmental effects of the proposed action on populations of concern when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. The geographic area considered in the cumulative environmental justice analysis includes the populations in the seven block groups that are within 6.4 km [4 mi] of the DU Impact Area boundary.

The direct and indirect impacts on minority and low-income populations from the proposed action are described in Section 4.8.1. As stated in Section 3.8.1, none of the census blocks within 6.4 km [4 mi] of the DU Impact Area boundary meet either of the two criteria outlined in Appendix C of NUREG–1748 for identifying minority and low-income populations. Regardless, the NRC staff conservatively looked at other potentially unique characteristics that could result in a disproportionate impact on minority and low-income populations. Based on the minor impacts of the proposed action on several resources, primarily due to the limited extent of DU migration from existing penetrator resting locations, the staff identified no means or pathways for minority or low-income populations to be disproportionately affected by the proposed action (see Section 3.8.4). Moreover, the NRC staff does not expect adverse health effects to any populations, including minority and low-income populations, under the proposed action, as summarized in Section 4.8.4. This is because the Army would maintain current access restrictions and institutional controls (see Section 2.1.1); continue to comply with license conditions, including sufficient monitoring to detect offsite migration of DU (see Section 2.1.2); and maintain safety practices, in accordance with the NRC-approved radiation safety plan (see Section 4.7.1). The NRC staff concluded there would be no high and adverse impacts to the general population. Accordingly, the incremental direct and indirect impacts to any group, including minority and low-income populations, would be SMALL.

The direct and indirect impacts on minority or low-income populations under the no-action alternative would be the same as impacts under the proposed action, because the general population, including minority or low-income populations, would not be affected any differently by the no-action alternative during the time period of analysis (20 years).

Past, present, and reasonably foreseeable future actions exist in the geographic region of the proposed action (Section 5.1) that could potentially contribute to cumulative disproportionately high and adverse human health or environmental effects. The presence of UXO and land use restrictions associated with the JPG facility and the management of BONWR all occur within 6.4 km [4 mi] of the DU Impact Area boundary, and these actions also overlap in time.

The NRC staff expects that institutional controls would protect the public from the explosive hazards of UXO and UXO constituents would be released slowly into the environment, and although environmental concentrations are likely to increase in the future (see Section 5.2.6), they would not present a safety concern over the time period of analysis (20 years). Potential impacts on any populations, including minority and low-income populations, from the presence of UXO would be unlikely during the time period of analysis, because intact UXO casings must corrode over a period estimated by the Army to be hundreds to thousands of years before the munitions constituents could be released into the environment.

Regarding the restricted use of large areas within BONWR and managed activities (e.g., INANG training areas, hunting area), potential impacts would mostly consist of limiting the use of public lands and temporary noise impacts from training exercises and from implementing institutional controls. All population groups, including minority and low-income populations, are restricted from entering restricted areas and are equally exposed to the UXO explosive hazards that exist within the public access areas. Other BONWR management activities, such as prescribed burns, may contribute visual, noise, and air quality impacts that extend beyond the larger JPG facility boundary; however, these types of impacts are not expected to overlap or accumulate significantly with the SMALL impacts expected on these resources from the proposed action.

In conclusion, the cumulative environmental justice impacts are the incremental impacts from the proposed action when added to the aggregate impacts of other past, present, and reasonably foreseeable future actions. As described in Section 4.8.1, considering none of the census blocks within 6.4 km [4 mi] of the DU Impact Area boundary meet either of NRC's two criteria for identifying minority and low-income populations and that no means or pathways were identified for any minority or low-income populations to be disproportionately affected by the proposed action, the NRC staff expects that no disproportionately high and adverse effects would occur from the incremental impacts associated with the proposed action or no-action alternative. Therefore, the cumulative impacts, which are the incremental impacts of the proposed action on minority and low-income populations when added to other past, present, and reasonably foreseeable future actions, such as the presence of UXO and land use restrictions associated with the JPG facility, and the management of BONWR, would not be disproportionate, and therefore would be SMALL.

Additionally, because the direct and indirect impacts on minority and low-income populations are the same for the no-action alternative and the proposed action over the time period of analysis, and the applicable past, present, and reasonably foreseeable future actions also would be the same for the no-action alternative as for the proposed action, the cumulative impacts for the no-action alternative would not be disproportionate and would therefore be SMALL, as determined in the preceding impact analysis for the proposed action.

6 AGENCIES AND ORGANIZATIONS CONSULTED

The U.S. Nuclear Regulatory Commission (NRC) staff consulted with other agencies regarding the proposed action, in accordance with NUREG–1748 (NRC, 2003). These consultations are intended to (i) ensure that the consultation requirements under Section 7 of the Endangered Species Act (ESA), P.L. 91-135, as amended, and under Section 106 of the National Historic Preservation Act (NHPA), P.L. 89-665, as amended are met; and (ii) provide the designated state liaison agency the opportunity to comment on the Environmental Assessment (EA).

6.1 Endangered Species Act Section 7 Consultation and Related Activities

The ESA was enacted to prevent the further decline of endangered and threatened species and to restore those species and their critical habitats. To comply with ESA Section 7 requirements, NRC staff consulted with the U.S. Fish and Wildlife Service (USFWS) Ecological Services Field Office in Bloomington, Indiana (Bloomington Ecological Services Field Office). In addition, in related activities, the NRC staff coordinated with the USFWS office that manages the Big Oaks National Wildlife Refuge (BONWR) at the Jefferson Proving Ground (JPG) site and the Indiana Department of Natural Resources (IDNR) Division of Nature Preserve (Natural Heritage Data Center) and Division of Fish and Wildlife. These consultation and coordination activities and their results are described below.

United States Fish and Wildlife Service

In developing the EA for the U.S. Department of the Army (Army's) proposed action to amend Source Material License SUB–1435 to possession-only for residual radioactive material in the depleted uranium (DU) Impact Area and request an exemption from the NRC's decommissioning timeliness requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) 40.42(d), NRC staff requested an official list of threatened and endangered species via the USFWS's Section 7 Technical Assistance Website (https://www.fws.gov/midwest/Endangered/section7/s7process/index.html). On February 12, 2018, NRC staff received an online letter response from the USFWS Bloomington Ecological Services Field Office listing the threatened and endangered species that may occur in the JPG area (USFWS, 2018). This list included the federally endangered Indiana bat (*Myotis sodalist*), sheepnose mussel (*Plethobasus cyphyus*), and running buffalo clover (*Trifolium stoloniferum*), and the federally threatened Northern long-eared bat (*M. septentrionalis*). The letter also stated that there are no critical habitats for the federally listed species in the JPG area. In response to a further NRC staff request for information on endangered and threatened species or critical habitat in the JPG area (email dated November 6, 2017), the USFWS Bloomington Ecological Services Field Office reiterated that JPG is within the range of the federally endangered Indiana bat, sheepnose mussel, and running buffalo clover and the federally threatened Northern long-eared bat (email dated November 7, 2017) (Reed, 2017). The USFWS email went on to state that the sheepnose mussel is limited to the Ohio River (indicating that it would not be present at JPG), and that running buffalo clover is not known to occur at JPG. The email also stated that the Indiana bat and Northern long-eared bat were captured at 12 sites within JPG during mist-net surveys conducted between 1992 and 2007. The email concluded that no critical habitat for any of the federally listed species is present in the JPG area (Reed, 2017). In a letter to the Bloomington Ecological Services Field Office dated November 14, 2017, NRC staff stated that the Army's proposed amendment and exemption for possession of DU at JPG would not require any demolition, construction, or land-disturbing activities and that the Army would continue to maintain institutional controls and land use restrictions to minimize exposure to the public and environment (NRC, 2017c). Consequently, the letter informed the Bloomington Ecological Services Field Office that the NRC staff had determined that the Army's proposed license amendment and exemption would not affect federally listed species or critical habitat, and no further consultation is required under Section 7 of the ESA (NRC, 2017c). In an email dated February 6, 2018, the Bloomington Ecological Services Field Office stated that they would not have any comments on the Army's proposed license amendment and exemption and confirmed that there is no need for formal consultation (Reed, 2018).

IDNR, Division of Nature Preserves (Indiana Natural Heritage Data Center)

NRC staff requested information on sensitive species and critical habitat in the JPG area from IDNR Division of Nature Preserves in an email dated February 6, 2018 (Clark, 2018). IDNR Division of Nature Preserves staff responded by email on February 12, 2018 with a list of endangered, threatened, and rare species observations within 1.6 kilometer (km) [1 mile (mi)] of JPG and BONWR (Clark, 2018). The species in this list are included in Appendix B (Federal and State Listed Species).

6.2 National Historic Preservation Act Section 106 Consultation

In accordance with 36 CFR 800.1(a), Section 106 of the NHPA requires Federal agencies to take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment on such undertakings. The circumstances under which the ACHP would comment on an undertaking or otherwise become involved in the Section 106 consultation process are described in 36 CFR 800.2(b). In implementing the Section 106 process, Federal agencies seek the views of consulting parties, which may include other Federal agencies, the State Historic Preservation Officer (SHPO), Native American Tribes, State and local agencies, the public, and the licensee. The goal of Section 106 consultation is to identify historic properties and seek ways to avoid, minimize, or mitigate any adverse effects on historic properties. As stated in 36 CFR 800.2(c)(1)(i), the role of the SHPO in the Section 106 process is to advise and assist Federal agencies in carrying out their 106 responsibilities and cooperate with such agencies, local governments and organizations, and individuals to ensure that historic properties are taken into consideration at all levels of planning and development.

In developing this EA, NRC staff initiated informal consultation under NHPA Section 106 with the Indiana SHPO and Native American Tribes. These Section 106 consultation efforts are described below.

Indiana State Historic Preservation Office

By letter dated October 24, 2017, the NRC staff notified the Indiana SHPO that the proposed action (i.e., the license amendment and exemption) is not a type of activity that has the potential to affect historic properties, and no further consultation is required under Section 106 of the NHPA (NRC, 2017d). The letter also informed the Indiana SHPO that the EA would include a discussion of the plans and agreements in place to protect any historic and cultural resources that may be identified on the JPG site.

In a letter to the NRC dated November 21, 2017 (IDNR, 2017), the Deputy SHPO stated the Indiana SHPO staff's understanding that the Army's proposed amendment and exemption to Source Material License SUB–1435 involves no demolition, construction, or ground-disturbing activities and that management of the property in regards to cultural resources would follow the Integrated Cultural Resources Management Plan (ICRMP) for the JPG/Jefferson Range prepared by the Indiana Air National Guard (INANG) (INANG, 2011). The ICRMP serves as a long-term plan for management of cultural resources on the 4.2 square kilometers (km^2) [1,038 acres (ac)] north of the firing line that was leased from the Army to the U.S. Air Force (USAF) for use as an air-to-ground bombing range (see Section 1.1). The Indiana SHPO staff had no additional comments but stated that the NRC should include in the EA any photographs or information regarding how the DU was used historically.

Native American Tribes

In letters dated January 11, 2018 (NRC, 2018a) and January 18, 2018 (NRC, 2018b), the NRC staff invited 16 federally-recognized Native American Tribes identified as having past religious or cultural ties to the JPG area to participate as consulting parties in the NHPA Section 106 process. In its letters, the NRC staff requested assistance in identifying and evaluating historic properties that may be affected by the Army's proposed action. The Tribes contacted are:

- Citizen Potawatomi Nation, Oklahoma
- Delaware Nation, Oklahoma
- Forest County Potawatomi, Wisconsin
- Hannahville Indian Community, Michigan
- Kickapoo Tribe in Kansas
- Kickapoo Tribe of Oklahoma
- Kickapoo Traditional Tribe of Texas
- Miami Tribe of Oklahoma
- Ottawa Tribe of Oklahoma
- Peoria Tribe of Indians of Oklahoma
- Pokagon Band of Potawatomi, Michigan
- Prairie Band Potawatomi Nation, Kansas
- Shawnee Tribe, Oklahoma
- United Keetoowah Band of Cherokee Indians in Oklahoma
- Wyandotte Nation, Oklahoma
- Osage Nation

In an email dated November 21, 2017, Ms. Bernadette Thomas, Council Member of the Kickapoo Tribe in Kansas, requested that the NRC keep the Kickapoo Tribe informed (Kickapoo Tribe in Kansas, 2017). She also noted that the Kickapoo Tribe in Kansas was formerly part of one tribe along with the Kickapoo Tribes in Oklahoma and Texas.

In a letter dated January 29, 2018, Ms. Diane Hunter, Tribal Historic Preservation Officer for the Miami Tribe of Oklahoma, informed the NRC that the Miami Tribe had no objection to the Army's request for amendment and exemption to Source Material License SUB–1435 for possession of DU at JPG (Miami Tribe of Oklahoma, 2018). Ms. Hunter indicated that the JPG site is within the aboriginal homelands of the Miami Tribe and requested immediate consultation if any human remains or Native American cultural items under the Native American Graves Protection and Repatriation Act (NAGPRA) or archaeological resources are discovered as a result of undertakings associated with the Army's proposed license amendment and exemption.

In an email dated February 8, 2018, Ms. Kimberly Penrod, Director of Cultural Resources/ 106 Archives for the Delaware Nation, requested that the Delaware Nation be included as a consulting party for the Army's proposed action (Delaware Nation, 2018). Ms. Penrod asked that the NRC staff keep the Delaware Nation up to date on the progress of the Army's proposed license amendment request and exemption and that NRC staff contact the Delaware Nation immediately if cultural resources are discovered.

In a letter dated February 9, 2018, Mr. James Munkres, Archaeologist for the Osage Nation Historic Preservation Office, stated that the Osage Nation has a vital interest in protecting its historic and ancestral cultural resources (Osage Nation, 2018). In its letter, the Osage Nation requested a copy of the Draft EA of the Army's proposed license amendment request and exemption for review and comment.

On February 22, 2018, Ms. Tonya Tipton of the Shawnee Tribe submitted a tribal response form indicating that, at this time, the Tribe had no comment or concern with the Army's proposed license amendment request and exemption (Shawnee Tribe, 2018). In its response, the Tribe requested to be updated regarding the proposed project (Shawnee Tribe, 2018).

No other responses were received from the Tribes.

7 CONCLUSION

Based on its review of the proposed action, in accordance with the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51, the U.S. Nuclear Regulatory Commission (NRC) staff has determined that amending NRC Source Material License SUB–1435 from "possession-only for decommissioning" to "possession-only" and granting an exemption to the NRC's decommissioning timeliness requirements in 10 CFR 40.42(d) for a period of up to 20 years will not significantly affect the quality of the human environment. In its license amendment request, the Army is proposing to leave the licensed, depleted uranium (DU) onsite in the DU Impact Area. Institutional controls that the U.S. Department of the Army (Army) has established under the Memorandum of Agreement with the U.S. Fish and Wildlife Service and U.S. Air Force would remain in effect to maintain legally enforceable access controls and land use restrictions over areas of Jefferson Proving Ground (JPG), including the DU Impact Area. The impacts of the proposed action analyzed in this Environmental Assessment – including those related to physical protection and safeguarding of licensed materials – would be small for all environmental resource areas. Additionally, public and occupational radiological dose exposures are expected to be below 10 CFR Part 20 regulatory limits. Effluents leaving the DU Impact Area (i.e., surface water, sediments, and groundwater) would continue to be monitored to ensure compliance with regulatory limits for radiological and nonradiological constituents. Therefore, based on this preliminary assessment, in accordance with 10 CFR 51.31, the NRC staff has concluded that the proposed action does not warrant the preparation of an Environmental Impact Statement, and, pursuant to 10 CFR 51.32, a Finding of No Significant Impact is appropriate.

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APPENDIX A

RESOURCE AREAS ELIMINATED FROM DETAILED ANALYSIS

APPENDIX A

RESOURCE AREAS ELIMINATED FROM DETAILED ANALYSIS

The U.S. Nuclear Regulatory Commission (NRC) staff has determined that detailed analyses associated with transportation, minerals, noise, historic and cultural resources, visual and scenic resources, socioeconomics, and waste management are not necessary, because these resource areas would not be affected by the proposed action or the no-action alternative [see Section 1.6 of this Environmental Assessment (EA)]. The reasons for eliminating these issues from detailed study are discussed next.

Transportation

Due to the rural location, the areas surrounding Jefferson Proving Ground (JPG) do not have any significant traffic congestion or access problems. No physical changes to transportation routes within or surrounding JPG are planned under the proposed action or the no-action alternative evaluated in this EA. Additionally, no significant traffic-generating transportation activities, such as workforce commuting, supply shipments, or waste shipments, are proposed or included in the evaluated alternatives. Therefore, no impacts to traffic patterns would be expected. Furthermore, under the alternatives considered for detailed analysis, the material currently in the depleted uranium (DU) Impact Area—which includes DU and unexploded ordinance (UXO)—would remain in place. Therefore, there would be no increased risks resulting from the transportation of radioactive or hazardous materials or other materials under the alternatives evaluated in detail.

Minerals

Under the proposed action and the no-action alternative evaluated in this EA, no activities are planned that would impact minerals or mineral extraction activities within or surrounding the DU Impact Area. None of the alternatives involve any drilling or other ground-disturbing activities within the DU Impact Area. Notwithstanding, no exploitable mineral deposits or petroleum resources exist within the JPG facility boundary. In addition, neither the proposed action nor the no-action alternative are expected to affect other resource areas, such as land use or transportation, in any ways that could impact mineral extraction activities in areas surrounding the JPG site.

Noise

Under the proposed action and the no-action alternative evaluated in this EA, no transportation, construction, demolition, or land-disturbing activities are planned that would generate noise within or surrounding the DU Impact Area. Minimal noise is generated from routine maintenance of roads and mowing and trimming to control vegetation in the DU Impact Area. These minor noise-generating activities would continue to occur as part of the proposed action and the no-action alternative (U.S. Army, 2013, 2000). Therefore, current baseline noise levels within and surrounding the DU Impact Area would not increase as a result of implementation of the proposed action or the no-action alternative.

Historic and Cultural Resources

Under the proposed action and the no-action alternative evaluated in this EA, no construction, demolition, land-disturbing, or other activities are planned that could impact cultural or historic resources within or surrounding the DU Impact Area. In addition, agreements and management plans are in place to identify and protect cultural and historic resources at JPG. Agreements include a 1992 Programmatic Agreement (PA) and 1992 Memorandum of Agreement (MOA) among the U.S. Department of the Army (Army), Advisory Council on Historic Preservation (ACHP), and Indiana State Historic Preservation Officer (SHPO) (Mbutu et al., 1996, Appendices L and M, respectively). The 1992 MOA required the Army to develop and implement a Cultural Resources Management Plan (CRMP) to meet its legal responsibilities for identification, evaluation, and treatment of historic properties at JPG (Mbutu et al., 1996). In 2011, the Indiana Air National Guard (INANG) prepared an Integrated Cultural Resources Management Plan (ICRMP) for the JPG/Jefferson Range (INANG, 2011). The ICRMP serves as a long-term plan for management of cultural resources on the 4.2 square kilometers (km^2) [1,038 acres (ac)] north of the firing line that was leased from the Army to the U.S. Air Force (USAF) for use as an air-to-ground practice bombing range (see Section 1.1).

As part of the CRMP for JPG (Mbutu et al., 1996), an inventory of archaeological cultural resources at JPG was compiled, based on previous archaeological research and surveys (i.e., archaeological research and surveys conducted prior to 1996). No archaeological sites or historic buildings or structures eligible for listing on the National Register of Historic Places (NRHP) were identified within the DU Impact Area (Mbutu et al., 1996). The presence of UXO shells and low-level radiation from DU penetrators make the DU Impact Area too hazardous to permit further field surveys to inventory historic and cultural resources. Further, any historic and cultural resources that may be present within the DU Impact Area are likely to be in poor condition because of the extensive land disturbance from the high-energy explosions of the conventional munitions fired into the DU Impact Area (Mbutu et al., 1996).

Visual and Scenic Resources

Under the proposed action and the no-action alternative evaluated in this EA, no transportation, construction, demolition, or land-disturbing cleanup activities are planned that would result in impacts to visual and scenic resources within the DU Impact Area or surrounding areas. Smoke from periodic controlled burns conducted by the U.S. Fish and Wildlife Service (USFWS) in the Big Oaks National Wildlife Refuge (BONWR) (including in the DU Impact Area) results in short-term, temporary impacts to the visual landscape at JPG (U.S. Army, 2013); however, these impacts are independent of the proposed action and no-action alternative (i.e., implementation of either the proposed action or no-action alternative would not result in discontinuation of the periodic controlled burns). Therefore, no additional impacts to visual and scenic resources would result from implementation of either the proposed action or the no-action alternative evaluated in this EA.

Socioeconomics

The NRC staff reviewed the potential employment and income impacts of the proposed action and no-action alternative evaluated in this EA. The only change in direct costs associated with the proposed action would be reduction of activities associated with the Army's existing Environmental Radiation Monitoring Plan (ERMP) (U.S. Army, 2016). Activities associated with the Army's existing ERMP occur over a 2- to 3-week period only twice a year and employ only a few workers who are contractors to the Army coming from locations outside the JPG area (U.S. Army, 2015). Therefore, ERMP continuation in some reduced form would have no significant employment or income impacts in the region. Also, no taxes or tax structure, populations or population distribution, or community or land use characteristics would change as a result of the proposed action no-action alternative. No changes to community services (e.g., transportation, housing, health care, schools, and utilities) within or surrounding JPG are planned. Therefore, no impacts to socioeconomics are expected by implementation of the proposed action that would differ from the no-action alternative.

Waste Management

Under the proposed action and the no-action alternative evaluated in this EA, the DU and UXO would remain in place within the DU Impact Area and would not be removed. Therefore, no radioactive or hazardous wastes would be generated. Also, no waste materials would be deposited or disposed of within the DU Impact Area.

The maintenance of the JPG site fence is a JPG site-wide activity that is necessary to support the proposed action and the no-action alternative. This infrequent activity would be expected to generate relatively small quantities of common waste materials (e.g., construction debris, municipal trash, used oil from vehicles, batteries), the disposal of which would not be expected to result in significant impacts to waste management resources. Therefore, no impacts to waste management are expected by implementation of the proposed action that would differ from the no-action alternative.

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APPENDIX B

FEDERAL AND STATE LISTED SPECIES

Table B-1. Federally and State Listed Species Documented at or within 1.6 km [1 mi] of Big Oaks National Wildlife Refuge and Jefferson Proving Ground, and Other Species That Could Occur at Big Oaks National Wildlife Refuge/Jefferson Proving Ground, Including the DU Impact Area

Species Common Name *Scientific Name*	**Status***	**General Habitat Type**
Mammals		
Gray bat† *Myotis grisescens*	FE, SE	Caves
Northern long-eared bat *Myotis septentrionalis*	FT	Caves, forest
Indiana Bat *Myotis sodalis*	FE, SE	Caves, forest
Smokey shrew† *Sorex fumeus*	SSC	Moist woods
Birds		
Sharp-shinned hawk *Accipiter striatus*	SSC	Mixed woodlands
Bachman's sparrow† *Aimophila aestivalis*	FC	Dry open woods
Wood duck *Aix sponsa*	FC	Palustrine and riverine wetlands, forests
Henslow's sparrow *Ammodramus henslowii*	FC, SE	Moist meadows and fields
Grasshopper sparrow *Ammodramus savannarum*	FC	Grasslands, oil fields
Blue-winged teal† *Anas discors*	FC	Palustrine wetlands, grasslands
American black duck *Anas rubripes*	FC	Lacustrine and palustrine wetland scrub
Great egret *Ardea alba*	SSC	Marshes
Short-eared owl *Asio flammeus*	FC, SE	Marshes, weedy fields
American bittern *Botaurus lentiginosus*	FC, SE	Marshes, wet meadows
Red-shouldered hawk *Buteo lineatus*	SSC	Moist, mixed woodlands
Broad-winged hawk *Buteo platypterus*	SSC	Woodlands
Northern harrier *Circus cyaneus*	SE	Wetlands, open fields
Marsh wren *Cistothorus palustris*	FC, SE	Marshes, swamps
Sedge wren *Cistothorus platensis*	FC, SE	Moist meadows
Yellow rail† *Coturnicops noveboracensis*	FC	Marshes, wet fields

Table B-1. Federally and State Listed Species Documented at or within 1.6 km [1 mi] of Big Oaks National Wildlife Refuge and Jefferson Proving Ground, and Other Species That Could Occur at Big Oaks National Wildlife Refuge/Jefferson Proving Ground, Including the DU Impact Area		
Species Common Name *Scientific Name*	**Status***	**General Habitat Type**
Cerulean warbler *Dendroica cerulea*	FC, SE	Swamps, bottomlands, mixed woodlands
Kirtland's warbler† *Dendroica kirtlandii*	FE, SE	Open woodlands, shrub, thickets
Bobolink *Dolichonyx oryzivorus*	FC	Weedy meadows, hayfields
Peregrine falcon† *Falco peregrinus*	FC, SSC	Palustrine, lacustrine, and riverine wetlands, grasslands
Sandhill crane *Grus canadensis*	FC, SSC	Marshes, grasslands
Worm-eating warbler *Helmitheros vermivorus*	FC, SSC	Mature forest
Bald eagle *Haliaeetus leucocephalsu*	FD, FC, SSC	Lacustrine and riverine wetlands, forests
Loggerhead shrike *Lanius ludovicianus*	FC, SE	Open or brushy areas
Least bittern† *Ixobrychus exilis*	FC, SE	Marshes, wet meadows
Black rail *Laterallus jamaicensis*	FC, SE	Marshes, wet meadows
Black-and-white warbler *Mniotilta varia*	SSC	Mixed mature woodlands
Black-crowned night-heron *Nycticorax nycticorax*	FC, SE	Moist woods, swamps
Osprey *Pandion haliaetus*	SE	Riverine and lacustrine wetlands
King rail† *Rallus elegans*	FC, SE	Swamps, marshes
Virginia rail *Rallus limicola*	SE	Marshes, wetlands
American woodcock *Scolopax minor*	FC, SSC	Moist woodland, thickets
Dickcissel *Spiza americana*	FC	Weedy meadows, prairies
Barn owl† *Tyto alba*	SE	Palustrine, lacustrine, and riverine wetlands, grasslands
Golden-winged warbler *Vermivora chrysoptera*	FC, SE	Shrub/scrub
Canada warbler *Wilsonia canadensis*	FC	Dense woodlands
Hooded warbler *Wilsonia citrina*	SSC	Moist mature woodlands

Table B-1. Federally and State Listed Species Documented at or within 1.6 km [1 mi] of Big Oaks National Wildlife Refuge and Jefferson Proving Ground, and Other Species That Could Occur at Big Oaks National Wildlife Refuge/Jefferson Proving Ground, Including the DU Impact Area		
Species Common Name *Scientific Name*	**Status***	**General Habitat Type**
Other Terrestrial Wildlife		
Kirtland's snake *Clonophis kirtlandii*	SE	Moist meadows, forests
Northern crawfish frog *Lithobates areolatus circulosus*	SE	Crawfish holes
Northern copperbelly water snake† *Nerodia erythrogaster neglecta*	FT, SE	Swamps, marshes
American burying beetle‡ *Nicrophorus americanus*	FE, SX	Forest, grassland, mixed woodland
Common mudpuppy *Nicrophorus maculosus*	SSC	Rivers, streams, ponds
Rough Greensnake† *Opheodrys aestivus*	SSC	Riparian
Aquatic Species		
Northeastern cave isopod *Caecidotea rotunda*	SR	Caves
Anomalous spring amphipod *Crangonyx anomalus*	ST	Spring-fed streams and caves
Indiana groundwater copepod (crustacean) *Diacoyclops indianensis*	SR	Subterranean groundwater habitats
Lewis' groundwater copepod (crustacean) *Diacyclops lewisi*	SE	Subterranean groundwater habitats
Salisa's groundwater copepod (crustacean) *Diacyclops salisae*	SE	Subterranean groundwater habitats
Fountain cave springtail *Pseudosinella fonsa*	ST	Caves
Salamander mussel *Simpsonaias ambigua*	FR, SSC	Medium to large rivers on mud and gravel bars
Springtail *Sminthurides hypogramme*	SWL	Caves
Weingartner's cave flatworm *Sphalloplana weingartneri*	SWL	Caves
Purple lilliput (mussel) *Toxolasma lividus*	FR, SSC	Impounded rivers, rocky and gravelly river bars
Little spectaclecase (mussel) *Villosa lienosa*	SSC	Sheltered areas in large rivers
Plants		
Yellow buckeye *Aesculus octandra*	SWL	Ravine forests

Table B-1. Federally and State Listed Species Documented at or within 1.6 km [1 mi] of Big Oaks National Wildlife Refuge and Jefferson Proving Ground, and Other Species That Could Occur at Big Oaks National Wildlife Refuge/Jefferson Proving Ground, Including the DU Impact Area

Species Common Name *Scientific Name*	**Status***	**General Habitat Type**
Clustered foxglove *Agalinis fasciculata*	SWL	Moist fields, young flatwoods
Silver bluestem *Andropogon ternarius*	SWL	Old fields, grassy barrens
Single-head pussytoes *Antennaria solitaria**	SWL	Woods, clearings
Wallrue spleenwort *Asplenium ruta-muraria*	SR	Limestone cliffs
Twining bartonia *Bartonia paniculata*	SWL	Open flatwoods
Sparse-lobe grape-fern *Botrychium biternatum*	SWL	Old fields
Blunt-lobe grape fern *Botrychium oneidense*	SWL	Mature flatwoods
Thicket sedge *Carex abscondita*	SWL	Moist forests, stream valleys
Louisiana sedge *Carex louisianica*	SWL	Floodplain forests
Pretty sedge *Carex woodii*	SWL	Moist woodlands
Spotted wintergreen *Chimaphila maculata*	SWL	Upland woods
Black bugbane *Cimicifuga racemosa*	SWL	Woods
Elliptical rushfoil *Crotonopsis elliptica*	SE	Eroded banks, bladed roadbanks
Crinkleroot *Dentaria diphylla*	SWL	Moist woods
Round-leaved boneset *Eupatorium rotundifolium*	SWL	Grassy fields, open flatwoods
Swamp sunflower *Helianthus angustifolius*	SE	Wet soils in open areas
Goldenseal *Hydrastis canadensis*	SWL	Moist ravine forests
Clasping St. John’s wort *Hypericum gymnanthum*	SE	Eroded areas
Ground juniper *Juniperus communis*	SR	Forests
Canada lily *Lilium canadense*	SR	Moist meadows, open woodlands
Ridged yellow flax *Linum striatum*	SWL	Flatwoods

Table B-1. Federally and State Listed Species Documented at or within 1.6 km [1 mi] of Big Oaks National Wildlife Refuge and Jefferson Proving Ground, and Other Species That Could Occur at Big Oaks National Wildlife Refuge/Jefferson Proving Ground, Including the DU Impact Area		
Species Common Name *Scientific Name*	**Status***	**General Habitat Type**
Northern bog clubmoss *Lycopodeiella inundata*	SE	Shallow ditches
Running pine *Lycopodium clavatum*	SWL	Regrowth flatwoods
Tree clubmoss *Lycopodium obscurum*	SR	Regrowth flatwoods
Climbing fern *Lygodium palmatum*	SE	Early successional flat woods
American pinesap *Monotropa hypopithes*	SWL	Woods
Thread-like naiad *Najas gracillima*	ST	Shallow waters
Small sundrops *Oenothera perennis*	SR	Meadows, fields
Illinois woodsorrel *Oxalis illinoensis*	SWL	Floodplain forests
American ginseng *Panax quinquefolium*	SWL	Rich woods
Dwarf ginseng *Panax trifolium*	SWL	Flatwoods, moist upland forests
Broom panic-grass *Panicum scoparium*	SE	Moist soil
Green fringed orchid *Platanthera lacera*	SWL	Wet, open fields, young flatwoods
Purple fringeless orchid *Platanthera peramoena*	SWL	Moist meadows, open swampy woods
Wolf bluegrass *Poa wolfii*	SR	Limestone boulders, moist woods
Maryland meadow beauty *Rhexia mariana var. mariana*	ST	Moist, acidic grasslands
Longbeak arrowhead *Sagittaria australis*	SR	Wetlands, flatwoods, stream banks
Carolina willow *Salix caroliniana*	SWL	Streams, exposed gravel bars
Weakstalk bulrush *Scirpus purshianus*	SR	Edge of water bodies
Fewflower nutrush *Scleria pauciflora*	SWL	Grassy fields
Lesser ladies'-tresses *Spiranthes ovalis*	SWL	Forests, floodplain forests
Little ladies'-tresses *Spiranthes tuberosa*	SWL	Eroded oil field, dry upland forests

Table B-1. Federally and State Listed Species Documented at or within 1.6 km [1 mi] of Big Oaks National Wildlife Refuge and Jefferson Proving Ground, and Other Species That Could Occur at Big Oaks National Wildlife Refuge/Jefferson Proving Ground, Including the DU Impact Area		
Species Common Name *Scientific Name*	**Status***	**General Habitat Type**
Grassleaf ladies'-tresses *Spiranthes vernalis*	SWL	Marshes, wet open areas
Slick seed wild-bean *Strophostyles leiosperma*	ST	Eroded areas
Running buffalo clover† *Trifolium stoloniferum*	FE, SE	Open woodlands
False hellebore *Veratrum woodii*	SWL	Forested ravines and narrow stream valleys
Sweet white violet *Viola blanda*	SWL	Mature flatwoods
Barren strawberry *Waldsteinia fragarioides*	SR	Woods, clearings
Netted chainfern *Woodwardia areolata*	SR	Regrowth flatwoods

Sources: Clark, 2018; Hedge et al., 1999, 1993; IDNR, 2017, 2016; USFWS, 2018, 2017, 2006.
*Status designations: FD = Federal De-listed; FE = Federal Endangered; FT = Federal Threatened; FC = Federal Concern; FR = Under Federal Review; SE = State Endangered; ST = State Threatened; SR = State Rare; SSC = State Species of Special Concern; SWL = State Watch List; SX = State Extirpated
†According to USFWS (2006), these species have not been recorded at the BONWR/JPG, but are suspected to occur or could potentially occur at the BONWR/JPG, including the DU Impact Area
‡According to USFWS (2006), it is unlikely that this species occurs at the BONWR/JPG, including the DU Impact Area

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APPENDIX C

METHODOLOGY FOR ASSESSING CUMULATIVE IMPACTS

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METHODOLOGY FOR ASSESSING CUMULATIVE IMPACTS

The cumulative impacts assessment in this Environmental Assessment (EA) examines the potential incremental impacts of the proposed action and of the no-action alternative on each resource area, in combination with the impacts of other past, present, and reasonably foreseeable actions. The U.S. Nuclear Regulatory Commission's (NRC's) general approach for assessing cumulative impacts is based on principles and guidelines described in the Council on Environmental Quality (CEQ's) "*Considering Cumulative Effects under the National Environmental Policy Act"* (CEQ, 1997). In addition, the NRC staff analysis considers relevant portions of the U.S. Environmental Protection Agency's (EPA's) "*Consideration of Cumulative Impacts in EPA Review of NEPA Documents"* (EPA, 1999). Based on these documents, NRC's regulations implementing the National Environmental Policy Act of 1969 (NEPA) in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51, and NRC's guidance for developing EAs in NUREG–1748 (NRC, 2003), the NRC developed the following methodology for assessing cumulative impacts in this EA:

1. The NRC staff identified potential cumulative impact issues associated with the proposed action and the no-action alternative during the process of scoping and consultation with other agencies, conducted as part of the prior effort to develop an environmental impact statement (EIS) for the U.S. Department of the Army (Army) 2013 license amendment application to terminate Source Material License SUB–1435 and decommission the depleted uranium (DU) Impact Area under restricted conditions (see Section 1.1). These issues were reviewed and determined to be applicable to the current proposed action (license amendment for possession-only and an exemption from the NRC's decommissioning timeliness requirement), and are thus evaluated in this chapter.

2. The individual resources, ecosystems, and human communities identified in the affected environment sections of Chapter 3 are the resource parameters evaluated in this analysis. Similarly, direct and indirect environmental impacts identified in Chapter 4 form the basis for the analysis in this chapter.

3. The spatial boundaries for the cumulative impact assessment are unique to each resource area and are defined in resource-specific analyses in this chapter. Each geographic area of analysis includes the DU Impact Area at Jefferson Proving Ground (JPG) (see Figure 3-1) and extends to surrounding areas, if applicable, wherever the resource would be affected by the proposed action or the no-action alternative and could also be affected by other past, present, and/or reasonably foreseeable future actions.

4. The temporal boundary (i.e., the timeframe) of the cumulative impacts analysis for each resource area begins at the point when impacts began to occur to the resource in the past and extends until 20 years into the future from the date of this EA (a 20-year term for the possession-only license and decommissioning timeliness exemption).

5. NRC staff evaluated cumulative impacts by considering the incremental impacts from the proposed action or the no-action alternative in combination with other past, present, and reasonably foreseeable future actions. NRC staff identified past, present, and reasonably foreseeable future actions, which are presented in Section 5.3. These actions include projects, activities, or trends that could impact resources, ecosystems, or

human communities within the defined spatial and temporal bounds. This includes the general regional and local current and likely trends and activities that could affect the resources within the spatial and temporal domains of the cumulative impact analysis, such as residential or commercial development, continued agricultural activities, transportation projects, or the availability of utilities and services. Overlapping or cumulative impacts could occur if the past, present, or reasonably foreseeable future action or general trends would affect the same resource, ecosystem, or human community as those affected by the proposed action (or the no-action alternative) within the defined temporal and spatial bounds.

6. Cumulative impacts for each resource area were then assessed.

7. Conclusions for resource-specific cumulative impact analyses refer to the same three-level classification scheme—SMALL, MODERATE, or LARGE— that is used for the environmental impact analyses in Chapter 4. For resource areas in which the cumulative impact could vary, depending on the circumstances, the analyses describe the circumstances for which a SMALL, MODERATE, or LARGE impact could occur.

Considerations Related to the Spatial and Temporal Boundaries of the Cumulative Impacts Assessment

The spatial and temporal boundaries describe the maximum distance and time, respectively, considered in the analysis. However, even if the execution of another project or action falls within these overall spatial and temporal bounds, the environmental effects of that project may not overlap in space and time with the effects of the proposed action, due to differences in timing and the extent of impacts from both actions. For example, an upstream construction activity occurring within the next 5 years may have temporary impacts on Big Creek. However, if impacts related to release and transport of DU into the stream water occur later in time (after 5 years), then the impacts from both actions would not overlap and cumulative impacts would not occur. On the other hand, if the construction-related impacts are either permanent or persistent (i.e., lasting a few decades) and overlap with the release of DU into Big Creek, cumulative impacts on the creek could occur. As stated above, the spatial boundaries for the cumulative impact assessment are resource-specific and are identified within each resource-specific analysis in Section 5.4.

The staff considered whether the 20-year time period for this EA is appropriate for evaluating the cumulative effects of the proposed action and the no-action alternative. As discussed in Chapter 2, this EA reflects a proposed action (possession-only license and decommissioning timeliness exemption) term of 20 years. If the possession-only license and exemption are granted for a 20-year term and then renewed, another environmental review would accompany that renewal action. Further, under the proposed action, the actions that the Army could pursue beyond the 20-year timeframe are a continuation of the same actions evaluated for the first 20 years in this EA. Additionally, license renewal reviews beyond the 20-year timeframe evaluated in this EA allow for the NRC to identify safety concerns and environmental impacts as site conditions, technology, and information evolve. This aspect also limits the utility of considering cumulative impacts beyond the 20-year timeframe for this action.

The no-action alternative would require the Army to resume efforts to decommission the DU Impact Area. As described in Section 2.2, the NRC staff assumes for the no-action alternative that the Army would follow NRC requirements for release of a site under restricted conditions (10 CFR 20.1403), because this is what the Army had previously proposed. If the

NRC granted release of the JPG site under restricted conditions, DU would remain onsite indefinitely with continued institutional controls. The NRC staff recognizes that the potential impacts of no action would extend well beyond the 20-year analysis timeframe for this EA. Should the NRC receive a decommissioning plan proposing restricted release in the future, the NRC would assess the associated potential environmental impacts in a detailed environmental review for that licensing action.

Because the environmental impacts of the no action alternative would be considered in detail if and when the NRC receives a decommissioning plan for review, and because the NRC would be reviewing the potential impacts of the proposed action (continued possession-only license and exemption) at regular intervals of 20 years, the staff has determined that the 20-year timeframe is adequate for evaluating and comparing the cumulative impacts of both the proposed action and no-action alternative.

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