REQUESTS FOR ADDITIONAL INFORMATION
FOR THE
ENVIRONMENTAL REVIEW AND ENVIRONMENTAL IMPACT STATEMENT FOR THE PROPOSED TERMINATION OF MATERIALS LICENSE SUB-1435, JEFFERSON PROVING GROUND DEPLETED URANIUM IMPACT AREA

1 INTRODUCTION

The purpose of the Requests for Additional Information (RAIs) presented below is to obtain additional data and information from the U.S. Army (Army) for the U.S. Nuclear Regulatory Commission (NRC) staff to complete the environmental review and Environmental Impact Statement (EIS) in support of the NRC's evaluation of the Army's license amendment application requesting termination of Materials License SUB-1435 for the Jefferson Proving Ground (JPG) Depleted Uranium (DU) Impact Area in Jefferson County, Indiana. The Army's license amendment application included an Environmental Report (ER) (U.S. Army, 2013a) and a Decommissioning Plan (DP) (U.S. Army, 2013b). The RAIs were developed by the NRC staff based on its review of the ER and DP and of other documentation provided by the Army or independently obtained by the staff. The NRC's EIS is being prepared to fulfill the requirements of the National Environmental Policy Act of 1969, as amended (NEPA), and the NRC's NEPA implementing regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51.

Note that a number of the RAIs presented below are based partially, or entirely, on EIS scoping comments from the U.S. Environmental Protection Agency (EPA) Region 5 based on the Army's ER and DP. These scoping comments were provided in a letter to the NRC dated December 18, 2014 (EPA, 2014). The NRC staff requested these comments from EPA Region 5 to ascertain Region 5's concerns regarding the Army's proposed action, to obtain information for developing the scope of the EIS, and in preparation for Region 5's required reviews of the NRC's Draft and Final EIS for this action. Section 309 of the Clean Air Act (CAA) authorizes the EPA to review certain proposed actions of other Federal agencies in accordance with NEPA and to make those reviews public. In the case of the proposed action to terminate NRC Materials License SUB-1435 for the JPG DU Impact Area under restricted conditions, EPA Region 5 will fulfill the requirements of CAA Section 309 by reviewing, providing comments on, and rating the environmental acceptability of the NRC's Draft and Final EIS. In cases in which the EPA's review finds a project to be environmentally unsatisfactory and the proposing agency (the NRC, in this case) does not make sufficient revisions to its EIS to remedy the situation, the EPA may refer the matter to the President's Council on Environmental Quality (CEQ) for mediation. Thus, in its review, EPA Region 5 will be expecting the issues identified in its scoping comments to be addressed in the NRC's EIS. Consequently, it would be prudent for the NRC staff to fully and thoroughly address EPA Region 5's EIS scoping comments in the Draft EIS; and additional information from the Army requested below is needed for the NRC staff to accomplish that goal.

Note also that unless the Army requests otherwise in accordance with NRC regulations in 10 CFR § 2.390, reports, computer files, and other files and documentation that have been or will be provided to the NRC by the Army or its contractors and cited by the NRC staff as references in the EIS will be added, as necessary, to the NRC's Agencywide Documents Access and Management System (ADAMS) as publicly available. All references cited in the NRC's Draft and Final EIS must be publicly available at the time of public release of these documents.

The RAIs are presented in the following categories: General, Purpose and Need, Regulatory Requirements, Alternatives, Land Use and Geology, Water Resources, Air Quality, Climate Change, Public and Occupational Health, Cumulative Impacts, Mitigation Measures, and Cost-Benefit. For each RAI, the basis (or justification) for the request is provided and relevant references are cited. Also, there is one additional information need/request from the Army presented below that is not an RAI. All cited references are listed at the end of this document.

All written reports, computer files, and other files and documentation submitted to the NRC by the Army or its contractors in response to the RAIs must be provided in electronic format that is compatible with entry by the NRC into ADAMS. The NRC document, "*Guidance for Electronic Submissions to the NRC"* (NRC, 2011), provides instructions for submitting documents in formats compatible with ADAMS.

2 REQUESTS FOR ADDITIONAL INFORMATION

2.1 GENERAL (GEN)

2.1.1 RAI GEN-1

Provide annotated input/output (I/O) files in an electronic format for the following modeling described in the ER (U.S. Army, 2013a): the groundwater modeling described in Appendix B, and the surface water and sediment DU fate and transport modeling described in Appendix E.

BASIS: In its assessment of environmental impacts of the proposed action and alternatives to the proposed action in the EIS, the NRC staff will be reviewing the inputs to and outputs from all of the Army's groundwater and surface water and sediment DU fate and transport modeling to conduct quality assurance (QA) on and independently verify the results of the modeling described in the ER (U.S. Army, 2013a) and also in the DP (U.S. Army, 2013b). The staff recognizes and appreciates that the I/O files for this modeling were informally provided to the NRC by the Army following our meeting at JPG on January 12, 2015; and those files were very helpful to the staff in its preliminary reviews leading to the development of the present set of RAIs. However, the content of the I/O files is, in many instances, not transparent. In order for the NRC staff to perform its independent evaluation of the modeling results and, if necessary, to perform its own simulations, the staff needs to clearly understand the content of each of the input and output files and how these files relate to the modeling reported in the ER and DP. In addition, to properly reference the I/O files in the EIS, the NRC staff needs the Army to formally submit the requested annotated I/O files to the NRC.

2.2 PURPOSE AND NEED (PN)

2.2.1 RAI PN-1

Provide additional information and justification relevant to the Army's proposed discontinuation of the Environmental Radiation Monitoring (ERM) program upon license termination, including – but not limited to – data from other, similar sites.

BASIS: In EPA Region 5's EIS scoping comments (EPA, 2014), on page 2 under the *Site Safety* section, the EPA stated, "If environmental monitoring is not proposed, the draft EIS should provide rationale for the decision not to monitor, preferably using data from other, similar sites...." (emphasis added). Because the Army's proposed action, as described in the ER and

DP, includes discontinuation of the ERM program upon license termination, the NRC staff needs the requested information to provide complete and adequate justification for this action in the NRC's EIS and to fully address EPA Region 5's concern about the discontinuation of environmental monitoring. The EIS also needs to adequately address public and stakeholder concerns about the Army's proposed discontinuation of the ERM program upon license termination, as documented in Section 13.4 and Appendix G of the DP (U.S. Army, 2013b) and the transcript of the NRC's EIS Public Scoping Meeting held on December 3, 2014 (NRC, 2014). Thus, EPA Region 5 and stakeholders will be expecting a detailed discussion of this matter to be included in the NRC's EIS.

2.3 REGULATORY REQUIREMENTS (RR)

2.3.1 RAI RR-1

Provide a description of the applicable U.S. Department of Defense (DOD), Army, and other Federal, State, and/or local statutory and regulatory authorities, requirements, programs, roles and responsibilities, and oversight roles that apply to the DU Impact Area and the DU within it and to the unexploded ordnance (UXO) and related munitions constituents within and surrounding the DU Impact Area at JPG. With regard to DU, the NRC is interested in any potential statutory and regulatory responsibilities separate from any related to the NRC license and associated NRC regulation and oversight.

BASIS: The NRC staff could not find any description in the ER of the DOD's and Army's statutory and regulatory responsibilities, or of any other Federal (non-NRC), State, and local regulatory and oversight authority over DU and the DU Impact Area and over UXO and the related munitions constituents at JPG. This information is needed to support the NRC staff's description and evaluation of applicable statutory and regulatory requirements and of cumulative impacts in the NRC's EIS. Such information, to the extent that it is available, is needed for the NRC staff to describe all applicable statutory and regulatory requirements in the EIS, as required in Section 5.1.4 on page 5-4 of the NRC's "*Environmental Review Guidance for Licensing Actions Associated with NMSS Programs*" (NUREG-1748) (NRC, 2003). (NMSS is the NRC's Office of Nuclear Materials Safety and Safeguards.)

In EPA Region 5's EIS scoping comments (EIS, 2014), on page 2 under the *Compliance with other Laws & Statutes* section, the EPA stated, "The draft EIS should list all required permits associated with the proposed action, and explain how compliance with other laws and statutes will occur."

The requested information is also needed to support the NRC staff's evaluation of cumulative impacts in the EIS. The presence of the UXO left in place by the Army and that will be remaining in place at JPG within and surrounding the DU Impact Area would be considered a past, a present, and a reasonably foreseeable future action in relation to the proposed action, which must be addressed by the NRC staff in the cumulative impact analysis in the EIS. (See the Cumulative Impacts RAIs presented later for the basis/justification of the needs for additional information from the Army for the EIS cumulative impacts analysis.) Understanding the applicable statutory and regulatory authorities, requirements, programs, roles/responsibilities, and oversight roles that apply to UXO and related munitions constituents within and surrounding the JPG DU Impact Area is an important part of evaluating the potential environmental impacts because these factors can affect the nature and magnitude of impacts that are possible, whether or not potential environmental impacts are monitored so they can be

identified, and whether or not response actions would need to be taken to mitigate any identified impacts.

2.4 ALTERNATIVES (ALT)

2.4.1 RAI ALT-1

Provide any official Army or other DOD documentation of the decision to leave the DU in place in the DU Impact Area at JPG. Also, provide any official Army or other DOD documentation of the decision to leave the UXO in place at JPG. In addition, provide copies of any letters, other correspondence, or written agreements between the Army (or DOD) and the Governor of Indiana and/or between the Army (or DOD) and other Federal, State, or local agencies regarding the Army's plans to leave the DU and UXO in place at JPG.

BASIS: Under the Army's proposed action described in Section 2.1.2 starting on page 2-1 of the ER (U.S. Army, 2013a), the NRC would terminate Material License SUB-1435 under restricted conditions, and the DU (and UXO) would be left in place within the DU Impact Area. The NRC staff understands that the Army's decision to leave the UXO in place at the DU Impact Area directly results in the Army's decision to leave the DU in place as well (due to the hazards and expense of having to remove the UXO prior to removing the DU). The NRC staff further understands that the Army plans to leave the UXO in place in the other areas of JPG north of the firing line. The requested documentation regarding the Army's plans to leave the DU and UXO in place at JPG is needed to support the NRC staff's assessment of the acceptability of the proposed action and reasonable alternatives to the proposed action in the EIS.

The requested information regarding the UXO is also needed to support the NRC staff's evaluation of cumulative impacts in the EIS. The presence of the UXO left in place by the Army and that will be remaining in place at JPG within and surrounding the DU Impact Area would be considered a past, a present, and a reasonably foreseeable future action in relation to the proposed action, which must be addressed by the NRC staff in the cumulative impact analysis in the EIS. (See the Cumulative Impacts RAIs presented later for the basis/justification of the needs for additional information from the Army for the EIS cumulative impacts analysis.) Understanding the Army's/DOD's decision to leave the UXO and related munitions constituents in place within and surrounding the JPG DU Impact Area is an important part of evaluating the potential environmental impacts.

2.4.2 RAI ALT-2

Provide additional information/clarification concerning the Army's plans to discontinue maintenance of the barricades (i.e., the pad locked metal swing gates) on improved and unimproved roads accessing the DU Impact Area. This information should include: (i) whether the metal gates will be left in place or removed if NRC Materials License SUB-1435 is terminated; (ii) if the metal swing gates are removed, whether any other institutional measure(s) will be implemented by the Army or some other agency to control and restrict access to the DU Impact Area via the roads (and if implemented, what the control measure(s) will be); and (iii) if the metal gates are left in place or replaced with some alternate control measure(s) following license termination, whether the U.S. Fish and Wildlife Service (USFWS) and/or the Indiana National Air National Guard (INANG)/U.S. Air Force (USAF) will be responsible for maintaining the metal gates or alternate control measure(s) under the Memorandum of Agreement (MOA) between the Army, USFWS, and USAF (provided in Appendix B of the DP [U.S. Army, 2013b]), or under some other agreement.

BASIS: In Section 3.2 on page 3-6 of the ER (U.S. Army, 2013a), the Army states, "Upon license termination, the Army will no longer maintain the swing gates approaching the DU Impact Area because these barricades are a requirement of the license…." Although the Army plans to discontinue maintenance of the swing gates on the roads accessing the DU Impact Area if the materials license is terminated, it is unclear if these barricades will be left in place, removed, or replaced with some alternate control measure(s); and if left in place or replaced, if the gates or alternate control meaure(s) will be maintained by the USFWS and/or the INANG/USAF under the MOA or some other agreement. Specifically, the MOA states, "All roads approaching the DU area shall be barricaded and marked with radiation safety signs" (see page 1, number 3 of MOA Enclosure 5 – Air Force Infrastructure Maintenance Responsibilities). The Army needs to clarify whether the barricades would be left in place, removed, or replaced; and left in place or replaced, which agency would be responsible for maintenance. The NRC staff needs the requested information to understand whether or not institutional controls will be implemented to control or restrict access to the DU Impact Area following license termination, and what those institutional controls would consist of if implemented. This information is needed to supplement the staff's description of the proposed action in the EIS.

2.5 LAND USE (LU) AND GEOLOGY (GEO)

2.5.1 RAI LU/GEO–1

Provide the geographical coordinates (Latitude, Longitude, Universal Transverse Mercator (UTM), or other coordinate system) of the area delineating the DU Impact Area as described in the ER (U.S. Army, 2013a).

BASIS: The geographical coordinates defining the DU Impact Area are needed by the NRC staff to accurately evaluate the land use, geologic, and water resource conditions in this area and to prepare various maps and illustrations for the EIS. Further, the geographical coordinates are needed by the NRC staff to accurately define the extent of the area affected by DU and to accurately compare data on land use, geologic conditions, and water resources presented by the Army and others to conditions in the DU Impact Area.

2.6 WATER RESOURCES (WR)

2.6.1 RAI WR-1

Provide the results of additional uranium transport modeling using the vadose zone soil column model described in Section 4 of Appendix B (Groundwater Modeling) of the ER (U.S. Army, 2013a), which extend until the time of peak simulated concentrations at the base of the soil column. In addition, perform and provide the results of sensitivity analyses/tests to determine the effect of the uranium distribution coefficient (K_d) on the time to peak concentration using the full range of K_ds based on rainwater sorption and desorption (R_d) values reported in Table 4-3 of ER Appendix B. Include simulations in the sensitivity analyses in which the upper 7.5 feet (ft) of the soil column consists of Cincinnati/Rossmoyne soil. Also include in the sensitivity analyses the case where the annual recharge rate is as high as 0.3 meters/year (m/yr) [12 inches/year (in/yr)] (ER Appendix B, page 4-11).

All simulations and sensitivity analyses requested in this RAI should be performed assuming that essentially all of the uranium from the DU penetrators has been released to the soil during the approximately 100-year period shown in Figure 4-1 of ER Appendix B. Provide a written

report detailing the parameters and boundary conditions used in the requested simulations and sensitivity analyses and graphs or tables showing the time histories of relative concentrations in the effluent from the column models and uranium concentrations in the soil.

BASIS: The Army provided simulations of uranium transport through the soil column in the DU Impact Area in Appendix B of the ER (U.S. Army, 2013a). These simulations were performed for a period of 1,000 years assuming a constant source of uranium in the surficial soil. Based on the distribution coefficient K_ds for uranium used in these simulations, the average travel time of uranium in the loess-derived soil comprising the upper 0.6 meter (m) (2 ft) of the column model would be greater than 1,000 years; thus, the Army concluded that the concentration of dissolved uranium reaching the water table during the 1,000-year simulation period would be *de minimis* except for the case where the depth to the water table was 0.6 m (2 ft).

However, the 1,000-year timeframe used by the Army in the simulations described above does not apply to the NRC staff's assessment of environmental impacts in the EIS in accordance with the NRC's guidance for implementing the requirements of NEPA. As discussed in Section 4.2.5.1 on page 4-12 of the NUREG-1748 (NRC, 2003), "The impacts should be assessed [in an EIS] over the expected lifetime of the action (e.g., expected duration of the site) and beyond." Also, in Section 4.2.5 on page 4-11 of NUREG-1748, it is specified that long-term impacts are to be considered in the impact assessment of an EIS (in addition to direct, indirect, cumulative, short-term, beneficial, and negative impacts). Furthermore, a prudent NEPA strategy is to estimate the maximum impacts under an alternative, and these impacts become an upper bound for likely impacts. To date, the Army has not specified a date by which DU penetrators, DU fragments, and DU-contaminated soil would be removed from the DU Impact Area; and in Section 1.3.2 on page 1-7 of the ER (U.S. Army, 2013a), the Army states, "…the Army is not planning to conduct any cleanup, retrieval, or any other remedial activities regarding the approximate 73,500 [kilograms] kg [162,040 pounds (lb)] of DU remaining in the DU Impact Area." Therefore, the NRC staff must assume for the EIS that the duration of the DU Impact Area site containing DU could exist over an undefined period of time that could be well beyond 1,000 years. Additionally, the uranium from the DU penetrators could travel through the soil column and eventually impact groundwater after 1,000 years. For these reasons, an estimate of the ultimate travel time and mass flux to groundwater is needed from the Army for the NRC staff to assess the ultimate environmental impacts even if they occur after 1,000 years.

Based on the Army's calculations of the corrosion and dissolution rates of the DU penetrators presented in the ER, nearly all of the uranium from the DU penetrators would be released to the soil within 100 to 120 years (Figure 4-1 of ER Appendix B). This uranium would represent an essentially fixed initial mass of uranium in the soil column that could potentially move downward for as long as water infiltrates into the soil, unless it is removed by surface erosion, although its movement through the soil column might be very slow if the K_ds presented in the ER are indeed representative of the site. However, review of Appendix D (Distribution Coefficient K_d Study Report) of the ER (U.S. Army, 2013a) indicates that there are numerous uncertainties and inconsistencies present in the results and analyses that lead to the final recommended K_d values for soils at JPG used in the Army's modeling. Thus, the K_d values used in the transport model described in Appendix B of the ER should reflect the range of uncertainty in the estimated K_d values and their natural variability in the soil. Additional analyses and justification would be required to exclude possible K_d values that are as much as an order of magnitude lower than the minimum values used in the transport model.

2.6.2 ***RAI WR–2***

Provide information on (i) current impairments of Clean Water Act (CWA) Section 303(d) listed water bodies crossing the boundaries of the JPG site (both north and south of the firing line) plus water bodies within 16 km [10 miles (mi)] of the JPG boundary into which streams crossing the JPG site flow, and (ii) how the proposed action may affect the impairments either positively or detrimentally.

BASIS: In EPA Region 5's EIS scoping comments (EPA, 2014), on page 1 under the *Water Quality* section, the EPA stated, "The draft EIS should analyze how the proposed action may affect CWA Section 303(d) listed water bodies and their listing status as impaired. We recommend this section of the document discuss current impairments and how the proposed action may affect the impairment, either positively or detrimentally." Because transport of uranium leached from DU penetrators, DU fragments, and DU corrosion products via surface water represents a significant potential pathway for migration of uranium from the DU Impact Area (Section 4.3.1 of the ER [U.S. Army, 2013a]), the NRC staff needs the requested information to address EPA Region 5's concern about how the proposed action may affect current impairments of CWA Section 303(d) listed water bodies within and downgradient of the DU Impact Area. In addition, this information is needed to assess the potential environmental impacts in the EIS of uranium on surface water use within and downgradient of JPG (e.g., on livestock and wildlife watering and on recreational uses such as fishing).

2.6.3 ***RAI WR-3***

Provide Microsoft Excel spreadsheets, or a database that can be converted into Microsoft Excel spreadsheets, containing the results of all surface water, groundwater, soil, sediment, and deer tissue data reported in the Data Presentation Tables in Appendix F of the ER (U.S. Army, 2013a). Specifically, provide the Microsoft Excel spreadsheets or database containing the data in the following Data Presentation Tables:

- Summary of Groundwater Quality Parameters (pages F-640 to F-647)
- Summary of Surface Water Qaulity Parmeters (pages F-648 to F-651)
- Summary of Soil Sampling Field Records (pages F-659 to F-669)
- Total and Isotopic Uranium Results for Soil and Sediment Samples (pages F-670 to F-697)
- Total and Isotopic Uranium Results of Surface Water and Groundwater Samples (pages F-698 to F-722)
- Deer Tissue (pages F-723 to F-733)
- Nonradiological Data for Soil Samples (pages F-734 to F-824)
- Nonradiological Data for Surface Water Samples (pages F-825 to F-844)
- Nonradiological Data for Soil Samples (page F-845)
- K_d Batch Testing Data for Leachant Samples (pages F-846 to F-883)
- Soil Characteristics for Modeling (pages F-884 to F-885)
- ERM Surface Soil Samples (pages F-886 to F-895)
- Nonradiological Groundwater Data (pages F-896 to F-925)

BASIS: The NRC staff needs to perform independent evaluation for the EIS of the statistical distribution of the various radiological and non-radiological constituents detected in environmental samples from JPG. In addition, the NRC staff needs to compare the analytical data in the Data Presentation Tables in Appendix F of the ER (U.S. Army, 2013a) with

parameters such as primary and secondary drinking water standards, soil release limits, and NRC dose limits, to independently evaluate the impacts of the proposed action on human health and safety and the environment. The data in the tables of results of analyses of surface water, groundwater, soil, sediment and deer tissue provided in the portable data files of Appendix F of the ER are not amenable to being extracted in one of the forms requested, to support such statistical analyses and comparisons.

2.6.4 RAI WR-4

Provide the results of surface water and sediment transport simulations that consider the effects of future climate conditions over the timeframes estimated in Section 6.4 of Appendix E (Surface Water Flow, Sediment, and Depleted Uranium Fate and Transport Model) of the ER (U.S. Army, 2013a) over which uranium would be released into the surface water from corrosion of DU penetrators. In Section 6.4 of ER Appendix E, it is estimated all uranium from corrosion of DU penetrators would be released in the Big Creek basins to surface water in approximately 1,000 years and would be released in the Middle Fork Creek basins to surface water in 10,000 years. The requested surface water and sediment transport simulations should consider the following climate change influences: (i) the frequency and intensity of precipitation events, (ii) the frequency and intensity of floods, (iii) the ambient air temperature, and (iv) the ecosystem. The surface water and sediment transport simulations should also include the in-growth of uranium decay products that could increase the concentration of radiological constituents in the source term for surface water, or the rationale for not including the in-growth of daughter products in the source term for surface water should be explained.

In addition, using the calibrated surface water model as described in Appendix E, Section 3, of the ER (U.S. Army, 2013a), for the current and future climate conditions and climate change influences over the timeframes as developed in response to the above request, provide calculations of the average annual mass of uranium transported as uranium adsorbed onto suspended sediment and uranium mass transported as uranium adsorbed onto bed load sediment at the downstream boundaries of (i) subbasins 15 and 16 on Middle Fork Creek, (ii) subbasin 122 on Big Creek, and (iii) subbasin 129 at the confluence of Big Creek and Middle Fork Creek. For each of the subbasin boundaries, provide the calculations of suspended and bed load sediment transport for the base case composite K_d value of 2,200 milliliters/gram (mL/g) (ER Appendix E, page 6-9) and for the desorption test composite K_d value of 429 mL/g and the sorption test composite K_d value of 7,004 mL/g (ER Appendix E, page 6-15). As above, the surface water and sediment transport simulations should also include the in-growth of uranium decay products which could increase the concentration of radiological constituents in the source term for surface water, or the rationale for not including the in-growth of daughter products in the source term for surface water should be explained.

The results should include a write-up explaining the development of the model simulations, annotated input and output files for all the simulations performed to respond to this RAI, tabular listings of the requested calculations, and appropriate graphics illustrating the results of the simulations.

BASIS: Surface water is the primary pathway by which uranium can be transported from the DU Impact Area to the environment outside JPG. Surface water and sediment transport simulations need to account for the effects of climate change to properly estimate the magnitude (i.e., concentrations or doses) of uranium released into the environment. On December 24, 2014, the CEQ released revised draft guidance describing how Federal agencies should consider the effects of climate change in their evaluation of all Federal actions in their NEPA

reviews (CEQ, 2014). This guidance explains that Federal agencies should consider both the potential effects of a proposed action on climate change and the implications of climate change for the environmental effects of a proposed action.

The simulations of uranium transport by surface water and sediment under future climate conditions reported in Section 7.2 of Appendix E of the ER (U.S. Army, 2013a) only considered an increase in ambient air temperature over 100 years even though the modeling covered 500 years. The effect of increased temperature as reported in the ER was to increase evapotranspirative losses and reduce runoff. However, climate change can also change the frequency and intensity of precipitation events, the frequency and intensity of floods, and ecosystems (U.S. Global Change Research Program (GCRP), 2014). These climate change influences can affect surface water runoff, soil erosion, and sediment transport which, in turn, can affect uranium transport by surface water and sediment**.** The NRC staff needs the results of surface water and sediment transport simulations that include the effects of future climate change to fully and independently evaluate potential uranium transport (in both the dissolved form and attached to sediment) and to evaluate potential uranium concentrations in onsite and offsite surface water and sediments. To account for the effects of climate change, the meteorological record used in the surface water and sediment transport simulations should be modified by the Army based on climate information from the GCRP. For example, "*Climate Change Impacts in the United States: The Third National Climate Assessment"* (GCRP, 2014) provides climate modeling information for the Midwest United States on the frequency and intensity of future precipitation, the frequency of future flood events, ambient air temperatures, and the ecosystem.

Furthermore, the calibrated surface water and sediment transport model described in Section 6.2, Appendix E, of the ER (U.S. Army, 2013a) was based on a uranium source term proportional to the time over which uranium was estimated to be released into the soil from corrosion of the DU penetrators (Figure 6-4, ER Appendix E). The description of the calibrated source term in Section 6.3 (Critical Parameters) of ER Appendix E states that the uranium source term or release rate for the Big Creek basins was one-ninth of the rate indicated in Figure 6-4. On that basis, it would take approximately 963 years (107 years times 9) to release all of the uranium in the Big Creek basins to surface water. The release rate for the Middle Fork Creek basins was reduced by a factor of 100, so it would take approximately 10,000 years to release the uranium to surface water. The NRC staff needs the surface water and sediment transport simulations to be conducted over the timeframe ranging from 1,000 to 10,000 years to capture the time of peak simulated uranium concentrations in surface water and sediments. In addition, the NRC staff needs the surface water and sediment transport simulations to include the in-growth of uranium decay products, which could potentially increase the concentration of radiological constituents released to surface water and sediment from corrosion of the DU penetrators. The results of surface water and sediment transport simulations conducted beyond 1,000 years, which include in-growth of uranium decay products, are needed to fully evaluate in the EIS the potential radiological constituent concentrations in onsite and offsite surface water and sediments and, in turn, the potential doses to onsite and offsite receptors.

Additionally, the NRC staff needs the calculation of uranium-bearing sediment mass loading that include the effects of future climate change and the in-growth of uranium daughters, over the timeframe ranging from 1,000 to 10,000 years, to fully and independently evaluate potential uranium transport and to evaluate potential uranium concentrations in onsite and offsite sediments in the EIS and to capture the time of peak simulated uranium concentrations in sediments. Uranium can be transported in the streams leaving JPG dissolved in surface water, adsorbed onto suspended sediment, and adsorbed onto bed load sediment that moves along

the beds of the streams draining from the DU Impact Area. Assuming, as the Army did in performing the surface water modeling (Appendix E, Section 5.1, page 5-2, of the ER [U.S. Army, 2013a]), that no net accumulation of sediment occurs in the beds of Big Creek and Middle Fork Creek within the JPG boundary, sediment carrying absorbed uranium will leave JPG and enter the surface water system downstream from JPG. Ultimately, any uranium that does not remain in the DU Impact Area will be transported out of JPG via Big Creek and Middle Fork Creek, then into the main channel of Big Creek, and then to the Muscatatuck River and downstream water bodies where it will mix with sediment from the drainage basins of these water bodies. The calculation of the uranium-bearing sediment mass loading from the DU Impact Area is necessary for the NRC staff to assess the potential offsite impacts (i.e., downgradient of the JPG boundary) of the proposed action and its alternatives in the EIS. The information on the surface water model simulations reported in Sections 6.4 and 6.5 of ER Appendix E does not include the suspended and bed load sediment transport rates needed for the NRC staff to assess uranium mass loadings to surface water downstream from the DU Impact Area and downstream of JPG. Simulations for a range of K_d values are needed because partitioning between dissolved and adsorbed uranium is strongly related to the K_d value.

2.6.5 __RAI WR-5__

Provide an annotated list of the files used as input to the Hydrologic Simulation Program – Fortran (HSPF) code to perform the surface water flow and sediment transport modeling described in Appendix E (Surface Water Flow, Sediment, and Depleted Uranium Fate and Transport Model) of the ER (U.S. Army, 2013a). The annotations should identify the input parameters contained in the file. If a file does not contain data used as direct input to the HSPF code, explain its relationship to the HSPF modeling process. In addition, identify any files that contain output from the HSPF simulations and what output they contain.

__BASIS__: In support of its independent verification of information provided in the Army's ER (U.S. Army, 2013a) , the NRC staff needs to perform QA checks on the simulations of surface water flow and sediment transport reported in Appendix E of the ER, and may perform independent simulations of surface water flow and transport. The Army previously informally provided the NRC staff with digital files contained in a folder titled, "Surface Water Modeling Files." This folder and its subfolders contain a multitude of files that the NRC staff understands may contain input used by the Army's contractor to perform the surface water and sediment transport simulations; however, the content of these files is not transparent. In order for the NRC staff to perform its independent evaluation of the simulation results and, if necessary, to perform its own simulations, the staff needs to clearly understand the content of each of the files provided by the Army and how these files relate to the simulations reported in ER Appendix E.

2.6.6 __RAI WR-6__

Provide the results of simulated water balances and simulated groundwater elevation contours produced by the calibrated groundwater flow model (MODFLOW-SURFACT) described in Section 5 (Groundwater Flow Model) in Appendix B (Groundwater Modeling) of the ER (U.S. Army, 2013a). In addition, provide annotated input files for the calibrated MODFLOW-SURFACT model. The simulated water balance results should include: (i) the simulated flow between the overburden layer (layer 1) and shallow bedrock layer (layer 2) for the entire model domain; (ii) flow to stream segments assigned the river boundary condition within JPG; (iii) flow to stream segments assigned the drain boundary condition within JPG; and (iv) simulated discharge between the overburden layer and the shallow bedrock layer within the footprint of the DU Impact Area. The simulated groundwater elevation contours should include original contour

maps of the simulated groundwater elevations in layers 1 and 2 of the model, or electronic files of the simulated groundwater elevations in these layers in the form of geographical coordinates (latitude-longitude, UTM coordinates, or model coordinates).

BASIS: The groundwater flow simulations reported in Section 5 of Appendix B of the ER (U.S. Army 2013a) indicate that groundwater flowing through the overburden (model layer 1) in and near the DU Impact Area discharges to streams within the local drainage basins; and this may also be the case for groundwater flowing through the shallow bedrock (model layer 2). However, these conclusions cannot be confirmed with the information provided in ER Appendix B. The simulated water balances and simulated groundwater elevation contours will allow the NRC staff to fully understand the characteristics of groundwater flow within the DU Impact Area, including the volume of groundwater flowing between the overburden and the shallow bedrock layer and the volume of groundwater discharging to streams from the overburden and shallow bedrock layer. The NRC staff needs the results of the simulated water balances and simulated groundwater elevation contours to independently evaluate impacts to groundwater in the DU Impact Area and impacts to surface water from uranium and other radiological constituents leached from the DU penetrators and corrosion products for the EIS.

2.6.7 RAI WR-7

Provide calculations of the range of possible concentrations of total dissolved uranium in soil pore waters that would result from an average uranium soil concentration in the Primary Contamination Zone (PCZ) and Secondary Contamination Zone (SCZ). These calculations should consider the mass of DU projectiles and corrosion products in each zone, the spatial area of each zone, and the range of possible uranium distribution coefficient (K_d) values in the surficial soil. For example, the mass of DU in the DU Impact Area could be assumed to completely partition between the soil and pore water in the upper six inches of the overburden to calculate an effective pore water concentration to use as a source in the Vadose Zone Column Model. Alternatively, calculations of the dissolved uranium concentration based on geochemical modeling, such as those reported in Table 6-7 of Appendix C of the ER (U.S. Army 2013a), could be used as a source in the Vadose Zone Soil Column Model. If the calculations reported in Table 6-7 of ER Appendix C are used, provide an explanation of the difference between the total dissolved uranium concentration based on Table 6-7 and the concentration of dissolved uranium based on the mass of schoepite added to the soil in the geochemical model calculations and the mass of water in the soil assumed in the calculations as stated in Section 6.1.3 of ER Appendix C, and reconcile that with the statement in Section 6.3.2 of ER Appendix C that, "In all of the [pH-Redox-Equilibrium] PHREEQC calculations, the schoepite dissolves completely and, as in the K_d tests, all of the uranium goes into solution." The explanation should clearly state the mass of uranium added to the soil to perform the calculations and which, if any, processes resulted in uranium being removed from the pore water solution.

In addition, provide calculations of the concentration of dissolved uranium that will reach the water table at the time of peak concentration (even if greater than 1,000 years), using the calculated range of potential concentrations of dissolved uranium in the soil pore water as a source and using the Vadose Zone Soil Column Model described in Section 4 of Appendix B (Groundwater Modeling) of the ER (U.S. Army, 2013a). Further, perform and provide the results of sensitivity analyses/tests to determine the effect of the K_d on the peak uranium concentration using the full range of K_ds based on rainwater sorption and desorption (R_d) values reported in Table 4-3 of Appendix B of the ER (U.S. Army, 2013a). Include in the sensitivity analyses simulations in which the upper 2.28 m (7.5 ft) of the soil column consists of Cincinnati/Rossmoyne soil. Perform all simulations under the assumption that essentially all of

the uranium from the DU penetrators has been released to the soil during the approximately 100-year period shown in Figure 4-1 of ER Appendix B. Include in the sensitivity analyses the case where the annual recharge rate is as high as 0.3 m/yr ([12 in/yr] (see Appendix B, page 4-11, of the ER [U.S. Army, 2013a]).

Based on the results of the vadose zone soil column simulations, provide calculations of the potential concentration of dissolved uranium in groundwater beneath the PCZ and SCZ due to infiltration of dissolved uranium, based on the calculation of uranium infiltrating through the soil column. Such calculations could be done with relatively simple mixing cell models or with more sophisticated groundwater transport modeling. In addition, provide calculations of the areal extent of any resulting dissolved uranium plume in the groundwater with concentrations of dissolved uranium above background levels due to the calculated groundwater uranium concentrations beneath the DU Impact Area. The calculations for the extent of the plume should be performed for a time period long enough to delineate the full extent of the area containing dissolved uranium concentrations above background concentration. For example, the calculations of the extent of the uranium plume could be performed based on simulated groundwater flow paths from the DU Impact Area or with concentrations computed using a groundwater transport model.

Provide a written report detailing the parameters and boundary conditions used in the requested calculations, simulations, and sensitivity analyses, as well as graphs and/or tables showing the time histories of dissolved uranium concentrations in the effluent from the column models and uranium concentrations in the soil and maps showing the full extent of the groundwater uranium plume. Provide annotated input and output files for any calculations involving the use of geochemical or flow and transport models.

BASIS: The Army provided simulations of uranium transport through the soil column in the DU Impact Area in Section 4.5 of Appendix B of the ER (U.S. Army, 2013a). These simulations were performed for a period of 1,000 years assuming a constant source of uranium in the surficial soil. Based on the K_ds for uranium used in the simulations, the average travel time of uranium in the loess-derived soil comprising the upper 0.6 m (2 ft) of the column model would be greater than 1,000 years; thus, the Army concluded that the concentration of dissolved uranium reaching the water table during the 1,000-year simulation period would be *de minimis* except for the case where the depth to the water table was 0.6 m (2 ft). However, in the case of the DU Impact Area, the Army did not provide calculations of the concentrations of dissolved uranium that might develop in the zone of saturated groundwater beneath the DU Impact Area after the 1,000 year simulation period. Calculations of the uranium concentration in the source pore water that will move through the soil column are needed by the NRC staff to calculate potential groundwater concentrations and impacts in the EIS. In addition, calculations of the ultimate extent of any groundwater plume that might originate from the DU Impact Area are needed by the NRC staff to assess the significance of the impacts in the EIS.

With respect to the calculations of dissolved uranium presented in Table 6-7 of Appendix C of the ER (U.S. Army, 2013a), the molality of U(VI) of 9.94×10^{-6} in Table 6-7 equates to a total uranium concentration of 2.37×10^{3} micrograms/liter (μg/L). Section 6.3.2 states that in the soil speciation calculations, "…uranium is added as schoepite. In all of the PHREEQC calculations, the schoepite dissolves completely and, as in the K_d tests, all of the uranium goes into solution." Section 6.1.3 of ER Appendix C states, "The mass of schoepite assumed to be present in the soil was based on the uranium concentration measured in the soil below the DU penetrators at JPG (see Table 6-2 of Appendix D)." Table 6-2 of ER Appendix D lists an average soil uranium concentration of 16,842 milligrams/kilogram (mg/kg) (16,842 μg/g). Section 6.3.2 of ER

Appendix C further states that the PHREEQC calculations were performed with a “mass ratio of soil to water” of 1,200 to 320. If the calculations of the uranium concentrations in the soil water were performed using the average soil uranium concentration from Table 6-2 of ER Appendix D and all of the uranium dissolved (as stated in Section 6.3.2), then the pore water concentration 1,200 g of soil times 16,842 µg uranium/g soil divided by 320 g water [0.32 L of water] gives 6.32×10^7 µg/L. A full explanation of the assumptions and processes involved in the uranium speciation calculations reported in Section 6.3.2 of ER Appendix C or in any geochemical modeling of pore water concentrations performed pursuant to this RAI is needed for the NRC staff to understand and evaluate the results of the calculations for the EIS.

Based on the Army’s calculations of the corrosion and dissolution rates of the DU penetrators presented in the ER (U.S. Army, 2013a), nearly all of the uranium from the DU penetrators would be released to the soil within 100 to 120 years (Figure 4-1 of ER Appendix B). This uranium would represent an essentially fixed initial mass of uranium in the soil column that could dissolve in the soil pore water and potentially move downward for as long as water infiltrates into the soil, unless it is removed by surface erosion (although its movement through the soil column might be very slow if the K_ds presented in the ER are indeed representative of the site). However, review of Appendix D (Distribution Coefficient K_d Study Report) of the ER (U.S. Army, 2013a) indicates that there are numerous uncertainties and inconsistencies present in the results and analyses that lead to the final recommended K_d values for soils at JPG used in the Army’s modeling. Thus, the K_d values used in the transport model described in ER Appendix B should reflect the range of uncertainty in the estimated K_d values and their natural variability in the soil. Additional analyses and justification would be required to exclude possible K_d values that are as much as an order of magnitude lower than the minimum values used in the transport model.

Furthermore, the 1,000-year timeframe of the Army’s simulations does not apply to the NRC staff’s assessment of environmental impacts in the NRC’s EIS, in accordance with the NRC’s guidance for implementing the requirements of NEPA in NUREG-1748 (NRC, 2003). As discussed in Section 4.2.5.1 on page 4-12 of this guidance document, “The impacts should be assessed [in an EIS] over the expected lifetime of the action (e.g., expected duration of the site) and beyond.” Also, in Section 4.2.5 on page 4-11, it is specified that long-term impacts are to be considered in the impact assessment of an EIS (in addition to direct, indirect, cumulative, short-term, beneficial, and negative impacts). Furthermore, a prudent NEPA strategy is to estimate the maximum impacts under an alternative, and these impacts become an upper bound for likely impacts. To date, the Army has not specified a date by which DU penetrators, DU fragments, and DU-contaminated soil would be removed from the DU Impact Area; and in Section 1.3.2 on page 1-7 of the ER (U.S. Army, 2013a), the Army states, “…the Army is not planning to conduct any cleanup, retrieval, or any other remedial activities regarding the approximate 162,040 lb (73,500 kg) of DU remaining in the DU Impact Area.” Therefore, the NRC staff must assume for the EIS that the duration of the DU Impact Area site containing DU could exist over an undefined period of time that could be well beyond 1,000 years. Furthermore, the uranium from the DU penetrators could travel through the soil column and eventually impact groundwater after 1,000 years. For these reasons, an estimate of the ultimate travel time and mass flux to groundwater and resulting groundwater concentrations is needed from the Army for the NRC staff to assess the ultimate environmental impacts in the EIS, even if they occur after 1,000 years.

*2.6.8 **RAI WR-8***

Provide the following maps, all to the same scale of no less than 1 inch to 200 meters: (i) a map showing the spatial distribution of crayfish burrows in the DU Impact Area; (ii) a map showing the thickness of overburden in the DU Impact Area; and (iii) a map showing the depth to the water table in the DU Impact Area. In addition, provide a review of technical information, including available reference documentation, on the burrowing habits of crayfish indigenous to JPG. Also, based on the depth of the crayfish burrows and position of the water table in the DU Impact Area, provide an evaluation of the potential for the crayfish burrows to act as fast pathways for uranium and UXO chemical constituents to reach the water table and impact groundwater quality.

BASIS: During the NRC site visits at JPG on December 2, 2014, and January 12, 2015, observations by the NRC and contractor staff and discussions with Army, Leidos, and USFWS staff indicated the presence of areas within the DU Impact Area and other parts of JPG with abundant crayfish burrows. Thoma and Armitage (2008) reported data on burrow depths of crayfish in Indiana that burrows may extend to the water table at depths of up to 2 m (6.5 ft) (see Figure C-12 in Thoma and Armitage, 2008). These burrows could represent fast pathways for uranium from DU and for UXO chemical constituents to migrate from the surficial soils to groundwater. That is, surface water running off from the portions of the DU Impact Area contaminated with uranium and munitions constituents could carry dissolved uranium and munitions constituents and uranium and munitions constituents adsorbed onto soil/sediment into the burrows where they could move directly into the overburden and potentially reach the water table without their movement being substantially retarded by adsorption onto the overburden soils. The NRC staff needs the requested maps and technical information to fully assess the potential for and estimated magnitude of contaminant transport in the DU Impact Area to groundwater in the EIS. Further, all three requested maps need to be provided on the same scale so that the maps can be effectively used by the staff to evaluate the potential for crayfish burrows to act as fast pathways for contaminant transport through the surficial soils to the water table.

*2.6.9 **RAI WR-9***

Provide an explanation of the uranium concentrations reported in Table 6-5 in Section 6.1.2.2 on page 6-12 of the ER (U.S. Army, 2013a), as to whether these concentrations represent dissolved uranium concentrations in surface water or if these concentrations include uranium in suspended sediment. Also explain whether the uranium concentrations in ER Table 6-5 were determined from samples that were filtered before acid digestion or if acid digestion was performed prior to filtration. In addition, provide clarification of the units reported on pages F-716 through F-722 of Appendix F of the ER (U.S. Army, 2013a) for total uranium concentration (picocuries/liter [pCi/L] or µg/L) for surface water samples that were analyzed by Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS).

BASIS: For the EIS, the NRC staff needs clarification of the results of analyses of surface water summarized in Table 6-5 in Section 6.1.2.2 on page 6-12 of the ER (U.S. Army, 2013a). Tabular data on surface water uranium analyses on ER Appendix F pages F-716 through F-722(U.S. Army, 2013a), on which the summary in Table 6-5 is presumed to be based, indicate that surface water samples from sampling locations SW-DU-001 through SW-DU-008 were not filtered. The ERM Program Plan for License Sub-1435 Jefferson Proving Ground, Addendum (U.S. Army, 2003a) states that the uranium analyses were to be performed using Method SW 6020A. Method 6020A states, "When dissolved constituents are required, samples must be

filtered and acid-preserved prior to analysis. No digestion is required prior to analysis for dissolved elements in water samples. Acid digestion prior to filtration and analysis is required for groundwater, aqueous samples, industrial wastes, soils, sludges, sediments, and other solid wastes for which total (acid-soluble) elements are required" (EPA, 2007a). If the surface water samples from sampling locations SW-DU-001 through SW-DU-008 were filtered, either in the field or in the laboratory prior to acid digestion, then the analytical results for total uranium would be interpreted as representing total dissolved uranium. If the samples were acid digested prior to filtering, then the analytical results would be interpreted as representing both dissolved uranium and uranium adsorbed onto suspended sediment.

The NRC staff needs to understand for the EIS how the surface water samples from sampling locations SW-DU-001 through SW-DU-008 were treated, in terms of the sequence of filtering and acidification, in order to be able to correctly interpret and evaluate the surface water transport pathway for uranium and to evaluate the results of surface water transport modeling in ER Appendix E which are presented in terms of simulated dissolved uranium and uranium adsorbed onto suspended silt (ER Appendix E Figures 6-4 and 6-4 of [U.S. Army, 2013a]). ,

With respect to the uranium concentration units reported for surface water samples analyzed by ICP-MS, the units reported in the tables in ER Appendix F are pCi/g whereas one would expect units of mass per volume, such as µg/L. Therefore, clarification of the units is also needed.

2.7 AIR QUALITY (AQ)

2.7.1 RAI AQ-1

Clarify the timeframe associated with the wind speed and gust data documented in Table 3-9 in Section 3.6 on page 3-33 of the ER (U.S. Army, 2013a).

BASIS: Text on page 3-31 in Section 3.6 of the ER (U.S. Army, 2013a) states that wind speed and gust data in Table 3-9 are for 2002 to 2013, whereas text within Table 3-9 states the time period for these data is 2007 to 2013. These data, including the timeframe for the data, will likely be documented and referenced in the EIS. Therefore, the correct timeframe associated with these data is needed so an accurate description can be included in the EIS.

2.7.2 RAI AQ-2

Describe activities and emissions sources and provide annual emission estimates for air emissions associated with the environmental monitoring, onsite inspections, and institutional controls. Consideration should be given to combustion emissions and fugitive dust emissions from vehicles and equipment conducting and supporting these activities. This information should be included for the JPG security fence replacement activity as described in Section 7.2 of the ER (U.S. Army, 2013a) and for the other institutional control activities as identified in Appendix F of the DP (U.S. Army, 2013b). The annual emission inventory estimates should include carbon monoxide, nitrogen oxides, particulate matter $PM_{2.5}$, particulate matter PM_{10}, sulfur dioxide, hydrocarbons, and carbon dioxide. The information provided should include all of the details and calculations used to generate the annual emissions estimates, including any mitigation incorporated into the estimates. Consideration should also be given to air emissions associated with any activities the Army would need to perform to implement institutional controls at JPG should the Army-USFWS-USAF MOA (Appendix B of the DP [U.S. Army, 2013b]) be terminated (see RAI CB-5 below).

BASIS: The air quality impact analysis in Section 4.6 of the ER (U.S. Army, 2013a) was limited to activities specifically associated with the DU Impact Area, and no air emission estimates were provided. Environmental monitoring and onsite inspections will be part of the no action alternative and possibly of other reasonable alternatives evaluated in detail by the NRC staff in the EIS. Institutional controls will be a part of all of the alternatives evaluated in detail by the NRC staff in the EIS, including the proposed action. As described in Section 1.3.2 of the ER (U.S. Army, 2013a), institutional controls include the perimeter chain-link fence and warning signs surrounding the JPG property north of the firing line as well as barriers and warning signs to restrict access to the DU Impact Area. The institutional controls described in Section 7.2 of the ER (U.S. Army, 2013a) and Appendix F of the DP (U.S. Army, 2013b) appear to be limited to the JPG site perimeter. It is unclear which, if any, activities the Army would need to perform to implement institutional controls and control access to and within the JPG site if the MOA is terminated. The institutional controls described in the MOA include physical mechanisms (e.g., gates and signage) and associated infrastructure maintenance. Air emission estimates from institutional control activities need to be described and evaluated by the NRC staff in the EIS for a complete discussion of potential air quality impacts, and because of the proximity of these activities to Madison Township which is nonattainment for particulate matter $PM_{2.5}$ (Annual NAAQS) (40 CFR 81.315).

2.8 CLIMATE CHANGE (CC)

2.8.1 RAI CC-1

Utilize climate modeling to estimate and provide information on the frequency and intensity of potential future flood events at JPG; and provide an analysis to determine the physical or chemical impact (if any) of the predicted future flooding events on the UXO and DU at JPG and the resulting potential radiological and non-radiological impacts (if any) on human health and the environment.

BASIS: In EPA Region 5's EIS scoping comments to the NRC (EPA, 2014), on page 2 in the *Climate Change and Stormwater Management* section, the EPA stated, "Over the past 50 years, the amount of rain falling during the most intense 1% of storms increased by almost 20% (EPA, 2013), resulting in more flooding. The draft EIS should utilize climate modeling to estimate the frequency and intensity of potential flood events in the future, and analyze that data to determine if future flooding events are likely to have any physical or chemical impacts on the UXO or DU." Thus, the NRC staff needs the requested information to address EPA Region 5's concern about future climate change and its potential impacts on release and transport of radiological and chemical constituents from UXO and DU.

The Army's hydrologic modeling documented in Appendices B (Groundwater Modeling) and E (Surface Water Flow, Sediment, and Depleted Uranium Fate and Transport Modeling) of the ER (U.S. Army, 2013a) does not address the influence of climate change in terms of the intensity and frequency of precipitation events and flooding, on the release and transport of radiological and chemical constituents from UXO and DU. Based on EPA Region 5's comments, that information now needs to be provided by the Army for the NRC staff's independent evaluation and inclusion in the NRC's EIS. The GCRP should serve as source for the climate change information. For example, "*Climate Change Impacts in the United States: The Third National Climate Assessment"* (GCRP, 2014) provides climate modeling information for the Midwest United States on the frequency and intensity of future precipitation and flood events.

2.9 PUBLIC AND OCCUPATIONAL HEALTH (POH)

2.9.1 RAI POH-1

Clarify the basis for converting the cited EPA maximum contaminant level (MCL) for uranium of 30 µg/L to 9 pCi/L in the ER (U.S. Army, 2013a) and DP (U.S. Army, 2013b). This conversion was used in describing site characterization results in ER Section 6.1.3.2, Section 2.27 of ER Appendix E, DP Section 3.8.5, and Section 2.1.2 of DP Appendix C, (U.S. Army, 2013a; U.S. Army, 2013b).

BASIS: Site characterization results presented in ER Section 6.1.3.2, Section 2.27 of ER Appendix E , DP Section 3.8.5, and Section 2.1.2 of DP Appendix C, (U.S. Army, 2013a; U.S. Army, 2013b) compare surface water monitoring results to the EPA MCL of 30 µg/L for total uranium. Because the surface water monitoring measured uranium activity rather than mass per unit volume, the Army converted the EPA MCL to an activity concentration of 9 pCi/L, by applying a conversion factor of 0.3 pCi/µg. The EPA *Federal Register* notice for the National Primary Drinking Water Regulations; Radionuclides; Final Rule (66 FR 76708), which established the 30-µg/L MCL, described that the conversion of total uranium mass to activity varies depending on the abundance of the uranium isotopes in the mixture. For example, the EPA reported conversion factors that ranged from 0.67 to 1.5 pCi/µg based on variations in natural uranium isotopic abundances in water samples. The specific activity for U-238 is 0.336 pCi/µg (e.g., the value of 3.36×10^{-7} Ci/g provided in Section 3.4.2 of Appendix C of the DP (U.S. Army, 2013b)expressed in different units) and is the lowest for the naturally occurring isotopes of uranium. The DP and ER sections referenced above that use the 0.3-pCi/µg conversion are unclear as to why the total uranium mass was converted to activity based on a conversion factor that is lower than the smallest specific activity of the available uranium isotopes. This information is needed so the NRC staff can ensure that the description and interpretation of site characterization results in the EIS is clear, accurate, and based on acceptable methods.

2.9.2 RAI POH-2

Verify the completeness and accuracy of the RESRAD dose modeling input and output files that were previously provided informally to the NRC staff by the Army/Leidos following our January 12, 2015, meeting at JPG. The previously provided files include the subdirectories and files listed below. Verify that the contents of each file match the receptor and scenario indicated by the filename and provide any missing or inaccurate input and output files, annotated in the manner of the previously provided files. If the guidance requires input files to be converted to a different format than is used by the RESRAD-OFFSITE code then provide an additional separate set of the input files in the original code format for NRC staff use. Additionally, if the guidance requires output files to be converted to a format that alters the readability of the formatted output tables (e.g., word wrapping) then an additional separate set of the output files should be provided in the original format (or the same Word format that was used for the informally submitted files) for NRC staff use.

Farmer\DU Trace Contaminants\
- Farmer_Onsite_PCZ_Trace_Contaminants_SUMMARY.docx
- JPG-FARMER PCZ TC-PU.ROF

Farmer\Offsite\PCZ\
- Farmer_Offsite_PCZ_lhs.rep.docx
- Farmer_Offsite_PCZ_MCSUMMAR.docx
- Farmer_Offsite_PCZ_SUMMARY.docx
- JPG-FARMER OFFSITE PCZ PROB R2.ROF

Farmer\Offsite\SCZ\
- Farmer_Offsite_SCZ_lhs.rep.docx
- Farmer_Offsite_SCZ_MCSUMMAR.docx
- Farmer_Offsite_SCZ_SUMMARY.docx
- JPG-FARMER OFFSITE SCZ PROB R2.ROF

Farmer\Onsite\1 Foot Deterministic - External Gamma\
- Farmer_Onsite_PCZ_1_Foot_Determ_SUMMARY.docx
- JPG-FARMER PCZ 1 FOOT.ROF

Farmer\Onsite\PCZ\
- Farmer_Onsite_PCZ_lhs.rep.docx
- Farmer_Onsite_PCZ_MCSUMMAR.docx
- Farmer_Onsite_PCZ_SUMMARY.docx
- JPG-FARMER PCZ PROB R2.ROF

Farmer\Onsite\SCZ Left\
- Farmer_Onsite_SCZ_Left_lhs.rep.docx
- Farmer_Onsite_SCZ_Left_MCSUMMAR.docx
- Farmer_Onsite_SCZ_Left_SUMMARY.docx
- JPG-FARMER SCZ LEFT PROB2.ROF

Farmer\Onsite\SCZ Right\
- Farmer_Onsite_SCZ_Right_lhs.rep.docx
- Farmer_Onsite_SCZ_Right_MCSUMMAR.docx
- Farmer_Onsite_SCZ_Right_SUMMARY.docx
- JPG-FARMER SCZ RIGHT PROB R2.ROF

Sensitivity\
- JPG-FARMER PCZ SENSITIVITY.ROF

FWS\Onsite\PCZ
- FWS_Worker_Onsite_PCZ_lhs.rep.docx
- FWS_Worker_Onsite_PCZ_MCSUMMAR.docx
- FWS_Worker_Onsite_PCZ_SUMMARY.docx
- JPG-FWS PCZ PROB R2.ROF

FWS\Onsite\SCZ Left\
- FWS_Worker_Onsite_SCZ_Left_lhs.rep.docx
- FWS_Worker_Onsite_SCZ_Left_MCSUMMAR.docx
- FWS_Worker_Onsite_SCZ_Left_SUMMARY.docx
- JPG-FWS SCZ LEFT PROB R2.ROF

FWS\Onsite\SCZ Right\
FWS_Worker_Onsite_SCZ_Right_lhs.rep.docx
FWS_Worker_Onsite_SCZ_Right_MCSUMMAR.docx
FWS_Worker_Onsite_SCZ_Right_SUMMARY.docx
JPG-FWS SCZ RIGHT PROB R2.ROF

Sportsman\Onsite\PCZ\
Sportsman_Onsite_PCZ_lhs.rep.docx
Sportsman_Onsite_PCZ_MCSUMMAR.docx
Sportsman_Onsite_PCZ_SUMMARY.docx
JPG-SPORTSMAN PCZ PROB R2.ROF

Sportsman\Onsite\SCZ Left\
Sportsman_Onsite_SCZ_Left_lhs.rep.docx
Sportsman_Onsite_SCZ_Left_MCSUMMAR.docx
Sportsman_Onsite_SCZ_Left_SUMMARY.docx
JPG-SPORTSMAN SCZ LEFT PROB R2.ROF

Sportsman\Onsite\SCZ Right\
Sportsman_Onsite_SCZ_Right_lhs.rep.docx
Sportsman_Onsite_SCZ_Right_MCSUMMAR.docx
Sportsman_Onsite_SCZ_Right_SUMMARY.docx
JPG-SPORTSMAN SCZ RIGHT PROB R2.ROF

BASIS: Input and output files for the RESRAD-OFFSITE dose modeling software that was used by the Army for the dose calculations in Section 4.12.2 of the ER (U.S. Army, 2013a) and Section 4.1 of the DP (U.S. Army, 2013b) were previously provided informally by the Army/Leidos to the NRC staff to support the NRC's environmental review. An initial NRC staff review of these files has found the output file for the onsite farmer, PCZ (filename: Farmer_Onsite_PCZ_SUMMARY) contains initial soil concentrations (i.e., source term input) applicable to the SCZ. Therefore, there may have been a problem with the code run, or in saving the output files, or in the labeling of files; and the correct output files for at least that receptor and exposure scenario have not been provided. This identified problem causes the NRC staff to be concerned that there may be other problems with the RESRAD-OFFSITE I/O files. Therefore, the NRC staff is requesting that the Army check all of the previously provided RESRAD-OFFSITE dose modeling I/O files and verify that the submitted information submitted is complete and accurate, and that any missing or inaccurate files be provided to the NRC in response to this RAI. These files are needed so the NRC staff can complete its detailed review of the RESRAD calculations to determine if they are suitable for supporting the analysis of public and occupational health impacts in the EIS.

2.9.3 RAI POH-3

Provide corrections as necessary to the descriptions of RESRAD-OFFSITE input parameter selections for the "Fraction of Water from SW (all uses including irrigation)" (SW means Surface Water) and the "Fraction of Drinking Water from Well Water (all uses including irrigation)" in Table 3-5 in Appendix C of the DP (U.S. Army, 2013b). The information presented in the table documenting these input parameter selections is not internally consistent (as described below under BASIS). Additionally, these table entries are not consistent with the DP description of the conceptual model (Figure 3-2 in Appendix C of the DP shows the water sources for each receptor). These table entries are also not consistent with the comparable input parameter

selections that are tabulated in an applicable RESRAD-OFFSITE output file. The response to this RAI can either describe any corrections or clarifications needed to clearly present the parameter selections for these groups of inputs or provide revised tables.

BASIS: The entries for "Fraction of Water from SW (all uses including irrigation)"and "Fraction of Drinking Water from Well Water (all uses including irrigation)" in Table 3-5 in Appendix C of the DP (U.S. Army 2013b) are internally inconsistent because the "Fraction of Water from SW (all uses including irrigation)" (for all receptors except the offsite farmer) is set to 1.0; however the description states that all water is from a groundwater well. Also, the "Fraction of Drinking Water from Well Water (all uses including irrigation)" for the offsite farmer has a value of 1.0; however the description notes that the drinking water pathway from surface water resulted in a higher dose than well water (implying that the more conservative surface water selection should be used rather than well water). Additionally, the parenthetical for "all uses" associated with the "Fraction of Drinking Water from Well Water (all uses including irrigation)" table entry is confusing because drinking water is a single water use; therefore, the parameter selection as described could not apply to other uses. The conceptual model information in Figure 3-2 of Appendix C of the DP (U.S. Army 2013b) shows the onsite receptors obtaining water from a groundwater source while the offsite receptors obtain water from a surface water source (the opposite of the table entries). A RESRAD-OFFSITE output file for the offsite farmer receptor (PCZ) was checked and the selections for these receptor water use fractions were consistent with the information in Figure 3-2 of Appendix C of the DP (all water use for the offsite farmer is from surface water and none is from well water), suggesting that the entries in Table 3-5 of Appendix C of the DP contains inconsistent information. The corrections are needed to ensure that the DP clearly and consistently describes the exposure pathways that were evaluated in the RESRAD-OFFSITE dose calculations, which are incorporated by reference into Section 4.12.2 of the ER (U.S. Army, 2013a), so that the NRC staff can evaluate and accurately describe these calculations in the public and occupational health impact analysis in the EIS.

2.9.4 RAI POH-4

Provide a descriptive analysis of the effect of projected future climate change on the input parameters selected for the RESRAD-OFFSITE dose calculations that are documented in Section 4.12.2 of the ER (U.S. Army 2013a) and Chapter 4 and Appendix C of the DP (U.S. Army 2013b). This analysis should consider the results of surface water and sediment transport simulations requested in RAI WR-4 which address the following climate change influences: (i) the frequency and intensity of precipitation events, (ii) the frequency and intensity of floods, (iii) the ambient air temperature, and (iv) the ecosystem. The GCRP should serve as source for the climate change information. For example, the *Climate Change Impacts in the United States: The Third National Climate Assessment* (GCRP, 2014) provides climate information for the Midwest United States on the changes to precipitation, air temperature, storm events, and ecology.

The requested analysis should identify all RESRAD-OFFSITE input parameters that could potentially be impacted by the projected climate changes. For each parameter or group of like parameters in the subset of inputs that could be affected by climate changes, describe the direction of expected change (i.e., increase or decrease) and whether, based on the use of the input parameter in the RESRAD-OFFSITE model, the expected change would increase or decrease the calculated receptor dose. For each input parameter for which climate change is expected to increase the calculated dose, provide an estimate of the magnitude of the input parameter change and the resulting expected change in dose. If the change in dose cannot be clearly estimated, the code should be run to estimate the magnitude of the change. If the

results of the analysis indicate climate change could significantly increase the calculated doses to any receptor (i.e., increase the total dose by more than a factor of 2), then a separate set of RESRAD-OFFSITE dose calculations that incorporates the climate change input parameter changes should be run for all affected receptor scenarios. The results of this analysis and any new code runs should be documented in the RAI response or separate written report and provided with all applicable annotated code I/O files.

BASIS: As discussed in the BASIS disucssion for RAI POH-4 above, the CEQ's revised draft guidance on how Federal agencies should consider the effects of climate change in NEPA reviews (CEQ, 2014) explains that agencies should consider both the potential effects of a proposed action on climate change and the implications of climate change for the environmental effects of a proposed action. Therefore, the effects of climate change on the dose calculations should be evaluated to ensure the calculated doses are not being underestimated by not accounting for the projected future changes in the environment.

Additionally, EPA Region 5's EIS scoping comments (EPA, 2014) included recommendations to consider the effect of climate change on specific projected environmental impacts. Because climate change has the potential to change the environment in ways that could alter conditions potentially affecting the DU source term release, as well as the DU fate and transport and exposure to projected releases, the NRC staff believes it is important to evaluate whether projected climate change could affect the calculated doses that support the evaluation of potential public and occupational health impacts in the EIS. The NRC staff also believes that EPA Region 5 will be expecting discussion of the effects of climate change on potential environmental impacts to be included in the NRC's Draft EIS.

2.9.5 RAI POH-5

Provide additional RESRAD-OFFSITE dose calculations for the PCZ onsite and offsite farming scenarios that extend beyond 1,000 years to the time of peak groundwater uranium concentration and dose (hereafter referred to as time-extended base case runs). This analysis should consider the results of additional uranium transport modeling using the Vadose Zone Soil Column Model requested in RAI WR-1 above, which extend until the time of peak simulated uranium concentrations at the base of the soil column. The analysis should also consider the response to RAI WR-8 requesting an evaluation of the effect of crayfish burrows on vadose zone transport. If the responses to RAI WR-1 or RAI WR-8 result in permanent changes to any input parameters in the groundwater modeling used to make impact determinations in the ER and these parameters are comparable to RESRAD-OFFSITE input parameters (e.g., distribution coefficients, hydraulic conductivities), then equivalent input parameter value changes should also be incorporated into the RESRAD-OFFSITE time-extended base case runs requested in this RAI. If the comparable groundwater modeling inputs are only being changed temporarily to evaluate sensitivities in response to the water resource RAIs but are not being permanently changed in the modeling used to make impact determinations, then similar sensitivity test cases should be run using RESRAD-OFFSITE and these runs should be separate from the requested time-extended base case runs. The time period for the analysis should be selected so that the groundwater concentration peaks and then shows a decline. Report the peak or peak of the mean groundwater concentration and dose results and the time of the peak. Additionally, update the sensitivity analysis in Section 3.8.3 of Appendix C of the DP (U.S. Army, 2013b) to evaluate the sensitive parameters for the time-extended base case.

In addition, repeat the time-extended base case calculations with an adjusted "Computed Erosion Rate of the Contaminated Zone" input parameter to test the effect of erosion on the

groundwater pathway. For this test, use a "Computed Erosion Rate of the Contaminated Zone" that is either the default value for RESRAD-OFFSITE or compute the lowest erosion rate based on site conditions and the same calculation approach used for the dose modeling runs reported in Section 4.12.2 of the ER (U.S. Army, 2013a) and Chapter 4 and Appendix C of the DP (U.S. Army, 2013b).

For all sets of calculations requested above, provide RESRAD-OFFSITE groundwater concentration vs. time plots for each scenario that show the peak or peak of the mean concentration. Also provide all annotated code I/O files for the additional modeling, and describe the analysis and results in the response to this RAI or in a separate written report.

BASIS: Review of the RESRAD-OFFSITE output file Farmer_Onsite_SCZ_Left_SUMMARY.docx shows the drinking water dose at a low level but increasing until the simulation ends at 970 years. Based on the distribution coefficient K_ds for uranium used in the simulations of uranium transport through the soil column in the DU Impact Area in Appendix B of the ER (U.S. Army, 2013a), the average travel time of uranium in the loess-derived soil comprising the upper 0.6 m (2 ft) of the column model would be greater than 1,000 years. To date, the Army has not specified a date by which DU penetrators, DU fragments, and DU-contaminated soil would be removed from the DU Impact Area; and in Section 1.3.2 on page 1-7 of the ER (U.S. Army, 2013a), the Army states, "…the Army is not planning to conduct any cleanup, retrieval, or any other remedial activities regarding the approximate 73,500 kg [162,040 lb] of DU remaining in the DU Impact Area." Therefore, the NRC staff must assume for the EIS that the duration of the DU Impact Area site containing DU could exist over an undefined period of time that could be well beyond 1,000 years, and that uranium from the DU penetrators could travel through the soil column and eventually impact groundwater after 1,000 years. Providing the simulation results for the groundwater dose when it peaks would provide necessary information for the NRC's EIS about the full range of dose impacts from the proposed action.

The RESRAD-OFFSITE sensitivity analysis needs to be updated to evaluate the sensitivity of groundwater transport input parameters over the extended simulation time. This is needed because the lack of sensitivity detected for these input parameters in the sensitivity analysis in DP Appendix C, Section 3.8.3 (U.S. Army, 2013b) may have been the result of limited groundwater transport during the 1,000-year simulation time.

The contaminated zone erosion rate test is necessary because review of the RESRAD-OUTPUT file *Farmer_Offsite_PCZ_SUMMARY.docx* by the NRC staff indicates that the computed erosion rate of the contaminated zone (the layer of soil defined in the model as containing the uniformly mixed inventory of DU) would erode the entire 1-m (3-ft) depth of the contaminated zone in 810 years. This relatively fast erosion of the contaminated zone, which is fairly level ground and mostly covered with vegetation, may be conservative for the surface water pathway because the eroded material is an input to the modeled surface water body; however, it may not be conservative for the groundwater pathway (due to source depletion) and, therefore, the test results will provide additional information for the EIS about the effect of the erosion rate selection on the groundwater pathway concentration and dose results from the RESRAD-OFFSITE simulations.

2.10 CUMULATIVE IMPACTS (CI)

2.10.1 RAI CI–1

Provide the following information to support the NRC staff's evaluation of the potential cumulative impacts on the environment from the proposed action and the past, present, and ongoing presence of UXO at the JPG DU Impact Area and elsewhere at JPG north of the firing line:

- Status and Conclusions of JPG Environmental Restoration Programs and Similar Programs: Clarify the status and any findings and conclusions from any past and present JPG site environmental restoration programs and from similar evaluations or analyses (e.g., from other, similar sites) that are directly related to the current status of JPG with regard to any characterization of the potential past, present, and long-term hazards of UXO constituents at JPG and possible response actions or determinations. The expected UXO constituents include, but may not be limited to RDX (Royal Demolition Explosive), HMX (Her Majesty's Explosive), TNT (trinitrotoluene), DEGDN (diethylene glycol dinitrate), lead azide, lead styphnate, perchlorate, and mercury fulminate (ASI, 1993). The Army has provided the NRC with historical documentation of past site environmental restoration programs and related studies; however, within the context of these programs or any more recent programs, the ER (U.S. Army, 2013a) and the DP (U.S. Army, 2013b) do not provide any discussion of the present status of addressing potential UXO constituent hazards from the UXO that remains in place in the areas north of the firing line. Describe whether these potential UXO hazards currently fall under any existing Army site restoration programs that have been developed to investigate and evaluate possible response actions to areas of JPG (or similar sites) where potentially harmful substances such as explosive compounds have been released to the environment or could potentially be released to the environment in the future. If no applicable programs exist, then explain why. If the current JPG status with respect to UXO is based on decisions from past environmental restoration programs, then describe the applicable findings and documentation.

- Munitions Response Site Prioritization Protocol (MRSPP) Status: Provide information to clarify the MRSPP status of all JPG sites listed on DOD's Environment, Safety, and Occupational Health Network and Information Exchange (DENIX) website (DOD, 2013). The status of all JPG sites are presently listed on DENIX as "MRSPP evaluation no longer required," with no supporting discussion, documentation, or rationale. Provide any documented basis or bases for these conclusions and describe whether these conclusions have any bearing on the potential future long-term hazards from munitions constituents in the UXO at JPG that could overlap with potential impacts from the DU in the DU Impact Area.

- Monitoring and Mitigation: Clarify if any applicable environmental response programs would detect or mitigate potential future UXO constituent impacts at JPG. If applicable programs are described, emphasize any program requirements or processes that would serve to detect and/or mitigate potential future impacts from releases of UXO constituents into the environment and to locations outside the JPG boundary. For example, describe any planned commitments to monitor UXO constituents in various environmental media. Summarize any program analyses, findings, and conclusions with regard to the nature and magnitude of any current and future risks from potential release

and migration of UXO constituents. If no such programs or mitigations are planned, provide the rationale for this course of action.

BASIS: Information provided in the ER (U.S. Army, 2013a) and the DP (U.S. Army, 2013b) on the past and potential present and long-term hazards from munitions constituents from the UXO located within and surrounding the DU Impact Area at JPG is limited and insufficient for the NRC staff to evaluate the potential for cumulative impacts in the EIS. The Executive Summary on page v in the CEQ's "*Considering Cumulative Effects Under the National Environmental Policy Act* "(CEQ, 1997), CEQ regulations in 40 CFR 1508.7, and NRC guidance in Section 4.2.5.2 on page 4-12 of NUREG-1748 (NRC, 2003) define a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonable foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. The presence of the UXO left in place by the Army and that will be remaining in place at JPG within and surrounding the DU Impact Area would be considered a past, a present, and a reasonably foreseeable future action in relation to the proposed action that must be addressed by the NRC staff in the cumulative impact analysis in the EIS.

In addition, NRC guidance in Section 6.2.3 on page 6-5 and Section 6.4 and subsections starting on page 6-18 of NUREG-1748 (NRC, 2003) further describes NRC expectations that cumulative impacts will be evaluated in licensees' and applicants' environmental reports. However, Section 2.3 (Cumulative Effects) of the Army's ER (U.S. Army, 2013a) does not include an analysis of cumulative effects, and it instead identified no other actions as occurring simultaneously with the proposed action.

Therefore, the NRC staff is requesting clarification of the current status of Army assessments and applicable environmental restoration programs and similar programs to inform the NRC staff's cumulative impact assessment in the EIS. Based on its initial review of the available information on the status of potential UXO constituent hazards in areas north of the firing line at JPG, the NRC staff found that potential hazards have been identified to some extent, but the readily available information is limited and may not be current. A brief summary of the NRC staff's present understanding of the status of the Army's environmental restoration program efforts for areas north of the firing line at JPG is as follows.

- The Army's past JPG environmental restoration program documentation in the ER and DP (U.S. Army 2013a,b) referenced a preliminary investigation that previously identified the entire firing range area north of the firing line as an area requiring further environmental evaluation (AREE) based, in part, on the potential for release of hazardous substances to soil, groundwater, and surface water from UXO that may leak constituents into the environment (such as when casings are compromised by cracking or corrosion) (U.S. Army, 1990).

- Subsequent monitoring for explosive compounds in the DU Impact Area and vicinity has not detected explosive compounds in groundwater as of 2003 (U.S. Army, 2003b). Some explosive compounds were found in soil and surface water but were reported as being below levels of concern (U.S. Army, 2003b). While the 2003 levels of munitions constituents were found to be low or undetected, intact UXO are capable of containing explosive materials for long time periods before the canisters are compromised and releases to the environment are possible. While no information has been identified that characterizes the number of UXO that are intact at JPG, information from another

military range where UXO has been studied suggests it is possible that only a small fraction of UXO casings have been compromised (MMRCT, 2011). Therefore, the potential exists for a large portion of the UXO constituent inventory at JPG to be contained within intact UXO that are subject to degradation and subsequent releases of munitions constituents in the future.

- Constituents of the munitions tested at JPG have been documented (ASI, 1993) and include perchlorate, lead, mercury, and explosive compounds such as TNT, RDX, HMX, and DEGDN. Some of these munitions constituents are considered potentially harmful to human health (including renal and possible carcinogenic effects similar to those from DU) and the environment (DOD, 2002; EPA, 2005).

- Army analysis of historical records (including staff interviews) indicates historical test firing records are incomplete for most of the testing period at JPG and do not provide information on the types of munitions that would be located in specific areas of the site (MHSMCI, 1992; U.S. Army, 1990). The Army reported that physical surveys would be needed to obtain additional characterization information on UXO (MHSMCI, 1992; U.S. Army, 1997). The NRC staff understands that such surveys (e.g., Remedial Investigation/Feasibility Study) would have been conducted as a normal part of the Army environmental restoration program at JPG following the preliminary site investigations that were completed, as they have been done at other military sites; however, such detailed characterization studies appear to have been deferred at JPG based on UXO explosive hazards (U.S. Army, 1997). The Army has stated that the timeframe for an environmental investigation of areas north of the firing line is dependent on regulatory requirements, the level of safety that may be attained during an investigation, the UXO removal technology available to eliminate potential hazards, the identification of reuse options for the area, and the establishment of reuse-based cleanup levels (U.S. Army, 1997).

As indicated in the summary above, NRC review of the historical documentation of UXO at JPG suggests the information is limited and the status of future characterization and response actions is indeterminate.

Note also that in EPA Region 5's EIS scoping comments (EPA, 2014), on page 2 under the *Site Safety* section, the EPA expressed the concern that if environmental monitoring is not proposed, the NRC's EIS should provide rationale for the decision not to monitor, preferably using data from other, similar sites, and explain what plans are in place to ensure any future contaminant movement is remediated before migrating offsite. In addition, on page 2 under the *Remediation* section, the EPA expressed concerns about the weathering of UXO casings leaving hazardous contents susceptible to erosion, and requested descriptions in the NRC's EIS of existing or planned measures that will remediate or contain UXO and any other hazardous wastes. (EPA Region 5's comment went on to state that this may include implementing one or more non-hazardous passive waste treatment systems that are described in the EPA's "*Technology Reference Guide for Radioactively Contaminated Media"* [EPA, 2007b]). Thus, the NRC staff needs the information requested in the RAI to address EPA Region 5's concern.

2.10.2 <u>RAI CI-2</u>

Provide and describe any available data and information, from Army or other DOD field investigations at JPG or other, similar military sites, and/or from other Army or other DOD studies (e.g., laboratory, pilot-level, modeling, or theoretical studies), that could be used by the

Army, in response to RAI CI-3 below, to conduct a quantitative analysis of the present and long-term environmental impacts of leaving the UXO in place at JPG and that could be used by the Army as a basis for evaluating the cumulative impacts of the proposed action when added to any similar and additive past, present, or reasonably foreseeable impacts on the environment from leaving UXO in place at JPG. If no quantitative data and information are available for any of the categories listed below, then instead provide and describe available qualitative information.

- Data and information to determine or estimate the inventory within the watershed of the DU Impact Area of UXO constituents including, but not limited to RDX, HMX, TNT, DEGDN, lead azide, lead styphnate, perchlorate, and mercury fulminate.

- Data and information on the persistence, degradation, and transformation of munitions constituents under the environmental conditions at JPG or at similar sites.

- Data and information on the failure rate and/or the corrosion rate of ordnance casings under the environmental conditions at JPG or similar sites.

- Data and information on the mobility of munitions constituents in the environment under the environmental conditions at JPG or similar sites.

- Data and information on the toxicity to humans and the potential human health effects from exposure to munitions constituents, with emphasis on effects such as carcinogenicity and renal effects that are similar to the known effects of exposure to DU.

- Data and information on the toxicity to animals and the potential ecological impacts from exposure to munitions constituents, with emphasis on any potential effects that are similar to any known ecological effects associated with exposure to DU.

- Models for evaluating the environmental fate, transport, exposure, and health effects from munitions constituents (e.g., U.S. Army Corps ARAMS code or similar).

BASIS: Information provided in the ER (U.S. Army, 2013a) and the DP (U.S. Army, 2013b) on the past and potential present and long-term hazards from munitions constituents in the UXO located within and in areas surrounding the DU Impact Area at JPG is limited and insufficient for the NRC staff to evaluate the potential for cumulative impacts in the EIS. Following review of the available information on the status of potential UXO constituent hazards in areas north of the firing line at JPG, the NRC staff found that potential hazards have been identified, but the information is limited and may not be current. Additional details supporting the need for cumulative impact analyses addressing the potential present and long-term impacts of UXO constituents are provided in the first two paragraphs and the last paragraph of the BASIS for RAI CI-1 and are not repeated here. The data, information and descriptions requested in this RAI will help the NRC staff to understand and describe in the EIS the level of impact analysis that is possible using available data and information.

2.10.3 RAI CI-3

Provide a quantitative cumulative impact analysis that evaluates the impact on the environment that results from the incremental impact of the proposed action when added to any similar and additive past, present, or reasonably foreseeable impacts on the environment from leaving UXO

in place at JPG, both within and outside the DU Impact Area. The CEQ provides information on conducting cumulative impact analyses in "*Considering Cumulative Effects Under the National Environmental Policy Act* "(CEQ, 1997). The requested analysis should consider the potential impacts to the environment from UXO constituents that have been or could be released from damaged or degraded UXO casings into the environment during past, present, and future timeframes (determined based on the data and information collected or developed by the Army in response to RAI CI-2). The geographic scope of the analysis should be based on the overlapping impact regions for the proposed action and the potential UXO constituent impacts. For example, the geographic scope of the analysis would include the watershed of the DU Impact Area, to evaluate significant potential additive impacts from releases of DU and UXO constituents to shared soils and water resources. However, potential cumulative impacts to all resources that could be affected by both the DU in the DU Impact Area and the UXO constituents in and around the DU Impact Area need to be evaluated. The temporal domain of the analysis should encompass the time period of peak cumulative impacts.

In defining and assessing the cumulative impacts, the Army would need to first consider the direct and indirect impacts of the proposed action (i.e., the impact analyses in Chapter 4 of the ER (U.S. Army, 2013a), as supplemented by the Army's responses to the NRC staff's RAIs as applicable) and would need to determine the direct and indirect impacts of potential releases of UXO constituents (as indicated above). The Army would then need to identify those impacts of the proposed action and of the potential releases of UXO constituents that could overlap spatially and temporally and accumulate, affecting the same resources, and then combine the applicable additive impacts to derive total (cumulative) impacts and evaluate the level of intensity of these impacts.

In evaluating the direct and indirect impacts of potential releases of UXO constituents, in conjunction with the data and information collected or developed by the Army in response to RAI CI-2, the Army may utilize existing NEPA or other analyses that have previously evaluated these types of impacts either generically (programmatically) or at sites that have conditions similar to those at JPG. Any existing analyses used for this purpose should be scientifically credible, should have explicitly evaluated the past, present, and/or long-term potential impacts from the release of munitions constituents from UXO to the environment, and should have made clear conclusions about the potential human health and environmental impacts.

Although the Army will need to evaluate the potential for cumulative impacts to all affected resource areas in the requested impact analysis (see NUREG-1748 [NRC, 2003] for a complete list of resource areas), the NRC staff expects the assessment of impacts of potential UXO constituent releases on human and ecological health would be one of the most significant parts of the cumulative impact analysis. In specifically assessing the impacts of potential UXO releases on human and ecological health, if no applicable prior analyses are available, then the Army may utilize a quantitative assessment of the human and ecological risks from UXO constituents, an example of which would be a screening risk assessment comparable to the U.S. Army Center for Health Promotion and Preventative Medicine (USACHPPM) "*Training Range Site Characterization and Risk Screening, Regional Range Study, Jefferson Proving Ground, Madison, Indiana"* (U.S. Army, 2003b), with the exception that the measured environmental media concentrations of munitions constituents used in that study would be supplemented by the Army with estimated long-term media concentrations of munitions constituents. These estimated media concentrations should be based on an analysis of potential past, present, and future releases of UXO constituents following loss of UXO canister containment.

The level of impact analysis that can be conducted to support a cumulative impact assessment depends on the available data and information to support such an analysis. Additionally, only those potential impacts that are known and/or reasonably foreseeable need to be included in the analysis. The results of investigations and the data and information requested in RAIs CI-1 and CI-2 will inform the level of cumulative impact analysis that can be conducted and may provide insights about the impacts that are known and reasonably foreseeable. Regardless of the scope and level of detail of the analysis, any resulting impact conclusions must be based on credible scientific evidence and methods that are generally accepted within the scientific community. For the various impact analyses associated with past, present, and reasonably foreseeable UXO constituent releases supporting the cumulative impact assessment, if insufficient information is available for any particular resource area or areas to support quantitative impact analysis, the unavailability of sufficient quantitative data and information should be explained/documented by the Army, and a semi-quantitative or qualitative impact analysis approach should instead be conducted by the Army based on accepted scientific methods.

The results of the Army's cumulative impact analysis should be documented in a written report, including appropriate results tabulations, annotated modeling I/O files, graphics, etc., as necessary.

BASIS: Information provided in the ER (U.S. Army, 2013a) and the DP (U.S. Army, 2013b) on the potential past, present, and long-term impacts from munitions constituents from the UXO remaining within and in the areas surrounding the DU Impact Area at JPG is very limited and insufficient for the NRC staff to evaluate the potential for cumulative impacts of the proposed action and reasonable alternatives to the proposed action. Based on its review of the available information on the status of potential UXO constituent hazards in areas north of the firing line at JPG, the NRC staff has found that potential hazards have been identified but information is limited and may not be current, and no applicable analyses of impacts with impact conclusions have been identified.

The Army's past JPG environmental restoration program documentation in the ER and DP includes a preliminary investigation that previously identified the entire firing range area north of the firing line as an area requiring further environmental evaluation (AREE) based, in part, on the potential for release of hazardous substances to soil, groundwater, and surface water from UXO that may leak constituents into the environment (such as when casings are compromised by cracking or corrosion) (U.S. Army, 1990).

Additional details supporting the need for cumulative impact analyses addressing the potential impacts of UXO constituents are provided in the first two paragraphs and the last paragraph of the BASIS for RAI CI-1 and are not repeated here. The requested cumulative impact analysis is needed to support the NRC staff's evaluation of cumulative impacts in the EIS.

2.10.4 RAI CI-4

Provide the basis for or clarify the statement in Section 3.11.4 on page 3-43 of the ER (U.S. Army, 2013a) that significant sources of chemical (non-radiological) exposure were confined to the cantonment area and are not applicable to the DU Impact Area.

BASIS: The Army's past JPG environmental restoration program documentation referenced in the ER (Montgomery Watson Harza [MWH], 2002 in Section 3.11.4 on page 3-43) referenced a preliminary investigation that previously identified the entire firing range area north of the firing

line as an area requiring further environmental evaluation (AREE) based, in part, on the potential for release of hazardous substances to soil, groundwater, and surface water from UXO that may leak constituents into the environment (such as when casings are compromised by cracking or corrosion) (U.S. Army, 1990). The clarification is needed to ensure the descriptions of the potential sources of chemical exposures within the DU impact area are correctly described and evaluated in the EIS.

2.10.5 __RAI CI-5__

Provide information about the potential for the USFWS controlled burns to accelerate the breakdown of DU penetrators and whether and specifically how these controlled burns could affect the magnitude of public health and safety impacts from DU as reported in Section 4.12 of the ER (U.S. Army, 2013a). This can include both qualitative and quantitative information. For example, describe (i) the frequency of the USFWS controlled burns and their expected temperature range and duration; (ii) whether the burn conditions are sufficient to affect the integrity of the DU penetrators including the formation and behavior of their corrosion products (e.g., due to changes in oxidation states and other chemical and physical mechanisms); (iii) whether changes to the rate of physical breakdown of penetrators or characteristics of DU corrosion products could significantly affect Army dose estimates including any possible effects on airborne releases of DU; and (iv) any resulting effects on airborne concentrations of DU and public and occupational health.

__BASIS__: The USFWS conducts periodic controlled burning of vegetation at JPG, including the DU Impact Area (see Section 4.6 of the ER [U.S. Army, 2013a]). Concerns have been expressed by stakeholders about uranium transport in the smoke (for example, see Hill, 2014); and these concerns need to be addressed in the NRC's EIS. Although not part of the Army's proposed action, the controlled burns would be considered past, present, and reasonably foreseeable future actions for purposes of the EIS, the impacts of which would need to be addressed in the cumulative impacts analysis. Therefore, an understanding of the potential thermal effects of the USFWS controlled burns on the DU penetrators and their corrosion products is needed for the NRC staff to conduct an adequate assessment in the EIS of the cumulative environmental impacts to public and occupational health associated with the USFWS controlled burns. Additional details supporting the need for cumulative impact analyses are provided in the first two paragraphs and the last paragraph of the BASIS for RAI CI-1 and are not repeated here.

2.11 MITIGATION MEASURES (MM)

2.11.1 __RAI MM-1__

Provide information describing plans that are in place to ensure that future contaminant movement from DU and UXO is identified and remediated before migrating offsite (i.e., off the JPG property), or provide justification that such plans are not needed.

__BASIS__: In EPA Region 5's EIS scoping comments (EPA, 2014), on page 2 under the *Site Safety* section, the EPA stated, "If environmental monitoring is not proposed, …explain what plans are in place to ensure any future contaminant movement is remediated before migrating offsite." Because the Army's proposed action (as described in the ER [U.S. Army, 2013a] and DP [U.S. Army, 2013b]) includes discontinuation of environmental monitoring upon license termination, the NRC staff needs the requested information to address EPA Region 5's concern

about remediation of potential future offsite contaminant migration from the DU and UXO remaining onsite.

2.11.2 RAI MM-2

Provide information to describe existing or planned measures that will remediate or contain the DU, UXO, and any other hazardous wastes at the JPG site, or provide justification that such measures would not be needed.

BASIS: In EPA Region 5's EIS scoping comments (EPA, 2014), on page 2 under the *Remediation* section, the EPA stated, "NRC's draft EIS should describe existing and planned measures that will remediate or contain the UXO [and DU] and any other hazardous wastes at JPG. This may include implementing one or more non-hazardous passive waste treatment systems that are described in *Technology Reference Guide for Radioactively Contaminated Media* (EPA, 2007b). Regarding the addition of DU to the EPA's comment, the NRC staff learned from a subsequent discussion with EPA Region 5 staff that the comment was also meant to include DU. The NRC staff needs the requested information to address EPA Region 5's request that the Draft EIS describe existing or planned measures that will remediate or contain the DU, UXO, and any other hazardous wastes at JPG.

2.12 COST-BENEFIT (CB)

2.12.1 RAI CB-1

Clarify the frequency for conducting JPG perimeter fence inspections and provide the associated cost of conducting these inspections.

BASIS: NRC regulations in 10 CFR 51.71(d) state that EISs will include a consideration of the benefits and costs of the proposed action and alternatives. Institutional controls will be a part of the proposed action and all other alternatives evaluated in detail in the EIS. The highest estimated cost for an aspect of the Army's proposed institutional controls in Appendix F of the DP (U.S. Army, 2013b) is for the perimeter fence inspection. The perimeter fence inspection cost in DP Appendix F is based on biweekly (i.e., once every two weeks) inspections. However, the descriptions of institutional controls in Section 3.11.7.1 of the ER (U.S. Army, 2013a) and in the MOA between the Army, USFWS, and USAF (Appendix B in the DP [U.S. Army, 2013b]) state that perimeter fence inspection occurs weekly. Cost is a function of inspection frequency, and the correct information is needed so that an accurate description of the JPG perimeter fence inspection frequency and associated costs can be included in the cost-benefit analysis in the NRC's EIS.

2.12.2 RAI CB-2

Provide a breakdown of the annual costs for conducting the current semi-annual ERM Program (two sampling events and one report per year), as described in Section 2.1.1 of the ER (U.S. Army, 2013a). Also provide a breakdown of the annual cost for conducting a single ERM sampling event and associated report per year.

BASIS: NRC regulations in 10 CFR 51.71(d) state that EISs will include a consideration of the benefits and costs of the proposed action and alternatives. Also, in accordance with CEQ regulations in 40 CFR 1502.14(d), EISs will analyze the no-action alternative, which in the case of the JPG project would be license continuation. In addition, the NRC's EIS for the proposed

JPG DU Impact Area license termination may analyze a "license termination with continued monitoring" alternative as a reasonable alternative to the Army's proposed action. The monitoring frequency for this alternative may vary from that under the current ERM program. Knowledge of the breakdown of costs for the current semi-annual ERM program and for conducting a single sampling event and associated reporting provides information needed for the NRC staff to distinguish between the costs of the various alternatives to be analyzed in detail in the NRC's EIS and to conduct the required cost-benefit analysis.

2.12.3 RAI CB-3

Provide a breakdown of all costs associated with the no-action alternative (i.e., license continuation) excluding the costs for conducting the ERM program (the costs of which are the topic of RAI CB-2). The requested cost breakdown would include, but may not be not limited to the costs for implementing the institutional controls and the Radiation Safety Program, the costs for conducting annual reviews and audits of radiation related JPG site activities and policies, and any fees paid to the NRC such as licensee fees and inspection fees.

BASIS: NRC regulations in 10 CFR 51.71(d) state that EISs will include a consideration of the benefits and costs of the proposed action and alternatives. Also, in accordance with CEQ regulations in 40 CFR 1502.14(d), the EIS will analyze the no-action alternative (i.e., license continuation in the case of the JPG DU Impact Area). The Army currently incurs costs from activities supporting the Army's compliance with and NRC oversight of Materials License SUB-1435, which would be equivalent to the costs associated with the no-action alternative. The Army's quantitative description of the costs for the no-action alternative in Section 7.1 of the ER (U.S. Army, 2013a) is limited to a reference to the proposed action's costs for specified institutional controls in Section 7.2 of the ER (U.S. Army, 2013a). However, text in ER Section 7.1 indicates that the institutional controls for the no-action alternative may differ from those for the proposed action. The requested costs, which are associated with the no-action alternative, are needed so that an accurate description and presentation of these costs can be included by the NRC staff in the cost-benefit analysis in the EIS.

2.12.4 RAI CB-4

Provide a breakdown of the costs incurred by the Army for the 5-year reviews to ensure the institutional controls are in place and continue to function in accordance with NUREG-1757, Volume 1, Revision 2, Appendix M, Section M.1.1 and Table M.1 (NRC, 2006).

BASIS: NRC regulations in 10 CFR 51.71(d) state that EISs will include a consideration of the benefits and costs of the proposed action and alternatives. The NRC staff acknowledges that for the proposed action, the Army is requesting not to conduct the five-year reviews identified above in the RAI (see Section 2.1.2 of the ER [U.S. Army, 2013a]). However, it is yet to be determined whether this request would be granted by the NRC. In addition, the EIS may analyze a "license termination with continued monitoring" alternative that may also include the five-year reviews. Therefore, costs for the five-year review activity are needed so that an accurate description and costs can be included in the cost-benefit analysis in the NRC's EIS.

2.12.5 RAI CB-5

Clarify whether the institutional controls specified in the cost estimates in Section 7.2 of the ER (U.S. Army, 2013a) and Appendix F of the DP (U.S. Army, 2013b) address all of the institutional controls specific to the Army's proposed action (i.e., license termination under restricted

conditions) in a case in which the MOA between the U.S. Army, USFWS, and USAF (Appendix B of the ER [U.S. Army, 2013a]) is terminated. Specifically, if the MOA is terminated, what activities would the Army then need to perform to implement, support, and maintain institutional controls and access control within the JPG site. Describe the activities and provide a breakdown of the costs for any of these activities not already addressed in Section 7.2 of the ER and Appendix F of the DP.

BASIS: NRC regulations in 10 CFR 51.71(d) state that EISs will include a consideration of the benefits and costs of the proposed action and alternatives. Institutional controls will be a part of the proposed action and of other alternatives analyzed in detail by the NRC staff in the EIS. The institutional controls described in Section 7.2 of the ER (U.S. Army, 2013a) and Appendix F of the DP (U.S. Army, 2013b) appear to be limited to the JPG site perimeter. However, the institutional controls associated with the proposed license termination under restricted conditions described in Section 1.3.2 of the ER (U.S. Army, 2013a) also include institutional controls within the JPG site to restrict access to the DU Impact Area as specified in the MOA (Appendix B of the ER [U.S. Army, 2013a]). The MOA identifies many responsibilities (e.g., activities, programs, functions) that the USAF and USFWS are required to conduct. The MOA also specifies that the USAF and USFWS are responsible for the cost of these responsibilities unless otherwise arranged. It is unclear which, if any, responsibilities the Army would need to perform to implement institutional controls and control access within the JPG site if the MOA is terminated. The institutional controls described in the MOA include administrative mechanisms (e.g., oversight responsibilities for controlling access), physical mechanisms (e.g., gates and signage), and associated infrastructure maintenance. Identification of institutional controls within the JPG site and a breakdown of their associated costs are needed so that an accurate description can be included in cost-benefit analysis the NRC's EIS.

3 ADDITIONAL INFORMATION NEED - ER AND DP FIGURES FOR THE EIS

Revised figures (maps, drawings, graphs, charts, photographs, etc.) from the ER (U.S. Army 2013a) and DP (U.S. Army, 2013b) are not required to complete the NRC staff's analysis for the environmental review. However, certain ER and DP figures provided in a different format would significantly aid in the NRC staff's development of the EIS, because: (i) most, if not all figures from the ER and DP used in the published Draft and Final EIS will first need to be modified, and (ii) per NRC publication guidelines, all figures in the published Draft and Final EIS must be clear, legible, and understandable when printed in black and white. Therefore, provide all of the figures in the ER main text (not including appendices except as otherwise specified), ER Appendix D Figure 2-1, ER Appendix E Figure 2-5, and DP Figure ES-5, DP Figure ES-6, and DP Figure 2-1 in their original digital form for the NRC staff's use in developing the EIS. For photographs, provide original copies in a .jpg format. Figures that are not needed for this request are ER Figures 6-9, ER Figures 6-14 through 6-17, ER Figures 6-21 through 6-25, and ER Figures 6-27 through 6-37. For figures developed by the Army/Leidos with drafting software, it is requested that those figures are provided in a non-flattened or non-compressed format in a high-quality grey scale and resolution. It is further requested that the figures provided do not contain figure numbers or titles. In addition, font sizes used in the figures should be adjusted if needed so that the text in each figure will be legible in the EIS.

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