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FINAL OPERATIONAL RANGE ASSESSMENT PROGRAM REPORT UNITED STATES ARMY GARRISON FORT A.P. HILL, VIRGINIA

To meet Department of Defense (DOD) requirements and support the United States (U.S.) Army's Sustainable Range Program, the Army is conducting assessments to determine whether a release or substantial threat of release of munitions constituents of concern (MCOC) from an operational range to an off-range area creates a potentially unacceptable risk to human health of the environment. The initial assessment – Phase I – was a qualitative evaluation of whether (a) a MCOC source existed on the operational range footprint, (b) there is a potential migration mechanism, and (c) human or sensitive ecological receptors are present. For the operational range footprints having a potentially complete source-receptor pathway, the Army conducted a Phase II, a quantitative assessment of potentially complete pathways of MCOC. This ORAP Phase II Report presents evaluation of source-receptor pathways at United States Army Garrison Fort A.P. Hill, Virginia. EA Engineering, Science, and Technology, Inc. (EA) conducted this evaluation under contracts W912DR-05-D-0008 and W912DR-09-D-0018 to the U.S. Army Corps of Engineers (USACE)-Baltimore District.

Initially, the ORAP Phase II establishes whether the source-receptor pathway identified during Phase I is complete or new information has been identified that would impact the Phase I's conclusions. To determine whether MCOC are potentially leaving an operational range footprint by an identified pathway (e.g., groundwater or surface water) and pose a potential risk to off-site receptors, the Phase II considers existing and any new sampling data. The ORAP team may accomplish Phase II through reevaluating existing literature (e.g., prior sampling and/or reports), modeling, and/or collecting additional samples. In Fort A.P. Hill's Phase II report, available information was used to establish a weight-of-evidence case that determines whether there has likely been release from the operational range footprint that may pose a potentially unacceptable risk to an off-range receptor.

Fort A.P. Hill occupies 75,794 acres in the eastern portion of Caroline County, Virginia, and is located approximately 20 miles southeast of Fredericksburg, Virginia. The Installation is bordered to the west by State Highway 2, to the north and east by U.S. Highway 17, and is bisected by U.S. Highway 301. The city of Bowling Green and the town of Port Royal lie outside the Installation to the southwest and northeast, respectively.

The Phase I was completed for Fort A.P. Hill in 2006. All 228 operational ranges were evaluated under the Phase I Assessment. The ranges were categorized as either "Unlikely" (MCOC are unlikely to migrate to off-range receptors at concentrations that pose an unacceptable risk), or "Inconclusive" (a determination could not be made based on readily available information). The Phase I concluded that current and/or historical sources of potential MCOC from 100 operational ranges have the potential to migrate off-range at levels that pose an unacceptable risk to off-range human and/or ecological receptors. These ranges were, therefore, categorized as Inconclusive for evaluation under the Phase II.

Seven watersheds comprise the Inconclusive range areas, but five were selected as representing the worst-case source, pathway, and receptor conditions and were, therefore, the focus of the investigation. EA conducted the Phase II multi-season field sampling events in the Inconclusive range complex during March, April, July, and August 2009 (Initial 2009 Investigation). Based on analytical data from those sampling events and supplementary information obtained from Installation personnel, an additional investigation was performed within White Lake Watershed, using the same multi-seasonal approach, in September 2010 and April 2011 (Expanded White Lake Investigation).

During the Initial 2009 Investigation, surface water, sediment, and groundwater samples were collected and analyzed for explosives, metals, and water quality parameters (pH, temperature, conductivity, oxidation-reduction potential, dissolved oxygen). Matrix-specific analytes included perchlorate and hardness in surface water; total organic carbon and simultaneously extracted metals / acid-volatile sulfides (SEM/AVS) in sediment; and perchlorate, hardness, and total dissolved solids in groundwater. Benthic macroinvertebrate populations and habitats were also assessed during the Initial 2009 Investigation.

Sample results were compared to reference concentrations and to applicable screening levels (Range and Munitions Use Subcommittee [RMUS] and State of Virginia). For surface water and sediment, sample results were screened against reference concentrations using the Student's t-test and against screening levels using a 95 percent upper confidence limit of the mean (UCLM) sample concentrations. For groundwater, individual sample results were screened against reference concentrations and to a range of uncertainty around screening levels. The range of uncertainty was calculated as an order of magnitude above and below the screening level for organic compounds, or based on combined accuracy and precision values for inorganic compounds.

For human health, one groundwater sample concentration for total lead was reported above the range of uncertainty in the Smoots Run Watershed. The corresponding dissolved lead value was below the range of uncertainty. As a human health risk assessment would only consider dissolved values for transport of groundwater to potential off-range receptors, there is no unacceptable risk to human health associated with this MCOC detection. The 95 percent UCLM concentration of cyclotrimethylenetrinitramine (RDX) exceeded the potable water screening level for surface water at one location in the White Lake Watershed. Based on this exceedance and updated information from Installation personnel, the Expanded White Lake Investigation, consisting of additional surface water and sediment sampling, was completed. No 95 percent UCLM concentrations of MCOC for surface water or sediment exceeded screening levels, at locations that were sampled as part of the expanded investigation.

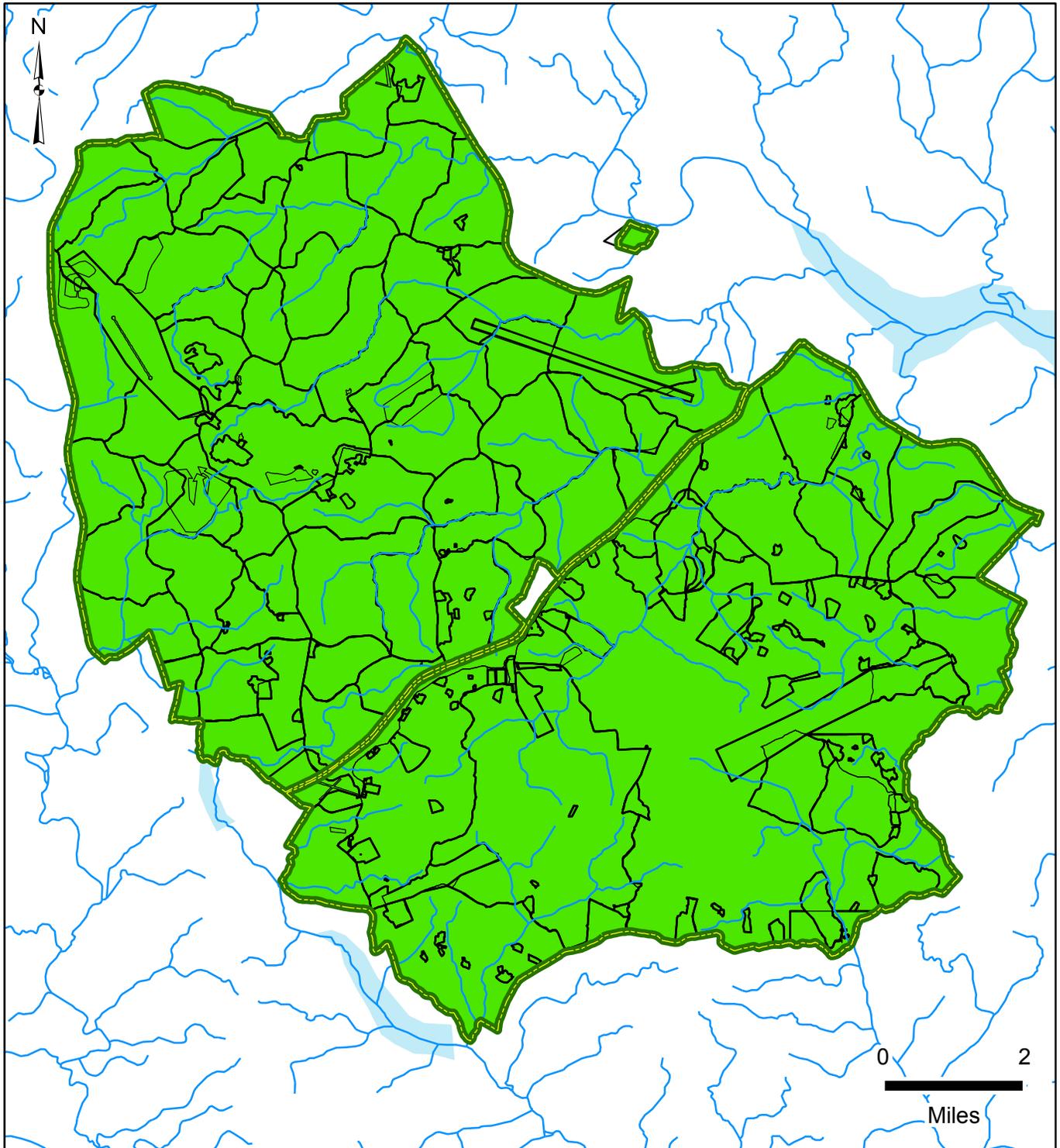
For ecological receptors, several sediment SEM/AVS ratios were in excess of 1.0, indicating that the aquatic community may be impaired; however, when the ratios were normalized with the fraction of organic carbon (foc), only one value in Mill Creek Watershed exceeded 130, indicating that divalent metals may, or may not, cause direct toxicity to benthic organisms. Additionally, there were no 95 percent UCLM exceedances of ecological screening levels in surface water and sediment, and the results of the benthic macroinvertebrate survey indicated optimal to sub-optimal habitat conditions with no overall degradation to the benthic populations. Therefore, there is no unacceptable risk to the environment associated with these metrics and MCOC detections. SEM/AVS was not analyzed during the Expanded White Lake Investigation as there was no unacceptable ecological risk to the White Lake Watershed environment found during the Initial 2009 Investigation.

Based on the data collected during the Initial 2009 Investigation and Expanded White Lake Investigation, no unacceptable off-range risks to human health or the environment were identified from MCOC migrating from operational ranges at Fort A.P. Hill. The Inconclusive ranges in the seven Inconclusive watersheds should be re-categorized as Unlikely and subjected to a periodic review under the ORAP (**Figure 1**).

Operational Range Assessment Program
Phase II Quantitative Assessment
Fort A.P. Hill, VA



Figure 1
Phase II Conclusions



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|--------------------------|-----------------------|------------------|
| Installation Data | Range Category | Hydrology |
| Installation Boundary | Unlikely | River/Stream |
| | | Waterbody |

Data Sources:
ARID-GEO May 2006
ESRI Streetmap 2006

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