FINAL

PHASE I REMEDIAL INVESTIGATION REPORT

FOR THE

ERIE BURNING GROUNDS AT THE RAVENNA ARMY AMMUNITION PLANT RAVENNA, OHIO

Prepared for

US Army Corps of Engineers®

U.S. Army Corps of Engineers – Louisville District
Contract No. DACA62-94-D-0029
Delivery Order 0072

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ABBREVIATIONS

amsl	above mean sea level
AOC	area of concern
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	chemical of concern
COPC	constituent of potential concern
DNB	dinitrobenzene
DNT	dinitrotoluene
DoD	U.S. Department of Defense
DQO	Data Quality Objective
EBG	Erie Burning Grounds
EDQL	Ecological Data Quality Level
EPA	U.S. Environmental Protection Agency
ERA	ecological risk assessment
FS	Feasibility Study
GOCO	government-owned, contractor-operated
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HQ	hazard quotient
HTRW	Hazardous, Toxic, and Radioactive Waste
IAP	Installation Action Plan
IEUBK	Integrated Exposure Uptake Biokinetic (Model)
IRP	Installation Restoration Program
LCS	laboratory control standard
MCX	Mandatory Center of Expertise
MRD	Missouri River Division
MS	matrix spike
MSD	matrix spike duplicate
NOAA	National Oceanic and Atmospheric Administration
NT	nitrotoluene
OE	ordnance and explosive
Ohio EPA	Ohio Environmental Protection Agency
OHARNG	Ohio Army National Guard
OSC	Operations Support Command
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PRG	preliminary remediation goal
QA	quality assurance
QA/QC	quality assurance/quality control
QC	quality control
QCSR	Quality Control Summary Report
RBSC	risk-based screening concentration
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RI	Remedial Investigation
RRSE	Relative Risk Site Evaluation
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan

SCM	site conceptual model
SRC	site-related contaminant
SVOC	semivolatile organic compound
TAL	Target Analyte List
TEL	Threshold Effects Level
TNB	trinitrobenzene
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USCS	Unified Soil Classification System
UXO	unexploded ordnance
VOC	volatile organic compound

EXECUTIVE SUMMARY

This Phase I Remedial Investigation (RI) Report characterizes the occurrence and distribution of contamination in soil, sediment, and surface water and evaluates potential risk to human health and the environment resulting from operations at the Erie Burning Grounds (EBG) at the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio. The EBG, designated as Area of Concern (AOC) RVAAP-002, was in operation from 1941 to 1951. This characterization is Step 1 of a phased approach, in accordance with the RVAAP CERCLA process. The Phase I characterization area covers approximately 14.2 hectares (35 acres) and encompasses the known operational area of EBG. The site was used to conduct open burning of explosives and related materials. Prior to purchase by the Army in 1940, the site may have been used for brick manufacturing (Jacobs Engineering 1989). Bulk, obsolete, or nonspecification explosives and propellants, rags, and Army railcars used for transporting explosives across the installation were treated at EBG.

HISTORY AND CURRENT SITE CONDITIONS

Prominent AOC features and former operational facilities at EBG are

- the Track 49 rail spur and embankment,
- the former waste chute and burn area on the north side of Track 49,
- the three pairs of water-filled trenches and intervening burn area known as the T-Area,
- a borrow area between Tracks 10 and 49 that may have been a burn/disposal area, and
- the gravel access road and parking/staging area on the east side of the site.

Materials slated for thermal destruction were brought into EBG either along the Track 49 spur or the gravel access road. Thermal destruction is known to have occurred in the T-Area and burn area north of Track 49. Activities may also have been performed in the former borrow area, on Track 49 itself, and in a wooded area located south of the T-Area.

Potential sources of contamination are the ash residues from the burning of trinitrotoluene (TNT), dinitrotoluene (DNT), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), and other explosives and propellants. These residues potentially contain small amounts of associated metals (e.g., chromium, lead, and mercury). Other sources may include the rail beds themselves, which are underlain by metal-rich slag and constructed with creosote-covered railroad ties, and the access road, which also contains slag material.

A large portion of EBG is currently submerged. Water has accumulated in four surface water basins since the early 1990s as a consequence of beaver activity, reaching a maximum depth of 1.5 meters (5 feet). Surface water enters the site from the north and east, along Blackberry Lane, and exits at a culvert at the southwest corner.

OBJECTIVES

The overall purpose of this RI Report is to assess the occurrence and distribution and potential risk for contamination in soil to a depth of 0.9 meter (3 feet), sediment, and surface water. The specific objectives of the Phase I RI are to

- determine the potential types and sources of contamination at EBG, using historical process information and previous sampling data to establish Phase I RI samples for soil, sediment, and surface water media within EBG;
- identify whether releases of contamination beyond the AOC are occurring by collecting environmental samples (surface water and sediment) downstream of the AOC boundary;
- perform a risk evaluation to determine the potential magnitude of risk associated with any contamination detected and if additional investigation is warranted; and
- provide preliminary recommendations for any additional investigations and/or actions.

Sampling to depths greater than 0.9 meter (3 feet) was not conducted (with the exception of two stations) considering the shallow depth of the water table (only a few feet in most areas), the presence of a hardpan or bedrock at shallow depths in many areas, and data use/quality objectives for the Phase I RI. Where areas are identified as having elevated surface soil or shallow subsurface soil contamination, follow-on subsurface soil sampling may be conducted; if site conditions allow, under a subsequent phase of investigation.

PAST AND CURRENT INVESTIGATIONS

Previous studies of EBG consist of collection and analyses of five soil samples in 1982 by Mogul Corporation (locations unknown) (Mogul Corp. 1982), 12 years (1980–1992) of water quality data from a stream sampling station that drains a large area including EBG (USATHAMA 1980–1992), and collection of two surface water and sediment samples as part of a relative risk site evaluation conducted in 1996 (USACHPPM 1996). Small quantities of metals were identified in surface water and sediment samples collected within EBG during previous sampling efforts; however, these data were insufficient for determining the occurrence and distribution of contamination or for evaluating potential risk. In addition, minor quantities of metals and RDX (one detected value) were observed in surface water at one location near the RVAAP boundary (PF534).

Additionally, annual stormwater sampling is conducted each Fall at three facility outfalls, including PF-534. The samples are tested for toxicity to *Ceriodaphnia dubia* (water flea) and *Pimephales promelas* (fathead minnow) larvae. Analyses for metals and explosives are also conducted. The most recent data (August 2000) show no toxicity or detectable explosives at PF-534. Magnesium was the only metal detected above background levels.

The Phase I RI addresses the identified data gaps to meet the following objectives:

- **Source Area Soil.** Potential source areas and contaminant accumulation points were the specific focus of the Phase I RI sampling effort. Biased sampling of soil in the T-Area, along Track 49, the former burn area, the borrow area, and along the access road was planned to target areas where soil contamination was most likely to be present. Additional soil samples were planned in the wooded area south of the T-Area.

- **Sediment.** Site conditions and operational data suggest that low-lying areas (i.e., surface water basins), stream channels, and T-Area ditches are the most likely areas for contaminant accumulation due to transport of eroded soil in storm runoff. The former stream channel that bisected the AOC may have been an accumulation point for site runoff and eroded soil during the operational period for EBG. Also, sediment may function as a transport mechanism because contaminants adsorbed to particulates can be mobilized by surface water flow. Accordingly, these areas were targeted for biased sediment sampling.

- **Surface Water.** Site conditions show that the culvert beneath Track 10 is the current exit pathway for surface water from EBG. Potential contaminants would be expected to leach or erode from source areas into surface water, particularly along the T-Area ditch lines and surface water basins. These areas were specifically targeted for sampling. One location at the RVAAP boundary (PF534) and one additional station along the perennial stream below EBG (station EBG-116) were also sampled. One additional sample was collected along a tributary draining the strategic ore pile storage area (station EBG-117) to distinguish any potential surface water impacts due to EBG from those potentially associated with the ore piles.

- **Groundwater.** Minor quantities of metals were observed in sediment within EBG; therefore, definitive analytical evidence did not exist prior to this Phase I RI for source contamination (i.e., in soil and sediment). Accordingly, groundwater characterization was not identified as a data quality objective (DQO) for the Phase I RI. The potential for leaching of contaminants to groundwater is evaluated in this Phase I RI based on the newly acquired source area characterization data.

These objectives were met through the field activities conducted in August and September 1999. Field investigation activities at EBG included ordnance and explosives (OE) field reconnaissance, surface and subsurface soil sampling, surface water sampling, and sediment sampling.

AVAILABLE DATA

The environmental database for the EBG Phase I RI includes only those data obtained from the field activities conducted in 1999. Historical data did not have sufficient quality documentation for use in this Phase I RI. The data collected under this Phase I RI include

- 59 surface soil samples,
- 42 subsurface soil samples,
- 86 sediment samples, and
- 18 surface water samples.

DISTRIBUTION AND OCCURRENCE OF CONTAMINATION

The RI evaluated the occurrence and contamination in four media: surface soil [from 0 to 0.3 meter (0 to 1 foot) below ground surface (bgs), subsurface soil [from 0.3 to 0.9 meter (1 to 3 feet)], sediment, and surface water. The results of this evaluation are summarized by medium.

Surface Soil

- Explosives occur along the Track 49 embankment, the gravel access road, at isolated locations on the north and east legs of the T-Area, the former borrow area, and the former burn area. No explosives were found in the wooded area south of the T-Area or on the west leg of the T-Area. 2,4,6-TNT was the most pervasive explosive detected in surface soil. The maximum concentration of 2,4,6-TNT was

7.1 mg/kg at station EBG-008 in the Track 49 embankment area. The propellant nitrocellulose was detected in four surface soil samples, with no apparent pattern of distribution.

- Inorganics are pervasive in surface soil. Aluminum, arsenic, chromium, manganese, nickel, and vanadium were detected in 100 percent of the surface soil samples, but they occurred above background in less than about 30 percent. Barium, copper, lead, and zinc were detected in 100 percent of the samples and were above background in at least 50 percent of the samples. Antimony and mercury were detected about 30 percent of the time, but nearly all detects exceeded background. The highest concentrations are associated with the former burn area, Track 49 embankment, and T-Area.

- SVOC contamination was primarily bis(2-ethylhexyl)phthalate and was limited to the wooded area south of the T-Area and gravel access road. Polynuclear aromatic hydrocarbons (PAHs) were detected along the Track 49 embankment, the gravel access road, and the north leg of the T-Area. Volatile organic compounds (VOCs) (acetone and methylene chloride) were sporadically detected. Polychlorinated biphenyl (PCB) compounds were not detected.

Subsurface Soil

- Explosives in subsurface soil occur mainly along the Track 49 embankment and gravel access road. The distribution of explosives was much less extensive in subsurface soil than in surface soil. The most frequently detected explosive was 2,4,6-TNT (3 detections out of 42 samples). Other explosives were detected in one or two samples. The propellant nitrocellulose was detected once. The maximum concentration of 2,4,6-TNT occurred at station EBG-008 at about one-half the surface soil concentration.

- Inorganics are pervasive in subsurface soil. Aluminum, arsenic, barium, chromium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc were detected in 100 percent of the subsurface soil samples. As with surface soil, the Track 49 embankment, gravel access road, and T-Area were the primary areas of metals contamination. Concentrations above background are lower in subsurface soil than in surface soil.

- Semivolatile organic compound (SVOC) contamination consists of bis(2-ethylhexyl)phthalate on the gravel access road, the wooded area south of the T-Area, and along Track 49 embankment. PAH compounds were detected at three stations on the Track 49 embankment and at one station on the gravel access road. VOCs (acetone, toluene, and methylene chloride) were sporadically detected. No PCB compounds were detected.

Sediment

- The Track 49 embankment and the staging/parking area closest to the eastern terminus of the spur represent the primary sources for metals, likely due to the presence of metal debris and abundant slag that was placed as ballast material. Additionally, the Track 49 embankment contains explosives and PAHs.

- No explosives were detected in T-Area sediment samples, with the exception of two stations located closest to the Track 49 embankment. Metals above background levels in the T-Area primarily exist along the north leg closest to Track 49. Mercury is present almost exclusively in the T-Area (northern and eastern legs). Sediment contamination is minimal in the western leg of the T-Area.

- The former burn area contains comparatively high numbers and concentrations of site-related metals, as well as explosives, PAHs, and the maximum concentration of bis(2-ethylhexyl)phthalate (1.3 mg/kg).

- Of the four surface water basins, the north and east basins exhibited the majority of detected constituents above background. The west and south basins contained few contaminants above background levels.

- Several metals were above background criteria at the north and east inlets, suggesting some potential for contaminant flux into EBG from upstream areas. Alternately, runoff from the gravel roadbed and deterioration of the galvanized culverts at these locations may contribute metals to sediment near the pipes.

- At the EBG outlet, one explosive (nitrobenzene) was detected. Nickel was the only inorganic constituent detected above background. No explosives or metals above background were identified at station EBG-120, a short distance downstream of the outlet.

- No explosives or SVOCs occurred at off-site stations EBG-114 at PF534, EBG-116 (EBG drainage way), and EBG-117 (ore pile tributary). Five metals above background were detected at EBG-116; four metals above background were detected at EBG-117.

Surface Water

- Explosives were detected in surface water primarily in the T-Area. Outside of the T-Area, samples collected from station EBG-114 (PF534), EBG-115 (east inlet), and EBG-120 (downstream of the EBG outlet) contained explosives. The number of detected explosives at any given station was limited to one compound, with the exception of station EBG-086 in the T-Area (three detected explosives). Nitrocellulose was detected on one occasion within the T-Area.

- The occurrence of metals detected above background values was concentrated within the T-Area. The north, west, and south surface water basins and the EBG outlet contained only arsenic, barium, and manganese above background values. The east surface water basin contained multiple metals above background.

- Low concentrations of 4-methylphenol and phenol were clustered in the T-Area. Low concentrations of five VOC compounds were detected at least once with toluene, acetone, and carbon disulfide being the most frequently detected VOCs. The majority of detected VOCs occurred in the T-Area.

- Off-site sampling results show that five explosives were detected at station EBG-114 (PF534). Arsenic, barium, and manganese were above background at EBG-114 and EBG-116 (EBG drainage way). The sample from station EBG-117 (ore pile tributary) contained multiple metals above their background criteria indicating potential impacts due to surface runoff.

ORDNANCE AND EXPLOSIVES AVOIDANCE SURVEY

No ordnance, propellants, or explosive compounds were discovered during field reconnaissance and magnetometer surveys of access routes and proposed sample points conducted by unexploded ordnance technicians. Various debris and metal scrap were encountered throughout EBG during visual and magnetometer surveys, including wood framing lumber, rail ties, vitrified clay pipe fragments, rail spikes, iron pipe, wire fencing, and vehicle parts. One metal fragment was found, which was suspected as a piece of shell casing. However, a conclusive identification could not be made due to the degree of deterioration.

SCREENING HUMAN HEALTH RISK EVALUATION

A screening-level human health risk evaluation was performed using conservative assumptions and screening criteria for each of the four media sampled. The selection of constituents of potential concern (COPCs) is based on comparisons of maximum contaminant concentrations to screening criteria. Screening criteria do not exist for every constituent; where no criterion is available, the constituent is retained as a COPC. The following points summarize the results of the risk screening presented in Chapter 5.0:

- **Surface Soil.** The greatest exceedances of risk screening levels are associated with explosives and metals at the former burn area, the terminus of Track 49, and the T-Area where it intersects the Track 49 embankment. Maximum values for 2,4-DNT, aluminum, arsenic, chromium, lead, and several SVOCs exceed residential and industrial screening criteria by several orders of magnitude in these locations. Other constituents (notably 2,4,6-TNT, barium, cadmium, copper, vanadium, and zinc) occur at concentrations that exceed the residential criteria in these locations. No VOCs were identified as COPCs in soil.

- **Subsurface Soil.** Two explosives, one propellant, and two metals are COPCs in subsurface soil. The greatest exceedances of risk screening values in subsurface soil are co-located with those in surface soil, with few exceptions. These constituents have maximum concentrations exceeding residential criteria but not industrial risk criteria. Two SVOCs exceed industrial criteria along the Track 49 embankment.

- **Sediment.** COPCs for human health are 2,4,6-TNT; 2,4-DNT; 2,6-DNT; nitrocellulose; 11 metals; Aroclor-1254; and 3 PAHs. The greatest exceedances of risk-based screening criteria are at the terminus of Track 49, north end of the gravel access road, and in ditches at the intersection of the T-Area with the Track 49 embankment. Aroclor and 2,4,6-TNT each occurred above both residential and industrial risk criteria on one occasion. Maximum concentrations of antimony, chromium, lead, and manganese exceeded industrial screening values in this area by 2 to 100 times. No VOCs were identified as COPCs in sediment.

- **Surface Water.** Maximum concentrations of 2,4,6-TNT and 2,4-DNT exceed risk screening values. Nitrocellulose is also a COPC. Most of the detections of metals above screening values occur in the T-Area. 4-Methylphenol and chloroform were identified as COPCs in the T-Area and in the north surface water basin.

SCREENING ECOLOGICAL RISK ASSESSMENT

The screening level ecological risk evaluation was performed using conservative assumptions to estimate risk in surface water and sediment. Suitable ecological screening criteria do not exist for soil. Maximum concentrations of constituents were compared to the ecological screening criteria. The following bullets summarize the results of the screening risk evaluation presented in Chapter 5.0:

- **Sediment.** Nine detected explosives and nitrocellulose are ecological COPCs. The maximum concentrations of 1,3,5-DNB, 2,4-DNT, and 2,6-DNT exceed ecological screening criteria by 10 to 100 times. The remaining six compounds are retained in absence of available screening criteria. Metals, including antimony, arsenic, cadmium, copper, lead, and zinc, in the T-Area exceed the ecological criteria by at least two orders of magnitude. Six SVOCs exceed the risk criteria by two to three orders of magnitude. Aroclor-1254, detected once, is also an ecological COPC. Two VOCs were identified as ecological COPCs.

- **Surface Water.** Maximum concentrations of 21 metals range from within one to three orders of magnitude above the ecological screening criteria. These exceedances occur primarily where the terminus of the Track 49 embankment intersects the T-Area. 4-Methylphenol, detected in three samples in the T-Area, is the only SVOC identified as an ecological COPC. Carbon disulfide, detected in one sample from the T-Area, is the only VOC identified as an ecological COPC.

SITE CONCEPTUAL MODEL

Information gathered during the EBG Phase I RI was used to develop a site conceptual model (SCM) for EBG. The elements of the SCM include source term definition and contaminant release mechanisms, contaminant migration pathways and exit points, and uncertainties. The SCM for EBG does not incorporate hydrogeologic or groundwater quality data because this element was not a DQO of the Phase I RI.

Source Areas and Release Mechanisms

Primary contaminant sources and release mechanisms included the thermal treatment of waste munitions and explosives and leaching of constituents from residual ash and debris into site soil. The occurrence and distribution of chemicals identified as COPCs was much more widespread in surface soil than in subsurface soil, which had comparatively few COPCs and sporadic distribution. Contaminated shallow soil areas, therefore, represent secondary sources. Based on soil sampling data, the Track 49 embankment, gravel access road, and north leg of the T-Area present the principal areas having residual contamination.

Sediment within surface water bodies is both a secondary source to surface water, and a transport mechanism as discussed below. The areas having the greatest levels of contamination and the highest potential to act as secondary sources include the former burn area and north side of the Track 49 embankment, the north leg of the T-Area, and the northern terminus of the gravel access road (staging/parking area).

Contaminant Migration Pathways and Exit Points

Migration of contaminants from secondary soil sources in surface water occurs primarily by: (1) mobilization of particle-bound contaminants in surface water runoff, and (2) transport of dissolved phase constituents in surface water. Upon reaching surface water conveyances, in particular the surface water basins, flow velocities decrease and particle-bound contaminants largely settle out as sediment accumulation. Sediment-bound contaminants may be remobilized during storm events or partition to surface water and be transported in dissolved phase.

Contaminants exceeded conservative soil leaching screening criteria for both surface and subsurface soil. However, concentrations of contaminants decreased significantly by depths of from 0.9 meter (3 feet) in subsurface soil to the point that only seven chemicals were identified as COPCs. With the exception of lead, the constituents exceeding screening criteria occur at a low number of locations. These observations suggest that leaching processes are of less importance than erosional processes for migration of contaminants.

The only identified contaminant exit pathway from EBG is the culvert beneath Track 10. Dissolved phase contaminants in surface water and remobilized sediment, particularly along the T-Area ditch lines and surface water basin north of Track 49, migrate slowly toward the exit point under ambient gradients. This pattern was evident in the observed distribution of sediment contamination, which suggested migration from the northern embankment of Track 49 toward the former drainage channel bisecting EBG.

The potential for dilution, settling, sorption onto organic matter, and biological uptake within EBG is high. These processes likely effectively attenuate constituents and restrict their migration from EBG.

Uncertainties

The SCM is developed based on available site characterization and chemical data. Uncertainties are inherent in the SCM where selected data do not exist or are sparse. The uncertainties within the SCM for EBG include the following:

- Due to extremely dry conditions during the investigation, water levels within EBG were abnormally low. High levels of suspended solids, vegetation, and organic matter were present, which potentially result in higher surface water constituent concentrations than would typically be expected under normal precipitation patterns.

- Because of the very dry conditions, no flow was observable at the EBG outlet or at the inlet pipes. Thus, water quality data at these points may simply reflect conditions within the surface water basins rather than that of outflow or inflow under normal precipitation conditions.

- Contaminant migration from source areas to groundwater via leaching or surface water infiltration is an unknown element of the conceptual model at present.

CONCLUSIONS

The Phase I RI at EBG identified contaminants in soil, surface water, and sediment. These contaminants, primarily explosives, metals, and PAH compounds, were subjected to a preliminary risk evaluation to determine whether further action or investigation is warranted at EBG. Human health and ecological COPCs have been identified for each medium based on the risk evaluation. The specific findings of this Phase I RI are presented below by medium.

Surface Soil

- The former burn area, the terminus of the Track 49 embankment, and the north leg of the T-Area host the highest concentrations of explosives and metals COPCs. The occurrences of COPCs in concentrations that exceed human health and ecological risk criteria are more sporadic on the northern end of the gravel access road. Several metals are present in concentrations that exceed the residential human health risk criteria but not the industrial criteria. Maximum values for aluminum, arsenic, chromium, and lead exceed residential and industrial screening criteria by several orders of magnitude in the former burn area, Track 49 embankment, and T-Area.

- Explosives do not pose a risk in the wooded area south of the T-Area, the former borrow area, or the west leg of the T-Area.

- The occurrence of PAHs is widespread at EBG. Eight PAHs had maximum concentrations greater than screening criteria or had no screening criteria. The presence of numerous creosote-coated cross ties in certain areas of EBG may represent the source for most PAHs. Additionally, the occurrence of PAHs in many environments is associated with the incomplete combustion of organic matter. Therefore, the presence of PAHs at EBG may or may not be associated with specific historical waste disposal activities.

- VOCs are not COPCs in surface soil or subsurface soil.

Subsurface Soil

- The number of COPCs in subsurface soil is lower than those in surface soil. Data suggest that leaching of surface constituents to the subsurface is slow and not as important a mechanism for contaminant migration as surface water transport. The greatest exceedances of human health risk screening values in subsurface soil are co-located with those in surface soil, with few exceptions. These constituents have maximum concentrations that exceed residential but not industrial risk criteria.

- Two SVOCs exceed industrial risk screening criteria along the Track 49 embankment. As noted for surface soil, PAHs may or may not be specific to the waste disposal practices at EBG.

Sediment

- COPCs for human health are 2,4,6-TNT, 2,4-DNT, 2,6-DNT, nitrocellulose, 11 metals, Aroclor-1254, and three PAHs. These contaminants show the greatest exceedances of risk-based screening criteria are at the east end of the Track 49 embankment, north end of the access road, and in ditches at the intersection of the T-Area with the Track 49 embankment.

- There are several ecological COPCs in sediment. Explosives 1,3,5-DNB, 2,4-DNT, and 2,6-DNT exceed their respective screening levels by large amounts and are concentrated in the same areas as human health COPCs.

- The west and south surface water basins and west T-Area contain few contaminants above background levels. The north and east surface water basins appear to have received the bulk of contamination from runoff from the burn area, the Track 49 embankment, and the parking/staging area. The drainage channel that bisected the site prior to its inundation with water may have conveyed contaminants from north to south across the AOC.

- There were few contaminants detected above background at the surface water exit point at the southwest corner of EBG, which suggest a high degree of attenuation and little migration of contaminants beyond the AOC boundary.

Surface Water

- The only concentrations of explosives high enough to exceed human health risk screening values were observed at PF534 and the east surface water inlet to EBG. The lack of explosives at the EBG outlet and downstream of the AOC, along with the fact that other potential sources drain to PF534, indicates that EBG is not the source of explosive contaminants observed at this exit point.

- Inorganics with maximum concentrations above screening values for human health were heavily concentrated in the T-Area. Seventeen metals were identified as ecological COPCs.

- PAHs were not COPCs in surface water. 4-Methylphenol, encountered in the T-Area, was identified as both a human health and ecological COPC. Chloroform and carbon disulfide were the VOCs identified as human health and ecological COPCs, respectively. Both of these VOCs also were concentrated in the T-Area.

RECOMMENDATIONS

Based on the human health and ecological screening risk evaluations, COPCs were identified for soil, sediment, and surface water within EBG. Based on the current and near future use and site conditions, the likelihood of exposure of human receptors to contaminants within EBG is low. A majority of the site is wetland, and site observations indicate that terrestrial and aquatic ecological receptors are present. Therefore, current site conditions do not support a “no further action” decision. Additional characterization and a baseline human health and ecological risk assessment are recommended under the auspices of a Phase II RI. Specific recommendations for further characterization include

- Because of the comprehensive characterization of soil and sediment during the Phase I RI and low number of COPCs identified in subsurface soil at depths of 0.9 meter (3 feet), the lateral and vertical distribution of contamination has largely been determined sufficient for a baseline risk assessment. Any further characterization of these media should be limited in extent and target surface soil to the principal source areas identified in the Phase I RI (northern of Track 49, north leg of T-Area, parking/staging area, and former burn area). Additional subsurface soil characterization outside of the former burn area and north embankment of Track 49 is not recommended. Additional subsurface soil data may be collected in conjunction with hydrogeologic data.

- As noted in the DQOs presented in the Phase I RI Sampling and Analysis Plan Addendum, collection of site-specific hydrogeologic data is recommended because soil constituents exceeded generic leaching criteria, and the depth to groundwater at the site is estimated to be shallow. Based on the observed vertical distribution of soil contaminants and the high likelihood of attenuation within EBG, the scope of these efforts should be limited in extent and target shallow groundwater in the unconsolidated zone within the principal source areas.

- Upon collection of groundwater characterization data, chemical fate and transport modeling and finalization of the SCM is recommended. Fate and transport assessment will identify contaminant migration potential within this medium and facilitate the decision-making process for any necessary remedial actions.

- An additional round of sampling of surface water points within the basins and at the EBG exit point is recommended under normal precipitation conditions to adequately assess contaminant levels within EBG, as well as the potential for migration off of the AOC.

- The baseline ecological risk assessment (ERA) may incorporate the field-observed effects approach currently under development in association with the Winklepeck Burning Grounds RI/Feasibility Study, deemed appropriate by the Army and Ohio Environmental Protection Agency. Conventional hazard quotient computations would be made as an initial step in the ERA process.