Decommissioning and Environmental Cleanup of a Small Arms Training Facility -13225

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ABSTRACT

USDOE performed a (CERCLA) non-time critical removal (NTCR) action at the Small Arms Training Area (SATA) Site Evaluation Area (SEA) located at the Savannah River Site (SRS), in Aiken, South Carolina. From 1951 to May 2010, the SATA was used as a small weapons practice and qualifying firing range. The SATA consisted of 870.1 ha (2,150 ac) of woodlands and open field, of which approximately 2.9 ha (7.3 ac) were used as a firing range. The SATA facility was comprised of three small arms ranges (one static and two interactive), storage buildings for supplies, a weapons cleaning building, and a control building. Additionally, a 113-m (370-ft) long earthen berm was used as a target backstop during live-fire exercises. The berm soils accumulated a large amount of spent lead bullets in the berm face during the facilities 59-years of operation. The accumulation of lead was such that soil concentrations exceeded the U.S. Environmental Protection Agency (USEPA) residential and industrial worker regional screening levels (RSLs). The RSL threshold values are based on standardized exposure scenarios that estimate contaminant concentrations in soil that the USEPA considers protective of humans over a lifetime. For the SATA facility, lead was present in soil at concentrations that exceed both the current residential (400 mg/kg) and industrial (800 mg/kg) RSLs. In addition, the concentration of lead in the soil exceeded the Toxicity Characteristic Leaching Procedure (TCLP) (40 Code of Federal Regulations [CFR] 261.24) regulatory limit. The TCLP analysis simulates landfill conditions and is designed to determine the mobility of contaminants in waste. In addition, a principal threat source material (PTSM) evaluation, human health risk assessment (HHRA), and contaminant migration (CM) analysis were conducted to evaluate soil contamination at the SATA SEA. This evaluation determined that there were no contaminants present that constitute PTSM and the CM analysis revealed that no constituents posed a migration risk to groundwater.

The NTCR action involved removal of approximately 12,092 m^3 (15,816 yd^3) of spent bullets and lead-impacted soil and off-site disposal. The removal action included soils from the berm area, a fill area that received scraped soils from the berm, and soil from a drainage ditch located on the edge of the berm area. Also included in the removal action was a mixture of soil, concrete, and asphalt from the other three range areas. Under this action, 11,796 m^3 (15,429 yd^3) of hazardous waste and impacted soil were removed from the SATA and transported to a permitted hazardous waste disposal facility (Lone Mountain Facility in Oklahoma) and 296 m^3 (387 yd^3) of nonhazardous waste (primarily concrete debris) were removed and transported to a local solid waste landfill for disposal. During the excavation process, the extent was continuously assessed through the use of a hand-held, field-portable X-ray fluorescence unit with results verified using confirmation sampling with certified laboratory analysis. Following the completion of the excavation and confirmation sampling,

final contouring, grading, and establishment of vegetative cover was performed to stabilize the affected areas.

The NTCR action began on August 17, 2010, and mechanical completion was achieved on April 27, 2011. The selected removal action met the removal action objectives (RAOs), is protective of human health and the environment both in the short- and long-term, was successful in removing potential ecological risks, and is protective of surface water and groundwater. Furthermore, the selected NTCR action met residential cleanup goals and resulted in the release of the SEA from restricted use contributing to the overall footprint reduction at SRS.

INTRODUCTION

The Savannah River Site (SRS) is a large federal installation encompassing 803 km^2 (310 mi^2) of land adjacent to the Savannah River, principally in Aiken and Barnwell counties of South Carolina. SRS is located approximately 40-km (25-mi) southeast of Augusta, Georgia, and 32-km (20-mi) south of Aiken, South Carolina. SRS is owned by USDOE, while Savannah River Nuclear Solutions, LLC (SRNS) provides management and operating services. SRS has historically produced tritium, plutonium, and other special nuclear materials for national defense. Chemical and radioactive wastes are by-products of the nuclear material production processes. Hazardous substances, as defined by CERCLA are present in the SRS environment.

The SATA SEA is located approximately 12.5-km (7.8-mi) northwest of the geographical center of SRS and approximately 2.0-km (1.2-mi) east of the nearest SRS boundary. The SEA is comprised of 870.1 ha (2,150 ac) of woodlands and open field, of which approximately 2.9 ha (7.3 ac) were used as a small weapons practice and qualifying firing range, the SATA facility. The remaining 867.2 ha (2,143 ac) was unused woodland which was fenced in its entirety and served as a safety buffer area for the SRS. The SEA lies between two tributary streams of Tims Branch, with the closest point of this stream system to SATA located approximately 50-m (164-ft) west of the facility.

The SATA facility was built by E.I. DuPont and from 1951 to 2010 it was operated as a small arms weapons training facility for SRS security personnel. In 1983, Wackenhut Services, Inc. (WSI) acquired the SRS security contract and operational control of the SATA facility. The facility consisted of three small arms ranges (one static and two interactive), a main building, Building 661-G, Patrol Training Building, and several structures and utilities bordered by a perimeter chain link fence (e.g., training building, shooting ranges, metal awnings, temporary weapons and storage containers, maintenance structures, and a guard house). The facility employed an approximately 113-m (370-ft) long earthen “berm” as a backstop for bullets shot during target practice. The amount of small arms ammunition fired since 1951 was estimated at 15 to 20 million rounds. The majority of the bullets fired were copper-jacketed lead rounds and lead rounds. However, since April 1992, Delta™ frangible bullets (molded brown plastic bullets containing copper and tungsten powders) were also used at the range.

In the early 1990s, to reduce the safety risk from ricocheting bullets, the SATA berm was reconfigured by scraping an estimated 765 m^3 (1,000 yd^3) of soil from the face of the berm and placing the removed soil/lead on the north end of the berm. No spent bullets and/or lead-impacted soil were moved offsite of the SATA facility at that time.

NATURE AND EXTENT OF CONTAMINATION

Since its construction in the early 1950s, SATA has had minimal environmental site characterization activities. In 1991, as part of the SRS Site Evaluation Program, 25 soil samples were collected from within the first 0.3 to 0.6 m (1 to 2 ft) of the berm face (i.e., penetration zone) for total metals and Toxicity Characteristic Leaching Procedure (TCLP) (40 CFR 261.24) analyses. Arsenic and lead were detected in several soil samples and were the only metals detected that exceed current USEPA RSLs. However, arsenic concentrations (maximum = 3.8 mg/kg) in berm soils were below the established SRS background concentrations (two times average = 4.3 mg/kg, 95th percentile = 8.2 mg/kg). Lead was present in soil at concentrations that exceeded both the current residential (400 mg/kg) and industrial (800 mg/kg) RSLs. In addition, lead concentrations in several berm soil samples exceeded the TCLP regulatory limit of 5 mg/L.

Using data that was collected in 1991, it was determined that lead from the bullets accumulated to the point where soil concentrations exceeded the USEPA residential and industrial worker RSLs. The RSL threshold values are based on standardized exposure scenarios that estimate contaminant concentrations in soil that the USEPA considers protective of humans over a lifetime. In addition, the concentration of lead in the soil exceeded the TCLP (40 CFR 261.24) regulatory limit in 1991. The TCLP analysis simulates landfill conditions and is designed to determine the mobility of contaminants in waste.

In 2009, a PTSM evaluation, HHRA, and CM analysis were conducted using the 1991 sampling data to evaluate soil contamination at the SATA SEA. Based on the 1991 sampling results, there were no contaminants present that constitute PTSM. Lead was present in soil at concentrations that exceed both the current residential (400 mg/kg) and industrial (800 mg/kg) RSLs. The CM analysis revealed that no constituents posed a migration risk to groundwater.

Lead exists in the shallow soil, but unit-related lead was not detected in groundwater at levels exceeding the maximum contaminant level. This was expected as 1) the water table is greater than 30.5 m (100 ft) below ground surface, 2) lead deposition in soil was recent (~50 yrs), 3) metallic lead is immobile (unless subjected to reducing conditions), and 4) soluble lead transport (e.g., hydrocerussite coating produced by the corrosion of lead bullets) was retarded by iron/manganese oxides and carbonate soil fractions (abundant in the native soil). The natural geochemical environment at SATA is oxidizing and the area surrounding the unit is relatively pristine, so reducing conditions and lead transport through the vadose zone was not expected.

Data Evaluation

A PTSM evaluation, HHRA, and CM analysis were performed in 2009 for the SATA SEA using the soil data collected in 1991 (WSRC 1992). The results of the PTSM evaluation and HHRA were as follows:

- Based on the 1991 soil sampling results of berm soils at SATA, there were no contaminants that constitute PTSM.

- The HHRA identified lead as a human health RCOC for SATA. Lead was present in surface soils at concentrations that present a hazard to a future resident (9.5 times greater than the RSL) and/or a future industrial worker (4.8 times greater than the RSL). This was a conservative estimate based on the maximum detected concentration (3,800 mg/kg).

Contaminant Migration Analysis

For the CM analysis, arsenic, beryllium, mercury, and lead were classified as Tier I CM constituents of potential concern. However, none exceeded the Tier 2 SRS site-specific screening levels and, therefore, there were no CM COCs and no contaminants posed a migration risk to groundwater based on CM analysis using the 1991 sampling data.

The highest concentration of extractable lead contained in the soil was directly correlated with the highest concentration of spent lead bullets in berm surface soil samples (e.g., berm and fill area at SATA). A fate and transport evaluation conducted with the CM analysis suggested that because the vadose zone thickness was greater than 30.5 m (100 ft) at SATA, the cation exchange capacity of the soil was high, and organic/inorganic ligands are not present in groundwater (e.g., as in landfill leachate), the potential for groundwater contamination was very low. Given that the mass of lead discharged to soil was high (estimated 2,268 to 4,082 kilograms per year [5,000 to 49,000 pounds per year] at SATA), and the average precipitation rate at SRS is high (approximately 116.8 cm per year [46 in per year]), low concentrations of lead was thought to have leached to surface water runoff near the earthen berm and soil fill area. Therefore, soluble lead transport in soil via runoff was thought to have occurred, but only over relatively short distances from the source (on the order of several feet), and contaminant migration to local surface water streams or groundwater was not expected.

Ecological Risk

An ecological risk assessment was not performed for the SATA SEA. The highest concentrations of extractable lead in soil were located within the berm and fill areas of the facility. Accordingly, there was some uncertainty related to the potential risk that spent lead bullets and lead-impacted soil posed to terrestrial receptors. The implemented removal action targeted the spent bullets and lead-impacted soils, which minimized the potential for significant ecological risk to wildlife receptors at the community level. Therefore, any uncertainty related to potential ecological risk was managed by implementing removal and offsite disposal as the selected action.

REMOVAL ACTION REQUIREMENTS AND OBJECTIVES (RAO)

RAOs are media- or operable unit (OU)-specific objectives for protecting human health and the environment. RAOs describe what the removal must accomplish and are used as a framework for developing removal alternatives. The RAOs are based on the nature and extent of contamination, threatened resources, and the potential for human and environmental exposure. The RAOs to protect human health and the environment included the following:

- Prevent human exposure to lead present in surface soils that presents a hazard to a future resident or future industrial worker greater than established RSLs.

Selected Removal Action

The selected NTCR action for the SATA SEA was removal and offsite disposal. The work involved removal of spent bullets and lead-impacted soil from the former berm area, the former fill area north of that berm area that was composed of previously scraped berm soils, and soil from the drainage ditch on the western edge and north of the former berm area. Also included in the removal action were mixed soil/concrete/asphalt from Range Areas 1, 2, and 3. Under this action, hazardous waste/impacted soil was removed from the SATA and transported to the Lone Mountain Landfill Facility (A Clean Harbors Disposal Site), and nonhazardous waste (primarily concrete debris) was transported to Three Rivers Landfill for long-term disposal. Extent characterization and confirmation sampling was assessed through use of a hand-held, field portable X-ray fluorescence unit as well as sampling and laboratory analysis. Upon completion of confirmation sampling, final contouring/grading and establishment of vegetative cover was performed to stabilize the affected areas.

CONSTRUCTION ACTIVITIES

Construction Team

SRNS provided project management and oversight of this project including worker protection, regulatory integration, confirmatory sampling, waste characterization sampling, and removal of contaminated media to the Lone Mountain Landfill Facility (a Clean Harbors Disposal Site in Oklahoma).

North Wind Inc., ATC, and Avisco provided construction services to include excavation, backfilling, and final grading.

Decommissioning Activities

SRNS completed the following decommissioning activities:

- Isolation of the 661-G building, ancillary structures and utilities,
- Removal and disposal of wood electrical poles,
- Removal and disposal of the structure, all equipment and components comprising Building 661-G,
- Removal of ancillary buildings and structures,
- Removal and relocation of identified containers and ancillary structures for reuse, and
- Filling of the wells, septic tank and tile field with grout in accordance with South Carolina Department of Health and Environmental Control regulations.

The end state for 661-G facility was demolition of the structure to grade. The decommissioning of a building is intended to reduce landlord costs, increase safety by removing excess facilities, and reduce the potential for release of hazardous substances to the environment.

Site Preparation

The site construction personnel started field activities on August 17, 2010, with the initial mobilization of construction personnel on site and pre-job safety briefings. Erosion control measures were implemented according to the requirements of the SC Stormwater Management Plan, the Sediment Reduction Regulations SCR 72-300 and the contract specifications. Safety procedures were implemented and the jobsite was prepared for excavation activities in accordance with the approved SRS Safety Procedures.

Removal of Construction Waste and Impacted Soils

All earthwork was completed with standard construction equipment (i.e., trackhoe, bulldozer, etc.). During excavation activities, primarily sediment and bullet fragment waste was identified at the SATA SEA. A total of 12,092 m^3 (15,816 yd^3) of hazardous and nonhazardous wastes were removed. Under this action, 11,796 m^3 (15,429 yd^3) of hazardous waste (spent bullets and lead-impacted soil) was removed from the SATA and transported to the Lone Mountain Landfill Facility (A Clean Harbors Disposal Site in Oklahoma) and 296 m^3 (387 yd^3) of nonhazardous waste (primarily concrete debris) was transported to Three Rivers Landfill for long-term disposal. No unforeseen wastes were generated.

The surface area of the SATA SEA footprint was approximately 16,027 m^2 (172,500 ft^2). The areas removed included the expanded extent of the SATA which had an additional footprint area of approximately 2,206 m^2 (23,750 ft^2) (Figure 8).

Confirmatory Sampling

Confirmatory sampling was conducted in accordance with the sampling and analysis plan (SAP) within the excavated areas after the contaminated media was removed. The purpose of the confirmatory sampling was to demonstrate that the remaining soil met the removal goals (RGs). The RGs for lead are the 400 mg/kg residential RSL or 800 mg/kg industrial RSL. The RG goal for this action was industrial RSL.

The density of the confirmation samples as defined in the SAP, exceedances of the USEPA RSL values, and the laboratory analytical method detection limits were used to determine if the RGs for removal had been met. Samples were collected from the SATA SEA using a 15.2-m (50-ft) linear grid spacing. Samples were collected from excavation expansion areas using a 7.6-m (25-ft) linear grid spacing. Composite soil samples were collected from the 0 to 0.3 m (0 to 1 ft) and 0.3 to 1.2 m (1 to 4 ft) depth intervals within the footprint of the removal zones. All composite soil samples were analyzed for the target compound list for volatiles, semi-volatiles, pesticides, polychlorinated biphenyls, and the target analyte list for metals and cyanide. To confirm removal, the analytical results were compared to the appropriate RSLs. The original 0 to 0.3m (0 to1ft) interval confirmation sample result for lead that corresponds to Station ID SATA-12 collected on December 8, 2010, was 2,580 mg/kg. Since this result was above the residential and industrial RGs for lead, additional material was excavated from the area (approximately
3 m [10 ft] horizontally and 0.3 m [1 ft] vertically) and the remaining soil was resampled on January 25, 2011. The result of this second round of sampling at this location was 3.62 mg/kg, which is below the residential and industrial RGs established for lead. All final confirmation sampling results for lead were below both residential and industrial RGs. In addition to the RSL/RG comparison for lead, all of the confirmatory results were compared to the residential and industrial RSLs in the Data Summary Screening Report. Residential RSLs were exceeded for the following six constituents: arsenic, thallium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene and dibenz(a,h)anthracene. Arsenic and thallium are naturally occurring constituents that are common in SRS soils. The maximum detected concentration of arsenic (12.8 mg/kg) from the confirmation sampling is less than the maximum detected concentration in SRS background soils (23.9 mg/kg). Similarly, the maximum detected concentration of thallium (2.67 mg/kg) is also within the SRS background soil concentrations (maximum = 7.28 mg/kg). Polychlorinated aromatic hydrocarbons (PAHs) are formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances. They are ubiquitous environmental pollutants that can be found in substances such as vehicle exhaust, asphalt road materials, crude oil, coal tar pitch, creosote, roofing tar, wildfires, and agricultural burning. Benzo(a)anthracene (0.169 mg/kg), benzo(a)pyrene (0.153 mg/kg), benzo(b)fluoranthene (0.225 mg/kg) and dibenz(a,h)anthracene (0.0167 mg/kg) were detected in only one of the 210 confirmatory samples that were taken. The low frequency of detection (1/210) is not considered a significant risk issue because only one sample result is greater than the residential RSL.

Backfilling and Final Grading

The excavated areas were backfilled with common fill (clean soil) obtained from the SRS Central Shops borrow pit. The common fill material was placed and compacted to the requirements specified on the design drawing. Backfill operations included a front end loader and bulldozer to spread the clean fill and a 15-ton roller compactor to compact fill materials in $\leq$12-inch lifts. A total of 2,644 m^3 (3,458 yd^3) of backfill was used at the SATA SEA.

The compaction of the fill material was accomplished by making a minimum of five passes over the lift of common fill with the compactor. Following compaction, the area was sodded for vegetative stabilization.

Waste Disposal

Building 661-G was mechanically demolished into rubble which was placed into multiple 30-yd^3 containers for disposal in the SRS Construction and Demolition (C&D) Landfill. In addition, non-friable asbestos containing material in Building 661-G were abated and disposed of in the C&D Landfill.

The waste streams generated from the NTCR action were dispositioned as hazardous waste and nonhazardous waste in accordance with state and federal laws and the SRS waste management procedures. Hazardous waste/impacted soil was transported to the Lone Mountain Landfill Facility (a Clean Harbors Disposal Site in Oklahoma). Nonhazardous/secondary waste was transported to Three Rivers Landfill for disposal. Secondary waste materials consisted primarily of personal protective equipment and small amounts of paper, plastic, rubber goods, cardboard, tape, etc. Since the volume of this secondary waste was small, it was included with the excavated soil and debris and disposed of at the Three Rivers Landfill.

Construction and Quality Control

The SRS forces construction team to performed routine quality control inspection activities as required by the applicable and approved construction procedures. To ensure compliance with site requirements, a Subcontract Technical Representative (STR) provided necessary construction oversight and monitored the construction activities. The STR was assisted by other SRS departments and organizations (i.e., Safety and Health, Engineering, Waste Management, Quality Assurance, Project Management, and USDOE). The project team also verified all confirmatory sampling/verification test results.

Chronology of Events

Description of Activity	Date
Submit RSER/EE/CA Rev. 0 to regulators	02/02/10
Submit RSER/EE/CA Rev. 0 Comment Responses with RSER/EE/CA Rev. 1 to regulators	06/03/10
RSER/EE/CA Rev. 1 (Public Comment Period)	06/10/10 – 7/10/10
Action Memorandum and Responsiveness Summary Public Notice Issue Date	08/04/10
Mobilization Start	08/17/10
Removal Action Start	09/13/10
Confirmatory Sampling	12/07/10-03/09/11
Backfill & Grading	03/14/11
Removal Action Mechanical Completion Date	04/27/11

Conclusion

The selected removal action met the RAOs, is protective of human health and the environment in both the short- and long-term, was successful in removing potential ecological risks, and is protective of surface water and groundwater. Furthermore, the selected NTCR action met residential cleanup goals and resulted in the release of the SEA from restricted use contributing to the overall footprint reduction at SRS.

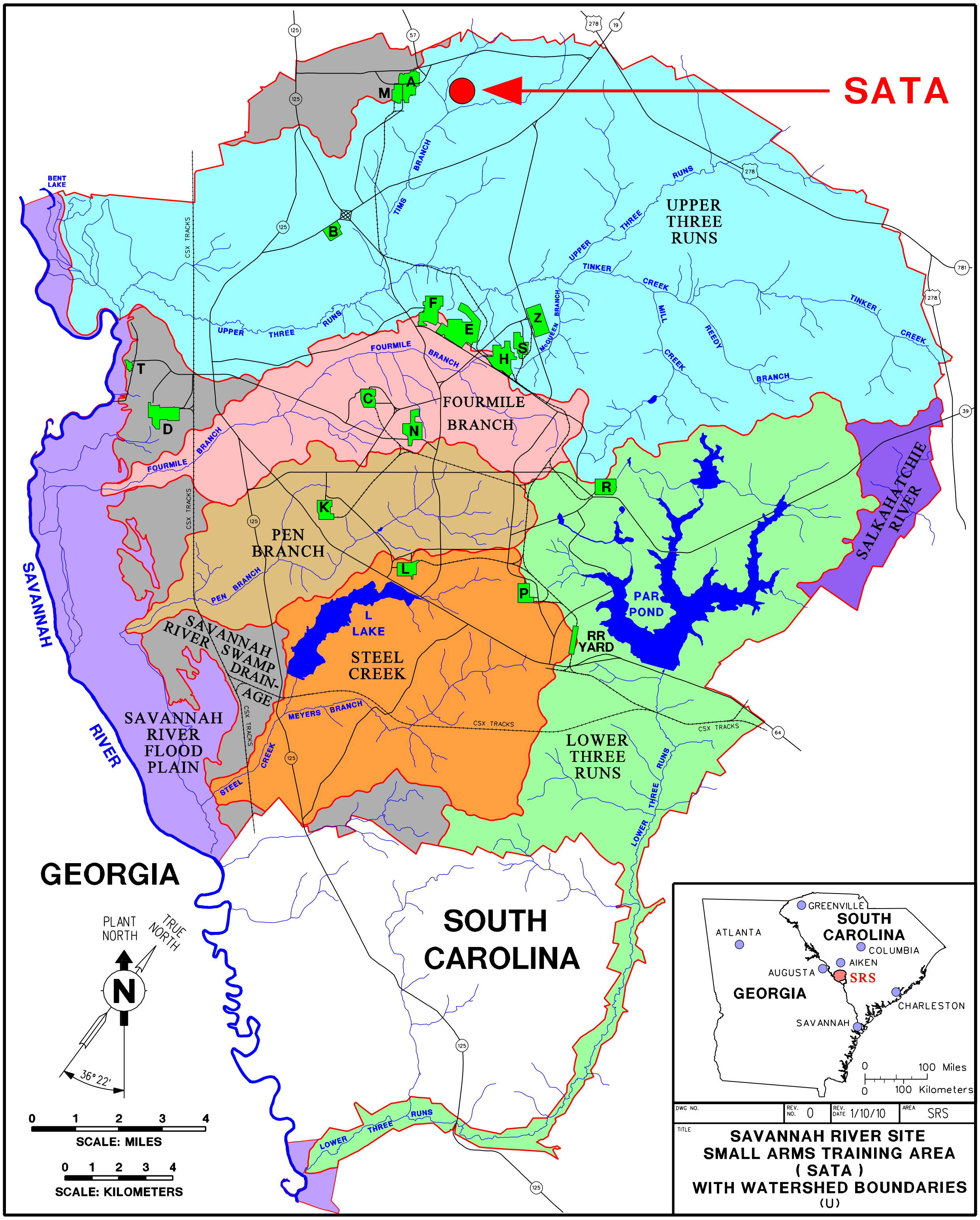

Figure 1. Location of SATA SEA

Figure 2. Aerial Photo of the SATA SEA Prior to the Removal Action

Figure 3. Aerial Photo of the SATA SEA After the Removal Action

Figure 4. View of Range Area 1 from the Northeast Prior to Removal Action

Figure 5. View of the Berm Area Prior to the Removal Action

Figure 6. View of Range Area

Figure 7. XRF Extent Characterization Field Screening

Figure 8. Soil Removal Area at SATA

Figure 9. 661-G, Patrol Training Building, View Looking Northwest Before Demolition

Figure 10. 661-G, Patrol Training Building, View Looking Northwest, After Demolition

Figure 11. Loading of Concrete Debris into Dump Trucks at SATA

Figure 12. Removal of Lead and Lead Contaminated Soil

Figure 13. Loading of Rail Cars

Figure 14. Loading of Rail Cars