Final

Site Investigation Report
Riverbank Army Ammunition Plant
Riverbank, California

Prepared for

U.S. Army Corps of Engineers, Louisville District
Contract No. W912QR-04-D-0020
Delivery Order No. 0015

March 2008

Prepared by

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Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
µg/kg	micrograms per kilogram (parts per billion)
ALCOA	Aluminum Company of America
AOC	area of concern
AST	aboveground storage tank
Autodin	Automated Digital Information Network
bgs	below ground surface
BRAC	Base Realignment and Closure
Cal-EPA	California Environmental Protection Agency
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHPPM	United States Army Center for Health Promotion and Preventive Medicine
cm	centimeter(s)
cm^2	square centimeter(s)
COC	contaminant of concern
DAF	dilution attenuation factor
DARCOM	United States Army Materiel Development Readiness Command
DCE	dichloroethene
DoD	Department of Defense
dpm	disintegrations per minute
DTSC	Department of Toxic Substances Control
DQO	data quality objective
E/P	evaporation/percolation
EBS	Environmental Baseline Survey
ECP	Environmental Condition of Property

EDI	Environmental Dimensions, Inc.
EPA	United States Environmental Protection Agency
FSP	field sampling plan
ft^2	square foot/feet
G-M	Geiger Mueller
HRR	historical records review
IDW	investigation-derived waste
IWTP	Industrial Wastewater Treatment Plant
LCS	laboratory control sample
LDC	Laboratory Data Consultants
LEL	lower explosive limit
MC	munitions constituent
mg/kg	milligrams per kilogram
MEC	munitions and explosives of concern
MMRP	Military Munitions Response Program
MS	matrix spike
MSD	matrix spike duplicate
NaI	sodium iodide
NI	NI Industries, Inc.
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
PARCC	precision, accuracy, representativeness, comparability, and completeness
pCi/L	picocuries per liter
PCB	polychlorinated biphenyl
PID	photoionization detector
ppm	parts per million
PRG	preliminary remediation goal
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control

RBAAP	Riverbank Army Ammunition Plant
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RI	remedial investigation
RL	reporting limit
ROD	Record of Decision
RPD	relative percent difference
SDG	sample delivery group
SI	site investigation
STLC	soluble threshold limit concentration
SWMU	Solid Waste Management Unit
TSCA	Toxic Substances Control Act
TTLC	total threshold limit concentration
U.S.	United States
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USAMC	United States Army Materiel Command
VOC	volatile organic compound
Weston	Roy F. Weston, Inc.
ZnS	zinc sulfide

1.0 Introduction

This Site Investigation (SI) Report was prepared by CH2M HILL on behalf of the United States (U.S.) Army Corps of Engineers (USACE), Louisville District. This SI was conducted to support the Department of Defense (DoD) mission to dispose of Base Realignment and Closure (BRAC) 2005 property, including the Riverbank Army Ammunition Plant (RBAAP) located in Riverbank, California (Figure 1-1), in a timely manner. The SI Report is the result of several phases of documentation including:

- Phase I Environmental Condition of Property (ECP) Report
- Phase II Recommendations
- SI Field Sampling Plan (FSP)
- SI Report (this report)

The Phase I ECP was prepared to characterize the existing environmental conditions at the Property by identifying the potential liabilities associated with remediation and property disposal, and providing information to assess health and safety risks. The Phase I ECP report was submitted as final in November 2006 (CH2M HILL, 2006a).

Based on the results of the Phase I ECP Report, areas that had not been evaluated or required additional investigation were identified. The final Phase II Recommendations Report was submitted in November 2006 and provided field sampling recommendations for these areas (CH2M HILL, 2006b).

An FSP was prepared for the areas that were included in the Phase II Recommendations Report. The purpose of the FSP was to detail the procedures followed during the SI at RBAAP. The overall objective of the SI is to determine the presence or absence of contamination in areas of concern (AOCs) identified in the Phase I ECP. The FSP was submitted as final in May 2007 (CH2M HILL, 2007).

The SI fieldwork was conducted in May 2007 and is being documented in this SI Report. The Draft Final Report was submitted to the California Department of Toxic Substances Control (DTSC), Central Valley Regional Water Quality Control Board, and the United States Environmental Protection Agency (EPA), Region IX, for their comment in October 2007. The DTSC indicated that it had no comments on the report and a letter is forthcoming. The U.S. EPA Region IX has provided its concurrence, as shown in the appendix labeled Regulatory Correspondence. To date, no comments have been received from the Regional Water Quality Control Board.

1.1 Project Objectives

The purpose of this report is to document the results of the SI conducted in May 2007 to support decision making on the eventual transfer of the property. The general objectives of the project are as follows:

- Where feasible, investigate the presence of contamination in AOCs that were identified in the Phase I ECP (CH2M HILL, 2006a).
- Further define the extent of contamination in AOCs where contamination was previously confirmed.
- Investigate the presence of contamination at the accessible tanks within the Industrial Wastewater Treatment Plant (IWTP) to support future Resource Conservation and Recovery Act (RCRA) closure decisions.
- Confirm and document the absence of radiological contamination in three buildings.
- Investigate Military Munitions Response Program (MMRP) site (Former Pistol Range) based on the information provided in the Historical Records Review (HRR) (USACE, 2006).

1.1 Project Scope

To meet the project objectives, the scope of this SI included activities at the following AOCs, as detailed in the Final SI FSP (CH2M HILL, 2007). These AOCs are shown in Figure 1-2 and described in further detail in Section 2.0 of this report.

- **RBAAP-001-R-01, Former Pistol Range** – Visual inspection, metal detector survey, surface sampling at the levee, surface and shallow subsurface soil sampling to 3 feet below ground surface (bgs) at the range, and laboratory analysis of soil samples were completed to determine the presence or absence of small arms munitions and lead contamination in soil, and to close the site.
- **Solid Waste Management Unit (SWMU) 1, IWTP** – Soil samples were collected and analyzed from the ground surface to the groundwater table at approximately 59 feet bgs at four tanks that were accessible by angle drilling to determine if soil was impacted by a release at the IWTP.
- **Building 11, Paint and Oil Storage** – Soil samples were collected to 3 feet bgs at historic sample location H01 and analyzed; also, a radiation survey was completed within the building following the Guidance on Radiological Decommissioning Surveys (U.S. Army Materiel Command [USAMC], 2004). The purpose of these activities was to characterize the extent of contamination at an isolated historical soil sample location (H01) and to confirm the absence of radioactive contamination at the building.
- **Structure 95, Substation No. 1** – Soil sampling to 1 foot bgs in an unpaved area and laboratory analysis of soil samples were conducted to determine the presence or absence of polychlorinated biphenyl (PCB) contamination in unpaved soil adjacent to the transformer pad where staining was historically observed.
- **Structure 97, Substation No. 3** – Soil sampling to 1 foot bgs in an unpaved area and laboratory analysis of soil samples were conducted to determine the presence or absence of PCB contamination in unpaved soil adjacent to the transformer pad where staining was observed.

- **Structure 101, Substation Spare** – Soil sampling to 1 foot bgs in an unpaved area and laboratory analysis of soil samples were conducted to determine the presence or absence of PCB contamination in unpaved soil adjacent to the transformer pad where staining was observed.
- **Structure 145, Substation No. 17** – Soil sampling in an unpaved area to 1 foot bgs and laboratory analysis of soil samples were conducted to determine the presence or absence of PCB contamination in unpaved soil adjacent to the transformer pad where staining was observed.
- **Building 162, Autodin A.B. Terminal Building** – A radiation survey was conducted in accordance with Guidance on Radiological Decommissioning Surveys (USAMC, 2004) to confirm the absence of radioactive contamination at the building.
- **Building 174, Hazardous Waste Storage Area** – A radiation survey was conducted in accordance with Guidance on Radiological Decommissioning Surveys (USAMC, 2004) to confirm the absence of radioactive contamination at the building.

Activities at the AOCs listed above also included:

- Laboratory data verification, validation, and management – Verification, validation, and management of laboratory data were completed for all sites.
- Management of investigation-derived waste (IDW) – IDW was stored onsite and then disposed at the spoils area as solid waste.

Access restrictions and/or ongoing activities prohibited sampling at several AOCs identified for additional sampling in the Phase I ECP Report (CH2M HILL, 2006a) and the Phase II ECP Recommendations Report (CH2M HILL, 2006b). The AOCs that were not investigated as part of this SI include the following:

- **Building 109, Substation Nos. 2 and 3:** Oil staining was observed on the concrete at the base of transformers during a site inspection in 2006. The integrity of the concrete pad appeared to be good. A gravel area surrounds the concrete pad. Based on these observations, there is potential that PCBs have impacted the soil in this unpaved area. Additional soil sampling in this area was recommended to determine the presence or absence of PCB contamination in soil. This sampling could not be conducted during this SI in 2007 because the transformer was active and could not be shut down.
- **Buildings 1, 6, and 8, Production Area Sumps and Pits:** Pits and sumps associated with the production line equipment and presses inside Buildings 1, 6, and 8 remain in place and have not been investigated for possible cracks and/or potential soil contamination. Based on other sumps and pits at RBAAP, which have been removed and have required some contaminated soil removal, there is a potential for the soil beneath the remaining sumps or pits to be impacted by hazardous substances. Further investigation was recommended once production activities cease or if the buildings are demolished. During this SI in 2007, these buildings were in place and sampling could not be conducted.
- **Former Location of Redwood Tanks at the IWTP:** The source of known total chromium and cyanide contamination in the groundwater is assumed to be the former redwood

storage and equalization tanks located at the IWTP. The redwood tanks were replaced in 1972 with a concrete tank (Tank G2: Equalization Basin); and Building 173, which functions as the IWTP office/laboratory, was constructed on the former tank site. The soils beneath the former redwood tanks were recommended for further investigation as part of the SI but could not be investigated due to access restrictions from tanks, overhead pipelines, underground pipelines, reinforced concrete pads, and underground utilities.

- **Inaccessible Process Tanks at IWTP:** The 2004 operations plan for hazardous waste treatment and storage for RBAAP identified post-closure plans for the IWTP to determine if soil contamination had occurred (NI Industries, Inc. [NI], 2004). The plan called for one soil boring to be advanced at each of the process tanks located within the IWTP. This SI included six borings, which addressed the 80-foot clarifier tank, flash mixer, equalization tank, and reactor clarifier; thus, at a minimum, the remaining locations (scum tank, sand filter sump, sludge thickener, filter press, sand filter, carbon filter, ion exchange columns, transfer tank, and collection sump) should be investigated at the time of permit closure as outlined in the 2004 operations plan (NI, 2004).

Figure 1-1 Vicinity Map

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1-2 Areas of Concern

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2.0 Site Background

This section presents background information as it relates to the focus of the SI.

2.1 Site Location and Setting

The RBAAP facility is located at 5300 Claus Road, Riverbank, Stanislaus County, California, 1 mile south of the Stanislaus-San Joaquin County border and approximately 5 miles northeast of the city of Modesto. The plant lies in the San Joaquin Valley in central California to the west of the Sierra Nevada Mountains (CH2M HILL, 2005).

The following sections summarize the natural and physical environment of RBAAP, including climate, topography, surface water hydrology, geology, hydrogeology, groundwater movement, and demography and land use as presented in the RCRA Facility Investigation Current Conditions Report (CH2M HILL, 2002).

2.1.1 Climate

The climate in Riverbank, California, is warm and generally dry. The rainy season generally extends from December to April, with a distinct dry season from May to October. The annual average rainfall is about 11 inches, with monthly averages ranging from 0.05 inch in July and August to 2.8 inches in January.

Winter air temperatures are mild, with a January average minimum temperature of 34 degrees Fahrenheit (°F) (1.1 Celsius [°C]) and a 17-year record minimum of 15°F (-9.4°C). Summer air temperatures are very warm, with the highest monthly average maximum of 96°F (35.6°C), and the 17-year record high temperature of 110°F (43°C).

2.1.2 Topography

The topography of RBAAP and the surrounding area can be described as flat valley land. The RBAAP topography is featureless, and the gradient of the land surface deviates from the norm in that the terrain within the plant slopes southwestward at a rate of 25 feet per mile. The average elevation of the plant is 135 feet above mean sea level.

2.1.3 Surface Water Hydrology

Runoff from the generally flat area is relatively slow. Much of the incident precipitation is absorbed by the soil, and very little runoff occurs from the surrounding agricultural lands except during unusually heavy rains. Runoff from paved areas generally is discharged either to local irrigation canals/ditches or to the Stanislaus River. Flow within the Stanislaus River is controlled by a series of reservoirs. There is no gauging station on the Stanislaus River at Riverbank.

2.1.4 Geology

2.1.4.1 Regional Geology

The San Joaquin-Madera Association comprises the soils near the RBAAP site. These two soil series are sometimes intimately associated and cannot be separated.

The San Joaquin Series is composed of moderately coarse, well-drained soils with silica-iron hardpans. The color of the soils is reddish brown to brown, and the soils are slightly to moderately acidic. Resting on the indurated hardpan at a depth between 41 and 76 centimeters (cm) is the red to reddish brown clayey subsoil.

The Madera Series is composed of medium to moderately coarse, well-drained soils with hardpans. The surface soil is usually neutral to brown loam or sandy loam; whereas, the subsoil is reddish brown to brown sandy clay and is underlain by indurated hardpan (iron and silica with seams of lime). The material underlying the hardpan is generally compact, stratified sandy loam that is cemented weakly in spots.

2.1.4.2 RBAAP Geology

The RBAAP site is located in an area of low alluvial plains and fans less than 2 miles south of the Stanislaus River in the northeastern part of the San Joaquin Valley. Near-surface deposits in the vicinity of the site consist of alluvial fan and river channel deposits originating from fluvial systems in the higher elevations to the east.

The surficial geology at RBAAP consists of unconsolidated Pleistocene nonmarine sedimentary deposits. These deposits are locally called the Riverbank Formation and Aromas Red Sands, and consist of gray-to-brown and yellow-to-red sands that are cross-bedded. Locally, these sands are pebbly with minor percentages of clay and silt.

The shallow subsurface geology consists of similar material. The fluvial depositional environment has resulted in the deposition of hundreds of feet of interlayered sands, clays, and gravels. Locally, substantial clay layers have been observed in the subsurface.

2.1.5 Hydrogeology

The hydrostratigraphy at RBAAP has been investigated through several remedial investigation (RI) phases and subsequent design phases. Results of these investigations are presented in the RI Report (Roy F. Weston, Inc. [Weston], 1991) and the Field Data Report (CH2M HILL, 1996). Five aquifer zones (A, A′, B, C, and D) were identified in the RI Report based on depth and stratigraphy. The A and A′ aquifers beneath the IWTP are the zones of interest for total chromium and cyanide in groundwater. These aquifer zones are summarized as follows:

- **A –** An unsaturated upper sand zone; average depth from 29 to 60 feet bgs.
- A′ – A partially to fully saturated, well-graded silty sand; average depth from 60 to 90 feet bgs; approximately 30 feet thick.
- B – Saturated, semicontinuous sand units interbedded with thin silt and clay layers; average depth from 90 to 120 feet bgs; approximately 30 feet thick.

- C – Saturated sand zone; average depth from 120 to 150 feet bgs; approximately 30 feet thick.
- D – Saturated coarse sand and gravel with volcanic material; between 150 and 220 feet bgs; approximately 70 feet thick.

The aquifer zones listed above are connected hydraulically. The presence of discontinuous fine-grained sediment layers creates the potential for a complex flow pattern in the subsurface. Aquifer testing indicates hydraulic connection between the A′, B, C, and D aquifer zones.

Regionally, the groundwater table is lowering, and the A zone aquifer beneath the site is essentially dry. Water levels have dropped sharply each summer since 2001. Despite winter increases, water levels have exhibited a net decline of approximately 16 feet over the last 30 years. Due to the decline in the water table elevation, the A zone is now completely unsaturated for a large portion of the year, with only the lower portion becoming saturated during late fall and winter seasons. At the IWTP specifically, the water table has lowered from approximately 50 feet bgs (aquifer zone A) in 1991 to 60 feet bgs (aquifer zone A′), as observed during this 2007 SI. This lowering of the aquifer has changed a 10-foot-thick layer of previously saturated soils into unsaturated soils.

2.1.6 Groundwater Movement

Locally, the groundwater flow direction beneath the site is westerly. Groundwater head contours in individual zones were plotted and reveal that the lateral component of the groundwater flow is toward the west, with a small component toward the north. The hydraulic conductivity of the A/A′ zone ranges between 1.1×10^{-4} and 1.6×10^{-3} feet per second, and the linear velocity ranges from 38 to 550 feet per year (CH2M HILL, 2006a).

2.1.7 Demography and Land Use

The predominant land use in the direct vicinity of RBAAP is agricultural. Most of the land to the north, east, and south of the plant is farmland. Most farmland adjacent to the plant is used for cattle and horse grazing. Some vineyards and orchards are also nearby. The predominant land use west of the plant on the opposite side of Claus Road is residential. This residential area is fairly light in density with about 150 homes per square mile (60 homes per square kilometer). Only a small percentage of the nearby land is in commercial use (Envirodyne, 1987). Riverbank, the closest town, has a population of 16,400. The nearest large community is Modesto, California, which is located approximately 5 miles southwest of the installation and has a population of 210,000 (Envirodyne, 1987; U.S. Army Environmental Command [USAEC], 2005a).

2.2 General Site Description

RBAAP occupies a total of 173 acres of land and consists of two noncontiguous areas represented by the main plant area (approximately 146 acres) and the evaporation/ percolation (E/P) ponds (27 acres), which are located approximately 1.5 miles north of the RBAAP boundary along the Stanislaus River. The four E/P ponds did not require additional investigation, and thus are not included in this SI Report.

In general, the main production area, which includes the IWTP, is mostly paved. The main production area consists of seven production lines, process water/groundwater treatment facilities, and various buildings used for maintenance, administration, and storage. Approximately 155 buildings are at RBAAP. The approximate total square footage of roofed area at RBAAP is 924,514 square feet (ft^2).

The general classification of RBAAP land is as follows:

- 99 acres used for RBAAP production
- 37 acres used as open land
- 10 acres covered by roads, rights-of-way, and easements
- 27 acres occupied by the E/P ponds located 1.5 miles north of the plant

2.3 Site Ownership and History

Under the authority of the Defense Plant Corporation, RBAAP was originally constructed in 1942 by the Aluminum Company of America (ALCOA) as an aluminum reduction plant. Until the government acquired the property, the land was used for agricultural purposes (CH2M HILL, 2002). The plant was closed by order of the War Production Board on August 7, 1944, due to the reduced need for aluminum by the military late in World War II. During the period of operation by ALCOA, cyanide-containing wastes were generated and disposed of in the southern section of the landfill located in the northeastern portion of the main plant area (CH2M HILL, 2002; USAEC, 2005a). These areas have been investigated; the environmental condition of the property was reported in the Phase I ECP (CH2M HILL, 2006a).

After August 1944, the plant was used for storing several types of government surplus materials, including corn and grain. Early in 1949, the title was transferred from the Defense Plant Corporation to the Federal Works Administration. In 1951, a decision was made by the Ordnance Corps to convert to the manufacture of steel cartridge cases for joint U.S. Army and Navy use.

The plant is now a government-owned, contractor-operated industrial installation under the jurisdiction of the U.S. Army Joint Munitions Command. NI has operated RBAAP from 1951 to the present producing cartridge cases for the U.S. Army and Navy.

2.4 Environmental History

2.4.1 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

RBAAP is on the EPA's National Priorities List (NPL). The U.S. Army is currently responsible for CERCLA actions as specified in the 1994 Record of Decision (ROD). EPA added RBAAP to the NPL on February 21, 1990, primarily due to the presence of groundwater contamination (cyanide and total chromium) detected on and off the plant. This groundwater contamination has been documented beneath the IWTP and is believed to have been released from the former redwood tanks that were located in the IWTP area (site of current Building 173).

In March 1994, EPA, DTSC, California Regional Water Quality Control Board (RWQCB), and U.S. Army signed the ROD for RBAAP. The sitewide ROD contains two response actions that address the media of concern at RBAAP. The two response actions, both of which have been implemented, are (1) groundwater response action, and (2) landfill response action.

2.4.2 Resource Conservation and Recovery Act (RCRA)

On July 30, 1995, DTSC issued a RCRA Part B Hazardous Waste Facility Permit for RBAAP. The permit was renewed (05-SAC-06), effective on May 6, 2006, and expires May 6, 2016 (State of California, 2006). RBAAP conducts daily and weekly inspections of all RCRA storage and treatment facilities at RBAAP, as required by the RCRA Part B permit.

The permit also required RBAAP to conduct a RCRA Facility Investigation (RFI). In June 2002, the U.S. Army and DTSC signed a Corrective Action Consent Agreement that identified 25 SWMUs and 16 AOCs that would be included in the RFI scope of work. SWMU 1, IWTP is the only AOC under the RFI in this SI. The U.S. Army completed the RFI in 2004 and DTSC concurred on August 10, 2006, that no further corrective action was required at all AOCs and SWMUs, except SWMU 1 due to the presence of existing system components, as described further in Section 3.6.2. Additional characterization of the IWTP is precluded until permit closure due to the presence of existing system components.

2.4.3 Environmental Condition of Property (ECP)

As a result of the 2005 BRAC recommendations, RBAAP was selected for closure and property transfer. As required by U.S. Army Regulation (AR) 200-1, an ECP must be prepared for locations that are being considered for acquisition, out-grants, or disposal. The ECP will allow the U.S. Army to meet its obligation under CERCLA to assess the environmental condition of the property prior to entering into designated real property transactions. The Phase I ECP for RBAAP was completed in November 2006 (CH2M HILL, 2006a). This document represents a source of additional information on RBAAP.

3.0 Field Activities, Analytical Protocol, and Results

This section presents a summary of the field sampling program as described in the Final FSP (CH2M HILL, 2007) and notes deviations from the plan that occurred during fieldwork. This section also presents the results of the soil sampling, laboratory analysis, and radiological surveys and compares those results to screening criteria determined during the data quality objectives (DQOs) workshop held in November 2006. The section has been organized to provide an overall summary of the field program, and then presents a site by site discussion. The section is organized into the following subsections:

- 3.1 General Sample Locations and Methodologies
- 3.2 Analytical Methods and Protocols
- 3.3 Investigation-Derived Waste
- 3.4 Quality Assurance/Quality Control
- 3.5 Screening Criteria and Background
- 3.6 Site-Specific Summaries

3.1 General Sample Locations and Methodologies

This section summarizes the methodologies used to perform the fieldwork as described in the Final FSP (CH2M HILL, 2007) and identifies the soil sample locations. Table 3-1 presents a summary of the SI methodology.

Preparatory SI field activities were performed on April 23 and May 15, 2007, and included utility clearances and visits to the AOCs. SI activities were conducted from May 16 through May 19, 2007, and on May 21, 2007, and included soil sampling and radiological surveys. The work conducted during the SI was performed in accordance with the Final FSP (CH2M HILL, 2007), except as specified in this section.

3.1.1 Soil Sampling

Surface and shallow subsurface soil samples were collected using a stainless-steel hand auger. Subsurface soil samples were collected using a limited access GeoProbe® 7730 direct-push rig with auger capability. This was the most powerful and versatile direct-push equipment available at the time. Additionally, this rig was selected to (1) access the small areas at which drilling was performed, (2) produce smaller disturbance to the subsurface, (3) drill at an angle, and (4) generate less IDW. Drill bits were modified to allow for the swelling soils encountered at the IWTP during past drilling at RBAAP. The borings were advanced to the depth desired (groundwater table) without incident. A soil boring log was completed to document the physical appearance of soil retrieved from each continuous soil core recovered. The completed boring logs for each borehole are included in Appendix A.

Field screening was conducted for both surface and subsurface soil samples. Field screening consisted of sheen testing and use of a multiple-gas-detection meter. The gas-detection meter (MultiRae® Model 2000) contains detection devices for lower explosive limit (LEL), photoionization detector (PID) for volatile organic compounds (VOCs), carbon monoxide, and oxygen. Atmospheric readings were collected during drilling, and headspace screening measurements were taken of soil cores from the IWTP borings. Additionally, general observations of odor, sheen, free product, and unusual discoloration were noted. Field screening results are presented in Appendix A with the soil boring logs. No deviations were made from the FSP procedures.

Table 3-1 provides a summary of soil samples collected at each AOC.

3.1.2 Radiation Survey

A Final Survey for a Class 3 Area following the Guidance on Radiological Decommissioning Surveys (USAMC, 2004) was performed to determine the absence of a historical release. Even though there is no record of Nuclear Regulatory Commission (NRC)-licensed material ever having been used at RBAAP, several potential sites (including Building 11, Building 162, and Building 175) were surveyed based on historical use and information from interviews obtained as part of the ECP effort. Although there was no documented evidence of a release of radioactive materials at these sites, the surveys were conducted to confirm there were no radioactive releases in these areas.

Three buildings were surveyed at the plant to confirm the absence of contamination. The building surveys were performed using a window pancake Geiger-Mueller (G-M) detector, a zinc sulfide/sodium iodide (ZnS/NaI) scintillation detector (Ludlum Model 43-89 coupled to a Ludlum Model 2224-1 Scaler/Ratemeter), and a smear counter (Ludlum Model 2929 Alpha Beta Scaler with a Model 43-10-1 Sample Counter). In accordance with the Final FSP (CH2M HILL, 2007), at least 30 random locations within each building were surveyed and sampled for the following:

- Direct alpha radiation
- Direct beta-gamma radiation
- Removable alpha contamination
- Removable beta-gamma contamination

The radiation equipment was operated, calibrated, and maintained by a licensed subcontractor, Environmental Dimensions, Inc. (EDI). The complete RBAAP Field Radiation Survey Report (EDI, 2007) is included in Appendix B.

Initial background measurements were taken onsite at the exterior corner of the entry gate of Building 174, in an area with no history of radioactive material or radioactive commodity use.

TABLE 3-1
Summary of Field Activities
Site Investigation Report, Riverbank Army Ammunition Plant, California

AOC	Investigation Activity	Location Description	Purpose	Sample Location ID	Laboratory Analysis (Method)	Sample Type	Sample Depth (feet bgs)	No. of Samples
RBAAP-001- R-01, Former Pistol Range	Metal Detection Survey	Former Pistol Range and Levee	Determine if small arms munitions existed at the Former Pistol Range and if lead was present or absent in soil in the former firing range and within the levee (former berm target). The intention is to close this site in the MMRP.	NA	NA	NA	NA	NA
	Visual Site Inspection/Photographic Documentation	Former Pistol Range and Levee	Determine if small arms munitions existed at the Former Pistol Range satisfy the requirements of an SI for the MMRP.	NA	NA	NA	NA	NA
	Soil Sampling	Levee	Determine if lead is present in levee soils.	0012-01	Lead (EPA 6020)	Discrete	Surface (0 to 0.5 foot bgs)	1
				0012-02	Lead (EPA 6020)	Discrete	Surface (0 to 0.5 foot bgs)	1
				0012-03	Lead (EPA 6020)	Discrete	Surface (0 to 0.5 foot bgs)	1
		Levee	Determine if lead is present in levee soils.	0012-04	Lead (EPA 6020)	Discrete	Surface (0 to 0.5 foot bgs)	1
					Lead (EPA 6020)	Discrete	Subsurface (2.5 to 3.0 feet bgs)	1
				0012-05	Lead (EPA 6020)	Discrete	Surface (0 to 0.5 foot bgs)	1
					Lead (EPA 6020)	Discrete	Subsurface (2.5 to 3.0 feet bgs)	1
				0012-06	Lead (EPA 6020)	Discrete	Surface (0 to 0.5 foot bgs)	1
					Lead (EPA 6020)	Discrete	Subsurface (2.5 to 3.0 feet bgs)	1
				0012-07	Lead (EPA 6020)	Discrete	Surface (0 to 0.5 foot bgs)	1
				0012-08	Lead (EPA 6020)	Discrete	Surface (0 to 0.5 foot bgs)	1
SWMU 1, IWTP	Site Walk	SWMU 1, IWTP	Identify safe and accessible borehole locations and mark the locations for utilities.	NA	NA	NA	NA	NA
	Soil Sampling	80-foot clarifier	Identify the presence or absence of contamination and provide data for future closure under RCRA.	0013-01	Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A) pH (EPA 9045) VOCs (EPA 8260)	Discrete	Surface (0.5 to 1 foot bgs)	1
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A pH (EPA 9045) VOCs (EPA 8260)	Discrete	Subsurface (5 and 10 feet bgs)	2
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Zinc and total chromium (EPA 6020A) pH (EPA 9045)	Discrete	Intermediate Subsurface (15, 20, 25, 30, 35, 39, 44, 49, and 54 feet bgs)	11
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A) pH (EPA 9045) VOCs (EPA 8260)	Discrete	Deep subsurface (59 feet bgs)	1

TABLE 3-1
Summary of Field Activities
Site Investigation Report, Riverbank Army Ammunition Plant, California

AOC	Investigation Activity	Location Description	Purpose	Sample Location ID	Laboratory Analysis (Method)	Sample Type	Sample Depth (feet bgs)	No. of Samples
SWMU 1, IWTP				0013-06	Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A) pH (EPA 9045) VOCs (EPA 8260)	Discrete	Surface (0.5 to 1 foot bgs)	1
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A) pH (EPA 9045) VOCs (EPA 8260)	Discrete	Subsurface (5 and 10 feet bgs)	2
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Zinc and total chromium (EPA 6020A) pH (EPA 9045)	Discrete	Intermediate subsurface (15, 20, 25, 30, 35, 40, 45, 50, 55 feet bgs)	11
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A) pH (EPA 9045) VOCs (EPA 8260)	Discrete	Deep subsurface (60 feet bgs)	1
		Flocculation tanks	Identify the presence or absence of contamination and provide data for future closure under RCRA.	0013-02	Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A) pH (EPA 9045) VOCs (EPA 8260)	Discrete	Surface (0.5 to 1 foot bgs)	1
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A) pH (EPA 9045) VOCs (EPA 8260)	Discrete	Subsurface (5 and 10 feet bgs)	2
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Zinc and total chromium (EPA 6020A) pH (EPA 9045)	Discrete	Intermediate subsurface (15, 19, 24, 29, 34, 39, 44, 48, and 53 feet bgs)	11
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A) pH (EPA 9045) VOCs (EPA 8260)	Discrete	Deep subsurface (58 feet bgs)	1
		Flash mixer spill area	Identify the presence or absence of contamination and provide data for future closure under RCRA.	0013-03	Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A) pH (EPA 9045) VOCs (EPA 8260)	Discrete	Surface (0.5 to 1 foot bgs)	1
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A) pH (EPA 9045) VOCs (EPA 8260)	Discrete	Subsurface (5 and 10 feet bgs)	2

TABLE 3-1
Summary of Field Activities
Site Investigation Report, Riverbank Army Ammunition Plant, California

AOC	Investigation Activity	Location Description	Purpose	Sample Location ID	Laboratory Analysis (Method)	Sample Type	Sample Depth (feet bgs)	No. of Samples
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Zinc and total chromium (EPA 6020A) pH (EPA 9045)	Discrete	Intermediate subsurface (15, 20, 25, 30, 35, 40, 45, 50, and 55 feet bgs)	11
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A) pH (EPA 9045) VOCs (EPA 8260)	Discrete	Deep subsurface (60 feet bgs)	1
		Equalization basin	Identify the presence or absence of contamination and provide data for future closure under RCRA.	0013-04	Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A) pH (EPA 9045) VOCs (EPA 8260)	Discrete	Surface (0.5 to 1 foot bgs)	1
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A) pH (EPA 9045) VOCs (EPA 8260)	Discrete	Subsurface (5 and 10 feet bgs)	2
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Zinc and total chromium (EPA 6020A) pH (EPA 9045)	Discrete	Intermediate subsurface (15, 19, 24, 29, 34, 39, 44, 48, and 53 feet bgs)	11
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A) pH (EPA 9045) VOCs (EPA 8260)	Discrete	Deep subsurface (58 feet bgs)	1
		Reactor clarifier tank	Identify the presence or absence of contamination and provide data for future closure under RCRA.	0013-05	Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A) pH (EPA 9045) VOCs (EPA 8260)	Discrete	Surface (0.5 to 1 foot bgs)	1
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A) pH (EPA 9045) VOCs (EPA 8260)	Discrete	Subsurface (5 and 10 feet bgs)	2
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Zinc and total chromium (EPA 6020A) pH (EPA 9045)	Discrete	Intermediate subsurface (15, 20, 25, 30, 35, 39, 44, 49, and 54 feet bgs)	11
					Cyanide (EPA 9012A) Chromium VI (EPA 7196A) Metals (EPA 6020A) pH (EPA 9045) VOCs (EPA 8260)	Discrete	Deep subsurface (59 feet bgs)	1

TABLE 3-1
Summary of Field Activities
Site Investigation Report, Riverbank Army Ammunition Plant, California

AOC	Investigation Activity	Location Description	Purpose	Sample Location ID	Laboratory Analysis (Method)	Sample Type	Sample Depth (feet bgs)	No. of Samples
Building 11, Paint and Oil Storage	Soil Sampling	Southwest of H01	Determine the extent of PCBs in surface soils at historical location H01.	1011-01	PCBs (EPA 8082)	Discrete	Surface (0 to 0.5 foot bgs)	1
					PCBs (EPA 8082)	Discrete	Shallow subsurface (2.5 to 3 foot bgs)	1
		Northeast of H01	Determine the extent of PCBs in surface soil at historical location H01.	1011-02	PCBs (EPA 8082)	Discrete	Surface (0 to 0.5 foot bgs)	1
					PCBs (EPA 8082)	Discrete	Shallow subsurface (0.5 to 1 foot bgs)	1
	Radiation Survey	Interior ground level floor and wall of Building 11	Detect the presence or absence of radioactive contamination in the building from potentially storing radioactive material.	NA	Alpha, beta and gamma radiation survey	NA	NA	31
Structure 95, Electrical Substation No. 1	Soil Sampling	Adjacent to concrete pad	Determine the presence or absence of PCBs in soil in the unpaved area adjacent to the oil-stained concrete.	1095-01	PCBs (EPA 8082)	Composite	Shallow subsurface (0.5 to 1 foot bgs)	1
Structure 97, Electrical Substation No. 3	Soil Sampling	Adjacent to concrete pad	Determine the presence or absence of PCBs in soil in the unpaved area adjacent to the oil-stained concrete.	1097-01	PCBs (EPA 8082)	Composite	Surface (0 to 0.5 foot bgs)	1
					PCBs (EPA 8082)	Composite	Shallow subsurface (0.5 to 1 foot bgs)	1
Structure 101, Electrical Substation Spare	Soil Sampling	Adjacent to concrete pad	Determine the presence or absence of PCBs in soil in the unpaved area adjacent to the oil-stained concrete.	1101-01	PCBs (EPA 8082)	Composite	Surface (0 to 0.5 foot bgs)	1
					PCBs (EPA 8082)	Composite	Shallow subsurface (0.5 to 1 foot bgs)	1
Structure 145, Electrical Substation No. 3	Soil Sampling	Adjacent to concrete pad	Determine the presence or absence of PCBs in soil in the unpaved area adjacent to the oil-stained concrete.	1145-01	PCBs (EPA 8082)	Composite	Surface (0 to 0.5 foot bgs)	1
					PCBs (EPA 8082)	Composite	Shallow subsurface (0.5 to 1 foot bgs)	1
		Stained soil north of concrete pad	Determine the presence or absence of PCBs in soil in the unpaved area adjacent to the oil-stained concrete.	1145-02	PCBs (EPA 8082)	Discrete	Surface (0 to 0.5 foot bgs)	1
					PCBs (EPA 8082)	Discrete	Shallow subsurface (0.5 to 1 foot bgs)	1
		Stained soil south of concrete pad	Determine the presence or absence of PCBs in soil in the unpaved area adjacent to the oil-stained concrete.	1145-03	PCBs (EPA 8082)	Discrete	Surface (0 to 0.5 foot bgs)	1
					PCBs (EPA 8082)	Discrete	Shallow subsurface (0.5 to 1 foot bgs)	1
Building 162, Auto A.B. Terminal Building	Radiation Survey	Building 162 floor, walls, tables and desks, chairs, and bookcases	Detect the presence or absence of radioactive contamination from past operations using alpha, beta, and gamma radiation survey.	NA	NA	NA	NA	30
Building 174, Hazardous Waste Storage	Radiation Survey	Building 174 floor and walls	Detect the presence or absence of radioactive contamination from the radium repackaging using alpha, beta, and gamma radiation survey.	NA	NA	NA	NA	31

ID = identification
NA = not applicable

3.2 Analytical Methods and Protocols

Soil samples collected during the investigation were analyzed by a laboratory certified by the National Environmental Laboratory Accreditation Program, Laucks Laboratories, Inc., located at 940 South Harney Street, Seattle, Washington. The quality assurance/quality control (QA/QC) laboratory analytical services were provided by EMAX, located at 1835 West 205th Street, Torrance, California. A summary of the analytical methods used for this SI are presented in Table 3-2. Analytical results are included in Appendix C.

3.3 Investigation-Derived Waste (IDW)

IDW soil cuttings were held at a temporary hazardous waste storage area (Building 174) in two 55-gallon drums pending laboratory analysis. Two samples were collected from the IDW drums and analyzed for metals, cyanide, PCBs, and pH. Sample results were below the RCRA regulatory levels as stated in 40 Code of Federal Regulations (CFR) 261, "Identification and Listing of Hazardous Wastes," Section 24, Toxicity Characteristic. Results also were below the State of California total threshold limit concentration (TTLC) concentrations for metals and below EPA Region 9 preliminary remediation goals (PRGs) (EPA, 2004). Analytical results are provided in Appendix C. IDW soils were then disposed in the onsite clean soil disposal area.

Miscellaneous IDW refuse, including gloves and core liners, were placed in a third 55-gallon drum at the temporary hazardous waste storage area and disposed in a general refuse dumpster subsequent to soil analysis. IDW water from decontamination activities also was stored in the temporary hazardous waste storage area and discharged to the onsite IWTP.

3.4 Quality Assurance/Quality Control (QA/QC)

The QA/QC was performed on samples collected and analyzed by conducting data verification and data validation. Data verification consisted of a completeness check of 100 percent of the data along with processing the analytical data through the automated data review tool provided to CH2M HILL by USACE. Data review and Level IV validation was performed for 10 percent of the data. In addition, an evaluation of the precision between the results from the primary and QA/QC laboratories was completed.

The results of the data verification and data validation indicate that data generated from soil sample analyses for the SI are of sufficient quality and quantity to accomplish project objectives. The sample results accurately indicate the presence and/or absence of target analyte contamination at sampled locations at the time of sample collection. Sample collection and analytical techniques followed approved, documented procedures (except as noted in this report and reflected in qualified data points). All results are reported in industry-standard units. Although blank contamination occurred, the concentrations were representative of normal laboratory procedures. In cases of elevated reporting limits (RLs) and method detection limits because of matrix interference and/or high target analyte concentrations, the results obtained for the associated sample/analyses reflect the best achievable data for the site-specific conditions.

TABLE 3-2
Summary of Soil Sample Analysis
Site Investigation Report, Riverbank Army Ammunition Plant, California

	Cyanide	**Hexavalent Chromium**	**Lead**	**Zinc**	**Title 22 Metals [a,b]**	**Total Chromium**	**PCBs**	**pH**	**VOCs**
Site	**Method SW 9012A**	**Method SW 7196A**	**Method SW6020**				**Method SW 8082**	**Method SW 9045**	**Method W 8260B**
RBAAP-001-R-01, Former Pistol Range			X						
SWMU 1, IWTP:									
0.5, 5, 10, and 60 feet bgs	X	X			X			X	X
15 to 55 feet bgs	X	X		X		X		X	
Building 11, Paint and Oil Storage							X		
Structure 95, Substation No. 1							X		
Structure 97, Substation No. 3							X		
Structure 101, Substation Spare							X		
Structure 145, Substation 17							X		

[a] Soluble threshold limit concentration (STLC) metals analysis was not required because TTLC concentrations did not exceed STLC limits.

[b] Title 22 metals include antimony, arsenic, barium, beryllium, cadmium, total chromium, cobalt, copper, lead, molybdenum, nickel, selenium, silver, thallium, vanadium, zinc, and mercury.

A description of the QA/QC procedures is provided in Appendix D. The full report of the data review and validation by Laboratory Data Consultants (LDC), the independent data validation firm, also is presented in Appendix D. An overall summary of data flagging requirements and reasons for flagging is presented in Appendix E.

3.5 Screening Criteria and Background

The screening criteria used for this SI are summarized in Table 3-3 and described below.

3.5.1 Soils

Laboratory analytical results in the top 15 feet of soil were compared to EPA Region 9 PRGs for direct contact with soil. The direct-contact exposure scenarios combine current EPA toxicity values for specific contaminants with standardized exposure factors to estimate contaminant concentrations in soil that are considered protective of human health (EPA, 2004). For direct contact with soil, the industrial PRGs will be used because this site is an industrial facility and will assist in determining when a corrective action is warranted. Additionally, the anticipated future land use at RBAAP is industrial. The residential PRGs for direct contact with soil also are provided for comparison purposes only. These PRGs are used for soils in the top 15 feet where residential or industrial workers could potentially be exposed.

Additionally, the migration-to-groundwater PRG for soil that is protective of groundwater will be used to determine if there is the potential for soil concentrations to result in an exceedance of the EPA Region 9 PRG for groundwater. These PRGs will be applied at all soil depths. Two numbers are presented in the EPA Region 9 tables, for a dilution attenuation factor (DAF) of 1 and a DAF of 20. The DAF of 20 is appropriate because it accounts for natural processes that reduce contaminant concentrations in the subsurface (as opposed to a DAF of 1, which assumes no dilution or attenuation between the source and the receptor well and is used at sites where little or no dilution or attenuation of soil leachate concentrations is expected; e.g., sites with shallow water tables, fractured media, or source size greater than 30 acres). Although both DAF PRGs are provided for comparison purposes in this SI, the DAF of 1 is not appropriate for use at this area because groundwater is not shallow, there are no receptor wells for the A and A′ aquifers, and the geology provides for natural attenuation of contaminants. Additionally, at the IWTP, as a conservative measure, total chromium PRGs are based on a 1:6 hexavalent chromium to trivalent chromium ratio, even though hexavalent chromium was not detected in soil.

TABLE 3-3
Screening Criteria
Site Investigation Report, Riverbank Army Ammunition Plant, California

			State of California	EPA Region 9[a]			
			DTSC	PRGs "Direct Contact Exposure Pathways"		Soil Screening Tables "Migration to Groundwater"	
Detected Analyte	**Unit**	**Site-Specific Background [b]**	**DTSC / TTLC[c]**	**Industrial**	**Residential**	**DAF 20[d]**	**DAF 1[d]**
Cyanide	mg/kg	<1.3 to 2.44		12,313	1,222		
pH	pH Units						
Metals –Title 22							
Antimony	mg/kg		150 to 500	409	31	5.0	0.30
Arsenic	mg/kg	<2 to 8	50 to 500	0.25 to 1.6[e]	0.062 to 0.39[e]	29	1.0
Barium	mg/kg	154 to 208	1,000 to 10,000	66,577	5,375	1,600	82
Beryllium	mg/kg		7.5 to 75	1,940	154	63	3.0
Cadmium	mg/kg	2.7 to 4.8	10 to 100	451	37	8.0	0.40
Total Chromium	mg/kg	8.8 to 29.2	50 to 2,500	450	210	38	2.0
Chromium, Hexavalent	mg/kg	<0.5	50 to 500	64	30	38	2.0
Cobalt	mg/kg	<10 to 12.8	800 to 8,000	1,921	903		
Copper	mg/kg	11.3 to 15.9	250 to 2,500	40,876	3,128		
Lead	mg/kg	2.1 to 17	50 to 1,000	800	150 to 400[e]		
Mercury	mg/kg	0.42	2 to 20	306	23		
Molybdenum	mg/kg		3,500 to 3,500	5,109	391		
Nickel	mg/kg	16.6 to 19.5	200 to 2,000	61,560	6,110	130	7.0
Selenium	mg/kg	3.0	10 to 100	5,110	390	5.0	0.30
Silver	mg/kg	0.5 to 2.0	90 to 500	5,110	390	34	2.0
Thallium	mg/kg		70 to 700	67	5.2		
Vanadium	mg/kg	47.8 to 52.2	240 to 2,400	1,021	78	6,000	300
Zinc	mg/kg	40 to 67.4	2,500 to 5,000	100,000	23,463	12,000	620
PCBs							
Aroclor 1260	µg/kg			740	220		
VOCs							
1,1,1,2-Tetrachloroethane	µg/kg			7,275	3,187		
1,1,1-Trichloroethane	µg/kg			1,200,000	1,200,000	2,000	100
1,1,2,2-Tetrachloroethane	µg/kg			929	408	3.0	0.20
1,1,2-Trichloroethane	µg/kg			1,605	729	20	0.90

TABLE 3-3
Screening Criteria
Site Investigation Report, Riverbank Army Ammunition Plant, California

			State of California	EPA Region 9[a]			
			DTSC	PRGs "Direct Contact Exposure Pathways"		Soil Screening Tables "Migration to Groundwater"	
Detected Analyte	**Unit**	**Site-Specific Background [b]**	**DTSC / TTLC[c]**	**Industrial**	**Residential**	**DAF 20[d]**	**DAF 1[d]**
1,1-Dichloroethane	µg/kg			6,000 to 1,740,000 [e]	2,800 to 506,400 [e]	23,000	1,000
1,1-Dichloroethene	µg/kg			413,325	123,531	60	3.0
1,1-Dichloropropene	µg/kg						
1,2,3-Trichlorobenzene	µg/kg						
1,2,3-Trichloropropane	µg/kg			76	34		
1,2,4-Trichlorobenzene	µg/kg			215,925	62,160	5,000	300
1,2,4-Trimethylbenzene	µg/kg			170,272	51,608		
1,2-Dibromo-3-chloropropane	µg/kg			76 to 2,000 [e]	30 to 460 [e]		
1,2-Dibromoethane	µg/kg			73	32		
1,2-Dichlorobenzene	µg/kg			600,000	600,000	17,000	900
1,2-Dichloroethane	µg/kg			600	280	20	1.0
1,2-Dichloropropane	µg/kg			742	342	30	1.0
1,3,5-Trimethylbenzene	µg/kg			69,712	21,253		
1,3-Dichlorobenzene	µg/kg			600,000	531,349		
1,3-Dichloropropane	µg/kg			360,521	104,817		
1,4-Dichlorobenzene	µg/kg			7,867	3,447	2,000	100
2,2-Dichloropropane	µg/kg						
2-Butanone	µg/kg			113,264,388	22,311,198		
2-Chlorotoluene	µg/kg			560,010	158,411		
2-Hexanone	µg/kg						
4-Chlorotoluene	µg/kg						
4-Isopropyltoluene	µg/kg						
4-Methyl-2-pentanone	µg/kg			47,001,434	5,280,886		
Acetone	µg/kg			54,320,986	14,126,571	16,000	800
Benzene	µg/kg			1,409	643	30	
Bromobenzene	µg/kg			92,152	27,833		
Bromochloromethane	µg/kg						
Bromodichloromethane	µg/kg			1,831	824	600	30
Bromoform	µg/kg			218,200	61,569	800	40

TABLE 3-3
Screening Criteria
Site Investigation Report, Riverbank Army Ammunition Plant, California

			State of California	EPA Region 9[a]			
			DTSC	PRGs "Direct Contact Exposure Pathways"		Soil Screening Tables "Migration to Groundwater"	
Detected Analyte	**Unit**	**Site-Specific Background [b]**	**DTSC / TTLC[c]**	**Industrial**	**Residential**	**DAF 20[d]**	**DAF 1[d]**
Bromomethane	µg/kg			13,078	3,897	200	10
Carbon disulfide	µg/kg			1,201,724	355,340	32,000	2,000
Carbon tetrachloride	µg/kg			549	251	70	3.0
Chlorobenzene	µg/kg			530,466	150,658	1,000	70
Chloroethane	µg/kg			6,485	3,026		
Chloroform	µg/kg			200 to 470 [e]	220 to 940 [e]	600	30
Chloromethane	µg/kg			155,746	46,853		
cis-1,2-Dichloroethene	µg/kg			146,301	42,942	400	20
cis-1,3-Dichloropropene	µg/kg			1,880	765		
Dibromochloromethane	µg/kg			2,554	1,109	400	20
Dibromomethane	µg/kg			233,550	66,908		
Dichlorodifluoromethane	µg/kg			308,058	93,879		
Ethylbenzene	µg/kg			395,000	395,000	13,000	700
Hexachlorobutadiene	µg/kg			22,099	6,236	2,000	100
Isopropylbenzene	µg/kg			1,977,451	572,133		
m,p-Xylene	µg/kg			897,490	270,630		
Methyl tert-butyl ether	µg/kg			36,435	16,701		
Methylene chloride	µg/kg			20,527	9,107	20	1.0
Naphthalene	µg/kg			4,200 to 188,000 [e]	1,700 to 56,000 [e]	84,000	4,000
n-Butylbenzene	µg/kg			240,000	240,000		
n-Propylbenzene	µg/kg			240,000	240,000		
o-Xylene	µg/kg			897,490	270,630		
sec-Butylbenzene	µg/kg			1,629,914	445,649		
Styrene	µg/kg			1,700,000	1,700,000	4,000	200
tert-Butylbenzene	µg/kg			390,000	390,000		
Tetrachloroethene	µg/kg			1,309	484	60	3.0
Toluene	µg/kg			520,000	520,000	12,000	600
trans-1,2-Dichloroethene	µg/kg			234,823	69,490	700	30
trans-1,3-Dichloropropene	µg/kg			1,880	765		

TABLE 3-3
Screening Criteria
Site Investigation Report, Riverbank Army Ammunition Plant, California

			State of California	EPA Region 9[a]			
			DTSC	PRGs "Direct Contact Exposure Pathways"		Soil Screening Tables "Migration to Groundwater"	
Detected Analyte	**Unit**	**Site-Specific Background [b]**	**DTSC / TTLC[c]**	**Industrial**	**Residential**	**DAF 20[d]**	**DAF 1[d]**
Trichloroethene	µg/kg			115	53	60	3.0
Trichlorofluoromethane	µg/kg			2,000,000	385,818		
Vinyl chloride	µg/kg			746	79	10	0.70

[a] PRG – EPA Region 9 residential and industrial PRGs (October 2004).
[b] Site-specific range of background based on analytical data for background samples MW-61A and SFSBG (Table 5-4 and 6-8 of the RI Report; Weston, 1991). Values include minimum and maximum detected values.
[c] DTSC TTLCs are listed in California Code of Regulations (CCR) Title 22, paragraph 66261.24, "Characteristics of Toxicity for Waste Classification." Values listed as a range of concentrations are provided by DTSC.
[d] DAF – Dilution attenuation factor. The value listed is the chemical concentration in soil that has the potential to contaminate groundwater. In general, the DAF is calculated by taking the EPA Region 9 groundwater PRG and multiplying by 1 or 20.
[e] Lower concentration is the California Environmental Protection Agency (Cal-EPA) PRG and the higher value is the EPA Region 9 PRG. Cal-EPA provides their own screening values in the Region 9 PRG tables because they deviate significantly from the federal values. These Cal-EPA values are different than DTSC values.
mg/kg – milligrams per kilogram
µg/kg – micrograms per kilogram
Blank cells indicate no value is available for detected analyte.

3.5.2 IWTP Soil Only

For SWMU 1, IWTP samples only, concentrations of metals detected in soil samples will be compared to EPA Region 9 PRGs (top 15 feet of soil) and DTSC TTLCs for Title 22 metals (all soil depths). This is being done because the IWTP is covered by a RCRA Part B permit, and the closure plan for the permit requires a comparison to the TTLC limits. According to the RCRA closure plan, if soil concentrations are within site-specific background levels at RBAAP, no corrective action is necessary. If concentrations exceed the TTLC limits, remedial action will be necessary. Site-specific background levels are defined as those developed during the CERCLA investigations. For those concentrations that exceed site-specific background levels, but are not deemed hazardous, a health-based risk assessment will be performed.

The TTLCs are listed in CCR Title 22, paragraph 66261.24, "Characteristics of Toxicity for Waste Classification." TTLCs are developed specifically to classify wastes for disposal purposes. For this investigation, soil sample concentrations also were compared to 10 times the STLC value. STLC values are used to determine the leaching potential of a contaminant from a soil sample.

3.5.3 Background

Site-specific background concentrations were initially developed during the CERCLA process (as shown in Table 5-4 and 6-8 of the RI Report; Weston, 1991). Only limited site-specific background information was available and may not be representative of the background for RBAAP, since only one boring location was deemed appropriate for use as site-specific background. The other location sampled was intended to be used for site-specific background, but was determined to be contaminated. Total chromium ranges from 8.8 to 29.2 mg/kg; total cyanide ranges from <1.3 to 2.4 mg/kg; and arsenic was less than 2.0 mg/kg. Regional background levels for the State of California (as provided in EPA Region 9 PRGs; EPA, 2004) for total chromium range from 23 to 1,579 mg/kg, and for arsenic range from 0.59 to 11 mg/kg.

3.5.4 Radiation

Fixed and transferable radiation survey data will be compared to Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors (U.S. Atomic Energy Commission, 1974) as summarized in Table 3-4.

TABLE 3-4
Acceptable Surface Contamination Levels
Site Investigation Report, Riverbank Army Ammunition Plant, California

Nuclide[a]	**Removable**[b,d]	**Direct/Total**[b,c] **(Fixed Plus Removable)**[d]
Alpha emitters: U-nat, U-235, U-238 and associated decay products	1,000 dpm α/100 cm^2	5,000 dpm α/ 100 cm^2
Alpha emitters: Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, AC-227, I-125, I-129[e]	20 dpm α/100 cm^2	100 dpm α/100 cm^2
Alpha emitters: Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and other noted above	1,000 dpm β - γ/100 cm^2	5,000 dpm β - γ/100 cm^2

[a] Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c] The levels may be averaged over 1 square meter, provided the maximum surface activity in any area of 100 square centimeters (cm^2) is less than 3 times the guide values. For purposes of averaging, any square meter of surface shall be considered to be above the activity guide G if: (1) from measurements of a representative number n of sections, it is determined that I/n s1>G, where s1 is the dpm - 100 cm^2 determined from measurements of section 1; or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100-cm^2 area exceeds 3G.

[d] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. (Note: the use of dry material may not be appropriate for tritium.) When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. Except for transuranics and Ra-226, Ra-228, Ac-227, Th-228, Th-230, and Pa-231 alpha emitters, it is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.

[e] This category of radionuclides includes mixed fission products, including the Sr-90, that are present in them. It does not apply to Sr-90 that has been separated from the other fission products or mixtures where the Sr-90 has been enriched.

3.6 Site-Specific Summaries

The following subsections provide a brief history, description of methodology, field observations, and the SI conclusions for each site.

3.6.1 RBAAP-001-R-01, Former Pistol Range

This site is included in the DoD MMRP. In 2006, the Phase I ECP concluded that, based on the assumed historical use of the range, there was potential for lead in surface soil. In 2005, an HRR was conducted to document historical and other known information regarding past range activities (USACE, 2006). The purpose of this SI was to confirm the findings of the HRR and conduct an investigation to determine if past range activities have impacted the site.

3.6.1.1 Historical Operations (Former Pistol Range)

In 2006, a historical records review was performed (USACE, 2006), but no environmental investigations were performed; following is a summary of the findings:

The Former Pistol Range is located in the northwest portion of the installation, adjacent to Claus Road. There is a locked gate along the western edge of the site that is accessible from Claus Road. The levee of the northwestern storm reservoir overlaps the east side of the Former Pistol Range. In this SI Report, the term *levee* means the current structure that comprises the levee for the reservoir. A concrete foundation from a former building was visible during the site visit, but no structures remain.

The Former Pistol Range is closed but is still owned by the U.S. Army. The former range comprises 0.29 acre in the northwest portion of the main installation property and is oriented toward the northeast. Only small arms munitions were expended on this former range.

The former range is part of an area that is currently undeveloped and used for cattle grazing. Although documentation was not located during the HRR indicating definite dates of construction or use, based on the available figures and interviews, it appears that it was used in the 1950s. This range is depicted on a historical map from 1956; however, more recent maps show no indication of the range. This map is included in the historical records review report (USACE, 2006).

The property manager for NI indicated that he recalled historically visiting the site and watching the security forces practice at the former range. He stated that the former range was used only in the 1950s. He stated that it was used rarely and estimated that no more than 100 rounds would have been used over the years. Other RBAAP personnel stated that the range was not used during his tenure, which began in 1967. The levee surrounding the reservoir was changed in the 1960s; however, there is no record of the project or what happened with the soil. It was also mentioned that the levees surrounding the reservoir, which included the backstop for this range, were torn down in 1980 due to their poor condition and then were reconstructed. The backstop that was used for target practice is referred to as the former target berm in this SI Report. The former target berm is different from the levee in that the berm is no longer present and has been reworked with other soils to make the current levee.

The former range may be present in an aerial photograph from June 1963; however, it is not possible to determine its presence conclusively due to the scale of the photograph. The range is not visible in the aerial photographs from April 1997. There have been no known response actions at this range. These photographs are included in the historical records review report (USACE, 2006).

The following conclusions were provided in the historical records review (USACE, 2006), based on the information reviewed:

- Based on information collected and that provided by interviewee, it was determined that the Former Pistol Range munitions response site was used periodically as a small arms range by security personnel during the 1950s.
- Because the site was used only briefly and the former target berm that was used as a backstop was reconstructed, it is unlikely that there are munitions constituents (MC) or munitions and explosives of concern (MEC) at the site related to use of the former range.
- No other areas of concern containing a potential explosive hazard or unexploded ordnance, discarded military munitions, or MC were identified.

During a site visit in 2006 by CH2M HILL, as part of the Phase I ECP, there was no sign of the range or any munitions. There appeared to be a concrete foundation from one of the former buildings, but none of the structures remain.

3.6.1.2 Sample Locations and Methodologies (Former Pistol Range)

To satisfy the requirements of an SI for the MMRP, activities were performed to determine (1) if small arms munitions existed at the Former Pistol Range, and (2) if lead was present or absent in soil in the former firing range and within the levee. The Former Pistol Range is shown in Figure 3-1.

Site Walk of the Former Pistol Range: On April 23, 2007, a site walk was performed in the open flat area of the firing range and along the boundary of the current stormwater reservoir levee to locate these features as part of the fieldwork planning process.

Visual Site Inspection and Photographic Documentation: On May 16, 2007, the field team conducted a visual inspection of the former firing range and the levee to inspect the former site for any evidence of past range activity, and collect photographic documentation. The area was vegetated with dry grasses, making it difficult to determine visually if small arms munitions and metal debris were present in surface soils.

Metal Detection Survey: The area was surveyed with a Fisher TW-6 inductive metal detector to supplement the visual inspection, with the purpose of detecting small arms munitions and other metallic debris. This metal detection survey was not included in the Final FSP, but was performed as an additional task. A surface survey with a metal detector was conducted by a utility location subcontractor on May 15, 2007, within the boundaries of the pistol range (shown in Figure 3-1). The metal detector was calibrated to detect all highly electrically conductive solids, including small arms munitions, within the top 6 inches of soil. Areas adjacent to the fence surrounding the range, including the levee, could not be surveyed because of the adjacent fence and metal interference in the cement wall behind the levee.

The survey was performed over a 5-foot-wide, north-south, east-west, criss-cross grid pattern, and metal detections were marked with orange paint. Each of the marked areas was cleared of grass, and soil was dug by hand to search for metal debris

Soil Sampling: On May 16, 2007, the field team collected soil samples at the Former Pistol Range. Eight samples were collected from surface soils (0 to 0.5 foot bgs) in the pistol range and levee. Locations are shown in Figure 3-1. Three samples were collected from subsurface soils (2.5 to 3.0 feet bgs) in the pistol range. These deeper samples were not collected within the soil of the levee to protect the structural integrity of the levee. Sample locations 0012-08 and 0012-06 were close to two of the six locations where the metal detector provided positive readings. These sample locations were shifted slightly in the field to coincide with metal detection readings. Soil samples were packaged and sent to the laboratory for lead analysis. Field activities at the pistol range are summarized in Table 3-1.

3.6.1.3 Field Observations and Analytical Results (Former Pistol Range)

The Former Pistol Range location, sample locations, and analytical results are shown in Figure 3-1.

Site Walk Observations: The open flat area for the firing range and the raised levee were located during the site walk and are shown in Figure 3-2, Photographs 1 and 2.

Visual Site Inspection and Photographic Documentation: Photographic documentation of the site inspection is presented in Figure 3-2, Photographs 1 through 3. No metal debris or indications of target practice were identified during the visual site inspection. Although tall grass interfered with the site inspection, it should be noted that the site was previously inspected in 2005 as a part of the HRR with the resulting conclusion that no evidence of the range remains (USACE, 2006).

Metal Detection Survey: Excavation of the six metal anomalies uncovered concrete rubble reinforced with wire and metamorphic cobbles. No ammunition, metal target fragments, or MEC were identified during the metal detection survey.

Soil Analytical Results: The sample locations and analytical results are shown in Figure 3-1. Analytical results also are presented in Table 3-5. Low levels of lead were detected in all soil samples collected, but all concentrations detected were below EPA Region 9 residential (150 to 400 mg/kg) and industrial (800 mg/kg) PRGs. Lead concentrations in surface samples ranged from 12 to 138 mg/kg; lead concentrations in subsurface samples ranged from 3.0 to 3.4 mg/kg. Lead concentrations in surface samples collected on the levee ranged from 8.3 (duplicate) to 15 mg/kg.

3.6.1.4 Conclusions (Former Pistol Range)

No small arms munitions or other MEC-related items were identified during the metallic survey or visual inspection at the Former Pistol Range. Additionally, no lead was detected above residential or industrial PRGs in the soil samples collected during the field investigation. Based on the results of the site inspection, metal detection survey, and soil sampling, the small arms range activities have not impacted soil. Based on these conclusions and on the findings of the HRR (USACE, 2006) and Phase I ECP (CH2M HILL, 2006a), no further action is recommended at this MMRP site.

TABLE 3-5
RBAAP-001-R-01, Former Pistol Range Lead Sample Results
Site Investigation Report, Riverbank Army Ammunition Plant, California

LEVEE

Location ID		Screening Criteria		0012-01		0012-01		0012-02	0012-03
Sample ID				0012-01-0.0-0.5		0012-01-0.0-0.5A		0012-02-0.0-0.5	0012-03-0.0-0.5
Sample Date				05/16/07		05/16/07		05/16/07	05/16/07
Depth Interval (feet)				0 to 0.5		0 to 0.5		0 to 0.5	0 to 0.5
QA Type						Field Duplicate			
Analyte	Unit	EPA Region 9 Industrial PRG[a]	EPA Region 9 Residential PRG[a]						
Lead	mg/kg	800	150 to 400[b]	9.2	U	8.3	J	15	11

FORMER PISTOL RANGE

Location ID		Screening Criteria		0012-04	0012-04	0012-05	0012-05	0012-06	0012-06	0012-07	0012-08
Sample ID				0012-04-0.0-0.5	0012-04-2.5-3.0	0012-05-0.0-0.5	0012-05-2.5-3.0	0012-06-0.0-0.5	0012-06-2.5-3.0	0012-07-0.0-0.5	0012-08-0.0-0.5
Sample Date				05/16/07	05/16/07	05/16/07	05/16/07	05/16/07	05/16/07	05/16/07	05/16/07
Depth Interval (feet)				0 to 0.5	2.5 to 3	0 to 0.5	2.5 to 3	0 to 0.5	2.5 to 3	0 to 0.5	0 to 0.5
QA Type											
Analyte	Unit	EPA Region 9 Industrial PRG[a]	EPA Region 9 Residential PRG[a]								
Lead	mg/kg	800	150 to 400[b]	29	3.4	16	3.0	12	3.0	138	15

[a] PRG – EPA Region 9 residential and industrial PRGs (October 2004).
[b] Lower concentration is the Cal-EPA PRG, and the higher value is the EPA Region 9 PRG. California provides their own screening values because they deviate significantly from the federal values.
Bold type indicates a detection.
J – The constituent was positively identified; the quantitation is an estimation.
U – The constituent was not detected. The associated numerical value is at or below the sample-specific method detection limit.

3.6.2 SWMU 1, IWTP

The IWTP is active and includes a system of tanks, sumps, filters, pipes, and other related equipment set up for treating facility wastewater. It is operated under the RCRA Part B Hazardous Waste Facility Permit. The redwood tanks are of concern because they are believed to be the historic source of hexavalent chromium contamination to groundwater. The entire IWTP area is covered with tanks, buildings, concrete, and asphalt. A series of concrete drainage trenches captures spills and overflows and drains to the former influent sump, which is currently used as a secondary containment sump for the IWTP. Groundwater contamination associated with this site (primarily hexavalent chromium and cyanide) is currently being addressed in accordance with the 1994 ROD.

Sampling activities were conducted at the IWTP in an attempt to assess potential subsurface soil contamination beneath accessible process tanks. Based on the history of releases associated with the IWTP (specifically associated with the former redwood tanks), which have resulted in hexavalent chromium and cyanide contamination of groundwater, the SI sampling was designed to provide a better understanding of the magnitude of potential subsurface soil contamination. The SI efforts were designed to be consistent with specifications documented in the RCRA closure and post-closure plans that require soil borings at each process tank at the time of permit closure; therefore, the soil data collected as part of this SI should be useful in assisting with future permit closure sampling efforts.

It should be noted that some of the process tank locations were not accessible for sampling during the SI due to current operation and subsurface utilities. Table 3-6 provides a complete list of process tanks at the IWTP that will require characterization during the permit closure process, and identifies those tanks where SI borings were advanced. Table 3-6 also provides the location of soil borings associated with the tanks being investigated under this SI to determine the magnitude of residual soil contamination associated with historical releases in this area. Refer to the Phase I ECP (CH2M HILL, 2006a) for details on aboveground storage tanks (ASTs) not included in this SI.

Since 1972, numerous upgrades and improvements have been implemented at the IWTP. The redwood equalization tanks were demolished and replaced with a concrete equalization basin in 1980. Reportedly, when the water level in the redwood tanks was reduced for a period, the upper portion of the redwood tanks would dry out and the seams would open slightly. When the liquid level was later raised, the upper portion of the redwood tanks would leak and spill onto the adjacent ground, which was not paved at the time. The site of the former redwood tanks is identified as the historical source of hexavalent chromium contamination in the groundwater; however, current groundwater data suggest that although some degree of residual contamination may remain in the unsaturated zone, this site is no longer an active source to groundwater. The entire active IWTP area is now covered with tanks and an impermeable concrete or asphalt layer. Currently, there is a series of concrete drainage trenches that captures spills and overflows, and drains to the former influent sump, which is currently used as a secondary containment sump for the IWTP.

TABLE 3-6
SWMU, IWTP Components and Aboveground Storage Tanks
Site Investigation Report, Riverbank Army Ammunition Plant, California

Tank Identification	Number of Tanks	2007 SI Boring Completed ID and Location
80-Foot Clarifier	1	0013-01 located north of tank 0013-06 located east of tank
Carbon Filter	1	Not accessible for SI boring
Collection Sump	1	Not accessible for SI boring
Filter Press	1	Not accessible for SI boring
Flash Mixer Spill Area	1	0013-03 northeast of tank G2: Equalization Basin
Flocculation Tanks	2	0013-02 located north of flocculation tanks
G2: Equalization Basin	1	0013-04 located northwest of G2: Equalization Basin
G7: Reactor Clarifier	1	0013-05 located south of G7: Reactor Clarifier
Ion Exchange Columns	1	Not accessible for SI boring
Sand Filter	1	Not accessible for SI boring
Sand Filter Sump	1	Not accessible for SI boring
Scum Tank	1	Not accessible for SI boring
Sludge Thickener	1	Not accessible for SI boring
Site of Former Redwood Tanks	0	Not accessible for SI boring
Transfer Tank	1	Not accessible for SI boring

Source: CH2M HILL, 2006a

Note: This is not a complete list of ASTs at SWMU 1, IWTP. This list includes only those referred to as process tanks in the RCRA closure plan that require soil sampling.

3.6.2.1 Historical Operations (IWTP)

The IWTP was originally built after the U.S. Army acquired the facility in 1951, and a decision was made to convert RBAAP to a manufacturing facility for steel cartridge cases. The configuration of the IWTP had remained nearly unchanged from the startup in 1952 until about 1972. It consisted of equalization tanks constructed of redwood, and a pH adjustment system. From 1952 to 1954, RBAAP produced zinc-plated shells for the U.S. Navy. Because the zinc was electroplated from a cyanide solution, a separate system was required to treat waste. Cyanide solutions were diverted to a special tank in the IWTP where chlorine was added for neutralization. The neutralized cyanide waste joined the normally treated waste, and both were transported to the E/P ponds. The cyanide treatment tanks have not been in use since 1954. Typical wastewater constituents included cyanide, total chromium, trace metals, and caustic solutions. Prior to 1978, hexavalent chromium wastes from the zinc chromate solution on the production lines did not receive special treatment. However, in 1978, a chromium-reduction pretreatment system was installed. The primary treatment process has been upgraded to lime coagulation.

3.6.2.2 Previous Investigations (IWTP)

The summaries below contain the major activities from previous investigations as they relate to soil contamination at the IWTP area at the accessible active tanks investigated during this SI for future RCRA closure.

As part of the Phase I RI, two borings (SB-14 and SB-15) were advanced in the IWTP in locations adjacent to the area of the former redwood tanks (Figure 3-3). Soil borings SB-14 and SB-15 were advanced to a depth of 50 feet bgs (groundwater level at the time) adjacent to the area where the former redwood tanks were located. Samples were analyzed for total and hexavalent chromium, total and free cyanide, and 1,1-dichloroethene (1,1-DCE) (Table 3-7). At SB-14, total chromium was detected at a concentration of 23.5 mg/kg at 40 feet bgs, and 18.0 mg/kg at 50 feet bgs. At SB-15, total chromium was detected at a concentration of 22.15 mg/kg at 40 feet bgs, and 55.83 mg/kg at 50 feet bgs (Weston, 1991). Hexavalent chromium was not detected in samples collected at SB-14 and SB-15. Cyanide and 1,1-DCE were not detected.

The SB-15 boring is also adjacent to the 80-foot clarifier tank. Two other borings were located within the IWTP area: MW-17A and MW-62A/62B (Figure 3-3).

The borehole at MW-62A was advanced to 50 feet bgs. The borehole at MW-62B is located at MW-62A and was advanced to 65 feet bgs. Since the boreholes were drilled in the same location, the location is labeled 62A/62B. Soil samples from these two locations were collected during monitoring well installation.

Soil samples were collected from MW-17A to a depth of 45 feet bgs. Total chromium concentrations ranged from 2.64 mg/kg at 5 feet bgs to 36.80 mg/kg at 45 feet bgs. Soil samples were collected from MW-62A/62B to a depth of 65 feet bgs. Total chromium concentrations ranged from 9.98 mg/kg at 5 feet bgs up to 34.30 mg/kg at 50 feet bgs. Hexavalent chromium was detected at 20 feet bgs and 30 feet bgs at concentrations of 1.47 and 1.28 mg/kg, respectively. Cyanide was not detected.

- Additional sampling at the IWTP area under the RI program was conducted in September 1991 (Weston, 1992). Soil samples were collected from SB-22 and SB-23, located adjacent to MW-17, to determine potential sources of soil contamination near the monitoring well. The monitoring well is near the IWTP, but is not adjacent to any of the tanks sampled during this SI. The results are presented to provide a summary of all soil samples collected in the IWTP area. The results of the sampling are shown in Table 3-7. Total chromium concentrations in SB-22 ranged from 3.70 mg/kg at 5 feet bgs to 22.00 mg/kg at 55 feet bgs. Total chromium concentrations in SB-23 ranged from 2.70 mg/kg at 10 feet bgs to 24.20 mg/kg at 55 feet bgs.
- The report concluded that total chromium concentrations in the samples were less than the presumed regional background concentrations. Background concentrations in California for total chromium range from 23 to 1,579 mg/kg, according to the EPA Users' Guide, Exhibit 3-2 (EPA, 2004). Analysis for hexavalent chromium and cyanide was not performed in soil samples collected at the SB-22 and SB-23 boreholes.

TABLE 3-7
IWTP Historical Soil Sample Results
Site Investigation Report, Riverbank Army Ammunition Plant, California

Sample ID	Depth (feet)	Units	Total Chromium	Hexavalent Chromium	Total Cyanide	Free Cyanide
Regulatory Screening Criteria						
DTSC/TTLC	na	mg/kg	50/2,500	50/500		
Industrial PRG	na	mg/kg	450	64	12,313	
Residential PRG	na	mg/kg	210	30	1,222	
Migration to Groundwater (DAF 20)	na	mg/kg	38	38		
Migration to Groundwater (DAF 1)	na	mg/kg	2.0	2.0		
MW-17A-5	5	mg/kg	2.64	0.5 U	1.25 U	1.25 U
MW-17A-10	10	mg/kg	22.40	0.5U	1.25 U	1.25 U
MW-17A-15	15	mg/kg	21.80	0.5U	1.25 U	1.25 U
MW-17A-20	20	mg/kg	16.20	1.47	1.25 U	1.25 U
MW-17A-25	25	mg/kg	16.10	0.5 U	1.25 U	1.25 U
MW-17A-30	30	mg/kg	16.60	1.28	1.25 U	1.25 U
MW-17A-35	35	mg/kg	23.90	0.5 U	1.25 U	1.25 U
MW-17A-40	40	mg/kg	13.40	0.5 U	1.25 U	1.25 U
MW-17A-45	45	mg/kg	36.80	0.5 U	1.25 U	1.25 U
MW-62A-1	1	mg/kg	19.70	0.5 U	1.25 U	1.25 U
MW-62A-5	5	mg/kg	9.98	0.5 U	1.25 U	1.25 U
MW-62A-10	10	mg/kg	10.60	0.5 U	1.25 U	1.25 U
MW-62A-15	15	mg/kg	11.30	0.5 U	1.25 U	1.25 U
MW-62A-20	20	mg/kg	23.00	0.5 U	1.25 U	1.25 U
MW-62A-25	25	mg/kg	11.90	0.5 U	1.25 U	1.25 U
MW-62A-30	30	mg/kg	13.70	0.5 U	1.25 U	1.25 U
MW-62A-35	35	mg/kg	10.80	0.5 U	1.25 U	1.25 U
MW-62A-40	40	mg/kg	23.50	0.5 U	1.25 U	1.25 U
MW-62A-45	45	mg/kg	18.00	0.5 U	1.25 U	1.25 U
MW-62A-50	50	mg/kg	32.50	0.5 U	1.25 U	1.25 U
MW-62B-51	50	mg/kg	34.30	0.5 U	1.25 U	1.25 U
MW-62B-53	60	mg/kg	31.50	0.5 U	1.25 U	1.25 U
MW-62B-58	60	mg/kg	25.50	0.5 U	1.25 U	1.25 U
MW-62B-63	65	mg/kg	31.80	0.5 U	1.25 U	1.25 U
SB-14-5	5	mg/kg	19.4	0.5 U	1.25 U	1.25 U
SB-14-10	10	mg/kg	3.6	0.5 U	1.25 U	1.25 U
SB-14-15	15	mg/kg	16.5	0.5 U	1.25 U	1.25 U
SB-14-115	15 (dup)	mg/kg	8.8	0.5 U	1.25 U	1.25 U
SB-14-20	20	mg/kg	21.3	0.5 U	1.25 U	1.25 U

TABLE 3-7
IWTP Historical Soil Sample Results
Site Investigation Report, Riverbank Army Ammunition Plant, California

Sample ID	Depth (feet)	Units	Total Chromium	Hexavalent Chromium	Total Cyanide	Free Cyanide
SB-14-30	30	mg/kg	9.5	0.5 U	1.25 U	1.25 U
SB-14-40	40	mg/kg	23.5	0.5 U	1.25 U	1.25 U
SB-14-50	50	mg/kg	18.0	0.5 U	1.25 U	1.25 U
SB-15-5	5	mg/kg	3.02	0.5 U	1.25 U	1.25 U
SB-15-10	10	mg/kg	2.01	0.5 U	1.25 U	1.25 U
SB-15-15	15	mg/kg	3.68	0.5 U	1.25 U	1.25 U
SB-15-20	20	mg/kg	3.70	0.5 U	1.25 U	1.25 U
SB-15-30	30	mg/kg	1.81	0.5 U	1.25 U	1.25 U
SB-15-35	35	mg/kg	11.49	0.5 U	1.25 U	1.25 U
SB-15-40	40	mg/kg	22.15	0.5 U	1.25 U	1.25 U
SB-15-50	50	mg/kg	55.83	0.5 U	1.25 U	1.25 U
SB-22-0	0	mg/kg	8.80	NA	1.1 U	NA
SB-22-5	5	mg/kg	3.70	NA	1.1 U	NA
SB-22-10	10	mg/kg	5.50	NA	1.1 U	NA
SB-22-15	15	mg/kg	7.70	NA	1.1 U	NA
SB-22-20	20	mg/kg	8.60	NA	1.1 U	NA
SB-22-25	25	mg/kg	4.40	NA	1.0 U	NA
SB-22-30	30	mg/kg	4.40	NA	1.1 U	NA
SB-22-35	35	mg/kg	8.50	NA	1.1 U	NA
SB-22-40	40	mg/kg	6.70	NA	1.1 U	NA
SB-22-45	45	mg/kg	15.70	NA	1.4 U	NA
SB-22-50	50	mg/kg	15.70	NA	1.4 U	NA
SB-22-55	55	mg/kg	22.00	NA	1.5 U	NA
SB-22-60	60	mg/kg	11.60	NA	1.2 U	NA
SB-23-0	0	mg/kg	8.60	NA	1.1 U	NA
SB-23-5	5	mg/kg	3.00	NA	1.0 U	NA
SB-23-10	10	mg/kg	2.70	NA	1.1 U	NA
SB-23-15	15	mg/kg	10.00	NA	1.2 U	NA
SB-23-20	20	mg/kg	6.60	NA	1.1 U	NA
SB-23-25	25	mg/kg	5.10	NA	1.1 U	NA
SB-23-30	30	mg/kg	5.20	NA	1.1 U	NA
SB-23-35	35	mg/kg	11.60	NA	1.1 U	NA
SB-23-40	40	mg/kg	8.30	NA	1.3 U	NA
SB-23-45	45	mg/kg	13.30	NA	1.4 U	NA
SB-23-50	50	mg/kg	13.90	NA	1.4 U	NA

TABLE 3-7
IWTP Historical Soil Sample Results
Site Investigation Report, Riverbank Army Ammunition Plant, California

Sample ID	Depth (feet)	Units	Total Chromium	Hexavalent Chromium	Total Cyanide	Free Cyanide
SB-23-55	55	mg/kg	24.20	NA	1.5 U	NA
SB-23-60	60	mg/kg	10.80	NA	1.2 U	NA

Source: Weston, 1991
Blank cells indicate no screening criteria.
U – The analyte was included in this analysis but not detected; value shown equals the detection limit.
NA – not analyzed
PRG – EPA Region 9 residential and industrial PRGs (October 2004).
Shaded results exceed DAF 1.
Boxed and shaded results exceed DAF 1 and DAF 20.

3.6.2.3 Sample Locations and Methodologies (IWTP)

Six borings were drilled at four tanks with a direct-push rig (GeoProbe®), and samples were collected between May 17 and May 21, 2007. These were the only locations that were accessible with the drill rig. Drilling was prohibited by overhead piping, reinforced concrete, tanks, underground utilities, and structures at the former redwood tank location (Building 173) and at the other IWTP tanks. Soil boring logs are included in Appendix A.

The purpose of collecting soil samples beneath these areas at the six locations was to identify the presence or absence of contamination, and to provide useful data for future closure under RCRA. Samples were collected at 5-foot intervals to the depth at which groundwater was encountered in each boring. Soil cores were screened for the presence of oils (sheen testing) and VOCs using the saturation and PID screening methods described in the FSP (CH2M HILL, 2007). The boreholes were abandoned according to the FSP procedures by backfilling with unhydrated bentonite chips to within 6 inches of the surface. The top 6 inches were backfilled with native soil and capped with asphalt to the completed surface grade. The soil cuttings and other IDW were placed in drums and stored onsite.

The following areas within the IWTP were investigated, and samples were analyzed in accordance with the specifications provided in the FSP:

- 80-foot Clarifier
- Flocculation tanks (2 tanks)
- Flash mixer spill area
- G2: equalization basin
- G7: reactor clarifier

The following areas are listed in the RCRA Closure Plan and were not investigated during this SI due to inaccessibility:

- Site of former redwood tanks
- Scum tank
- Sand filter sump
- Sludge thickener

- Filter press
- Sand filter
- Carbon filter
- Ion exchange columns
- Transfer tank
- Collection sump

3.6.2.4 Field Observations and Analytical Results (IWTP)

Geology / Hydrogeology

Based on the six geological borings included in this investigation, local geology in the immediate vicinity of the IWTP generally consists of silty sand interlayered with massive silt and clay lenses and lithic sand due to abundant mica and mafic minerals, which indicate igneous and metamorphic sources for the sand grains. Silt lenses occur at depths greater than 45 feet in the northeast portion of the IWTP (borings 0013-01, 0013-05, and 0013-06). In the northwest portion of the IWTP, sandy silt layers occur in the shallow subsurface between approximately 15 and 20 feet bgs, and at depths greater than 50 feet bgs (borings 0013-02, 0013-03, and 0013-04). Clay deposits are generally less than 2 feet thick and occur in lenses at depths of approximately 18 to 20 feet bgs (borings 0013-01, 0013-02, and 0013-05) and 51 to 63 feet (borings 0013-03, 0013-04, and 0013-06). The clay deposits appear to be locally discontinuous, but may be regionally significant. Generally, groundwater was observed between 58 and 60 feet bgs.

The results of sampling activities for each area within the IWTP followed by a general summary of results for the IWTP are presented below. Boring locations are shown in Figure 3-4. Tables 3-8 and 3-9 present analytical results for the constituents detected in the samples. Appendix C contains a complete set of analytical results, including constituents that were not detected.

80-Foot Clarifier Tank (0013-01 and 0013-06)

One borehole (0013-01) angled at 10 degrees from vertical was drilled beneath the 80-foot clarifier tank. A second borehole (0013-06) was drilled adjacent to the 80-foot clarifier tank. The purpose of these two boreholes was to determine if contaminated soils are present beneath the tank. The two boreholes were drilled at an angle to obtain soils beneath the tank, the depth below the ground surface converts from 60 linear feet to 59 vertical feet bgs. Soil boring logs in Appendix A provide this conversion. Approximately 4 inches of asphalt was underlain by 0.5 foot of gravel fill. Native soils encountered were described as sand and silty sand. In general, groundwater was encountered between 57 and 58 feet bgs. Minor clogging due to swelling soils occurred in boring 0013-01 (see boring logs in Appendix A).

Field Screening Results: Sheens, odors, and soil staining were not observed in soils. Only low PID (less than 1.6 parts per million [ppm]) readings were detected during the sampling, and no patterns or areas of contamination were measured.

Analytical Results: Soil samples were collected at 5-foot intervals between 0.5 and 60 linear feet and were analyzed for hexavalent chromium, total chromium, zinc, cyanide, and pH. Samples collected at 0.5, 5, 10, and 60 feet were additionally analyzed for VOCs and Title 22 metals.

Inorganics: All metals for which analyses were performed, with the exception of hexavalent chromium and mercury, were detected in soil samples collected from boring 0013-01; and all metals except hexavalent chromium, mercury, and silver were detected in soil samples collected from boring 0013-06. Total chromium and zinc were selected as indicator parameters for contamination at the IWTP area in the RCRA Closure Plan (NI, 2004). Total chromium concentrations ranged from 10.9 to 28.2 mg/kg in borehole 0013-01 and from 4.3 to 41.2 mg/kg in borehole 0013-06. Concentrations of total chromium are similar to, but exceed, the site-specific background values of 8.8 to 29.2 mg/kg presented in the RI Report (Weston, 1991). Zinc concentrations ranged from 17.6 to 75.5 mg/kg in borehole 0013-01 and from 17.1 to 77.4 mg/kg in borehole 0013-06. Soils from the borings were above site-specific background ranges for cyanide, total chromium, cobalt, copper, nickel, vanadium, and zinc.

Organics: The VOCs 2-butanone, acetone, methylene chloride, and trichlorofluoromethane were detected in low concentrations in soils at the clarifier, as presented in Table 3-9. NI confirmed that the VOCs detected in low concentrations are not used at the IWTP or in IWTP processes (NI, 2007).

pH: The pH results at 0013-01 ranged between 6.1 and 9.2. The pH values at 0013-06 ranged between 6.7 and 11. The surface sample (0.5 to 1 foot bgs) collected at 0013-06 was the highest pH value observed in the IWTP, with a value of 11.

Comparison to Screening Criteria: Methylene chloride was the only constituent detected at concentrations above the migration to groundwater DAF 20. Methylene chloride is not associated with clarifier operations and is a common laboratory contaminant. Analytical results for all inorganic constituents, except arsenic, did not exceed industrial and residential PRGs or soil values for protection of groundwater using a DAF of 20. Arsenic concentrations ranged from 0.614 to 2.03 mg/kg in 0013-01 and 0.47 to 4.16 in 0013-06. These concentrations are similar to the RBAAP site-specific background value of 2 mg/kg presented in the RI Report (Weston, 1991). Detected arsenic values also are within the range of EPA Region 9 California regional background levels at 0.59 to 11 mg/kg (Exhibit 3-2 in EPA, 2004). Hexavalent chromium and cyanide, which are the primary contaminants of concern (COCs) in groundwater at RBAAP, were not detected. Concentrations of zinc are similar to, but exceed, the site-specific background values of 40 to 67.4 mg/kg presented in the RI Report (Weston, 1991).

Flocculation Tanks (0013-02)

One borehole (0013-02) angled at 15 degrees from vertical was drilled beneath the bermed secondary containment for the flocculation tanks. The purpose of this borehole was to determine if contaminated soils are present beneath the tanks. The borehole was drilled beneath the bermed secondary containment for the flocculation tanks to a depth of 60 linear feet. Because 0013-02 was drilled at an angle to obtain soil samples beneath the tank, the depth below the ground surface converts from 60 linear feet to 58 vertical feet bgs (Appendix A). Soil core recovery was high and allowed for continuous field screening from the surface to groundwater. Groundwater was observed at 59 feet bgs.

Slipsheet (Excel Table)

TABLE 3-8
SWMU 1, IWTP, Analytical Results for Inorganic Compounds and pH in Soil

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TABLE 3-9
SWMU 1, IWTP Analytical Results for Detected VOCs in Soil (µg/kg)

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Field Screening Results: Sheens, odors, and soil staining were not observed at 0013-02. PID readings did not exceed 0.0 ppm during the sampling, and no patterns or areas of contamination were measured. Approximately 4 inches of asphalt was underlain by 0.5 foot of gravel fill. Native soils encountered were described as silty sand.

Analytical Results: Soil samples were collected at 5-foot intervals between 0.5 and 60 linear feet and were analyzed for hexavalent chromium, total chromium, zinc, cyanide, and pH. Samples collected at 0.5, 5, 10, and 60 feet were additionally analyzed for VOCs and Title 22 metals.

Inorganics: All metals included in the analysis, except hexavalent chromium, mercury, and silver, were detected in soil samples collected at 0013-02. Total chromium concentrations ranged from 13.2 to 32.4 mg/kg. Zinc concentrations ranged from 22.2 to 112 mg/kg. Concentrations of total chromium are similar to, but exceed, the site-specific background values of 8.8 to 29.2 mg/kg presented in the RI Report (Weston, 1991). Concentrations of zinc are similar to, but exceed, the site-specific background values of 40 to 67.4 mg/kg presented in the RI Report (Weston, 1991). Many analytes, including cyanide, barium, total chromium, cobalt, copper, nickel, and zinc, exceeded site-specific background values.

Organics: Acetone and methylene chloride were detected in low concentrations in soils at the tanks, as presented in Table 3-9. NI confirmed that the VOCs detected in low concentrations are not used at the IWTP or in IWTP processes (NI, 2007).

pH: The pH results at 0013-02 ranged between 7.6 and 9.6; these results are within the normal range of pH values observed at the IWTP.

Comparison to Screening Criteria: None of the analytical results for metal constituents, except arsenic, exceeded direct-contact industrial and residential PRGs or the migration to groundwater DAF 20. Methylene chloride, a common laboratory contaminant, was detected at concentrations above the migration to groundwater DAF 20. NI confirmed that the VOCs detected in low concentrations are not used at the IWTP or in IWTP processes (NI, 2007).

Flash Mixer Spill Area (0013-03)

One borehole (0013-03) was drilled beneath the area identified as the location of a historic spill that had been remediated. The purpose of the borehole was to identify the presence or absence of contamination resulting from the spill that may have been left in place following remediation. The borehole was drilled to a depth of 60 feet bgs beneath the location of a historic spill area that had been remediated. Groundwater was encountered at 60 feet bgs.

Field Screening Results: Sheens, odors, and soil staining were not observed. Only low PID readings (0.2 ppm) were detected during the sampling, and no patterns or areas of contamination were measured. Approximately 4 inches of asphalt was underlain by 0.5 foot of gravel fill. Native soils encountered were described as silty sand.

Analytical Results: Soil samples were collected at 5-foot intervals between 0.5 and 60 linear feet for analysis of hexavalent chromium, total chromium, zinc, cyanide, and pH. Samples collected at 0.5, 5, 10, and 60 feet were additionally analyzed for VOCs and Title 22 metals.

Inorganics: All metals included in the analysis, except antimony, hexavalent chromium, mercury, and silver, were detected in soil samples collected at 0013-03. Total chromium concentrations ranged from 14.2 to 30.7 mg/kg. Concentrations of total chromium are similar to, but exceed, the site-specific background values of 8.8 to 29.2 mg/kg presented in the RI Report (Weston, 1991). Zinc concentrations ranged from 25 to 110 mg/kg. Concentrations of zinc are similar to, but exceed, the site-specific background values of 40 to 67.4 mg/kg presented in the RI Report (Weston, 1991). Many analytes, including cyanide, total chromium, cobalt, copper, lead, nickel, and zinc, exceeded site-specific background values.

Organics: Acetone, methylene chloride, and trichlorofluoromethane were detected in low concentrations in soils, as presented in Table 3-9. NI confirmed that the VOCs detected in low concentrations are not used at the IWTP or in IWTP processes (NI, 2007).

pH: The pH results at 0013-03 ranged between 7.2 and 9.5; these results are within the normal range of pH values observed at the IWTP.

Comparison to Screening Criteria: None of the analytical results for constituents, except arsenic, exceeded direct-contact industrial and residential PRGs or the migration to groundwater DAF 20. Methylene chloride, a common laboratory contaminant, was detected at concentrations above migration to groundwater DAF 20. NI confirmed that the VOCs detected in low concentrations are not used at the IWTP or in IWTP processes (NI, 2007).

G2: Equalization Basin (0013-04)

One borehole (0013-04) angled at 15 degrees from vertical was drilled beneath a location identified as a spill area. The purpose of this borehole was to determine if contaminated soils are present beneath the tanks. The angled borehole was drilled beneath the location identified as a spill area to a depth of 60 linear feet (58 vertical feet bgs).

Field Screening Results: Sheens, odors, and soil staining were not observed. PID readings did not exceed 0.0 ppm during the sampling, and no patterns or areas of contamination were measured. Approximately 3 inches of asphalt was underlain by 1.0 foot of gravel fill. Native soils encountered were described as silty sand. Groundwater was encountered at 59 feet bgs.

Analytical Results: Soil samples were collected at 5-foot intervals between 0.5 and 60 linear feet and analyzed for hexavalent chromium, total chromium, zinc, cyanide, and pH. Samples collected at 0.5, 5, 10, and 60 feet were additionally analyzed for VOCs and Title 22 metals.

Inorganics: All metals included in the analysis, except cyanide, hexavalent chromium and mercury, were detected in soil samples collected at 0013-04. Total chromium concentrations ranged from 11.1 to 24.9 mg/kg and were less than background levels. Zinc sample results ranged from 22.8 to 52.6 mg/kg and were less than site-specific background levels. Copper and nickel exceeded site-specific background values.

Organics: Acetone, methylene chloride, and trichlorofluoromethane were detected in low concentrations in soils, as presented in Table 3-9. NI confirmed that the VOCs detected in low concentrations are not used at the IWTP or in IWTP processes (NI, 2007).

pH: The pH results at 0013-04 ranged between 7.2 and 8.7; these results are within the normal range of pH values observed at the IWTP.

Comparison to Screening Criteria: None of the analytical results for constituents, except arsenic, exceeded direct-contact industrial and residential PRGs or the migration to groundwater DAF 20. Methylene chloride, a common laboratory contaminant, was detected at concentrations above migration to groundwater DAF 20. NI confirmed that the VOCs detected in low concentrations are not used at the IWTP or in IWTP processes (NI, 2007).

G7: Reactor Clarifier (0013-05)

One borehole (0013-05) angled at 10 degrees from vertical was drilled beneath the reactor clarifier tank. The purpose of this borehole was to determine if contaminated soils are present beneath the tanks. The angled borehole was drilled beneath the reactor clarifier tank to a depth of 60 linear feet (59 feet bgs). Soil core recovery was high and allowed for continuous field screening from the surface to groundwater. Approximately 2 inches of asphalt was underlain by 0.5 foot of gravel fill. Native soils encountered were described as silty sand. Groundwater was observed at 58 feet bgs.

A deviation from the FSP occurred when one sample container that was intended for metals, cyanide, and pH analysis from the deepest sample (59 feet bgs at boring 0013-05) was broken in transport to the laboratory, and the sample could not be analyzed. A duplicate sample was collected at that depth and those results are reported in this SI Report. The VOC sample jar for boring 0013-05 was unharmed and was analyzed in the laboratory.

Field Screening Results: Sheens, odors, and soil staining were not observed at 0013-05. PID readings did not exceed 0.8 ppm during the sampling, and no patterns or areas of contamination were measured.

Analytical Results: Soil samples were collected at 5-foot intervals between 0.5 and 60 linear feet and were analyzed for hexavalent chromium, total chromium, zinc, cyanide, and pH. Samples collected at 0.5, 5, and 10 feet were additionally analyzed for VOCs and Title 22 metals.

Inorganics: All metals included in the analysis, except antimony, hexavalent chromium, and mercury, were detected in soil samples collected at 0013-05. Detected sample concentrations of cyanide ranged up to 6.3 mg/kg. Total chromium concentrations ranged from 9.36 to 28.9 mg/kg and were less than site-specific background values. Zinc sample results ranged from 18.8 to 78.8 mg/kg and exceeded site-specific background values. Many analytes, including cyanide, cobalt, copper, nickel, vanadium, and zinc, exceeded site-specific background values.

Organics: Acetone, methylene chloride, and 2-butanone were detected in low concentrations in soils, as presented in Table 3-9. NI confirmed that the VOCs detected in low concentrations are not used at the IWTP or in IWTP processes (NI, 2007).

pH: The pH results at 0013-05 ranged between 7.7 and 8.3; these results are within the normal range of pH values observed at the IWTP.

Comparison to Screening Criteria: None of the analytical results for constituents, except arsenic, exceeded direct-contact industrial or residential PRGs or the migration to groundwater DAF 20.

3.6.2.5 IWTP Summary and Conclusions

Analytical results for the locations sampled at the IWTP indicate that significant historic leaks or spills have not occurred at the 80-foot clarifier tank, flocculation tanks, flash mixer spill area, equalization basin, and reactor clarifier. This conclusion is supported by the absence of detections exceeding the DTSC TTLC screening values and lack of any visual or field screening evidence of release. Hexavalent chromium, which is the primary contaminant in groundwater at the site, was not detected in any of the SI soil samples. Cyanide, also of concern in groundwater, was detected at concentrations well below regulatory screening values.

Arsenic and methylene chloride (a common laboratory contaminant) exceeded the residential and/or industrial PRGs at isolated locations; however, these exceedances do not show a pattern of a release from the area. Arsenic concentrations can be attributed to naturally occurring substances in the area. Although there is a lack of direct evidence that methylene chloride detections were from laboratory contamination, there is a degree of certainty that methylene chloride is not present in soils at the IWTP because it is not a COC associated with the IWTP operations. In addition, the methylene chloride concentrations were low and showed no apparent spacial pattern. All other constituents were below regulatory screening values.

Soil concentrations for barium, cyanide, cadmium, total chromium, cobalt, copper, lead, nickel, vanadium, and zinc were above site-specific background levels at the IWTP. The RCRA closure plan uses background values as screening criteria when a risk assessment needs to occur. However, the existing site-specific background data set is limited, and therefore may not represent an accurate range of background values.

As stated previously, the site of the former redwood tanks was inaccessible for SI sampling. The former redwood tanks represent the location of a past release of wastewater containing hexavalent chromium, which resulted in contamination of groundwater at RBAAP and the surrounding area. Although direct sampling could not be conducted, the results of the SI and prior studies can be used to draw some preliminary conclusions regarding the redwood tanks as follows:

- The lateral extent of potential chromium- and cyanide-contaminated soil appears to be limited to the approximate footprint of the former redwood tanks. This conclusion on the footprint is based on the absence of hexavalent chromium and cyanide in samples from soil borings SB-14 and SB-15, which were completed directly adjacent to the site, and the absence of hexavalent chromium in any of the nearby SI borings. Cyanide concentrations were all well below regulatory screening values.

- The site no longer appears to be a direct source to groundwater as supported by quarterly groundwater sampling results.

Source attenuation has occurred as a result of (1) active treatment (groundwater extraction and treatment); (2) the lowering of the water table, which has made groundwater contact with contaminated soils less likely; and (3) complete pavement of the surface, which has eliminated infiltration and mobility of potential contaminants in soil.

3.6.3 Building 11, Paint and Oil Storage

Sampling was conducted at Building 11 to further evaluate soils in the vicinity of the building where PCBs previously were detected, and to survey the building for potential radiological contamination based on a 1980 interview comment suggesting that the building was used for radioactive material storage.

Building 11 is an 8,960-ft^2 metal building that contains a transfer pumping system, a railroad car loading/unloading dock inside, and a truck loading/unloading dock. Asphalt-paved roads line the east and north sides of the building; a concrete pad lies between two rail spurs on the north side of Building 11.

3.6.3.1 Historical Operations (Building 11)

Building 11 was originally constructed in 1951 as a bauxite ore receiving facility. The ore was dropped from rail cars down two levels where it was later transported to the main plant via a conveyor belt. The conveyor was removed in approximately 1958. The lower two levels of this building have been used as a fallout shelter, records storage area, and drummed materials (including lubricating oils) storage area. Building 11 is adjacent to Substation No. 5, which includes three PCB transformers installed in 1951.

3.6.3.2 Previous Investigations (Building 11)

As a part of the Environmental Baseline Survey (EBS) (Norris-Riverbank Environmental [Norris-Riverbank], 1998a), five near-surface soil samples were collected from the graveled areas just outside Building 11 along the southern and western sides as shown in Figure 3-5. Aroclor 1260 was identified in all five sample results, in concentrations ranging from 400 µg/kg to 1,000 µg/kg (Table 3-10). The source of PCBs is not known; and although no evidence of leaks or spills involving the two electrical substations in close proximity to the areas sampled have been reported, these substations (Structure 53, Substation 5; and Structure 97, Substation 3) were considered possible sources.

TABLE 3-10
Building 11, Paint and Oil Storage Historical Soil Sample Results
Site Investigation Report, Riverbank Army Ammunition Plant, California

Method	Analyte	Unit	EPA Region 9 Industrial PRG[a]	EPA Region 9 Residential PRG[a]	H01	H02	H03	H04	H05
EPA 8080	Aroclor 1260	µg/kg	740	220	1,000	870	680	410	400

Source: Norris-Riverbank, 1998a
[a] PRG – EPA Region 9 residential and industrial PRGs (October 2004).

According to the installation assessment from 1980, one facility representative interviewed recalled that radiological material may have been stored during the late 1950s in Building 11. The U.S. Army Materiel Development Readiness Command (DARCOM) Headquarters indicated that NRC permits were not required in the 1950s, and information concerning these radiation activities was not available (U.S. Army, 1980). No additional information concerning the storage of radioactive materials at Building 11 was identified through records searches conducted by the USAMC Radiation Safety Officer (Prins, 2006), U.S. Army Joint Munitions Command (Crooks, 2006), or the U.S. Army Center for Health

Promotion and Preventive Medicine (CHPPM) Office (Alberth, 2006). Correspondence with the onsite contractor (NI) indicated that a fallout shelter sign with the radioactive materials symbol was posted on the building during the 1950s. It may be that the facility representative saw this sign and believed radioactive material was stored there (NI, 2006).

There has been no past investigation for radioactive materials in the building; therefore, this building was addressed as a part of this SI.

3.6.3.3 Sample Locations and Methodologies (Building 11)

Soil Sampling

On May 21, 2007, two borings were advanced by hand auger at Building 11, Paint and Oil Storage, in the area where an elevated level of Aroclor 1260 had been identified in soils during the 1998 EBS (Norris-Riverbank, 1998a). The objective of the sampling was to determine the extent of PCBs in soil at the historical sample location by collecting soil samples from two borings surrounding the original location. A surface soil sample (beneath asphalt and thin gravel fill) and subsurface soil sample (3 feet bgs) were collected from each boring location and analyzed for PCBs using EPA Method SW8082. The area had been paved since the 1998 EBS sampling, and the patchwork from the H01 borehole was no longer visible. RBAAP maps and memories of field personnel who had seen the patchwork for the H01 borehole were used to locate the original H01 location within a few feet, and to place sampling points adjacent to H01.

The drill rig at the IWTP was used to punch holes in the asphalt to facilitate sampling. Approximately 4 inches of asphalt was underlain by 6 to 8 inches of gravel fill. Native soils encountered were described as sand and silty sand. No soil staining or odors were observed on the pavement or in the underlying material.

Radiological Survey

A radiological survey was performed on May 22, 2007, in the building to determine the presence or absence of radioactive contamination. The radiological survey was conducted following the Guidance on Radiological Decommissioning Surveys (USAMC, 2004). A total of 31 random locations—27 locations on the ground-level floor and 4 locations on the wall—were surveyed. Direct alpha and beta-gamma measurements at each location were measured using both a G-M detector and a ZnS/NaI scintillation detector to detect the absence of radioactive contamination. Removable alpha and beta-gamma measurements also were collected using a smear survey at each of the 31 locations. Sample details, including sample locations and calibration records, are presented in Appendix B.

3.6.3.4 Field Observations and Analytical Results (Building 11)

Soil Sampling Results

The soil sample locations and analytical results are shown in Figure 3-5. Aroclor 1260 was detected in surface and subsurface soils at concentrations well below residential and industrial direct-contact PRGs, as well as previous sample results. PCBs were not detected at the second soil boring located southwest of H01 (1011-02). There is no groundwater protection PRG for PCBs in soil. Table 3-11 presents sample results for Aroclor 1260, which was the only PCB detected. Complete analytical results are provided in Appendix C.

TABLE 3-11
Building 11, Paint and Oil Storage Detected PCB Sample Results
Site Investigation Report, Riverbank Army Ammunition Plant, California

Location ID		**Screening**		**1011-01**		**1011-01**		**1011-02**		**1011-02**		**1011-02**	
Sample ID		**Criteria**		**1011-01-0.0-0.5**		**1011-01-2.5-3.0**		**1011-02-0.0-0.5**		**1011-02-0.0-0.5A**		**1011-02-2.5-3.0**	
Sample Date				**05/21/07**		**05/21/07**		**05/21/07**		**05/21/07**		**05/21/07**	
Depth Interval (feet)				**0 to 0.5**		**2.5 to 3**		**0 to 0.5**		**0 to 0.5**		**2.5 to 3**	
QA Type										**Field Duplicate**			
Detected Analyte	**Unit**	**EPA Region 9 Industrial PRG[a]**	**EPA Region 9 Residential PRG[a]**										
Aroclor 1260	µg/kg	740	220	**38**	**J**	**30**	**J**	18	UJ	18	UJ	19	UJ

Notes:
This table includes only detected analytes. Appendix C contains all analytical results.
[a] PRG – EPA Region 9 residential and industrial PRGs (October 2004).
J – The constituent was positively identified; the quantitation is an estimation.
UJ – The constituent was not detected; the quantitation is an estimation.
Bold type indicates a detection.

Radiological Survey Results

The survey results were below acceptable levels as established by the U.S. Atomic Energy Commission, as shown in Table 3-12. Therefore, delineation of contamination or specific isotopes was not required.

TABLE 3-12
RBAAP Radiation Survey Results, Building 11
Site Investigation Report, Riverbank Army Ammunition Plant, California

AOC	Site Description	Direct alpha dpm/100 cm^2 (Limit = 100 to 5,000)a	Direct beta-gamma dpm/100 cm^2 (Limit = 1,000 to 5,000)a	Removable alpha dpm/100 cm^2 (Limit = 20 to 1,000)a	Removable beta-gamma dpm/100 cm^2 (Limit = 200 to 1,000)a
Building 11	Hazardous Waste Storage Area	-8.0 to 6.9	-51.6 to 896.7	-0.6 to 2.6	-37.3 to 30.7

[a] Acceptable surface contamination limit from Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors (U.S. Atomic Energy Commission, 1974).

3.6.3.5 Conclusions (Building 11)

Site Inspection and Soil Sampling

Based on the SI sampling results, the lateral extent of PCBs in excess of PRGs appears to be limited. Due to the relative insolubility of PCB compounds and lack of mobility of PCBs in soil, the PCB detected at H01 is likely restricted to the near-surface soils in an isolated area at a concentration that exceeds both residential and industrial direct-contact PRGs. Because the PCBs in soil are beneath asphalt, there is no current risk of exposure and no further action is recommended.

Radiological Survey

According to guidelines established in 1974 by the U.S. Atomic Energy Commission, if survey results are below the limits established in the guidelines, the building is safe for general used without restrictions. The radiological survey results for Building 11 were well below the screening levels and confirm the absence of radioactive contamination at this building.

3.6.4 Structure 95, Substation No. 1

SI sampling was conducted at this site to further evaluate soils in the vicinity of observed oil staining at Structure 95, Substation No. 1. Structure 95 is an active transformer substation that covers an area of approximately 280 ft^2. The transformer is mounted on a concrete pad and is surrounded by a gravel blanket approximately 1 foot thick. The gravel blanket is enclosed by a concrete curb with a chain-link fence; the entire structure is surrounded by pavement on the north, west, and south, and by Building 33 on the east.

3.6.4.1 Historical Operations (Structure 95, Substation No. 1)

Structure 95 includes one active PCB-containing transformer installed in 1951. This transformer is reported to have an oil PCB concentration of 106 mg/kg (CH2M HILL, 2006a). By definition under the Toxic Substances Control Act (TSCA), PCB-containing equipment contains PCB concentrations of 50 mg/kg or greater, but less than 500 mg/kg. Oil staining was observed on the concrete at the base of the transformer at Substation No. 1 during the Phase I ECP visual site inspection on June 22, 2006.

3.6.4.2 Sample Locations and Methodologies (Structure 95, Substation No. 1)

On May 19, 2007, after NI completed de-energization and lock-out/tag-out procedures, the SI field team conducted soil sampling at Structure 95, Substation No. 1. The purpose of this sampling effort was to determine the presence or absence of PCB-contaminated soil beneath the gravel blanket adjacent to the oil-stained concrete. During the 2006 visual site inspection, oil staining was observed on the concrete pad at the base of the transformer. On May 19, 2007, the stained concrete was still visible. Further inspection did not reveal any staining or visual evidence of release on gravel areas adjacent to the concrete pad, and the concrete pad appeared to be good condition.

An attempt was made to collect one composite sample from three discrete locations as described in the FSP (CH2M HILL, 2007). Because no staining was observed in the gravel area, three discrete locations were selected for the composite sample based on the slope of the concrete pad and location of the stain on the concrete pad. An attempt was made at three locations, but due to the thickness of the gravel blanket and the presence of hardpan, soil could only be retrieved from two locations in the shallow subsurface soils (0.5 to 1 foot bgs).

3.6.4.3 Field Observations and Analytical Results (Structure 95, Substation No. 1)

Aroclor 1260 was the only PCB detected in samples collected near Structure 95, Substation No. 1. Aroclor 1260 was detected in the composite sample (230 μg/kg) and field duplicate (260 μg/kg) collected between 0.5 and 1 foot bgs. This concentration is below the industrial PRG and slightly above the residential PRG. Sample locations are shown in Figure 3-6. Table 3-13 presents the analytical results for the one constituent (Aroclor 1260) detected in the composite sample and field duplicate. Appendix C contains a complete set of analytical results.

TABLE 3-13
Structure 95, Substation No. 1 Detected PCB Sample Results
Site Investigation Report, Riverbank Army Ammunition Plant, California

Location ID				**1095-01**		**1095-01**	
Sample ID				**1095-01-0.5-1.0**		**1095-01-0.5-1.0A**	
Sample Date				**05/19/07**		**05/19/07**	
Depth Interval (feet)				**0.5 to 1**		**0.5 to 1**	
Sample Type				**composite**		**composite**	
QA Type						**field duplicate**	
Analyte	**Unit**	**EPA Region 9 Industrial PRG[a]**	**EPA Region 9 Residential PRG[a]**				
Aroclor 1260	μg/kg	740	220	**230**	**J**	**260**	**J**

[a] PRG – EPA Region 9 residential and industrial PRGs (October 2004).

Shaded result exceeds residential PRG.

Bold type indicates a detection.

J – The constituent was positively identified; the quantitation is an estimation.

3.6.4.4 Conclusions (Structure 95, Substation No. 1)

Aroclor 1260 was detected at 230 µg/kg in a composite soil sample collected at a depth of 0.5 to 1 foot bgs beneath the gravel blanket surrounding the concrete pad. The detected Aroclor concentration was below the industrial PRG and only slightly above the residential PRG. Staining was observed on the concrete pad, but was not observed in the gravel or in the soil.

Future use of this area is expected to be industrial. In addition, access to the substation area is limited to occasional maintenance personnel and controlled by a locked fence with signage. No further action is recommended based on the following factors:

- The PCB concentration in soil is below the industrial PRG.
- Land use is currently industrial and expected to remain industrial.
- Access restrictions limit the potential for exposure to this area.

3.6.5 Structure 97, Substation No. 3

SI sampling was conducted at this site to further evaluate soils in the vicinity of observed oil staining at Structure 97, Substation No. 3. Structure 97 is comprised of two active transformers designated as Substation No. 3. The transformers sit on individual concrete pads and are surrounded by a gravel blanket approximately 1 ft thick. The gravel blanket is enclosed by a chain-link fence. Substation No. 3 is a 1,050-ft^2 facility surrounded by pavement on all sides.

3.6.5.1 Historical Operations (Structure 97, Substation No. 3)

Structure 97 includes two active transformers installed in 1951. During the Phase I ECP visual site inspection on June 22, 2006, oil staining was observed on concrete at the base of the two transformers. The transformers have PCB concentrations of 64 mg/kg and 33 mg/kg (CH2M HILL, 2006a). By definition under TSCA, PCB-contaminated equipment contains PCB concentrations of 50 mg/kg or greater, but less than 500 mg/kg.

3.6.5.2 Sample Locations and Methodologies (Structure 97, Substation No. 3)

On May 17, 2007, the field team conducted soil sampling at Structure 97, Substation No. 3. The purpose of this sampling effort was to determine the presence or absence of PCB-contaminated soil in the unpaved area adjacent to the oil-stained concrete. During the 2006 visual site inspection and during this SI on May 17, 2007, oil staining was observed on the concrete pads at the base of two transformers. No staining was observed on gravel blanket adjacent to the concrete pad. The integrity of the pad appeared to be good; discrete sample locations were based on the slope of the concrete pad and location of the stain on the concrete pad.

One composite sample was collected from three discrete locations in surface soil (0 to 0.5 foot bgs) and shallow subsurface soil (0.5 to 1 foot bgs). Because no staining was observed in the unpaved area, three discrete locations were selected for the composite sample based on the slope of the concrete pad and location of the stain on the concrete pad. Soils were encountered 0.8 foot below coarse gravel fill. Soils were described as silty and gravelly sands. No staining or odors were observed in soil; however, rusty staining was noted on gravel fill above the soil.

3.6.5.3 Field Observations and Analytical Results (Structure 97, Substation No. 3)

Aroclor 1260 was the only PCB detected in samples collected near this substation. Aroclor 1260 was detected at concentrations of 330 µg/kg from 0 to 0.5 foot bgs. This concentration is below the industrial PRG and above the residential direct-contact PRG. Aroclor 1260 was also detected at a concentration of 23 µg/kg from 0.5 to 1 foot bgs. This concentration is below both residential and industrial PRGs. There is no groundwater protection PRG for PCBs in soil. Sample locations are shown in Figure 3-7. Table 3-14 presents analytical results for the one constituent detected in the project samples, Aroclor 1260. Appendix C contains a complete set of analytical results.

TABLE 3-14
Structure 97, Substation No. 3 Detected PCB Sample Results
Site Investigation Report, Riverbank Army Ammunition Plant, California

Location ID				**1097-01**		**1097-01**	
Sample ID				**1097-01-0.0-0.5**		**1097-01-0.5-1.0**	
Sample Date				**05/17/07**		**05/17/07**	
Depth Interval (feet)				**0 to 0.5**		**0.5 to 1**	
Sample Type				**Composite**		**Composite**	
QA Type							
Analyte	**Unit**	**EPA Region 9 Industrial PRG[a]**	**EPA Region 9 Residential PRG[a]**				
Aroclor 1260	µg/kg	740	220	**330**	**J**	**23**	**J**

[a] PRG – EPA Region 9 residential and industrial PRGs (October 2004).
Shaded result exceeds residential PRG.
Bold type indicates a detection.
J – The constituent was positively identified; the quantitation is an estimation.

3.6.5.4 Conclusions (Structure 97, Substation No. 3)

Aroclor 1260 was detected in a composite surface soil sample (0 to 0.5 foot bgs) at a concentration (330 µg/kg) exceeding the residential PRG but well below the industrial PRG. The deeper sample collected from 0.5 to 1 foot bgs contained Aroclor 1260 at a concentration of 23 µg/kg, which is well below the industrial and residential PRGs. Staining was observed on the concrete pad, but was not observed on the gravel or in the soil.

Future use of this area is expected to be industrial. In addition, access to the substation area is limited to occasional maintenance personnel and controlled by a locked fence with signage. No further action is recommended based on the following factors:

- The PCB concentration in soil is below the industrial PRG.
- Land use is currently industrial and expected to remain industrial.
- Access restrictions limit the potential for exposure to this area.

3.6.6 Structure 101, Substation Spare

SI sampling was conducted at this site to further evaluate soils in the vicinity of observed oil staining at Structure 101, Substation Spare. Structure 101 is an inactive transformer substation measuring approximately 600 ft^2; it is surrounded by pavement on the east and south, and by dirt and grass on the north and west. The transformer sits on a concrete pad and is surrounded by a gravel blanket approximately 1 foot thick. The gravel blanket is enclosed by a concrete curb with a chain-link fence.

3.6.6.1 Historical Operations (Structure 101, Substation Spare)

According to information provided by NI, the transformer at Structure 101 has an unknown PCB concentration CH2M HILL, 2006a). Based on the visual site inspection conducted on June 22, 2006, oil staining was observed on the western edge of the concrete pad at the base of the transformer. No staining was observed in the gravel areas adjacent to the concrete pad. The pad appeared to be good condition.

3.6.6.2 Sample Locations and Methodologies (Structure 101, Substation Spare)

On May 17, 2007, the field team conducted soil sampling at Structure 101, Substation Spare. The purpose of this sampling effort was to determine the presence or absence of PCB-contaminated soil beneath the gravel blanket adjacent to the oil-stained concrete. The integrity of the pad appeared to be good

One composite sample was collected from three discrete locations in surface soil (0 to 0.5 foot bgs) and shallow subsurface soil (0.5 to 1 foot bgs). Because no staining was observed in the gravel area during the visual site inspection, three discrete locations were selected for the composite sample based on the slope of the concrete pad and location of the stain on the concrete pad.

3.6.6.3 Field Observations and Analytical Results (Structure 101, Substation Spare)

On May 17, 2007, the oil staining previously observed remained on the western edge of the concrete pad at the base of one PCB transformer. No staining was observed on unpaved areas adjacent to the concrete pad. Aroclor 1260 was the only PCB detected in the soil samples at this site. Aroclor 1260 was detected at a concentration of 1,900 µg/kg in the shallow soil sample collected from 0 to 0.5 foot bgs. This concentration exceeds both the residential and industrial PRGs.

Aroclor 1260 was detected at a concentration of 33 µg/kg in the shallow subsurface soil sample collected from 0.5 to 1 foot bgs. This concentration was less than the residential and industrial PRGs. Sample locations are shown in Figure 3-8. Table 3-15 presents analytical results for the constituents detected in the project samples. Appendix C contains a complete set of analytical results.

3.6.6.4 Conclusions (Structure 101, Substation Spare)

Aroclor 1260 was detected in the composite surface soil sample at a concentration of 1,900 µg/kg, which exceeds industrial and residential PRGs. However, in the 0.5 to 1 foot bgs sample, the Aroclor 1260 concentration of 33 µg/kg is well below the industrial and residential PRGs. Oil staining was observed on the western edge of the concrete pad at the base of the transformer. No staining was observed in the gravel areas adjacent to the concrete pad. The concrete pad is in good condition.

TABLE 3-15
Structure 101, Substation Spare Detected PCB Sample Results
Site Investigation Report, Riverbank Army Ammunition Plant, California

Location ID				**1101-01**		**1101-01**	
Sample ID				**1101-01-0.0-0.5**		**1101-01-0.5-1.0**	
Sample Date				**05/17/07**		**05/17/07**	
Depth Interval (feet)				**0 to 0.5**		**0.5 to 1**	
Sample Type				**Composite**		**Composite**	
QA Type				**1101-01**		**1101-01**	
Analyte	**Unit**	**EPA Region 9 Industrial PRG[a]**	**EPA Region 9 Residential PRG[a]**				
Aroclor 1260	µg/kg	740	220	**1,900**	**J**	**33**	**J**

[a] PRG – EPA Region 9 residential and industrial PRGs (October 2004).
Shaded result exceeds residential PRG.
Shaded and boxed result exceeds residential and industrial PRG.
Bold type indicates a detection.
J – The constituent was positively identified; the quantitation is an estimation.

Future use of this area is expected to be industrial, and the substation area access is controlled by a locked fence with signage. The substation is typically inactive but functions as a spare and is accessed very infrequently by maintenance personnel. As a point of reference under TSCA in 40 CFR 761.61, PCB concentrations may remain in soils up to 50,000 µg/kg in low-occupancy outdoor electrical substation areas.

No further action is recommended based on the following factors:

- While exceeding the industrial PRG, the PCB concentration in soil is well below TSCA requirements.
- PCB concentrations in deeper soils are well below the industrial and residential PRGs, indicating that the contamination is superficial.
- Land use is currently industrial and expected to remain industrial.
- Access restrictions limit the potential for exposure to this area.

3.6.7 Structure 145, Substation No. 17

SI sampling was conducted at this site to further evaluate soils in the vicinity of observed oil staining at Structure 145, Substation No. 17. Structure 145 is comprised of three active transformers and a control panel. The transformers are mounted on concrete pads, which show minor cracking and are surrounded by a gravel blanket approximately 1 foot thick. The gravel blanket is enclosed by a concrete berm and a chain-link fence. Substation No. 17 is a 1,321-ft^2 facility surrounded by pavement on all sides.

3.6.7.1 Historical Operations (Structure 145, Substation No. 17)

Structure 145 included three transformers: one active PCB transformer and two active non-PCB transformers installed in 1967. One transformer is non-PCB and the other is PCB-containing with PCB concentrations of 28 mg/kg and 134 mg/kg, respectively

(CH2M HILL, 2006a). By definition under TSCA, PCB-containing equipment has PCB concentrations of 50 mg/kg or greater, but less than 500 mg/kg.

3.6.7.2 Sample Locations and Methodologies (Structure 145, Substation No. 17)

On May 19, 2007, after NI de-energization and lock-out/tag-out procedures were completed, the SI field team conducted soil sampling at Structure 145, Substation No. 17. The purpose of this sampling effort was to determine the presence or absence of PCB-contaminated soil in the unpaved area adjacent to the oil-stained concrete. During the 2006 visual site inspection, heavy oil stains were observed on the northern edge of the concrete pad at the base of two transformers located on the east and west sides of the concrete pad. The concrete pad had visible minor cracking. Based on these observations, there was a potential for PCBs to have affected the soil below the gravel. Additionally, because of the cracking observed in the concrete pad, there is a potential for the PCBs to have affected the soil beneath the concrete pad.

One composite sample (from three discrete points) was collected from surface soil (0 to 0.5 foot bgs) and shallow subsurface soil (0.5 to 1 foot bgs) along the northern side of the concrete pad, which slopes toward the north. In addition to the composite sample, two discrete surface soil (0 to 0.5 foot bgs) and shallow subsurface soil (0.5 to 1 foot bgs) samples were collected on the north and south sides of the concrete pad where stained gravel was observed.

3.6.7.3 Field Observations and Analytical Results (Structure 145, Substation No. 17)

The heavy oil stains observed during the 2006 visual site inspection were seen during the SI field effort. Soils were encountered at approximately 0.8 foot below the gravel blanket. Soils were described as sands and silty sands. No staining or odors were observed in soil; however, gray and black staining was observed on gravel fill.

Aroclor 1260 was the only PCB detected in samples collected near the substation. Concentrations of Aroclor 1260 in surface soil samples ranged from 33 to 9,500 µg/kg. Concentrations of Aroclor 1260 in shallow subsurface soil samples ranged from 96 to 240 µg/kg. The highest concentration of Aroclor 1260 was detected in the composite sample (1145-01) located on the north side of the pad where no staining was visible. This area did not have any visible staining.

Aroclor 1260 concentrations were above residential and industrial PRGs in the surface composite sample (1145-01) collected on the north side of the concrete pad and the discrete surface sample (1145-03) collected on the south side of the pad. The shallow subsurface composite (1145-01) and the southern shallow subsurface discrete sample (1145-03) were below industrial PRGs and at or above residential PRGs. Aroclor 1260 concentrations at the surface and shallow subsurface discrete sample (1145-02) collected along the north side of the pad did not exceed residential or industrial PRGs. Sample locations are shown in Figure 3-9. Table 3-16 presents analytical results for Aroclor 1260. Appendix C contains a complete set of analytical results.

TABLE 3-16
Structure 145, Substation No. 17 Detected PCB Sample Results
Site Investigation Report, Riverbank Army Ammunition Plant, California

Location ID				1145-01	1145-01	1145-02	1145-02	1145-03	1145-03
Sample ID		Screening		1145-01-0.0-0.5	1145-01-0.5-1.0	1145-02-0.0-0.5	1145-02-0.5-1.0	1145-03-0.0-0.5	1145-03-0.5-1.0
Sample Date		Criteria		05/19/07	05/19/07	05/19/07	05/19/07	05/19/07	05/19/07
Depth Interval (feet)				0 to 0.5	0.5 to 1	0 to 0.5	0.5 to 1	0 to 0.5	0.5 to 1
Sample Type				composite	composite	discrete	discrete	discrete	discrete
QA Type									
Detected Analyte	Unit	EPA Region 9 Industrial PRG[a]	EPA Region 9 Residential PRG[a]						
Aroclor 1260	µg/kg	740	220	9,500 J	240 J	33 J	96 J	2,000 J	220 J

This table includes only detected analytes. Appendix C contains complete analytical results.
[a] PRG – EPA Region 9 residential and industrial PRGs (October 2004).
Shaded result exceeds residential PRG.
Bold type indicates a detection.
J – The constituent was positively identified; the quantitation is an estimation.

3.6.7.4 Conclusions (Structure 145, Substation No. 17)

Aroclor 1260 concentrations exceed residential and industrial PRGs in one discreet surface soil sample (1145-03) at 2,000 µg/kg, and in the composite surface soil sample (1145-01) at 9,500 µg/kg. In the remaining samples, the Aroclor 1260 concentrations were below the industrial PRG, or in some cases, below both the industrial and residential PRGs. Staining was observed on the concrete pad, which has minor cracking, and in surrounding gravel. However, staining was not observed in soil beneath the gravel blanket.

Future use of this area is expected to be industrial, and the substation area access is controlled by a locked fence with signage. The substation has to be de-energized for access to be permitted and thus, access is strictly controlled. As a point of reference under TSCA in 40 CFR 761.61, PCB concentrations may remain in soils up to 50,000 µg/kg in low-occupancy outdoor electrical substation areas.

No further action is recommended based on the following factors:

- While exceeding the industrial PRG, the PCB concentrations in soil are well below TSCA requirements.
- Land use is currently industrial and expected to remain industrial.
- Access restrictions limit the potential for exposure to this area.

Aroclor 1260 concentrations exceeded residential and industrial PRGs in one discreet (1145-03) and in the composite (1145-01) surface soil sample. Aroclor 1260 concentrations exceeded residential PRGs in the shallow subsurface soil samples from 1145-03 and 1145-01. At the other discrete sample location (1145-02), the Aroclor 1260 concentrations were below residential and industrial PRGs.

Although the PCB concentrations exceeded the industrial PRG, the results are well below TSCA requirements for spills in outdoor electrical substations. Under TSCA, the cleanup requirement for soils in outdoor electrical substations is 25 or 50 ppm PCBs. In addition, since the release is contained within the substation area, which is controlled by a locked fence, potential contact with contaminated soils is minimized. Based on this isolated detection and the limited potential exposure at this site, no further action is recommended.

3.6.8 Building 162, Autodin A.B. Terminal Building

The Autdodin A.B. Terminal Building was historically a communications building. It was common for radio tubes used in the communications equipment to contain small quantities of radioactive material and, therefore, radioactive materials could have been released as a result of broken tubes (Alberth, 2006). Although there was no documented release of radioactive material at this site, the survey was conducted because the building was used in the past for communications operations and there was a slightly elevated historical radon detection. Building 162 is a 1,036-ft^2 brick building surrounded by concrete and asphalt, and is currently used for administrative functions (Figure 3-10).

3.6.8.1 Historical Operations (Building 162)

The name of the building indicates that an automated digital information network (Autodin) operation was conducted in this building, which was constructed in 1971. The

Autodin is a communications system that supported DoD communications needs for 30 years and now has been replaced (CH2M HILL, 2006b). It is not known when the Autodin operation ceased at RBAAP. The communications equipment is no longer present in the building, which is currently being used for administrative functions. There are no reports of leaks or spills from this equipment.

3.6.8.2 Previous Investigations (Building 162)

In 1998, an EBS that included visual inspection of the site was conducted at Building 162 (Norris-Riverbank, 1998b). No staining, odor, or signs of disposal were observed during the visual inspection of Building 162. No "recognized environmental conditions" were identified at this building during the EBS. Radon levels at the building were determined to be 5.2 picocuries per liter (pCi/L) (above the health risk level of 4.0 pCi/L). Based on the findings of the EBS, it was determined that no additional investigation was required (Norris-Riverbank, 1998b).

3.6.8.3 Sample Locations and Methodologies (Building 162)

On May 23, 2007, Building 162 was surveyed at 30 random locations including the study area floor (19 samples), walls (4 samples), tables and desks (2 samples), chairs (2 samples), and bookcases (3 samples). The radiation survey was performed in accordance with Guidance on Radiological Decommissioning Surveys (USAMC, 2004).

Direct alpha and beta-gamma measurements at each location were measured using both a G-M detector and a ZnS/NaI scintillation detector to detect radioactive contamination. Removable alpha and beta-gamma measurements also were collected using a smear survey at each of the 30 locations. Sample details, including sample locations and calibration records, are presented in Appendix B.

3.6.8.4 Field Observations and Analytical Results (Building 162)

According to guidelines established in 1974 by the U.S. Atomic Energy Commission, if survey results are below the limits established by the guidelines, the building is safe for general use. The survey results meet the acceptable surface contamination levels as shown in Table 3-17. Therefore, delineation of contamination or specific isotopes was not required.

TABLE 3-17
RBAAP Radiation Survey Results, Building 162
Site Investigation Report, Riverbank Army Ammunition Plant, California

AOC	***Site Description***	***Direct alpha dpm/100 cm^2 (Limit = 100 to 5,000)[a]***	***Direct beta-gamma dpm/100 cm^2 (Limit = 1,000 to 5,000)[a]***	***Removable alpha dpm/100 cm^2 (Limit = 20 to 1,000)[a]***	***Removable beta-gamma dpm/100 cm^2 (Limit = 200 to 1,000)[a]***
Building 162	Paint and Oil Storage	2.3 to 26.3	-49.8 to 104.1	-0.6 to 2.6	-47.2 to 43.3

[a] Acceptable surface contamination limit from Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors (U.S. Atomic Energy Commission, 1974).

3.6.8.5 Conclusions (Building 162)

The radiological survey results for Building 162 were well below the screening levels. This survey confirms the absence of potential radioactive contamination. As a result, Building 162 can be released for general use without restrictions.

3.6.9 Building 174, Hazardous Waste Storage Area

The purpose of the survey was a conservative measure to document the presence or absence of radioactive contamination related to a historical one-time radium dial repackaging that occurred in the building. Other than the radium dial repackaging, radioactive wastes have not been stored or generated at this building. Building 174 is the Hazardous Waste Storage Area and consists of a concrete slab with three 400-gallon sumps. The building is 100 feet long by 50 feet wide. The floor slopes approximately 0.5 inch per foot toward the sumps. The perimeter of the slab has 6-inch-high curbing for overall secondary containment and control of surface water run-on from outside the area. The location of Building 174, Hazardous Waste Storage Area is shown in Figure 3-10.

The Hazardous Waste Storage Area is an active unit regulated under RCRA; the facility operates under a Part B permit and stores hazardous waste.

3.6.9.1 Historical Operations (Building 174)

The Hazardous Waste Storage Area is an active unit regulated under RCRA; the facility operates under a Part B permit and stores hazardous waste. This structure was built specifically for use as a Hazardous Waste Storage Area and has not had any other past use.

Previous Investigations

During the 2004 RFI, operations and waste management practices were evaluated at Building 174 along with the other AOCs and SWMUs. Based on the RFI findings documented in the Final RFI Report, no further action was required at Building 174 (CH2M HILL, 2005).

No known spills have been recorded in this building.

Radiological

According to the former Commander's Representative, one temporary activity in 1995 inside Building 174 involved the packaging of instruments and gauges known to contain radium (USAEC, 2005b). According to the former Commander's Representative, RBAAP was contacted in 1995 by the state and asked if RBAAP could assist a contractor with repacking DoD instruments and gauges that were known to contain radium. They further advised that none of the items were broken, and therefore the radium would not be released to the environment. The action resulted in packing activities that lasted for approximately 1 week. Activities included a contractor working in the storage facility with 55-gallon drums, putting the allowed number of gauges in the drums, and then encasing all gauges in concrete in the drum. Once packed, the drums were sent off-base. During this operation, the former Commander's Representative recalls that the gauges were received from bases overseas, and were sent initially to Tracy Defense Site, which had no facility to handle the transfer of drums. No additional information concerning the packaging of instruments and gauges known to contain radium or the storage of radioactive materials at Building 174 was identified through records searches by the USAMC Radiation Safety Staff Officer (Prins, 2006), U.S. Army Joint Munitions Command (Crooks, 2006), or the U.S. Army CHPPM Office (Alberth, 2006).

3.6.9.2 Sample Locations and Methodologies (Building 174)

On May 22, 2007, Building 174 was surveyed for radioactive materials at a total of 31 random locations including the study area floor (26 samples) and walls (5 samples). Direct alpha and beta-gamma measurements at each location were measured using both a G-M detector and a ZnS/NaI scintillation detector to detect the absence of radioactive contamination on study area surfaces. The ZnS/NaI scintillation detector was typically used as the primary, direct radiation detection device due to its 50-cm^2 detection window and its improved detection resolution over the G-M detector. Removable alpha and beta-gamma measurements were smear-sampled at each random location and measured in a low background area using a smear counter. Sample details, including sample locations and calibration records, are presented in Appendix B.

3.6.9.3 Field Observations and Analytical Results (Building 174)

According to guidelines established in 1974 by the U.S. Atomic Energy Commission, if survey results are below the limits established by the guidelines, the building is safe for general use. The survey results meet the acceptable surface contamination levels as shown in Table 3-18. Therefore, delineation of contamination or specific isotopes was not required.

TABLE 3-18
RBAAP Radiation Survey Results, Building 174
Site Investigation Report, Riverbank Army Ammunition Plant, California

AOC	Site Description	Direct alpha dpm/100 cm^2 (Limit = 100 to 5,000)[a]	Direct beta-gamma dpm/100 cm^2 (Limit = 1,000 to 5,000)[a]	Removable alpha dpm/100 cm^2 (Limit = 20 to 1,000)[a]	Removable beta-gamma dpm/100 cm^2 (Limit = 200 to 1,000)[a]
Building 174	Autodin A.B. Terminal Building	-3.4 to 6.9	-174.6 to 147.4	-0.6 to 2.6	-47.4 to 25.7

[a] Acceptable surface contamination limit from Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors (U.S. Atomic Energy Commission, 1974).

3.6.9.4 Conclusions (Building 174)

The radiological survey results for Building 174 were well below the screening levels. This survey confirms the absence of potential radioactive contamination. As a result, Building 174 can be released for general use without restrictions.

Figure

3-1 RBAAP-001, Former Pistol Range

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Figure

3-2 Former Pistol Range Photographs

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Figure

3-2 Former Pistol Range Photographs

(page 2 of 2)

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Figure

3-3 IWTP Historical Soil Sample Locations

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Figure

3-4 SWMU, IWTP

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Figure

3-5 Building 11, Paint and Oil Storage

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3-6 Structure 95, Substation No. 1

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3-7 Structure 97, Substation No. 3

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3-8 Structure 101, Substation Spare

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Figure

3-9 Structure 145, Substation No. 17

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Figure

3-10 Radiological Survey Location Map

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4.0 Summary and Conclusions

This section presents the summary and conclusions for each AOC investigation during the SI. This section also contains a summary of those locations that were not sampled, and may represent data needs for the future. Table 4-1 provides a summary of SI activities, findings and future recommendations

TABLE 4-1
Summary of SI Activities, Findings, and Recommendations
Site Investigation Report, Riverbank Army Ammunition Plant, California

Site	Investigation Activity	Summary of Results	Recommendations
RBAAP-001-R-01, Former Pistol Range	Metal Detection Survey, Visual Site Inspection, and Soil Sampling	No MEC present based on metal survey and visual inspection. Lead soil detections below screening criteria.	(1) No further assessment (2) Close under MMRP
SWMU 1, IWTP	Soil Sampling	Hexavalent chromium was not detected in soil and cyanide was below screening values. Arsenic exceedance of screening criteria attributed to natural background, though only limited background values exist.	(1) Further investigation of inaccessible areas at the time of permit closure (2) Obtain background soil data sufficient for statistical comparison
Building 11, Paint and Oil Storage	Soil Sampling	PCB historically detected at H01 is likely restricted to the near-surface soils in an isolated area.	No further assessment
	Radiation Survey	All survey results met the acceptable surface contamination levels.	No further assessment
Structure 95, Electrical Substation No. 1	Soil Sampling	Aroclor 1260 was detected at concentrations below the industrial PRG.	No further assessment
Structure 97, Electrical Substation No. 3	Soil Sampling	Aroclor 1260 was detected below the industrial PRG.	No further assessment
Structure 101, Electrical Substation Spare	Soil Sampling	The Aroclor 1260 concentration exceeded the industrial PRG; however, the results were well below TSCA requirements for spills in outdoor electrical substations. Access is restricted.	No further assessment
Structure 145, Electrical Substation No. 3	Soil Sampling	The Aroclor 1260 concentration exceeded the industrial PRG; however, the results were well below TSCA requirements for spills in outdoor electrical substations. Access is restricted.	No further assessment

TABLE 4-1
Summary of SI Activities, Findings, and Recommendations
Site Investigation Report, Riverbank Army Ammunition Plant, California

Site	Investigation Activity	Summary of Results	Recommendations
Building 162, Auto A.B. Terminal Building	Radiation Survey	All survey results met the acceptable surface contamination levels.	No further assessment
Building 174, Hazardous Waste Storage	Radiation Survey	All survey results met the acceptable surface contamination levels.	No further assessment

4.1 RBAAP-001-R-01 Former Pistol Range

The Former Pistol Range was identified in the March 2003 Closed, Transferring and Transferred Range/Site Inventory Report as a former small arms range and was included in the U.S. Army's Military Munitions Response Program as an MMRP site. The SI activities at the Former Pistol Range included a metal survey, visual site inspection, soil sampling, and laboratory analysis for lead. The purpose of these activities was to determine if small arms munitions existed at the Former Pistol Range, and if lead was present or absent in soil in the former firing range and/or within the levee. The current stormwater reservoir levee is assumed to be composed of reworked soils from the former target berm, which served as the target backstop during pistol target practice in the 1950s.

During the metal survey and visual inspection, no small arms munitions or other MEC-related items were identified. A total of eight locations were sampled within the former range and levee and all lead concentrations in soil, which ranged from 3 to 138 mg/kg, were below regulatory screening criteria.

The range was reportedly used only for a short time in the 1950s for small arms target practice, and the former target berm has been reworked at least twice since it was used as a backstop. Based on the limited use of this site and the absence of munitions or soil contamination, no further action is recommended for the site. Based on these results, it is recommended that this site should be closed and considered *Response Complete* in the U.S. Army Environmental Restoration database.

4.2 SWMU 1, IWTP

The IWTP is active and includes a system of tanks, sumps, filters, pipes, and other related equipment set up for treating facility wastewater. It is operated under the RCRA Part B Hazardous Waste Facility Permit. SI activities at the IWTP included soil sampling and laboratory analysis for metals, cyanide, VOCs, and pH. The purpose of soil sampling was to identify the presence or absence of contamination and to provide useful data for potential future closure requirements under RCRA. As discussed in Section 3.6.2.3, all units at the IWTP could not be investigated due to the presence of active underground utilities and building structures.

The SI activities and findings at the IWTP are summarized as follows:

- Six borings were drilled to approximately 60 feet bgs at the 80-foot clarifier tank, flocculation tanks, flash mixer spill area, equalization basin, and reactor clarifier. Boreholes were drilled and angled where appropriate to obtain soil samples from underneath the active tanks. Samples were collected every 5 feet to groundwater (approximately 57 to 60 feet bgs), and select samples were sent offsite for laboratory analysis. Results for the locations sampled at the IWTP indicate the following:
- Based on visual observation, field screening, and analytical results of soil samples, it does not appear that significant releases have occurred at the 80-foot clarifier tank, flocculation tanks, flash mixer spill area, equalization basin, and reactor clarifier.
- All soil analyte concentrations are below the DTSC TTLC screening values.
- Soils from borings appeared relatively undisturbed and lacked any visual signs of staining, odor, or positive PID field screening.
- Arsenic and methylene chloride (a common laboratory contaminant) exceeded the residential and/or industrial PRGs at isolated locations; however, these exceedances do not show a pattern of a release from the area. Arsenic concentrations can be attributed to naturally occurring substances in the area because concentrations are similar to background values.
- Soil concentrations for barium, cyanide, cadmium, total chromium, cobalt, copper, lead, nickel, vanadium, and zinc were above the limited site-specific background values, but were below residential and industrial PRGs and DTSC TTLC screening values.
- The primary contaminants found in groundwater at Riverbank include hexavalent chromium and cyanide. Hexavalent chromium was not detected in any of the soil samples; cyanide was detected only at low concentrations that were well below the residential and industrial PRGs and DTSC TTLC screening values. This information helps to further define the former groundwater chromium and cyanide source area (see discussion below).

The current RCRA closure plan refers to the use of background levels as comparison criteria for the determination of no corrective action or the need for a health-based risk assessment to determine cleanup levels. It should be noted that the background soil data used in this SI were collected during the 1991 RI efforts at RBAAP and are limited to eight samples collected from only one soil boring. As a result, even though some SI soil concentrations exceeded background, it is recommended that additional background soil data sufficient for statistical comparisons be collected prior to RCRA permit closure.

As discussed in Section 3.6.2, there were nine tanks/areas at the IWTP that were inaccessible for drilling. Of these inaccessible areas, the most significant area that could not be evaluated through drilling and sampling was the site of the former redwood tanks. As discussed in Section 3.6.2, the location of the former redwood tanks (currently the site of Building 173) has been the area identified as the former source of hexavalent chromium released to soils and groundwater at RBAAP. Although this IWTP site was originally planned for subsurface investigation as part of the SI, the area was determined to be inaccessible for drilling due to current operations and existing aboveground and underground utilities. Although there is a lack of direct soil data from this area, the data collected from nearby perimeter borings as part of earlier studies and from the current SI effort provide evidence that there does not appear to be a widespread area of hexavalent chromium in subsurface soils outside the footprint of the former redwood tank site.

By all current evidence collected from quarterly groundwater sampling events, it would appear that the former redwood tank area no longer represents a continuing source to groundwater contamination. Significant lowering of the water table as a result of regional pumping, along with the installation of concrete pavement and buildings above the former site, appear to have eliminated direct contact of contaminated soils to groundwater and reduced infiltration/migration routes to groundwater. However, as a result of historical releases of chromium-contaminated wastewater from the redwood tanks, it is possible that some degree of residual hexavalent chromium contamination remains in subsurface soils beneath the tank footprints.

Under the current RCRA permit, the owner of the permit is required to investigate the IWTP site upon closure to ensure that impacts or potential impacts to the environment are mitigated. The future requirement to investigate the former redwood tank area is also documented in the 1994 ROD as a post-ROD action to be conducted at the time of closure.

4.3 Building 11, Paint and Oil Storage

SI activities at Building 11 included soil sampling near the building, laboratory analysis, and a radiological survey inside the building. The purpose of collecting soil samples near Building 11 was to determine the extent of PCB contamination in the vicinity of a former soil sample that contained Aroclor 1260 at a concentration of 1,000 µg/kg.

SI samples show a single detection of Aroclor 1260 at a concentration of 38 µg/kg, which is well below the industrial and residential PRGs and TSCA cleanup requirements. Based on the SI soil sampling, it appears that the area of soil contaminated with PCBs above regulatory screening criteria is localized in nature. Although the source of the PCBs in soil is not known, two electric substations in close proximity to the areas sampled have been reported. Since the area is covered with asphalt, the current contact exposure pathway to soils is minimized and no further action is recommended.

The purpose of the radiation survey at Building 11 was to determine the presence or absence of radioactive contamination in the building, even though there is no record of NRC-licensed material ever having been used at RBAAP. During a 1980 interview, it was reported that a radioactive storage sign may have been posted. There are no records indicating that radioactive materials were stored at RBAAP. The radiation survey was performed by taking a total of 31 direct measurements and collecting smear samples that were measured for alpha, beta, and gamma radiation. All survey results met the acceptable surface contamination levels as established by the NRC, and delineation of contamination for specific isotopes was not required. No further action is recommended at this MMRP site.

4.4 Structure 95, Substation No. 1

Aroclor 1260 was detected at 230 µg/kg in a composite soil sample collected at a depth of 0.5 to 1 foot bgs beneath the gravel blanket surrounding the concrete pad. The detected Aroclor concentration was below the industrial PRG and only slightly above the residential PRG. Staining was observed on the concrete pad, but was not observed in the gravel or in the soil.

Future use of this area is expected to be industrial. In addition, access to the substation area is limited to occasional maintenance personnel and controlled by a locked fence with signage. No further action is recommended based on the following factors:

- The PCB concentration in soil is below the industrial PRG.
- Land use is currently industrial and expected to remain industrial.
- Access restrictions limit the potential for exposure to this area.

4.5 Structure 97, Substation No. 3

Aroclor 1260 was detected in a composite surface soil sample (0 to 0.5 foot bgs) at a concentration (330 µg/kg) exceeding the residential PRG but well below the industrial PRG. The deeper sample collected from 0.5 to 1 foot bgs contained Aroclor 1260 at a concentration of 23 µg/kg, which is well below the industrial and residential PRGs. Staining was observed on the concrete pad, but was not observed on the gravel or in the soil.

Future use of this area is expected to be industrial. In addition, access to the substation area is limited to occasional maintenance personnel and controlled by a locked fence with signage. No further action is recommended based on the following factors:

- The PCB concentration in soil is below the industrial PRG.
- Land use is currently industrial and expected to remain industrial.
- Access restrictions limit the potential for exposure to this area.

4.6 Structure 101, Substation Spare

Aroclor 1260 was detected in the composite surface soil sample at a concentration of 1,900 µg/kg, which exceeds industrial and residential PRGs. However, in the deeper 0.5 to 1 foot bgs sample, the Aroclor 1260 concentration of 33 µg/kg was well below the industrial and residential PRGs. Oil staining was observed on the western edge of the concrete pad at the base of the transformer. No staining was observed in the gravel areas adjacent to the concrete pad. The concrete pad is in good condition.

Future use of this area is expected to be industrial, and the substation area access is controlled by a locked fence with signage. The substation is typically inactive but functions as a spare and is accessed very infrequently by maintenance personnel. As a point of reference under TSCA in 40 CFR 761.61, PCB concentrations may remain in soils up to 50,000 µg/kg in low-occupancy outdoor electrical substation areas.

No further action is recommended based on the following factors:

- While exceeding the industrial PRG, the PCB concentration in soil is well below TSCA requirements.
- PCB concentrations in deeper soils are well below the industrial and residential PRGs, indicating that the contamination is superficial.
- Land use is currently industrial and expected to remain industrial.
- Access restrictions limit the potential for exposure to this area.

4.7 Structure 145, Substation No. 17

Aroclor 1260 concentrations exceed residential and industrial PRGs in one discreet surface soil sample (1145-03) at 2,000 µg/kg, and in the composite surface soil sample (1145-01) at 9,500 µg/kg. In the remaining samples, the Aroclor 1260 concentrations were below the industrial PRG, or in some cases, below both the industrial and residential PRGs. Staining was observed on the concrete pad, which has minor cracking, and in surrounding gravel. However, staining was not observed in soil beneath the gravel blanket.

Future use of this area is expected to be industrial, and the substation area access is controlled by a locked fence with signage. The substation has to be de-energized for access to be permitted and thus, access is strictly controlled. As a point of reference under TSCA in 40 CFR 761.61, PCB concentrations may remain in soils up to 50,000 µg/kg in low-occupancy outdoor electrical substation areas.

No further action is recommended based on the following factors:

- While exceeding the industrial PRG, the PCB concentrations in soil are well below TSCA requirements.
- Land use is currently industrial and expected to remain industrial.
- Access restrictions limit the potential for exposure to this area

4.8 Building 162, Autodin A.B. Terminal Building

Small quantities of radioactive material as components in radio tubes may have been used and/or stored in Building 162; therefore, radioactive materials could have been released as a result of broken tubes. Building 162 was surveyed at 30 random locations for alpha, beta, and gamma radiation contamination in accordance with Guidance on Radiological Decommissioning Surveys (USAMC, 2004). The purpose of the survey was to document the absence of radioactive contamination at the building related to equipment that was used for communications in the building. The radiation survey results for Building 162 were well below the screening levels. As a result, Building 162 can be released for general use without restrictions.

4.9 Building 174, Hazardous Waste Storage Area

Building 174 was surveyed at 31 random locations for alpha, beta, and gamma radiation contamination in accordance with Guidance on Radiological Decommissioning Surveys (USAMC, 2004). The purpose of the survey was to document the absence of radioactive contamination related to radium dial repackaging that occurred in the building. The radiation survey results for Building 174 were well below the screening levels. As a result, Building 174 can be released for general use without restrictions.

4.10 Areas Requiring Further Investigation

Several AOCs identified for additional sampling in the Phase I ECP Report (CH2M HILL, 2006a) and the Phase II ECP Recommendations Report (CH2M HILL, 2006b) were not investigated in this SI due to access restrictions and/or ongoing activities that prohibited sampling. The following AOCs still require investigation:

- **Building 109, Substation Nos. 2 and 3:** Oil staining was observed on the concrete at the base of transformers during a site inspection in 2006. The integrity of the concrete pad appeared to be good. A gravel area surrounds the concrete pad. Based on these observations, there is potential that PCBs have impacted the soil in this unpaved area. Additional soil sampling in this area was recommended to characterize the extent of soil contamination. This sampling could not be conducted during this SI in 2007 because the transformer was active and could not be shut down.

- **Buildings 1, 6, and 8, Production Area Sumps and Pits:** Pits and sumps associated with the production line equipment and presses inside Buildings 1, 6, and 8 remain in place and have not been investigated for possible cracks and/or potential soil contamination. There is a potential for the soil beneath the remaining sumps or pits to be impacted by hazardous substances. Further investigation was recommended once production activities cease or if the building is demolished. During this SI in 2007, these buildings were in place and sampling could not be conducted.

- **Redwood Tanks:** The source of known total chromium and cyanide contamination in the groundwater is assumed to be the former redwood storage and equalization tanks located at the IWTP. The redwood tanks were replaced in 1972 with a concrete tank (Tank G2: Equalization Basin) and Building 173, which functions as the IWTP office/laboratory. The soils beneath the former redwood tanks were recommended for further investigation. During this SI in 2007, the redwood tanks could not be investigated due to access restrictions from tanks, overhead pipelines, underground pipelines, reinforced concrete pads, and underground utilities.

- **Inaccessible Process Tanks at IWTP:** The 2004 operations plan for hazardous waste treatment and storage for RBAAP identified post-closure plans for the IWTP to determine if soil contamination had occurred (NI, 2004). The plan called for one soil boring to be advanced at each of the process tanks located within the IWTP. This SI included six borings, which addressed the 80-foot clarifier tank, flash mixer, equalization tank, and reactor clarifier; thus, at a minimum, the remaining locations (scum tank, sand filter sump, sludge thickener, filter press, sand filter, carbon filter, ion exchange columns, transfer tank, and collection sump) should be investigated at the time of permit closure as outlined in the 2004 operations plan (NI, 2004).

- Pits and sumps associated with production line equipment and presses inside Buildings 1, 6, and 8 serve as collection areas for oils, grease, and runoff associated with the operations. The sumps and pits are concrete lined, but there is no documentation that they have been thoroughly inspected for integrity. Based on evidence of soil contamination associated with sumps previously removed at the plant, there is the potential for soil contamination beneath the remaining sumps or pits. Further inspection and potential investigation is recommended once production activities cease.

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Regulatory Correspondence

Appendix A
Soil Boring Logs

APPENDIX B

Radiation Survey Results

APPENDIX C

Soil Sample Analytical Results

APPENDIX D
Quality Assurance/Quality Control

Appendix D
Quality Assurance/Quality Control

The following quality assurance/quality control (QA/QC) summary provides an overview of the quality and usability of analytical data from environmental samples collected during the Riverbank Army Ammunition Plant (RBAAP) Site Investigation (SI). The work was performed on behalf of the U.S. Army Corps of Engineers (USACE), Louisville District.

The sample collection and analytical work was conducted in accordance with the project specific work plan, which contains the quality assurance project plan (QAPP) and field sampling plan (FSP). Data review, verification, and validation are the processes by which data generated in support of the project are reviewed against the data QA/QC requirements. The data are evaluated for precision and accuracy against the analytical protocol requirements. Nonconformances or deficiencies that could affect the precision or accuracy of the reported result are identified and noted. The effect on the result is then considered when assessing whether the result is sufficient to achieve project data quality objectives (DQOs) as documented in the Final FSP (CH2M HILL, 2007).

For this project, only data verification was performed by CH2M HILL. Data verification is defined as a completeness check of 100 percent of the data along with processing the analytical data through the automated data review tool provided to CH2M HILL by USACE. Therefore, 100 percent of the data was verified as defined.

Data review and Level IV validation, in accordance with the QAPP, was performed by an independent third-party subcontractor, Laboratory Data Consultants (LDC), for 10 percent of the data provided by the primary laboratory. In addition, an evaluation of the precision between the results from the primary and QA/QC laboratories was completed.

Deficiencies discovered as a result of data review and/or validation were documented and submitted in the form of a written report, which was presented as part of the third-party validation deliverables. A copy of this report is attached. Data validation was completed using the United States Environmental Protection Agency (EPA) Contract Laboratory National Functional Guidelines for Organic Data Review (EPA, 1999) and Contract Laboratory National Functional Guidelines for Inorganic Data Review (EPA, 2002), following the criteria in the QAPP and Louisville Chemistry Guidelines.

D.1 Analytical Laboratories and Analytical Methods

Laucks Laboratory in Seattle, Washington, performed the sample analyses as the primary laboratory. EMAX Laboratory in Torrance, California, was the QA/QC laboratory performing analyses on approximately 10 percent of the samples/methods. The following methods were used for sample analysis:

- Volatile organic compounds (VOCs) – Method SW5035A/SW8260B

- pH – Method SW9045C
- Polychlorinated biphenyls (PCBs) – Method SW3540/SW8082
- Total metals, total threshold limit concentration (TTLC) Title 22 – Methods SW3050/SW6020B and 7471A
- Extractable metals, soluble threshold limit concentration (STLC) Title 22 – Methods SW3050/SW6020B and 7471A
- Total chromium – Method SW3050/SW6020
- Lead – Method SW3050/SW6020
- Zinc – Method SW3050/SW6020
- Hexavalent chromium – Method SW7196A
- Total cyanide – Method SW9012A

D.2 Field Sample Collection

The field effort was conducted in April and May 2007. Final data included seven sample delivery groups (SDGs) from Laucks Laboratory and two SDGs from EMAX. The following sample quantities/types were collected and analyzed:

- 106 soil samples
- 11 soil field duplicates
- 12 QA/QC split soil samples
- 7 matrix spike/matrix spike duplicate (MS/MSD) soil samples
- 8 trip blanks
- 7 equipment blanks

All samples, split samples, field duplicates, blanks, and MS/MSDs were collected in accordance with project objectives.

Samples collected for the analysis of STLC Title 22 metals were held at the laboratory until the analysis of TTLC Title 22 metals was completed, and an evaluation of the detected concentrations was performed. None of the STLC Title 22 metals samples were analyzed because of the low concentrations detected in the TTLC Title 22 metals samples.

D.3 Overall Data Validation Findings

The full report of the data review and validation by LDC, the independent data validation firm, is attached. An overall summary of data flagging requirements and reasons for flagging is presented in Appendix E of the RBAAP SI Report.

D.4 Summary of Precision, Accuracy, Representativeness, Comparability, and Completeness

The quality of the field sampling efforts and laboratory results was evaluated for compliance with project DQOs through a review of overall precision, accuracy, representativeness, comparability, and completeness (PARCC). Procedures used to assess PARCC are in accordance with the respective analytical methods and QAPP requirements.

D.4.1 Precision

Matrix precision from MS/MSDs, or MS and duplicates, is in control overall. Matrix precision from blind field duplicates also is in control overall.

The analyses for QA/QC split samples were in control, with the exception of Aroclor 1260 in sample 1101-01-0.5-1.0 with a relative percent difference (RPD) of 53 percent. In addition, due to project schedule constraints and the logistics of contracting the QA/QC laboratory, all cyanide QA/QC split samples were analyzed by a different method than that used by the primary laboratory. The method used by the QA/QC split laboratory was SW9010B (for the distillation only)/SW9014; the primary laboratory used SW9012A. All samples analyzed by SW9010B/SW9014 at the QA/QC laboratory demonstrated nondetected results. Most samples analyzed by Method SW9012A at the primary laboratory demonstrated low-level detected results; therefore, the precision from the two laboratories was not optimum. The results of the primary laboratory were used for project objectives. A table of the QA/QC sample results and the primary laboratory results is provided in Appendix E of the RBAAP SI Report.

Laboratory precision is in control as shown by the repeated, overall in-control performance (accuracy) of the laboratory control samples (LCSs). There were no field duplicates collected.

The laboratory and matrix precision is acceptable.

D.4.2 Accuracy

Matrix accuracy from surrogate spikes, MS/MSDs, and post-digestion spikes is in control overall. The accuracy for the LCSs is in control for all methods and analytes, with the exception of a limited amount of PCBs. Calibrations also were in control overall. Results qualified from out-of-control accuracy (matrix and laboratory) are predominantly qualified as estimated concentrations.

Overall, the laboratory and matrix accuracy is acceptable.

D.4.3 Representativeness

Sample data are representative of the site conditions at the time of sample collection. All samples were properly stored and preserved. Analytical data are reported from an analysis within the EPA-recommended or project-specified holding time. Although some holding times were exceeded, the results utilized for final project use were not taken from samples that were over the holding time. The results of field and laboratory blanks were generally at concentrations less than the reporting limits (RLs). Overall, blank contamination was indicative of normal laboratory and field sampling operations.

D.4.4 Appropriateness of Reporting Limits

This project was designed to allow decisions to be made based on the results of common EPA-approved analytical methodologies. Sample dilutions required from matrix interference and/or high target analyte concentrations results in elevated RLs for sample data. RLs achieved are the best possible, based on sample variables.

D.4.5 Comparability

All samples were reported in industry-standard units. Analytical protocols for the methods were followed. Results obtained are comparable to industry standards in that collection and analytical techniques followed approved, documented procedures.

D.4.6 Completeness

There are 10 sample results qualified as unusable for project objectives, including 6 nondetected PCB Aroclors from one sample. However, the detected Aroclor 1260 in this PCB sample is usable for project objectives (only the nondetected values are unusable). There also were two antimony and two molybdenum results qualified as unusable. All sample results qualified as estimated concentrations, flagged J or UJ, are usable for project objectives. The completeness objective of 90 percent for soil samples was met.

As required by the QAPP, a contractual completeness check also was completed for 100 percent of the data. Deficiencies noted during the completeness check required resubmission of additional data from the laboratory. All SDGs/methods are complete.

D.5 References

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APPENDIX E

Validation Flagging Summary