EXPLANATION OF SIGNIFICANT DIFFERENCES FOR SECTION 36 BALANCE OF AREAS SOIL REMEDIATION PROJECT

ROCKY MOUNTAIN ARSENAL FEDERAL FACILITY SITE

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TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

BAS	Biological Advisory Subcommittee
bcy	bank cubic yard(s)
BOA	Balance of Areas
CAR	Contamination Assessment Report
CAT	Complex (Army) Trenches
CCR	Construction Completion Report
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CIP	Cast Iron Pipe
COC(s)	Contaminant(s) of Concern
CPA	Central Processing Area
CSA	Central Study Area
CSV	Contingent Soil Volume
DDESB	Department of Defense Explosives Safety Board
DIMP	Diisopropyl methylphosphonate
EDS	Explosive Destruction System
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
ESS	Explosives Safety Submission
FCS	Former Chemical Sewer
FS	Feasibility Study
GB	Sarin Nerve Agent (isopropyl methylphosphonofluoridate)
HHE	Human Health Exceedance
HWL	Hazardous Waste Landfill
ICP	Inductively-Coupled Plasma
ICS	Integrated Cover System
IMPA	Isopropyl methylphosphonic acid
IRA	Interim Response Action
JARDF	Joint Administrative Record Document Facility
LAMS	Large Area Maintenance Structure
MEC	Munitions and Explosives of Concern
NCP	National Contingency Plan
NCSA	North Central Study Area
NPL	National Priorities List

OCPs	Organochlorine Pesticides
OU	Operable Unit
P1	Priority 1
P2	Priority 2
QA	Quality Assurance
RAB	Restoration Advisory Board
RCRA	Resource Conservation and Recovery Act
RER	Residual Ecological Risk
RI	Remedial Investigation
RMA	Rocky Mountain Arsenal
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SAR	Study Area Report
SDT	Shell Disposal Trenches
SEC	Site Evaluation Criteria
TCHD	Tri-County Health Department
TRER	Terrestrial Residual Ecological Risk
UXO	Unexploded Ordnance
VCP	Vitrified Clay Pipe
VCS	Vapor Containment Structure

1.0 INTRODUCTION

This Explanation of Significant Differences (ESD) documents a significant change in a portion of the remedy for the Section 36 Balance of Areas (BOA) Soil Remediation of the Rocky Mountain Arsenal (RMA) Federal Facility Site. The RMA On-Post Operable Unit (OU) is a federally owned facility located in southern Adams County, Colorado, approximately 10 miles northeast of downtown Denver, directly north of the former Stapleton International Airport and west of Denver International Airport as shown on Figure 1.0-1. The RMA On-Post OU site encompasses approximately 5.6 square miles and is currently on the U.S. Environmental Protection Agency (EPA) National Priorities List (NPL) for environmental cleanup as a result of contamination released during previous RMA operations. The Section 36 BOA Project consists of 21 separate areas located in the central part of the On-Post OU as shown on Figure 1.0-2.

The Record of Decision (ROD), which describes the remedy for the entire On-Post OU of RMA, was signed by the U.S. Army (Army), the EPA, and the Colorado Department of Public Health and Environment (CDPHE) on June 11, 1996 (FWENC 1996b). The selected remedy includes 31 cleanup projects for soil, structures, and treatment of groundwater contamination (PMRMA 2007). As the site-wide remediation is completed, most of the On-Post OU of RMA will become a National Wildlife Refuge, as provided for in Public Law #102-402.

The Army is the lead agency for RMA and is issuing this ESD as part of its responsibilities under Section 117 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendment and Reauthorization Act of 1986, and pursuant to the National Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Section 300.435(c)(2)(i). The NCP requires an ESD when the remedial action taken differs significantly from the remedy selected in the ROD with respect to scope, performance or cost. Regulatory Agency oversight is conducted by the EPA, CDPHE, and Tri-County Health Department (TCHD). The TCHD oversees local public health and environmental issues in Adams, Arapahoe, and Douglas Counties.

This ESD summarizes modifications to the remedy for the Section 36 BOA Project that result from new information developed by the Army since the ROD was signed. Significant changes include changes to project boundaries, increase in remediation volumes, and increase in project cost. These changes, while resulting in the need for an ESD, do not alter the overall hazardous waste management remedy that was selected in the ROD.

The remedy requirements for the Section 36 BOA Project include excavation of human health exceedance (HHE) soil and biota risk soil along with soil sampling to ensure that all contaminated soil is removed. During implementation, sampling conducted after excavation of ROD-identified volume showed extensive HHE and biota risk soils remaining. The additional contaminated soils were removed (with the exception of a biota risk soil area south of the Lime Basins) and as a result, the remediation volumes for HHE soil, including chemical sewers, and biota risk soil increased significantly. In addition, extensive chemical staining and odors were identified in the area surrounding the Shell Disposal Trenches (SDT). Strong odors were also observed in the South Plants chemical sewer area south of the Lime Basins. Although the identified contaminated soil was removed, these field observations along with the post-

excavation soil sample results suggest that all contaminated soil cannot be reliably located and removed as required by the ROD.

As a result, these areas were identified for soil covers to provide additional protection and minimize potential migration of contaminants to groundwater and were transferred to other projects for cover construction. The SDT Resource Conservation and Recovery Act (RCRA)-equivalent cover was extended over approximately five acres south of the SDT. In addition approximately 31 acres surrounding the SDT were identified for a 2-foot-thick soil cover (TtEC 2006a). The South Plants chemical sewer area, approximately six acres south of the Lime Basins, was transferred to the South Plants Central Processing Area (CPA) Project for inclusion beneath the South Plants CPA RCRA-Equivalent cover (TtEC 2008e).

Changes to the project scope also resulted in significant cost growth for the project. The ROD-estimated cost for implementation of the Section 36 BOA Project was approximately $7 million; however, additional project scope increased the overall project costs. The most significant cost growth factor was the increased remediation volumes for chemical sewers, HHE soil and biota risk soil. Other significant scope additions include expanded munitions and explosives of concern (MEC) clearance requirements, subgrade construction and surface grading for the surrounding soil covers, and addition of structures demolition. Overall, project costs increased to approximately $18.7 million, which represents a cost increase of approximately 167 percent over the ROD estimate.

This ESD will become part of the Administrative Record as required by the NCP, 40 CFR 300.825(a)(2) (EPA 1990). The Administrative Record is available to the public at the Joint Administrative Record Document Facility (JARDF) that is located on the RMA in Building 129, Room 1010. The JARDF is open Monday through Friday between Noon and 4 pm or by appointment. The telephone number for the JARDF is 303-289-0983.

2.0 SITE HISTORY, CONTAMINATION AND SELECTED REMEDY

2.1 RMA Operational History

The RMA was established in 1942 by the Army to manufacture chemical warfare agents and agent-filled munitions and to produce incendiary munitions for use in World War II. Following the war and through the early 1980s, the facilities continued to be used by the Army. Beginning in 1946, some facilities were leased to private companies to manufacture industrial and agricultural chemicals. Shell Oil Company, the principal lessee, manufactured pesticides from 1952 to 1982 at the site. Common industrial and waste disposal practices during those years resulted in contamination of structures, soil, surface water, and groundwater.

The On-Post OU is one of two operable units at RMA. The Off-Post OU primarily addresses groundwater contamination north and northwest of RMA. The On-Post OU addresses contamination within the approximately 26.6 square miles of RMA. As of August 2006, approximately 21 square miles of the On-Post OU have met cleanup requirements and are no longer part of the NPL site. Implementation of the remedy for the remaining approximately 5.6 square miles is ongoing and is scheduled for completion in 2010.

The contaminated areas within the On-Post OU included approximately 3,000 acres of soil, 15 groundwater plumes, and 798 structures. The most highly contaminated areas were identified in South Plants (the CPA, Hex Pit, Buried M-1 Pits, and the chemical sewers), Basins A and F, the Lime Basins, the Complex (Army) Trenches (CAT) and the SDT. The primary contaminants found in soil and groundwater in these areas are organochlorine pesticides (OCPs), solvents, metals, and chemical warfare agent byproducts.

The areas with the highest levels and/or the greatest variety of contaminants are located in the central manufacturing, transport, and waste disposal areas. The highest contaminant concentrations tend to occur in soil within five feet of the ground surface, although exceptions are noted, particularly where burial trenches, disposal basins, or manufacturing complexes were located.

The characteristics and locations of the groundwater plumes suggest that the greatest contaminant releases to the groundwater have occurred from Basin A and the Lime Basins, the South Plants chemical sewer, the South Plants tank farm and production area, the CAT and SDT in Section 36, and the former Basin F. The Motor Pool/Rail Yard and North Plants areas have been other sources of contaminant releases to the groundwater.

2.2 Section 36 BOA History and Contamination Summary

Section 36 is located in the central part of RMA and was the primary solid and liquid waste disposal area for RMA in the 1940s, 1950s and 1960s. Solid wastes were disposed in the CAT, SDT and the Section 36 Sanitary Landfill. Liquid wastes were disposed through chemical sewers and surface ditches to the Lime Basins and Basin A. The Section 36 BOA project consists of 11 ROD-identified areas of soil contamination and nearby surficial soil surrounding the Section 36 disposal areas. Ten additional areas were identified during design or implementation for inclusion in the Section 36 BOA Project. The sites included in the Section 36 BOA Project are shown on Figure 1.0-2. The contamination areas consist of inactive chemical sewer lines, munitions testing locations, potential storage and disposal locations and areas of windblown surface contamination within the Central Study Area (CSA) and North Central Study Area (NCSA). The principal contaminants in these areas are OCPs and mercury. The following ROD-identified areas are included in the Section 36 BOA project soil remedy:

Section 36 BOA

- Complex Disposal Area (South) (CSA-1b)
- Munitions Testing Area (CSA-2a)
- Shallow OCP Contamination Area (CSA-4)
- General Surface Contamination Areas (NCSA-1g)

Chemical Sewers

- North Plants Chemical Sewer (CSA-3)
- North Plants Chemical Sewer (NCSA-6b)
- South Plants Chemical Sewer (NCSA-6a)

Ditches/Drainage Areas

- North Plants Parking Lot (CSA-2b)
- Buried Sediment/Ditch (NCSA-1c)
- South Plants Drainage Ditches (NCSA-1f)
- Liquid Storage Pool (NCSA-1d)

Surficial Soil Exceedance Areas

During design and implementation, ten additional areas were identified for remediation under the Section 36 BOA Project:

- Three Priority 1 (P1) Soil Areas
- Priority 2 (P2) Soil Area
- Groundwater Extraction Line (CSA-1d & CSA-4)
- Deep Acute Contingent Soil Volume (CSV) Excavation (NCSA-6a)
- CAT P1 Soil Area
- Section 36 Lime Basins Surficial Soil (NCSA-1b)
- Two Terrestrial Residual Ecological Risk (TRER) Areas

A summary of the information collected during the Remedial Investigation (RI)/Feasibility Study (FS) process can be found in various Contamination Assessment Reports, the RI Summary Report (Ebasco 1992) and in the Detailed Analysis of Alternatives Report (FWENC 1995). Risk-based analysis of data collected during the RI resulted in designation of HHE and biota risk soil in the Section 36 BOA project areas. A summary of use and contamination history for each area is provided below.

2.2.1 Section 36 BOA

The Section 36 BOA subgroup, located primarily in the southern portion of Section 36, includes areas CSA-1b, CSA-2a, CSA-4 and NCSA-1g. Sites within this subgroup are located generally within the southern area of Section 36 and do not have unique site characteristics or contamination patterns. These areas are adjacent to other identified storage and disposal sites and are characterized by windblown contamination, primarily OCPs, from the adjacent disposal sites. Portions of the Section 36 BOA areas were also used for surface storage, possibly resulting in surface contamination.

2.2.1.1. CSA-1b

Site CSA-1b is located east of Basin A, south of the CAT and completely encompasses the SDT. Site CSA-1b was used by the Army, Hyman, and Shell for various types of waste storage and reported waste disposal from the early 1940s to the late 1970s. The northwest portion of site CSA-1b was covered by Basin A liquids from approximately 1950 to 1958. From approximately 1966 to approximately 1974, Shell operated a drum storage area immediately south of the SDT. The drums were stored either on pallets or directly on the ground. Additionally, the storage area

was used for temporary storage of contaminated soil resulting from leaks and spills of Shell chemicals occurring in South Plants. From 1971 to 1974, the drums were removed and disposed at an off-site disposal facility. During drum removal, Shell removed contaminated soil resulting from drum leaks and spillage and placed the soil into the last open disposal trench of the SDT (ESE 1988l).

The RI also indicated the possibility of a waste disposal area north of the SDT and a trash burning area in the western portion of the site, although neither area could be confirmed during design field investigations.

Samples collected during the RI/FS showed concentrations of aldrin, chlordane and dieldrin exceeding the site evaluation criteria (SEC). The samples exceeding SEC were located in the upper four feet primarily in the areas surrounding the SDT. Lower concentrations of aldrin and dieldrin present in surface soil resulted in biota risk area over the remainder of the site. Diisopropyl methylphosphonate (DIMP), isopropyl methylphosphonic acid (IMPA) and chloroacetic acid (chemical agent degradation and byproducts) were detected in soil samples from the northwestern and western portions of CSA-1b with concentrations of chloroacetic acid exceeding SEC (ESE 1988l, 1988a). Basin A is considered to be the primary source of chemical agent associated compounds in these soils since the majority of the DIMP and IMPA detections and all of the chloroacetic acid detections were located within the Basin A high-water line area. This area was transferred to the Basin A project during the 36 BOA design. The ROD identifies the northern portion of site CSA-1b as a potential chemical agent and MEC area.

2.2.1.2. CSA-2a

Site CSA-2a is a 1.3-acre rectangular site located within CSA-4 occupied by a bomb-test structure (Building 725) and several other structures (726, NN3603, NN360, and NN3605). The Army conducted testing on a variety of agent and non-agent munitions from the 1940s through the 1960s both in the structures and on the surrounding grounds including (ESE 1988j):

- open storage of various conventional and chemical agent munitions components
- proof testing of 6-lb M69 incendiary bomblets (M13 and M19 Clusters), 10-lb M74 incendiary bomblets (E48 Cluster), and 4-lb M50 incendiary bomblets (M17A1 Cluster).
- disassembly of M23 VX landmine and detonation of explosive components
- sampling and inspection of VX-filled M56 warheads and M121A1 155mm VX-filled projectiles
- testing of XM45E1 Microgravel mines
- disposal of anti-intrusion mines (Button Bombs, Microgravel Mines, and Sandwich Button Bombs)
- environmental testing of agent-filled munitions
- vibration testing for Sandwich Button Bomb canisters and possibly agent-filled munitions
- drop tests and wet sensitivity tests on Sandwich Button Bombs and loaded Command Destruct Unit canisters

There is no record of operations after 1970, and by 1980 the facilities in site CSA-2a were inactive and abandoned. In 1996, TVA relocated four buildings (Buildings NN3603, NN3604, NN3605, and a building with no number identified as 726) from Section 36 to the North Plants Storage Yard (TVA 1996).

Soil samples collected during the RI/FS did not contain detections of chemical agents or concentrations of any contaminants of concern (COCs) above the SEC; however, based on site use history the ROD identifies site CSA-2a as being a potential agent and MEC area (ESE 1988b). Low concentrations of OCPs and arsenic resulted in biota risk area over the remainder of the site.

2.2.1.3. CSA-4

CSA-4 is comprised of two areas, CSA-4 North and CSA-4 South. Site CSA-4 North is located in north central Section 36 immediately south of a sanitary landfill (site CSA-1d). No records were discovered that documented any Army or Shell activities occurring on site CSA-4 North.

Site CSA-4 South is characterized as a shallow OCP contamination area. This contamination is attributed to wind dispersion from source areas to the west, including Basin A, SDT (CSA-1a), and the former Shell drum storage area in CSA-1b. A portion of site CSA-4 South was reportedly used for open field (outdoor) munitions proof tests, quality tests, temporary munitions storage, and a small amount of disposal of burn debris. In 1948, a firebreak was constructed on site CSA-4 South as a fire protection measure for munitions testing being performed in Bldg 725 (CSA-2a). The firebreak was enlarged twice during the 1950s to accommodate testing activities. Beginning in 1950, the Army began proof-testing of M19 incendiary clusters, which consist of M69 napalm-filled bomblets. During operations, metal debris was routinely picked up and salvaged. Unsalvageable bomb parts and incendiary residues from the M19 program were reportedly burned in 5 burn pits located northeast of Building 725. Between 1951 and 1957, M74 incendiary bomblets and M15 white phosphorus grenades were directed to site 36-2 for proof testing. Between 1960 and 1969, M34 white phosphorus grenades were directed to Site 36-2 for proof testing. After 1970, the munitions testing areas were no longer in use (ESE 1988j).

The southeastern portion of CSA-4 South was used for munitions storage from 1950 through 1953. M19 incendiary cluster bombs were stored in crates at nine separate storage plots. In 1961, the hydrazine storage spur was constructed parallel to and west of the existing GB (chemical agent sarin) rail line. The majority of the spur is located within the eastern portion of site CSA-4 South. The spur was used between 1961 and 1982 to store tank cars containing unsymmetrical dimethylhydrazine and hydrazine. During a 2-week period in 1966, rail cars containing agent-filled M55 rockets were stored on the spur. The CAR did not document any spills or leaks associated with the operation of this storage facility (ESE 1988m, 1988k).

A vehicle decontamination station was constructed in 1988 in the southwest corner of CSA-4 South to decontaminate vehicles exiting Section 36. When active, liquids drained from the trough into a belowgrade sedimentation vault. The facility is identified as Structure No. 730, but is not identified in the ROD. The building's use history indicates that it is properly designated as an Other Contamination History Structure.

The RI identified several trenches and burn pits within the munitions testing area. Samples collected contained low levels of metals; however, concentrations did not exceed the SEC and the majority was attributed to background levels. One dieldrin detection was found but the concentration was below the SEC. Subsurface soil samples collected during the RI in the incendiary cluster storage plots did not contain concentrations of COCs above the SEC. However two surface soil samples collected in this area contained concentrations of dieldrin exceeding the acute SEC. Samples collected along the hydrazine storage spur contained detections of Inductively-Coupled Plasma (ICP) metals, mercury, and dieldrin; however none of the detected analytes exceeded SEC (ESE 1988j, 1988m, 1988k, 1988b). Lower concentrations of aldrin and dieldrin present in surface soil resulted in biota risk area over the remainder of the site.

A portion of CSA-4 South, generally encompassing the cumulative area within each firebreak, is identified in the ROD as potential MEC area. The extreme northwestern portion of CSA-4 South is within a ROD-identified potential agent area.

2.2.1.4. NCSA-1g

Site NCSA-1g is located in the southwest quarter of Section 36 around the south end of Basin A and the southern and western edges of the Section 36 Lime Basins. The area is traversed by several other Study Area Report (SAR) sites, including former South Plants Chemical Sewer (site NCSA-6a), two South Plants ditches (site NCSA-1f), a plugged sanitary sewer (site NCSA-8a), and by Basin A (site NCSA-1a). As a result, NCSA-1g is divided into six areas. A paved rectangular 5.5-acre parking lot known as the South Plants Parking Lot is located southeast of Basin A on the southern portion of the site abutting 7th Avenue. The lot was built around 1945 and was used for automobile parking until about 1965. Between July 1984 and July 1998, approximately 5,700 bank cubic yards (bcy) of soil, asphalt, concrete rubble, well protective casings and pads, bollards, and telephone poles, and approximately 38 rectangular well head covers were stockpiled on the paved lot.

Soil samples were collected throughout NCSA-1g to characterize the area and to investigate several reported disposal and spill areas (ESE 1988n, 1988o, 1988h). Two surface samples were identified with concentrations of dieldrin exceeding the acute SEC, resulting in delineation of two small HHE areas. Lower concentrations of aldrin and dieldrin present in surface soil resulted in biota risk area over the remainder of the site. No spill or disposal areas were identified. As a result, NCSA-1g is characterized by the ROD as surface soil contamination areas due to wind dispersion.

2.2.2 Chemical Sewers

The Chemical Sewers consist of North Plants (CSA-3 and NCSA-6b) and South Plants (NCSA-6a) chemical sewer lines located within Section 36 as shown on Figure 1.0-2. The Section 36 BOA design assigned line numbers to each sewer, Lines 1 through 10, to provide clarity to the discussions related to the various sewer lines. These line numbers are shown on Figure 1.0-2 along with the SAR site numbers.

2.2.2.1. North Plants Chemical Sewer (CSA-3 and NCSA-6b)

The North Plants chemical sewer (CSA-3) was constructed in 1952 and included a 6-inch cast-iron pipe (CIP) pressurized line to convey chemical wastes from the North Plants neutralization sump to manhole 5-4 in Section 36 where the waste was discharged into Basin A. In approximately 1954, a 12-inch steel sewer line was installed between the North Plants neutralization sump and manhole 5-4. The steel line is parallel to and approximately 11 feet west of the existing CIP. Following construction of Basin F in 1956, the North Plants chemical sewer was rerouted from Basin A to Basin F via a 12-inch non-pressurized vitrified clay pipe (VCP) sewer line (CSA-3 and NCSA-6b) between manhole 5-4 and the South Plants interceptor line at manhole 1-4 in Section 35. The North Plants chemical sewer is identified as Lines 8, 9 and 10.

In 1982, the Army removed the chemical sewer interceptor line and the chemical sewer line in southwest Section 36 through Sections 35 and 26 to Basin F (USACE 1983). This removal did not include the North Plants chemical sewers in Section 36. In 1997, three chemical sewer segments within the CAT (CSA-1c) were grouted per the Chemical Sewer Plugging Project requirements. The sewer was grouted to the edges of the CAT boundary (RVO 1998).

The RI for the chemical sewers included investigative trenches to expose the sewer and collection of soil samples from 0.5 to 3 feet below pipe invert. Samples contained detections of DIMP and aldrin as well as arsenic and mercury above their background levels. However, none of the concentrations exceeded SEC. Although no agent was detected during the investigations, the ROD identified the sewers as a potential agent area based on use history.

2.2.2.2. South Plants Chemical Sewer (NCSA-6a)

The South Plants Chemical Sewer system was constructed in the 1940s to convey chemical wastes from South Plants to Basin A. The original system in the east side of South Plants included a 30-inch pipe that carried liquid waste from the M-1 settling basins to the Section 36 Lime Basins (Line 1). Between 1944 and 1946, the Army constructed a 12-inch VCP sewer that received waste from mustard purification and ton container decontamination activities (Line 2). The sewer transported the wastes past the east edge of the Section 36 Lime Basins and into Basin A. In 1953, Hyman constructed a 12-inch sewer line to segregate Hyman waste flows from Army waste (Line 3). The line crossed over (or under) the existing Army 12-inch VCP and discharged Hyman waste to a stilling basin, and eventually to Basin A.

Following construction of Basin F in 1956, an 8-inch VCP chemical sewer line was constructed to divert South Plants chemical wastes from Basin A to Basin F (ESE 1987c). In Section 36, this VCP intercepted waste flows from both 12-inch VCPs (Lines 6 and 7). Another segment of this line included an 8-inch VCP extension from South Plants that crossed beneath 7th Avenue and terminated at manhole I-10 in Section 36 (Line 5). In 1982, the Army removed the majority of the VCP chemical sewer lines that were constructed in 1956 (USACE 1983).

Also, a north-trending buried 8-inch CIP chemical sewer (Line 4) enters the southern portion of CSA-1b approximately 100 feet east of the South Plants Parking Lot. This line originated from former South Plants Building 732 which was used for munitions assembly, testing and storage.

According to the CAR for site 36-14, the sewer line was installed in connection with the installation of a white phosphorus filling process line in the building. The Army reports that the sewer line had '...never been used for contaminated waste.' (ESE 1988l).

Soil samples were collected during the RI along the location of the lines removed in 1982 (ESE 1987c, 1988g). Low concentrations of ICP metals, arsenic, dicyclopentadiene and OCPs were detected; however, all concentrations were below SEC.

Also during the RI, soil sample SS36000161 was collected from ground surface above Lines 2 and 3 within the Lime Basins boundary. The sample contained concentrations of OCPs above acute SEC. However, the ROD did not identify this area for excavation since the sample location was under the existing Interim Response Action (IRA) soil cover. Although the sample is located within the Lime Basins Project site, this HHE soil was removed by the Section 36 BOA project to provide access to Lines 2 and 3.

2.2.3 Ditches/Drainage Areas

Sites in this medium group include the North Plants Parking Lot (CSA-2b), Basin A Drainage Ditch (NCSA-1c), Liquid Storage Pool (NCSA-1d) and South Plants Drainage Ditches (NCSA-1f). These sites were primarily used to convey surface water from other sites and only sporadically contained water. They are characterized by shallow contamination, mainly OCPs, with concentrations presenting a potential risk to biota.

2.2.3.1. North Plants Parking Lot (CSA-2b)

Site CSA-2b, located just south of 8th Avenue, consists of an abandoned asphalt parking lot with 7 soil/asphalt stockpiles and a narrow strip of land south of the lot. The lot was constructed in 1951 for use by North Plants employees and was used for vehicle parking from 1951 to about 1957 (C2bCAR). By 1982, the lot appeared to be vacant and unused. In 1983, the Army's Escort and Disposal Detachment conducted a surface sweep of Section 36, excluding Basin A proper. The purpose of the sweep was to remove all potentially contaminated surficial or partially buried items. Site CSA-2b became the designated storage area for all recovered items except munitions suspected of being fuzed or chemically filled, which were directed to the Toxic Storage Yard. Some materials were directed to site CSA-2b to be decontaminated by the incinerator in south-central site CSA-1d. However, decontamination was apparently never completed (ESE 1988i).

Soil samples were collected during the RI in shallow drainage ditches traversing the eastern and southern edges of the site (ESE 1988i, 1988c). Although some samples contained low concentrations of mercury, lead, zinc, copper, and OCPs, none of the concentrations exceeded SEC. Low concentrations of OCPs present in surface soil resulted in biota risk area over the entire site. No chemical agent degradation products were detected.

From October 16, 2000 through November 20, 2000, personnel conducting cleanup activities on site CSA-2b as part of the Miscellaneous RMA Structure Demolition and Removal Project discovered six M139 bomblets containing the chemical agent GB. This bomblet is a 4.5-in-

diameter, spherical, self-dispersing munition containing 1.3 pounds of GB. The bomblets were discovered in soil/scrap piles located on or near the southern edge of the parking lot.

The six bomblets were destroyed by the Army between January 28, 2001 and February 9, 2001, using the Explosive Destruction System (EDS), which was brought on-site by the Army specifically for the bomblet destruction. The EDS demilitarizes munitions through detonation followed by the introduction of a chemical reagent in a sealed vessel. The destruction of all six bomblets was performed in a vapor containment structure (VCS) that covered the EDS (FWENC 2001b).

Concurrent with the EDS and VCS systems, a Large Area Maintenance Structure (LAMS) was also constructed over the remaining soil/scrap piles to provide containment and a temperature-controlled working environment while Unexploded Ordnance (UXO) Specialists screened the material for potential additional munitions. In June 2001, four additional M139 bomblets were discovered in the LAMS-covered soil/scrap piles. These bomblets were destroyed in the EDS in July 2001 (FWENC 2001a). After the remaining soil was screened and no additional munitions were found, the LAMS facility was dismantled and removed.

2.2.3.2. Basin A Drainage Ditch (NCSA-1c)

Site NCSA-1c, located in the northwest quarter of Section 36, is the original overflow ditch which drained aqueous wastes from Basin A west into Basin B (ESE 1987b). The ditch flows north out of Basin A, into a gradual 90-degree bend to the west, then due west into Section 35. The ditch is approximately 1,600 feet in length. No action was required for this site since no contamination was identified in the portion of the ditch within the Section 36 BOA Project (ESE 1988h, 1988d). The southern portion of the ditch is identified as biota soil, but this portion is within the Basin A project boundary and will be beneath the Basin A RCRA-Equivalent Cover.

2.2.3.3. Liquid Storage Pool (NCSA-1d)

Site NCSA-1d, located in the southwest quarter of Section 36, is a natural basin that was reportedly used by South Plants for periodic retention of potentially contaminated surface drainage. Liquid is visible in this area in aerial photographs between 1953 and 1962. The basin was suspected to have been fed by a potentially contaminated stormwater drainage ditch (NCSA-1f) from the South Plants area (ESE 1987a). The site boundary encompasses approximately 3.5 acres, which roughly corresponds to the high water line from the 1958 photograph where the maximum extent of liquid was observed.

Soil samples were collected during the RI/FS in and around the site ranging in depth from 1 to 13 feet (ESE 1987a, 1988f). Concentrations of OCPs, ICP metals, arsenic, mercury and dibromochloropropane were found in some of the samples, but the levels were below SEC. Concentrations of OCPs present in surface soil resulted in biota risk area over the entire site.

2.2.3.4. South Plants Drainage Ditches (NCSA-1f)

Site NCSA-1f is a chemical waste drainage ditch system consisting of two north-south ditches located in the southwest quarter of Section 36.

The western ditch conveyed South Plants storm drainage to the NCSA-1d holding pond from about 1948 to 1975. An October 15, 1975 photograph revealed that the ditch was rerouted east of the holding pond, then north-northwest to the western edge of Section 36. The ditch drained into a culvert beneath D Street and into a Section 35 ditch (NCSA-5d) (ESE 1987d). In 1982, the ditch carried surface flows from an east-west ditch (possibly a surface water interceptor ditch) which ran along the southern boundary of the Lime Basins (RMA aerial photograph July 10, 1982). Sometime after 1982, the ditch became inactive and has remained so since that time.

The eastern ditch is located immediately east of Basin A on the southern edge of Section 36 and reportedly drained potentially contaminated surface drainage from South Plants to Basin A. The ditch appears to be active through at least 1982, based on review of RMA aerial photographs. Recent photos indicate that the ditch is inactive and revegetated.

In the western ditch, low concentrations of OCPs, arsenic and mercury were found (ESE 1987d, 1988e). In the eastern ditch, low concentrations of OCPs, ICP metals and mercury were detected. All concentrations were below SEC; however, concentrations of OCPs present in surface soil resulted in biota risk area over the entire site.

2.2.4 Surficial Soil

The Section 36 BOA Project includes a ROD-identified surficial soil area in the southwest corner of Section 36. This area consists of a small HHE area and approximately 7.4 acres of biota risk soil. These areas are contaminated with low concentrations of OCPs in the upper 1 foot of soil attributed to windblown contamination from other source areas.

2.2.5 Priority 1 Soil Areas

Three P1 soil areas were identified for remediation under this project during design. The P1 areas are located along the northern (P1 North), eastern (P1 East) and western (P1 West) boundaries of Section 36. A fourth P1 area along the northwest boundary of the CAT was added to the P1 North area during project implementation. Sampling completed during the RI/FS in these areas was typically limited to the uppermost 2 inches of soil. Results indicate the primary COCs to be OCPs.

2.2.6 Priority 2 Soil Area

One P2 soil area (36SW-6) was addressed under this project. The P2 area was located east of the Fire Station (Building 312) in the extreme southwest corner of Section 36.

2.3 Summary of the Selected On-Post Remedy

The overall remedy required by the 1996 ROD for the On-Post OU includes the following:

- Interception and treatment of contaminated groundwater at the three existing on-site treatment plants
- Construction of a new RCRA- and Toxic Substances Control Act-compliant hazardous waste landfill (HWL) on-post

- Demolition of structures with no designated future use and disposal of the debris in either the new, on-post HWL or the Basin A consolidation area, depending upon the degree of contamination
- The contaminated soil at RMA is addressed primarily through containment in the on-post HWL or under caps/covers, or through treatment depending upon the type and degree of contamination. Areas that have caps or covers require long-term maintenance and will be retained by the Army. These areas will not become part of the wildlife refuge.
- The Basin A disposal area is used for consolidation of biota risk soil and structural debris from other RMA contamination areas and is covered with a soil cover including a biota barrier.

2.4 Summary of the Selected Remedy for the Section 36 BOA Project

The Section 36 BOA project includes areas identified in the ROD as part of the medium groups/subgroups of Chemical Sewers, Ditches/Drainage Areas, Section 36 BOA and Surficial Soil as well as additional areas identified during design and implementation. During the remedial design process, several changes to the Section 36 BOA remedy were identified based on new information developed during the design (FWENC 2003d). These changes were documented in an ESD completed along with the final remedial design (FWENC 2003e). The required remedial actions based on the ROD and subsequent ESD are identified below. A summary of the design ESD is also provided to highlight changes from the original ROD.

Chemical Sewers

- Remove overburden (soil above the bottom of the pipe) from excavation areas and stockpile.
- Excavate remaining sewer line and dispose in on-post HWL.
- Excavate contaminated soil associated with the chemical sewer lines to a depth of 10 feet or 2 feet below the line, whichever is deeper, and dispose in on-post HWL. The width of excavation extends up to 10 feet laterally from each sewer line (width for some lines was reduced to extend 2 feet laterally based on design sampling).
- Backfill excavation with stockpiled overburden and other clean fill dirt.
- Finish grade and revegetate all disturbed areas.

Ditches/Drainage Areas

- Excavate biota risk soil and consolidate in Basin A.
- Backfill excavation with clean fill dirt.
- Finish grade and revegetate all disturbed areas.

Section 36 BOA

- Excavate HHE soil and munitions debris and dispose in the on-post HWL.
- Backfill HHE soil excavations with clean soil.

- Excavate biota risk soil and consolidate to Basin A.
- Collect soil samples following excavation to ensure no contaminated soil remains.
- Perform geophysical survey over potential MEC area and cover deletion area following excavation. Clear all targets identified from the post-excavation geophysical survey. Excavate and detonate (or otherwise demilitarize) any MEC encountered.
- Monitor for chemical agent during excavation. Treat agent-contaminated soil by caustic solution washing.
- Revegetate all disturbed areas. For areas within the Army-maintained area, revegetation will be consistent with requirements for the Integrated Cover System (ICS) project.

Surficial Soil

- Excavate HHE soil and dispose in the on-post HWL.
- Backfill HHE soil excavations with clean soil.
- Excavate biota risk soil and consolidate to Basin A.
- Revegetate all disturbed areas.

In addition several structures located within Section 36 were incorporated into the Section 36 BOA remedy. The ROD-identified remedy for structures is demolition of structures and disposal of debris in the on-post HWL or Basin A.

The ESD prepared during remedial design included documentation of changes to the chemical sewer excavation, soil cover requirements and excavation volumes (FWENC 2003e). These changes were identified during the design based on new information obtained by the Army during detailed document review and additional design sampling. For chemical sewers, four additional sewer lines were identified and incorporated into the Section 36 BOA remedy (Lines 1 through 4). Also, excavation of soil along the ROD-identified NCSA-6a sewer lines (Lines 5 through 7) was eliminated based on documentation of previous removal and additional sampling, which showed no HHE soil remaining along the former lines. The ROD-identified excavation widths for remaining chemical sewers was also reduced based on sampling completed during design (FWENC 2003f).

Additional soil sampling completed during design also supported eliminating the ROD-identified soil covers for Section 36 BOA (FWENC 2003f, 2003g). To further support elimination of the covers, a geophysical survey and additional soil sampling were required following excavation of all identified contaminated soil. These activities resulted in elimination of 172 acres of soil covers. Changes to project boundaries and remediation volumes were also identified during design. The northwestern boundary of CSA-1b was adjusted to coincide with the former Basin A high water line. This adjustment allowed the Basin A remedy to be applied consistently over the historical extent of the basin. Also, excavation limits near slurry walls in place around the adjacent SDT and CAT were incorporated to protect the integrity of the slurry walls. Overall, design modifications resulted in a decrease in HHE soil volume of 37,450 bcy. These changes

are discussed in detail in the ESD completed during design (FWENC 2003e). The original ROD boundaries and modified design boundaries are shown on Figure 1.0-2.

2.5 Section 36 BOA Remedy Implementation

The remedial design for the Section 36 BOA Project was completed in 2003 (FWENC 2003d). The Section 36 BOA Project remedy was implemented in two parts over a five-year period. Part 1, which was completed in three separate Phases, focused on the removal and disposal of remediation wastes identified for disposal in the HWL and Basin A. All remediation waste identified in the original, approved design was removed during Part 1. However, over the course of the project additional waste was identified. Most of the additional waste, such as further chemical sewer excavation and CSV removal, was remediated during Part 1. Part 2 primarily consisted of clean earthwork, including gradefill and construction of stormwater drainage swales. Part 2 also included minor remediation efforts to remove surface soil contamination (biota risk soil, P1 soil and TRER soil) and demolish support facilities.

Additional soil sampling was performed during Part 1 and Part 2 under three different Sampling and Analysis Plans (SAP). The Former Chemical Sewer (FCS) SAP, which was initiated during design, was modified to include soil sampling along chemical sewer lines following excavation of design volumes (FWENC 2004). Confirmatory sampling was conducted following excavation of HHE soil under the site-wide CSV SAP (RVO 2007). The Biota SAP included 5-point composite sampling following excavation and again after subgrade construction to ensure that no contaminated soil remained in place at the final soil surface (FWENC 2003h). The results of the various sampling events and the impact on remediation are discussed in Sections 3.1 and 3.2.

3.0 BASIS FOR THE ESD

Significant changes to the Section 36 BOA Project include changes in project boundaries, increases in remediation volumes, and an overall increase in project cost. Project boundaries changed due to areas transferred to other projects for soil cover construction, including an area surrounding the SDT and the South Plants chemical sewer area south of the Lime Basins. Remediation volumes increased for chemical sewer excavation, HHE soil excavation, biota risk soil excavation and Residual Ecological Risk (RER) soil. Cost increases were a result of the increased remediation volumes, expanded geophysical survey and MEC clearance area, and additional scope items including structures demolition, surface debris removal, addition of P1 and TRER soil remediation, extensive surface grading to support construction of adjacent Section 36 soil covers, and increased project support costs.

3.1 Change in Project Boundaries

3.1.1 Shell Disposal Trenches Area

Remediation for the Section 36 BOA project included the former drum storage area located within CSA-1b just south of the SDT. This area was within the ROD-identified 2-foot soil cover area; however, as discussed in Section 2.4, an ESD was prepared during design to eliminate the soil cover. To support elimination of the cover, the ESD required removal of all contaminated soil followed by additional soil sampling and removal of any contaminated soil identified (FWENC 2003e).

Remediation of the former drum storage area was initiated under the Section 36 BOA project and excavation was completed in accordance with the design during Part 1 of the project. Following completion of Part 1, Phase 2, soil sampling was conducted in accordance with the Section 36 BOA design ESD to ensure that all contaminated soil was removed and support the basis for eliminating the soil cover. Samples were collected pursuant to the CSV SAP (RVO 2007) and Biota SAP developed specifically for the Section 36 BOA project (FWENC 2003h). The sample results from both events showed that significant areas of HHE and biota risk soils remained within the Section 36 BOA (TtEC 2008c). In addition, extensive chemical staining was identified in the former drum storage area. These stained soils were observed at or below the design excavation surface, indicating that the design sampling may not have located all contamination existing beyond the ROD-identified HHE volume. Pesticide odors were also detected and attributed to this area. While the source of the odors could not be determined, the pesticide nature of the odor suggested a possible relationship to the SDT activities.

Excavation outside the SDT and former drum storage area was also completed under the Section 36 BOA project with similar observations of unexpected field conditions. Although the most significant staining was observed south of the SDT in the former drum storage area, stained soils were observed to the north, west and east of the SDT as well. Results of the RI and design sampling indicated that contamination in the Section 36 BOA area was limited to surface or near surface soils and this assumption was significant for support of the design ESD. However, sample results following excavation showed that the area surrounding the SDT had concentrations of OCPs exceeding the SEC and biota risk criteria at the design excavation surface. Although the identified contaminated soil was excavated, the presence of stains and additional identified exceedance volumes indicated that the design sampling may not have located all contamination existing beyond the ROD-identified HHE volume, and suggested that all contaminated soil could not be reliably located and removed as required by the Section 36 BOA design ESD.

These field observations, including variability in pre- and post-excavation soil sample results, extensive HHE and biota risk soil volumes present at final excavation grades, and the persistence of stained soils and odors led to the decision to extend the SDT RCRA-Equivalent cover over the former drum storage area as defined by the limits of disturbance visible in the 1973 aerial photograph, approximately 5 acres. In addition, approximately 31 acres of the Section 36 BOA project area surrounding the SDT and former drum storage area was identified for construction of a 2-foot-thick soil cover to provide additional protection and minimize potential migration of contaminants to groundwater (TtFW 2005a). The 2-foot-thick soil cover was added as an element of the overall SDT Project since the field observations indicate potential contamination related to historical disposal activities at the SDT. The cover areas incorporated into the SDT Project are shown on Figure 3.1.1-1.

Both the RCRA-Equivalent cover extension and the 2-foot-thick soil cover were added as expansions to the SDT project since the field observations indicated potential contamination related to historical disposal activities at the SDT. An ESD was completed for the Shell Disposal Trenches project to document the increases in cover area (TtEC 2006a). Overall this change resulted in approximately 36 acres being transferred from the Section 36 BOA project to the

SDT project (TtEC 2008d). However, because all excavation activities were completed under the Section 36 BOA project, excavation and remediation volumes are included in the Section 36 BOA project documentation and Construction Completion Reports (CCRs). Construction of the RCRA-Equivalent cover is documented in the SDT CCR (TtEC 2008b). Construction of the 2-foot-thick soil cover is being completed as part of the ICS and will be documented in the ICS CCR.

3.1.2 South Plants Chemical Sewer Area

Remediation for the Section 36 BOA project included excavation of chemical sewers associated with the South Plants sewer system located south of the Lime Basins and north of the South Plants CPA. During design, excavation of soil along the ROD-identified NCSA-6a sewer lines, Lines 6 and 7, was eliminated based on documentation of previous removal and additional sampling, which showed no HHE soil remaining along the former lines (FWENC 2003e, 2003c). Three sewer lines not documented in the ROD, Lines 1, 2, and 3, were identified and incorporated into the project as part of NCSA-6a.

During excavation of these sewer lines and associated soil, strong odors were observed emanating from the excavations and stockpiled overburden soil. Results of confirmatory sampling also showed contamination remaining after excavation of the design volume had been completed. Also during excavation, an abandoned storm sewer was uncovered as well as pipe fragments and bedding associated with the ROD-identified previously removed sewer, Lines 6 and 7.

These changes in field conditions resulted in a significant increase in chemical sewer remediation volume as discussed in Section 3.2.1. Although all identified contaminated soil was removed, field conditions suggested that all contamination could not be reliably located and removed as required by the design ESD. This conclusion was based on the presence of odors throughout the sewer excavation area, variability in pre- and post-excavation soil sample results, and the presence of pipe fragments and contaminated soil along the sewer lines that were previously documented as removed. In addition analytical data from composite sampling of the post-excavation surface classify this area as biota risk soil.

Based on these field conditions, the remedy was modified to include this area under a soil cover to ensure long-term protectiveness. Because the area is located between the South Plants CPA and Lime Basins RCRA-Equivalent covers, the biota risk soil was left in place and the South Plants CPA RCRA-Equivalent cover was expanded to incorporate this area as shown on Figure 3.1.1-1 (TtEC 2008e). Therefore the Section 36 BOA project boundary was modified transferring approximately six acres from the Section 36 BOA project to the South Plants CPA project (TtEC 2008d). Since all excavation activities were completed under the Section 36 BOA project, excavation and remediation volumes are included in the Section 36 BOA project documentation and CCRs. Construction of the RCRA-Equivalent cover will be documented in the ICS CCR.

3.2 Increase in Remediation Volumes

3.2.1 Chemical Sewers Remediation Volume

The ROD identified three chemical sewers within Section 36; CSA-3, NCSA-6a and NCSA-6b. These are identified in the design as Lines 5 through 10 as shown on Figure 1.0-2. During design, a review of site drawings, historical aerial photographs and site records for the Section 36 BOA identified four additional chemical sewer lines originating in South Plants and discharging into Section 36. These lines, Lines 1 through 4, were incorporated into NCSA-6a based on use history and proximity to the ROD-identified lines. Also during design, a review of existing literature, RI data and documentation relevant to Lines 5, 6 and 7 in area NCSA-6a indicated that a large portion of the soil to be removed as required by the ROD had already been removed as part of a 1982 sewer response action (FWENC 2003d).

Additional soil sampling was completed during design along each sewer line to further characterize soil along these lines and assess if HHE soil was present. With the exception of Line 1, no HHE soil was identified. The complete results of the design sampling effort are presented in the Section 36 Balance of Areas Soil Remediation Project Data Summary Report for Initial Cover and Former Chemical Sewer Sampling and Analysis Plans (FWENC 2003f). Based on sampling results, the remedy was modified to reduce the design HHE soil corridor to be removed beneath all remaining lines. For Lines 5, 6 and 7, excavation was eliminated based on sample results and documentation of soil removal in 1982. A small portion of Line 5 remaining in the South Plants project area was included for removal. The portion of Line 1 where HHE soil was confirmed retained the ROD-identified excavation width.

The changes completed during the design process resulted in a significant reduction in design remediation volume for the chemical sewers. These changes are discussed in the Section 36 BOA design and documented in a previous ESD (FWENC 2003e).

Consistent with the ROD and design ESD, the Section 36 BOA design included excavation of South Plants chemical sewer Lines 1 through 5 and North Plants chemical sewer Lines 8 through 10. Following excavation of the design volume along the chemical sewer lines, additional sampling was completed in accordance with the FCS SAP to determine if HHE soil was remaining beyond the extent of the excavation (FWENC 2004). Sample results along Lines 1 and 2 showed concentrations exceeding the SEC (TtEC 2008c). Therefore, additional HHE soil was removed to the extent of the ROD-identified width (10 feet laterally on either side of pipe). Following the removal of the ROD-defined corridor width, Lines 1 and 2 were sampled in accordance with the CSV SAP. Based upon sample results, CSV was identified at the north end of Line 2 as well as the full extent of Line 1 to 20 feet laterally on either side of pipe. The expanded excavation along Lines 1 and 2 resulted in an additional 2,793 bcy of HHE and CSV soil for Line 1 and 1,422 bcy for Line 2. The resulting excavation boundaries and sample locations are shown on Figure 3.2.1-1.

While excavating Line 1, a storm drain running parallel to Line 1 was discovered. The storm drain ran north to a manhole, and it was discovered that, from the manhole, two storm drains branched off to the northeast and east. Considering the proximity to the Line 1 excavation and the possibility that the storm drains could have contributed to the contamination in the area, the

three storm drains were added to the NCSA-6a remedy (TtEC 2006c). Approximately 540 feet of the storm drain were removed and surrounding soil was excavated in the same manner as for chemical sewers. The addition of the storm drains resulted in 5,780 bcy of additional remediation volume.

Also while excavating Lines 1, 2 and 3, pipe bedding was discovered below the location of former Chemical Sewer Lines 6 and 7. As discussed earlier, these lines were removed in 1982 and sampling along the former alignment indicated no HHE soil remaining. Therefore, the design did not require excavation along these former sewer lines (FWENC 2003e). However, the evidence of pipe bedding observed below the location of former Lines 6 and 7 indicated that all the material may not have been removed during the previous excavation. As a result, excavation of soil along the former chemical sewer lines was added to the remedy (TtEC 2006c). The excavation limits were based on sewer alignments determined from historical photos and drawings and extended 10 feet laterally on both sides of the former pipes. The lines ran parallel approximately 15 feet apart so the total design excavation width for the two lines was approximately 35 feet. The ROD-prescribed depth for sewer excavation, the greater depth of 2 feet below the invert of the pipe or 10 feet below grade, was implemented. However, excavation was limited to the depth to the groundwater table. The pipe bedding and underlying material were excavated from the west sidewall of the Chemical Sewer Line 3 excavation to approximately 200 feet west of the Chemical Sewer Line 1 excavation. During the excavation shards of pipe, pipe bedding, and some sections of intact pipe were observed. Due to odors encountered during this portion of the excavation, some overburden was also transported to the HWL for disposal.

Before continuing the former chemical sewer line removal, additional sampling was performed in accordance with the CSV SAP to determine the extent of contamination west of the excavated material along the chemical sewer alignment. These sample locations are included on Figure 3.2.1-1. Test pits were excavated along the former alignment of Chemical Sewer Lines 6 and 7 at 50-foot intervals to a depth of two feet below the invert of the previously removed pipe. One sample was collected from the floor of the pit and a second sample was collected on the sidewall. Based on the results of the sampling an additional length of 120 feet along the alignment of Chemical Sewer Line 6 east of D Street required removal. No additional remediation was required based on the other sample results (TtEC 2008c). Excavation of soil from former chemical sewer Lines 6 and 7 resulted in an additional 12,707 bcy of remediation volume.

There were several smaller volume increases contributing to the overall increase in chemical sewer remediation volume. During project implementation, actual excavation depths completed exceeded the minimum required remediation depth. This overexcavation ensured that the minimum depth was achieved and minimized the possibility of having to return to the area for additional excavation. These minor increases included 125 bcy for Line 3, 54 bcy for Line 4, 87 bcy for Line 5, and 219 bcy for Line 10. For Lines 8 and 9, the overexcavation added 3,027 bcy due to the overall length (1,380 ft) and width (15 ft) of the excavation. In addition, excavation of 379 bcy of CSV was included based on review of soil data and identification of soil at depth along Line 6 with concentrations of contaminants that exceed the ROD acute SEC remaining (deep acute). Although the ROD did not require excavation of deep acute soils, this soil was

identified for remediation due to concerns that the soil might be inadvertently brought to the surface during future refuge work thereby creating an exposure pathway at the surface.

Overall, chemical sewer remediation volume for Section 36 BOA increased from a ROD volume, as modified by the previous ESD, of 3,940 bcy to an actual remediation volume of 30,533 bcy.

3.2.2 Human Health Soil Volume

The ROD identified HHE soil in CSA-1b, CSA-4, NCSA-1g and a small surface soil area. During design, several changes were made to project boundaries resulting in changes to the HHE soil remediation volume, as discussed in Section 2.4. These changes are discussed in detail in the Section 36 BOA design ESD (FWENC 2003e) and are reflected in the Section 36 BOA design (FWENC 2003d). The ROD HHE soil volume as modified by the design ESD is 48,888 bcy (excluding chemical sewers).

Following completion of the design but prior to beginning excavation, the HHE volume was modified. As discussed in Section 2.4, the northwestern site boundary of CSA-1b was adjusted to coincide with the former Basin A high water line. Most of CSA-1b is characterized by surficial pesticide contamination with concentrations above HHE, but not in the same order of magnitude as those found in Basin A. The area inside the historical high water line includes surficial pesticide contamination but also has a chloroacetic acid detection at a depth of 9 feet that exceeds human health SEC. The boundary adjustment resulted in the deletion of chloroacetic acid as a Section 36 BOA COC since chloroacetic acid was present only inside the Basin A high water line. Some of the HHE area remaining within northern CSA-1b had remediation depths based on the chloroacetic acid detection from the sample located within the Basin A high water line. This area was remodeled with the remaining Section 36 BOA COCs. Consequently, the remediation depths were reduced. This change resulted in a net reduction of design HHE soil of 4,705 bcy, documented in DCN-BOA-009 (FWENC 2003b).

As discussed earlier, the Section 36 BOA project was implemented in two parts, with Part 1 being completed in three phases. All ROD-identified contaminated soil was removed during Part 1 of the project in either Phase 1 or Phase 2. Following completion of Part 1, Phase 2, soil sampling was conducted in accordance with the design ESD to identify and remove remaining contaminated soil and support the basis for eliminating the soil cover. Samples were collected pursuant to the CSV SAP (RVO 2007) and Biota SAP developed specifically for the Section 36 BOA project (FWENC 2003h). Confirmatory sample locations are shown on Figure 3.2.2-1 and the Biota SAP sample locations are shown on Figure 3.2.2-2. The sample results from both events showed that significant areas of HHE and biota risk soils still remained within Section 36 BOA (TtEC 2008c). In addition, extensive chemical staining was identified in the former drum storage area. These stained soils were observed at or below the design excavation surface, indicating that the design sampling may not have located all contamination existing beyond the ROD-identified HHE volume. Pesticide odors were also detected and attributed to this area. While the source of the odors could not be determined, the pesticide nature of the odor suggested a possible relationship to the SDT activities.

Also, a review of the SDT IRA as-built drawings indicated that gradefill had been placed outside of the SDT boundary and within the Section 36 BOA site boundary during the 1990 and 1991 IRA work. The soil contaminant modeling that determined the depth of contamination did not account for the added fill because the RI sample data used in the model was collected in 1988 and 1989. Excavation depths identified in the Section 36 BOA design calculations were based on the results of the modeling and did not account for the depth of fill added during the IRA. Both SAR sites CSA-1b and CSA-4 were affected. An evaluation of the modeling data, IRA gradefill information, and the actual excavation depths achieved during the initial remediation indicated that HHE areas adjacent to the SDT cover required additional excavation to achieve the remediation depths calculated by the soil modeling program.

Based on this new information, DCN-BOA-032 was completed to document the results of the sampling events, findings from the review of the SDT IRA documentation, and the resulting identified HHE and biota risk soils (TtFW 2004b). Excavation of the additional contaminated soil was performed under Part 1, Phase 3 of the project. Upon meeting the required excavation depths, areas were sampled again to confirm no contamination remained in place. The results of this sampling identified one small area of HHE soil and one small area of biota risk soil (TtEC 2008c). The excavation limits of contaminated soil associated with these two samples is defined in DCN-BOA-043 (TtFW 2005b). The additional soil was excavated and post-excavation sampling of these areas showed no detections of contamination. The remediation efforts completed in Part 1, Phase 3, resulted in an additional 38,355 bcy HHE soil.

Several other factors contributed to the overall volume growth. During project implementation, actual excavation depths completed exceeded the minimum required remediation depth. This overexcavation ensured that the required depth was achieved and minimized the possibility of having to return to the area for additional excavation; however, the resulting actual volume increased compared to the ROD or design estimates. Overexcavation accounted for approximately 17,021 bcy of additional volume. Small HHE volumes were identified during design or implementation including a soil mound, chemical sewer Line 4 outfall ditch, slurry wall working benches and Lime Basins surficial soil. These additions totaled 225 bcy. In addition, 912 bcy of CSV was identified based on confirmatory sampling conducted following excavation.

Together these changes resulted in an increase in HHE soil remediation volume from 48,888 bcy to 100,696 bcy. Overall, when combined with increases in HHE volume associated with the chemical sewers excavations, the project HHE soil remediation volume increased from 52,828 bcy to 131,229 bcy, an approximate 148 percent increase.

3.2.3 Biota Risk Soil Volume

The ROD identified biota risk soil in CSA-1b, CSA-2b, CSA-4, NCSA-1c, NCSA-1d, NCSA-1f, NCSA-1g and a surface soil area. During design, some minor changes were made to biota risk soil volumes. The most significant was the addition of debris piles located in CSA-2b and NCSA-1g (old South Plants parking lot). Although these soil/debris piles were located within ROD-identified biota risk soil areas, the ROD did not account for the volume associated with the piles. The debris piles consisted of soil mixed with asphalt, concrete rubble, well protective

casings and pads, bollards, telephone poles and well head covers. Removal of these piles added 1,464 bcy to the CSA-2b volume and 5,656 bcy for NCSA-1g. Another small soil mound in CSA-1b added 103 bcy to the biota risk soil volume.

Excavation for NCSA-1c was eliminated during the design because the location of the ditch is within the design cover boundary for the Basin A cover. Since the remedy requirement for biota risk soil is consolidation beneath the Basin A cover, excavation of this ditch was not required. This eliminated 282 bcy from the ROD-identified remediation volume.

Biota risk soil identified in the design was excavated during Part 1 of the project in either Phase 1 or Phase 2. Excavated biota risk soil was hauled to Basin A for consolidation beneath the RCRA-Equivalent cover. Following excavation of HHE soil south of the SDT, two rounds of confirmatory sampling showed biota risk soil remaining. Additional excavation of biota risk soil in this area totaled 5,133 bcy.

Also during Phase 2, removal of biota risk soil along the CAT extraction trench groundwater line was added to the project scope. This line, which conveys contaminated groundwater from the CAT extraction trench to the Basin A Neck System for treatment, was installed on existing grade (biota risk soil) prior to the Section 36 BOA project and covered with clean soil for freeze protection. The line crosses a portion of CSA-4 and also CSA-1d, which was remediated under the Existing Sanitary Landfills project. The Section 36 BOA design acknowledged the presence of this line and the underlying biota risk soil; however, soil removal was not included because the line is required to remain operational until groundwater is drawn down below the bottom of the disposal trenches in the CAT. During implementation of the project, DCN-BOA-022 was approved, adding this work to the Section 36 BOA scope (TtFW 2004c). This activity added 1,124 bcy of biota risk soil to the project.

Following completion of Part 1, Phase 2, additional soil sampling was conducted throughout the proposed cover deletion area as required by the design ESD. The cover deletion area was divided into 58 approximate 3 acre parcels and 5-point composite samples were collected from the excavation surface within each parcel in accordance with the Biota SAP (FWENC 2003h). Sample locations are shown on Figure 3.2.2-2. The results from this sampling showed that biota risk soils remained in 13 of the parcels (TtEC 2008c). In addition, two of the parcels exceeded human health SEC as discussed in Section 3.1.2. Based on this new information, DCN-BOA-032 was completed to document the results of the sampling and the resulting identified biota risk soils (TtFW 2004b). Excavation of the additional contaminated soil was performed under Part 1, Phase 3 of the project. One parcel, B-56, was not excavated. Instead, this area was incorporated into the South Plants CPA project leaving 4,771 bcy in place beneath the South Plants CPA RCRA-Equivalent cover.

Upon meeting the required excavation depths, areas were sampled again in accordance with the CSV SAP to confirm no contamination remained in place. The results of this sampling identified one small area of biota risk soil. The excavation limits of contaminated soil associated with this sample are defined in DCN-BOA-043 (TtFW 2005b). The additional soil was excavated and post-excavation sampling of these areas showed no detections of contamination. The

remediation efforts completed in Part 1, Phase 3, resulted in an additional 57,159 bcy biota risk soil.

During project implementation, actual excavation depths completed exceeded the minimum required remediation depth. This overexcavation ensured that the required depth was achieved and minimized the possibility of having to return to the area for additional excavation; however, the resulting actual volume increased compared to the ROD or design estimates. Overexcavation accounted for approximately 26,571 bcy of additional volume.

Additional sampling was conducted following completion of subgrade construction in Part 2 of the project. Discrete samples were collected from the final subgrade surface within the Army-maintained area in accordance with the CSV SAP. Part 2 sample locations are shown on Figure 3.2.3-1. One sample adjacent to the 2-foot cover boundary exceeded the biota risk criteria and approximately 160 bcy of soil were removed. Another 102 bcy were removed from around the lift station near Building 312. Composite samples were collected from the final subgrade surface outside the Army-maintained area in accordance with the Biota SAP. All composite samples were below the biota risk criteria (TtEC 2008a).

Overall, the project biota risk soil remediation volume increased from 166,857 bcy to 264,047 bcy, an approximate 58 percent increase.

3.2.4 RER Soil Remediation

The ROD included a requirement for continued biomonitoring and risk assessment in order to refine design boundaries for surface soil areas. In accordance with the ROD requirements, the Biological Advisory Subcommittee (BAS) was tasked with completing the assessment to determine acceptable levels of risk to biota and recommend refinements to remediation boundaries. The initial assessment, completed in 1997, resulted in identification of RER soil areas exhibiting unacceptable risk to biota. The areas identified in the initial assessment were classified as P1 and P2 soil areas. Based on their evaluation, the BAS made recommendations for additional surface soil remediation including most P1 soil areas (BAS 1997). For the Section 36 BOA project, three P1 soil areas were identified for remediation during design and were added to the project scope. These were designated P1 East, P1 West and P1 North. One P2 soil area was also incorporated into the project due to its location adjacent to project surface soil remediation areas. A fourth P1 area along the northwest boundary of the CAT was added to the P1 North area during project implementation (FWENC 2003c).

Following initial identification of P1 and P2 soil areas, the BAS continued to evaluate potential residual risk to biota in order to complete the ROD requirements for residual risk evaluation. The continued evaluation included P2 soil areas and some P1 soil areas not included in the initial remedy refinement. Based on these evaluations, the BAS identified additional soil areas with potential risk and labeled them TRER areas. The terrestrial portion of the risk assessment was issued by the BAS in April 2002 (BAS 2002) and an addendum was issued in April 2003 (BAS 2003). The assessment included recommendations for remediating the TRER areas, which were approved by the RMA Committee in 2003. Two TRER areas (36NW-4-B and 36NW-5-A) were identified for the Section 36 BOA project (TtEC 2005). The P2 soil area, designated by the BAS

as 36SW-6, was identified as an area with acceptable risk; however, the area was ripped and revegetated as part of the Section 36 BOA Project. Collectively, the P1, P2 and TRER soils are referred to as RER soil. For the Section 36 BOA Project, 72,496 bcy of RER soil were remediated. These areas are shown on Figure 1.0-2. Additional detail related to remediation of RER soil areas is presented in the RER CCRs (TtEC 2006b, 2009).

3.3 Increase in Project Cost

Changes to the project scope resulted in a significant increase in project cost. Estimated costs for the Section 36 BOA project decreased during design due to elimination of the soil cover and reduction of chemical sewer volume. These changes, documented in the design ESD, resulted in a revised ROD estimate of approximately $7.0 million. However, changes in project scope as documented in this ESD resulted in a significant cost increase compared to the estimate provided in the design ESD. The main factors include increased excavation costs, primarily due to increases in remediation volumes, expanded geophysical survey and MEC clearance area, structure demolition, subgrade construction, and project oversight. There were minor cost reductions for backfill and revegetation efforts.

3.3.1 Excavation Costs

Increases in excavation costs accounted for nearly half of the overall project cost increase. The increased excavation costs were driven primarily by increases in remediation volumes for chemical sewers, HHE soil, biota risk soil and the addition of RER soil. As discussed in Section 3.2, actual conditions based on field observations and post-excavation sampling resulted in increases for these remediation volumes. For chemical sewers, the increased remediation volume resulted in a final excavation cost of $1.26 million, an approximate $859,000 increase.

For soil excavation, the final excavation costs total $8.29 million, a $5.54 million increase compared to the ROD estimate. These costs reflect the significant increases in HHE and biota risk soil volumes and the addition of RER soil remediation. Also, extensive soil sampling throughout the project was completed as part of the excavation effort. Although these sampling costs were not reported separately from the excavation costs, the sampling effort contributed to the overall excavation cost increase.

3.3.2 Geophysical Survey and MEC Clearance

The ROD included a requirement for a geophysical survey in potential UXO areas prior to excavation to locate and remove any UXO. The ROD used the term UXO as a generic term for all military munitions that are potentially active. In the Section 36 BOA design, the term ordnance and explosives was used to refer to hazardous military munitions. Based on Department of Defense direction, the new term MEC has replaced the previously mentioned terms when describing hazardous military munitions (DA 2005). Therefore, discussion of MEC clearance here meets the ROD requirements for UXO removal.

The ROD requirement included MEC clearance over approximately 49.5 acres within the Section 36 BOA project area, including portions of CSA-1b, CSA-4 and all of CSA-2a. In May 2001, in support of remedial design, a surface sweep using all-metals detectors was conducted over most of the ROD-identified area to clear the area of metallic debris. However, the design

evaluation of potential MEC hazards identified a larger area of concern than was identified in the ROD (FWENC 2003d). Therefore, the area was expanded to include the cover deletion area as described in the design ESD. The ESD also required a new geophysical survey following excavation in the cover deletion areas where potential MEC hazards exist (FWENC 2003e). The ROD cost estimate including the changes discussed in the design ESD was approximately $1.25 million.

In July 2003, in support of project implementation, a magnetometer-assisted surface sweep was conducted over a portion of CSA-4. The surface sweep resulted in the recovery of five M15 white phosphorous grenades, one of which was characterized as UXO. The surface sweep also identified a probable demolition pit and delineated a seven-acre area which was believed to have the greatest potential for MEC. As a result, an Explosives Safety Submission (ESS) was prepared to obtain Department of Defense Explosives Safety Board (DDESB) approval for remediation of this area. Soil excavation in this area was not allowed until target characterization efforts were completed in accordance with the DDESB-approved ESS.

Remediation within the ESS area, shown on Figure 1.0-2, consisted of a sweep using both an electromagnetic detector (all metals) and a magnetometer (ferrous metal). This clearance method is commonly referred to as "mag and dig." All surface and subsurface anomalies identified during the sweep were recovered and characterized (FWENC 2003a). After the mag and dig clearance the ESS area was released for soil excavation along with the rest of the Section 36 BOA project area.

Following excavation, an electromagnetic geophysical survey was conducted over the ROD-identified potential UXO area and cover deletion area as required by the design ESD, approximately 135 acres. A Geophysical Survey Plan (TtFW 2004a) and Work Plan for Target Characterization (TtFW 2005c) were developed to meet the requirements of the design ESD and revised as necessary based on field conditions. The survey data were evaluated and targets were selected with the objective of recovering all anomalies which had the potential to be a metallic item. After characterization was completed, a Quality Assurance (QA) geophysical survey was conducted over 63 acres. The extent of the QA geophysical survey included areas that were outside the Integrated Cover System perimeter road and potential MEC areas that would not be covered by a RCRA-Equivalent cover or 2-foot soil cover. Data evaluation and target clearance were performed in the same manner as the initial survey and clearance.

During the ESS Area clearance, the initial geophysical survey and the QA geophysical survey, demolition pits were identified. Additional clearance activities were required for the demolition pits since the data could not be effectively evaluated to identify single targets for clearance. Clearance of these demolition pits was primarily facilitated by bounding each pit area, either in the field using hand-held detectors or by selecting targets (identified during the geophysical survey) around the perimeter of the pit, and using the mag and dig technique to clear all identified anomalies within the bounded area.

In addition, some data gaps from the initial geophysical survey were identified in areas where the collection of geophysical data was not feasible due to physical obstructions or difficult terrain.

The mag and dig clearance method was used to address these areas and minimize the potential for future discovery of MEC. The results of all MEC clearance efforts are documented in the Section 36 BOA Munitions Response Report (TtEC 2008f).

The resulting geophysical survey and MEC clearance effort was considerably more extensive than anticipated and involved multiple steps to ensure that the ROD requirements were met. The expanded MEC clearance area and additional clearance efforts resulted in a project cost of approximately $1.81 million, an increase of $558,000 compared to the ROD estimate.

3.3.3 Structures Demolition

The ROD requires demolition of all structures not designated for future use. However, demolition of structures located in the Section 36 BOA project area was included in the Miscellaneous Structures Demolition Project in the ROD estimate. During design, two structures identified in the ROD (Buildings 725 and NN3605) and one additional structure (Building 730) were identified for demolition under the Section 36 BOA Project, Part 1 due to their location within the project area. In addition, utility poles, substation SS WR, fencing, railroad ballast, pipe runs and miscellaneous debris were removed as part of the Section 36 BOA Project.

During Part 2, three additional structures were identified for demolition, Buildings 312, 307 and 889. Building 312, Fire Station, was identified as a Future Use structure in the ROD but was reclassified as No Future Use and added to the project scope. Building 307, Potable Water Valve and Meter Pit, was also added. Building 889, Basin A Operations Facility, was constructed to support remediation activities and was therefore not identified in the ROD (DCN48).

Since demolition was not included in the ROD estimate for the Section 36 BOA Project, demolition costs are a direct addition to the ROD estimate. Demolition costs contributed approximately $500,000 to the overall project cost.

3.3.4 Subgrade Construction and Surface Grading

Another significant cost growth area is the addition of surface grading over much of the Section 36 BOA area. The remedy requirements included excavation and backfill but did not involve any additional grading work. However, soil covers for adjacent projects (Basin A, Lime Basins, CAT, South Plants and SDT) require drainage away from the covers. To accommodate these drainage requirements, the Section 36 BOA design included subgrade construction and surface grading following completion of remedy requirements to facilitate cover construction and provide drainage for stormwater. These activities were completed in Part 2 of the project and included the following:

- Removal of soil from the region south and east of the ROD-prescribed 2-foot cover area and RCRA-Equivalent cover limits to ensure appropriate drainage of surface water runoff from the covers and non-cover areas in the region. Soil excavated from the ROD-prescribed 2-foot cover area was placed in the footprints of future RCRA-Equivalent Covers (i.e. SDT, CAT, or Basin A). Soil removed from outside of the ROD-prescribed 2-foot cover area was used as gradefill in the 2-foot soil cover area, the SDT, CAT, and the Basin A.

- Excavation of the Section 36 north drainage swale.
- Excavation of soil from Borrow Area 3 to fill the depressed area in Section 36 BOA west of Basin A and grade to drain to prevent collection of stormwater.
- Excavation of soil from Borrow Area 3 and placement in South Plants 3-Foot Cover Area and Lime Basins area for use as frost protection berms over the Groundwater Mass Removal piping.
- Excavation and stockpiling of P1 soil, from Borrow Area 9C, for use as RCRA-Equivalent cover soil.
- Construction of interim subgrade contours via field fit in Contractor-approved locations to allow surface area drainage, from Basin A, Section 36 BOA, and SDT, to the main east west drainage feature during the interim period between subgrade construction and cover construction.

Because this additional grading work was not included in the ROD estimate, the subgrade preparation and surface grading costs are a direct addition to the ROD estimate. These costs accounted for an additional $1.76 million for the project. In addition, completion of the grading work as Part 2 of the project required a separate mobilization and demobilization, resulting in an added $158,000 to the project cost.

3.3.5 Project Oversight

Another area exhibiting cost increase is project oversight. Although the ROD estimate did include project support and oversight costs, the level of oversight required for Section 36 BOA remediation exceeded that anticipated in the ROD. Extensive odor monitoring and quality control requirements could not be provided at the level of support included in the ROD cost estimate. Also, the scope additions discussed in the previous sections are accompanied by corresponding additional project support costs. For the Section 36 BOA remediation, project support costs account for approximately $3.8 million compared to the ROD estimate of $1.1 million. Support costs were not revised during the design ESD, therefore the actual project support cost represents a $2.7 million increase compared to the original ROD estimate.

4.0 DESCRIPTION OF SIGNIFICANT DIFFERENCES

4.1 Changes to Project Boundaries

There were two significant changes to the Section 36 BOA Project boundaries made during project implementation. Remediation of all identified HHE and biota risk soil was completed in accordance with the ROD and design. However, extensive soil staining was observed at or below the design excavation surface in the area surrounding the SDT, particularly in the former drum storage area south of the SDT. Strong odors were also observed in the chemical sewer excavation area south of the Lime Basins. Soil samples collected in these areas following excavation showed that significant areas of HHE and biota risk soils remained. Although the identified contaminated soil was excavated, the presence of stains and additional identified exceedance volumes indicates that there was contamination existing beyond the ROD-identified HHE volume, and suggests that all contaminated soil cannot be reliably located and removed as required by the Section 36 BOA design ESD.

As a result, the SDT RCRA-Equivalent cover was extended over the former drum storage area, approximately 5 acres. In addition, approximately 31 acres of the Section 36 BOA project area surrounding the SDT and former drum storage area was identified for construction of a 2-foot-thick soil cover to provide additional protection and minimize potential migration of contaminants to groundwater. These areas were transferred to the SDT project to complete the soil cover remedy requirements. Also, the chemical sewer area south of the Lime Basins, approximately six acres, was transferred to the South Plants project and the South Plants CPA RCRA-Equivalent cover was expanded to incorporate this area.

4.2 Changes to Remediation Volumes

Remediation volumes increased significantly compared to the ROD estimates. Soil samples collected following design excavation showed HHE soil remaining in Section 36 BOA Project excavation areas and along the removed chemical sewer lines. In addition, stained and odorous soils were observed at or below the design excavation surface, indicating that all HHE soil had not been identified in the ROD. All additional HHE soil identified was removed and disposed in the HWL resulting in an increase in remediation volume. Overall, the project HHE soil remediation volume, including chemical sewers, increased from 52,828 bcy to 131,229 bcy, an approximate 148 percent increase.

Biota risk soil volume also increased compared to the ROD estimate. Soil samples collected following design excavation showed biota risk soil remaining throughout the project area. Most of the additional biota risk soil was removed resulting in an increase in remediation volume. Approximately six acres of biota risk soil was left in place under the expanded South Plants CPA RCRA-Equivalent cover. Overall, the project biota risk soil remediation volume increased from 166,857 bcy to 265,785 bcy, an approximate 59 percent increase. Table 4.2-1 provides a summary of the remediation volume increases for the Section 36 BOA Project HHE and biota risk soil sites.

In addition, 72,496 bcy of RER soil were identified for remediation under the Section 36 BOA Project. Although RER soil was identified in accordance with the process described in the ROD, there was no volume estimated in the ROD, therefore the entire RER soil volume is a direct increase in remediation volume.

4.3 Summary of Cost Change

The estimated cost for implementation of the Section 36 BOA Project was $7.0 million based on cost estimates presented in the ROD and modified by the design ESD. However, changes in project scope resulted in a significant increase in project cost. The final cost for implementation of the Section 36 BOA Project is estimated at $18.7 million.

The primary contributor to the project cost increase is the increased remediation volumes. Significant volume increases for HHE soil and biota risk soil, along with the addition of RER soil remediation, resulted in approximately $5.5 million in cost increases. The increased chemical sewer remediation volume contributed another $859,000. Project requirements for MEC clearance, including geophysical surveys and target characterization/removal efforts, were

also more extensive than anticipated and resulted in a project cost increase of $558,000 compared to the ROD estimate.

Another major scope change is the addition of subgrade construction and surface grading to facilitate cover construction for adjacent projects and provide drainage for stormwater away from the soil covers. These activities added nearly $1.76 million to the project cost. Also, demolition of several structures was added to the project scope resulting in $500,000 in additional costs. Finally, increased project oversight contributed another $2.7 million. Minor cost savings were realized for backfill and revegetation activities. A decrease in the volume of backfill required resulted in approximately $275,000 savings. For revegetation, project areas transferred to other projects for cover construction (approximately 40 acres) are being restored as part of the other Section 36 cover projects, reducing the Section 36 BOA revegetation cost. For other non-cover areas within the Army-maintained area (approximately 78 acres), revegetation requirements were modified to be consistent with the ICS project. Total revegetation costs were reduced by approximately $140,000 compared to the ROD estimate. Overall, these factors result in a cost increase of approximately $11.7 million above the ROD-estimated cost, as modified by the design ESD, or an approximate 167 percent increase. Table 4.3-1 provides a summary of the cost changes for the major project elements.

A review of the range of alternatives evaluated in the ROD for the Section 36 BOA Project indicates that three of the other four site-wide alternatives (not selected) would likely have experienced similar cost change. Alternatives 2, 3 and 5 included the same remedy selection for the Section 36 BOA Project, consisting of excavation of HHE soil with disposal in the HWL and excavation of biota risk soil with consolidation in Basin A. Scope changes and associated cost growth discussed in this ESD would have been encountered under each scenario; therefore, these alternatives would have likely experienced the same cost growth.

The exception is site-wide alternative 1, which included capping all HHE and biota risk soil areas. With no intrusive work, the increases in excavation volumes and associated cost increases would not have been realized. Coordination with the adjacent Section 36 cover projects would still have been required and it is likely that some cost growth would have occurred to provide surface grading to accommodate drainage away from the central areas; however; without a completed design for this site-wide alternative, the exact cost growth for this alternative cannot be estimated.

5.0 SUPPORT AGENCY COMMENTS

The EPA, CDPHE, and TCHD have reviewed this ESD. Comments from these Agencies have been incorporated into the document.

Table 4.2-1: Changes to Remediation Volumes for the Section 36 BOA Project

ROD-Prescribed Remedy	Modification	ROD-Prescribed Remediation Volume (bcy)[1]	Actual Remediation Volume (bcy)	Percent Change
Excavate chemical sewers and HHE soil and dispose in on-post HWL.	**Chemical Sewers Volume increase.** Four additional chemical sewer lines were identified during design. Excavation along lines 6 and 7 added based on field observation of remaining pipe bedding. Expanded excavation widths for lines 1 and 2. Over-excavation of minimum depths.	**HHE Soil** **Area** **Volume** CSA-3 2,035 NCSA-6a 1,100 NCSA-6b 805	**HHE Soil** **Area** **Volume** CSA-3 5,062 NCSA-6a 24,447 NCSA-6b 1,024	
	HHE Soil Volume increase. Soil sampling following design excavation showed extensive HHE soil remaining. Additional excavation of stained and odorous soil. Over-excavation of minimum depths.	**HHE Soil** **Area** **Volume** CSA-1b 29,102 CSA-4 17,404 NCSA-1b NA NCSA-1g 1,885 Surface Areas 497	**HHE Soil** **Area** **Volume** CSA-1b 69,400 CSA-4 27,851 NCSA-1b 135 NCSA-1g 2,670 Surface Areas 640	
Total Project HHE Soil Volume Change		**52,828**	**131,229**	**+ 148 %**
Excavate biota risk soil and dispose in Basin A.	**Biota Risk Soil Volume Increase.** Soil sampling following design excavation showed extensive biota risk soil remaining. Over-excavation of minimum depth.	**Biota Soil** **Area** **Volume** CSA-1b 28,602 CSA-1d NA CSA-2b 8,668 CSA-4 82,727 NCSA-1c 282 NCSA-1d 3,169 NCSA-1f 1,137 NCSA-1g 30,775 Surface 11,497 Debris Piles NA	**Biota Soil** **Area** **Volume** CSA-1b 81,705 CSA-1d 641 CSA-2b 11,590 CSA-4 113,066 NCSA-1c 0 NCSA-1d 4,278 NCSA-1f 4,053 NCSA-1g 35,169 Surface 7,889 Debris Piles 5,656	
Total Project Biota Risk Soil Volume Change		**166,857**	**264,047**	**+ 58 %**
Refinement of surface soil areas for remediation.	RER soil areas identified in accordance with the ROD. Excavate RER soil and dispose in Basin A.	NA	**RER Soil** **Area** **Volume** P1 East 10,400 P1 North 11,813 P1 West 35,523 CSA-1b 185 36NW-4-B 10,102 36NW-5-A 4,473	
Total Project RER Soil Volume Change			**72,496**	**NA**

[1]ROD volumes were modified by ESD in 2003 to account for remediation area boundary changes (FWENC 2003e). Original ROD volumes are calculated in the Soil Quantity Calculation Summary Report (FWENC 1996a).

Table 4.3-1: Summary of Costs for Section 36 BOA Remediation

Cost Element	ROD Cost[1]	Actual Cost[2]	Reason for Change
Mobilization/Demobilization	$ 464,000	$ 622,000	Additional mob/demob for Part 2 subgrade construction
Chemical Sewer Excavation	$ 405,000	$ 1,264,000	Increase in sewer remediation volume
Excavation	$ 2,750,000	$ 8,292,000	Increase in HHE and biota risk soil volumes, addition of RER soils
Geophysical Survey and MEC Clearance	$ 1,249,000	$ 1,807,000	Expanded MEC clearance area
Backfill	$ 532,000	$ 257,000	Reduced backfill requirements
Demolition	NA[3]	$ 497,000	Added scope
Subgrade	NA[3]	$ 1,758,000	Added scope
Revegetation	$ 475,000	$ 335,000	Reduced revegetation area
Other Project Costs (includes procurement, subcontractor incentives, engineering oversight, and reporting)	$ 1,126,000	$ 3,848,000	Odor monitoring, QC oversight, expanded scope
Total Estimated Project Costs	**$ 7,001,000**	**$ 18,680,000**	**Total % change = + 167 %**

[1]ROD estimates as modified by the design ESD.

[2]Costs presented are estimates at completion as of July 3, 2009.

[3]Activity added during design or implementation. No cost provided in the ROD.

6.0 PUBLIC PARTICIPATION COMPLIANCE

The Army published a public notice in the Denver Post on July 20, 2009, making the Draft Section 36 BOA Project ESD available for public review and comment. Notices were also published in the Brighton Blade and Gateway News. A presentation explaining the proposed changes contained in the ESD was provided to the RMA Restoration Advisory Board (RAB) on July 16, 2009. The RAB is a community group that meets periodically to receive information and provide input on the cleanup being conducted at the RMA. The public comment period will close on August 19, 2009. The requirements set out in the National Contingency Plan, Section 300.435(c)(2)(ii), have been met.

This ESD and all documents that support the changes and clarifications are part of the Administrative Record and are available at the JARDF and the EPA Region 8 Superfund Record Center. The JARDF is open Monday through Friday between Noon and 4 pm or by appointment. The telephone number for the JARDF is 303-289-0983. The EPA Superfund Record Center can be reached at 303-312-7287. Hours of operation are Monday through Friday from 8:00 am to 4:00 pm.

7.0 STATUTORY DETERMINATIONS

Considering the new information presented in this ESD, the Army, in consultation with EPA and CDPHE, believes that the Section 36 BOA Project remedy, with the modifications described, satisfies the requirements of CERCLA Section 121 and is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, uses a permanent solution through proper disposal and containment of the wastes in the on-post HWL or Basin A, and is cost effective.

Signatures

For U.S. Environmental Protection Agency

_____ Date _____

Carol L. Campbell
Assistant Regional Administrator
Office of Ecosystems Protection and Remediation

For U.S. Army

_____ Date _____

Charles T. Scharmann
Program Manager for Rocky Mountain Arsenal

For State of Colorado

_____ Date _____

Gary W. Baughman
Director, Hazardous Materials and Waste Management Division
Colorado Department of Public Health and Environment

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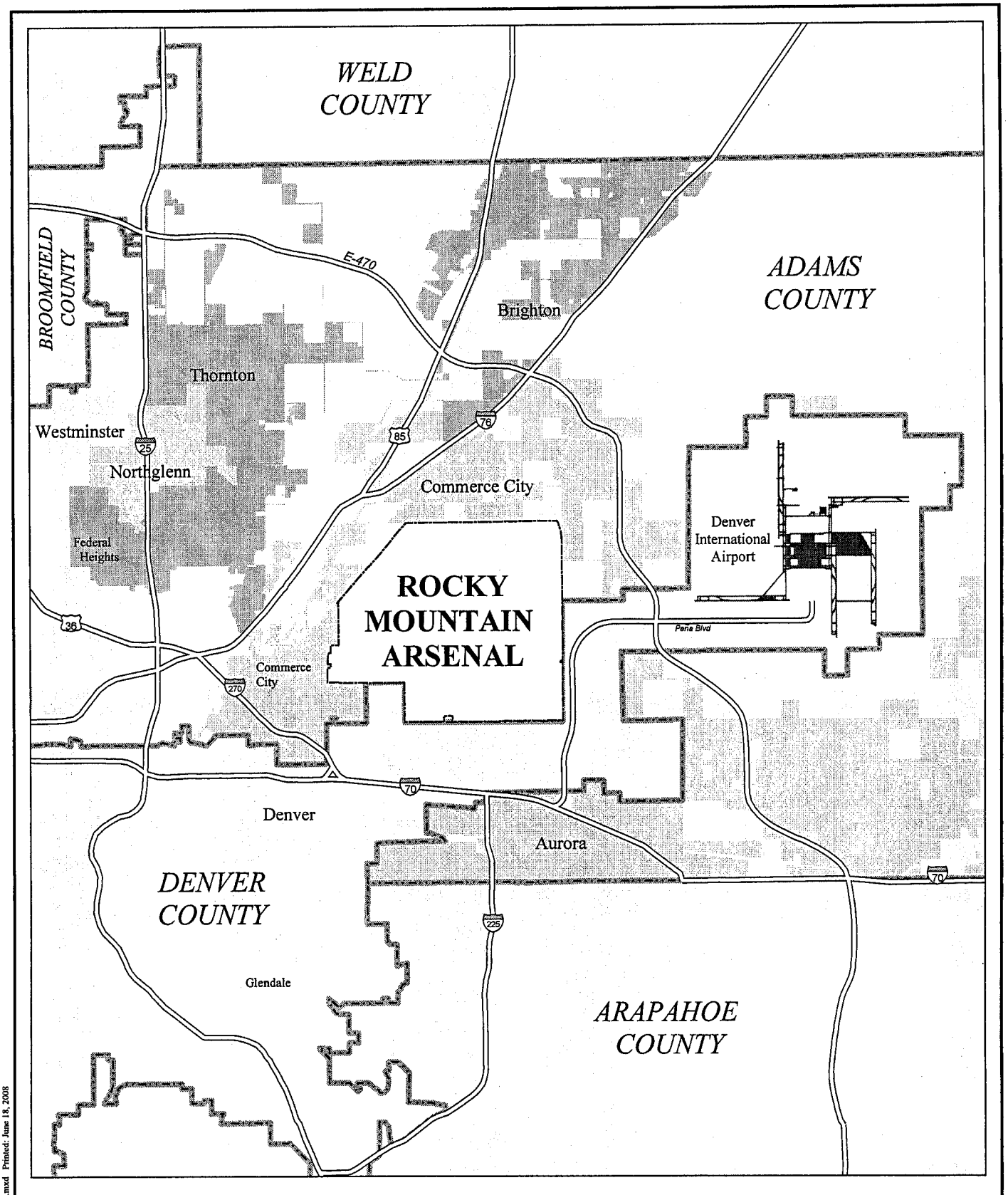
TVA (Tennessee Valley Authority)

1996 (Nov. 25) *Letter from Wendell Plain (TVA) to Bernard Stockman (TVA) regarding disposition of buildings removed from Section 36.*

USACE (U.S. Army Corps of Engineers)

1983 (Mar. 2) *Liquid Waste Disposal Facility, Basin "F" Area Plan (Drawing No. 71-07-15), Record Drawing. Basin, Final Grading Plan.*



ROCKY MOUNTAIN ARSENAL
Regional Reference

Figure 1.0-1

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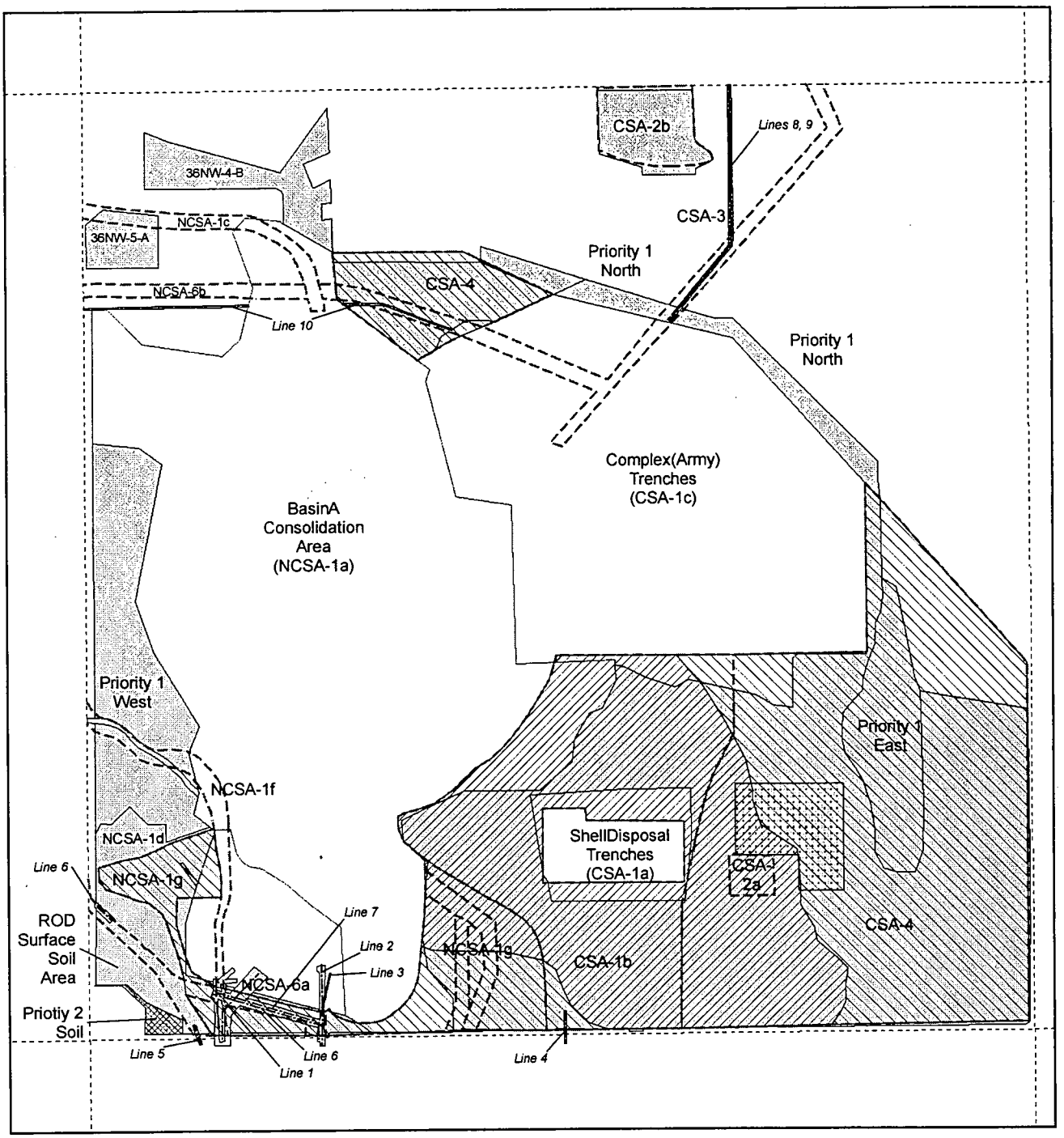
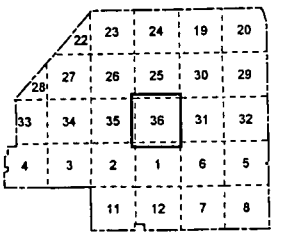


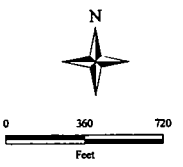
ROCKY MOUNTAIN ARSENAL

Section 36 Balance of Areas Project Areas

- Chemical Sewer
- Section 36 Balance of Areas Project Boundary*
- Original ROD Boundary
- ROD-Identified 2-Foot Soil Cover
- ROD-Identified 1-Foot Soil Cover
- Explosives Safety Submission Area

*Boundaries shown are a result of changes made as reflected in the design ESD and as modified by DCN during implementation.





Lambert Conic Conformal Projection
State Plane Coordinate System
Colorado North Zone - NAD 1927

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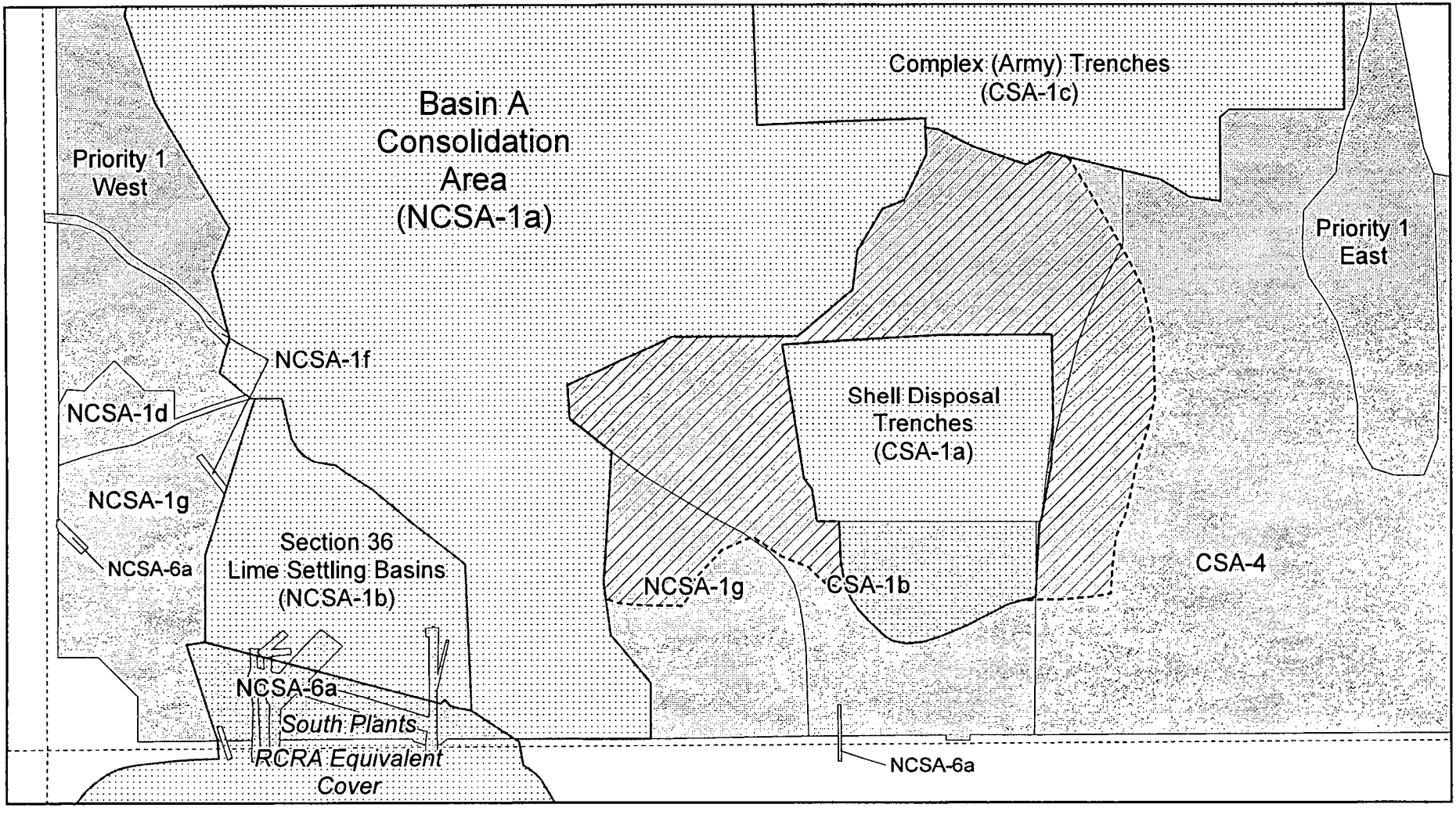
Figure 1.0-2

Map Document: D:/Map Documents/ESD_Section36BOA_Figure1.0-2_DRAFT.mxd Date Printed: May 21, 2009



ROCKY MOUNTAIN ARSENAL

Section 36 Balance of Areas Project Boundary Changes

Section 36 Balance of Areas Design Boundary

RCRA Equivalent Cover

2-Foot Soil Cover

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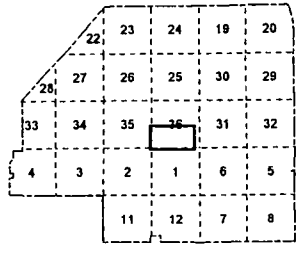
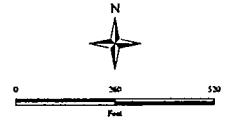
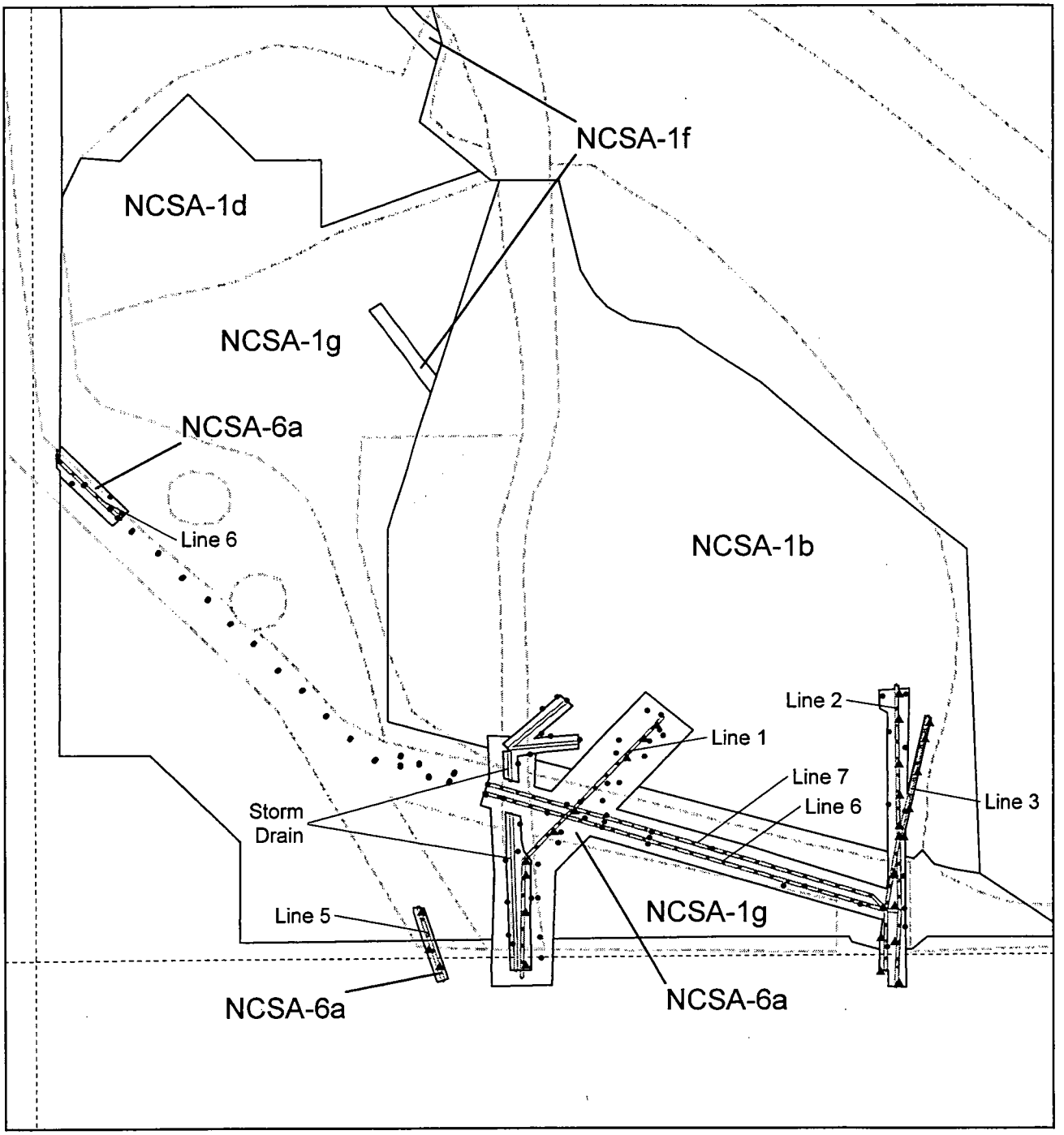




Lambert Conic Conformal Projection
State Plane Coordinate System
Colorado North Zone - NAD 1927

Figure 3.1.1-1

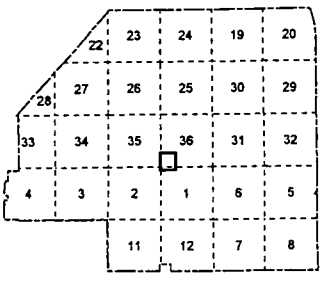
Map Document: D:\Map Documents\ESD_Section36BOA_Figure1.0-2_DRAFT.mxd Date Printed: May 26, 2009

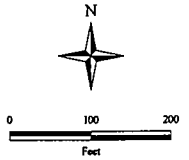


ROCKY MOUNTAIN ARSENAL

Section 36 Balance of Areas
South Plants Chemical Sewer Area

- ▲ Chemical Sewer FCS Sample Locations
- • Chemical Sewer CSV Sample Locations
- Chemical Sewer
- Storm Drain
- Section 36 Balance of Areas Excavation Boundary
- Original ROD Boundary





Lambert Conic Conformal Projection
State Plane Coordinate System
Colorado North Zone - NAD 1927

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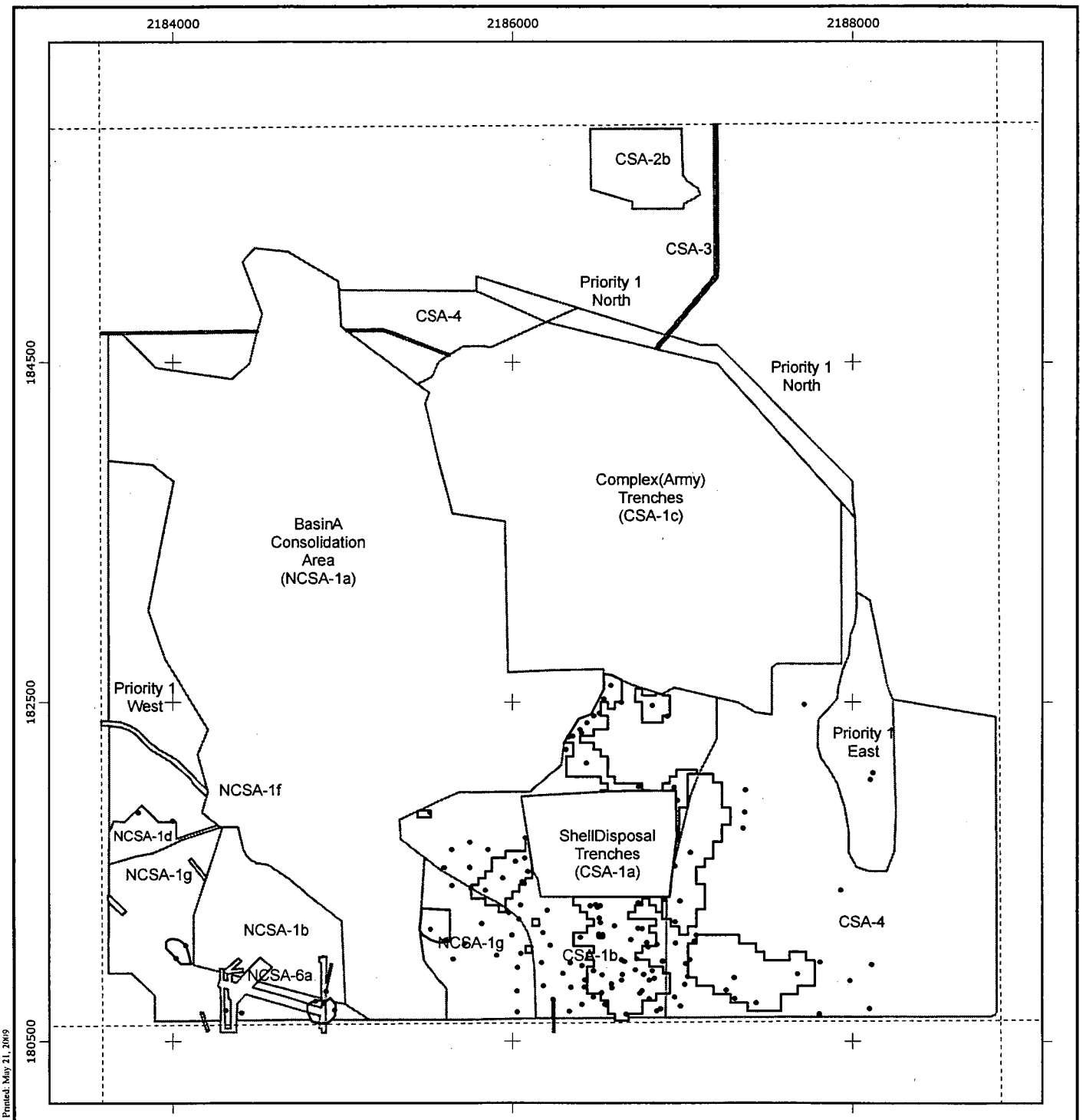
Figure 3.2.1-1

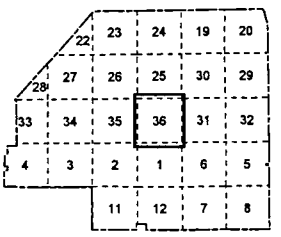
Map Document: D:/Map Documents/ESD_Section36BOA_Figure3221_DRAFT.mxd Date Printed: May 21, 2009

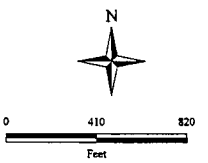


ROCKY MOUNTAIN ARSENAL

Section 36 Balance of Areas
Part 1 Confirmatory Soil Sample Locations

- Part 1 Confirmatory Soil Saple Location
- Human Health Exceedance Areas
- Section 36 Balance of Areas Project Boundary





Lambert Conic Conformal Projection
State Plane Coordinate System
Colorado North Zone - NAD 1927

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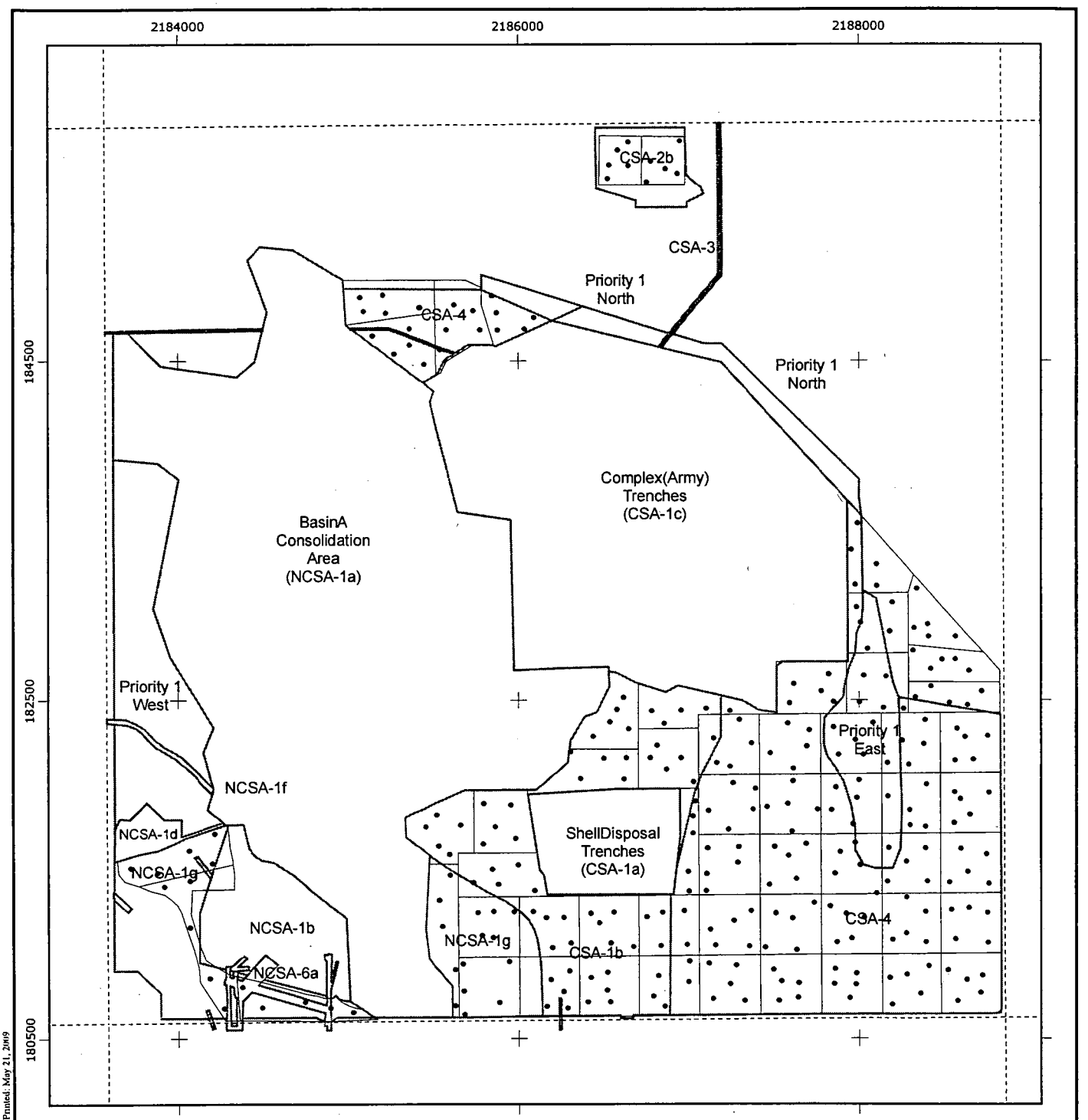
Figure 3.2.2-1

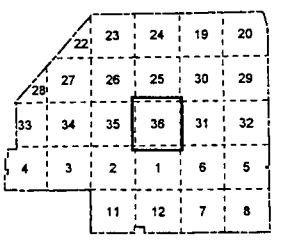
Map Document: D:/Map Documents/ESD_Section36BOA_Figure3221_DRAFT.mxd Date Printed: May 21, 2009

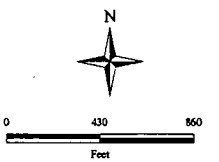


ROCKY MOUNTAIN ARSENAL

Section 36 Balance of Areas
Part 1 Composite Soil Sample Locations

- Composite Soil Sample Location
- Composite Soil Sample Parcel
- Section 36 Balance of Areas Project Boundary





Lambert Conic Conformal Projection
State Plane Coordinate System
Colorado North Zone - NAD 1927

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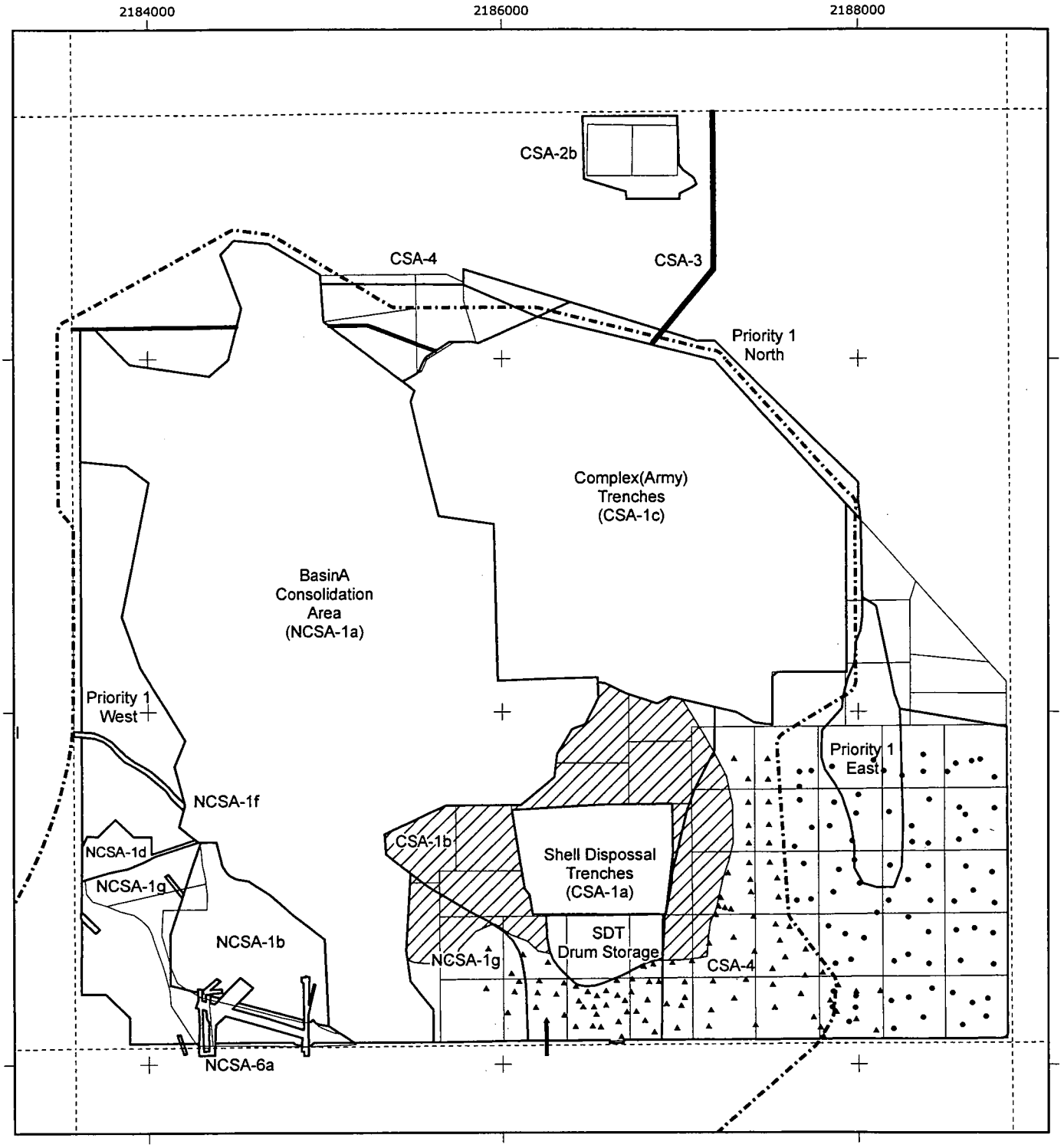
Figure 3.2.2-2

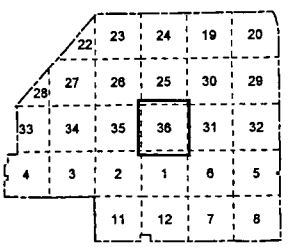
Map Document: D:/Map Documents/ESD_Section36BOA_Figure1 2.2.2_DRAFT.mxd Date Printed: May 21, 2009

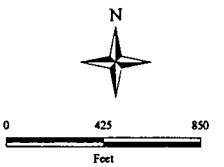


ROCKY MOUNTAIN ARSENAL

Section 36 Balance of Areas
Part 2 Confirmatory and Composite Soil Sample Locations

- ▲ Part2 Confirmatory Soil Sample Location
- • Part 2 Composite Soil Sample Location
- Composite Soil Sample Area
- Section 36 Balance of Areas Project Boundary
- 2-Foot Soil Cover
- Army Maintained Area





Lambert Conic Conformal Projection
State Plane Coordinate System
Colorado North Zone - NAD 1927

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Figure 3.2.3-1

Map Document: D:/Map Documents/ESD_Section36BOA_Figure3231_DRAFT.mxd Date Printed: May 21, 2009