

**ASARCO EL PASO COPPER SMELTER
PHASE II REMEDIAL INVESTIGATION REPORT
EL PASO, TEXAS**

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JUL 10 2000

REMEDIAL DIVISION
Corrective Action Section

Prepared For:

ASARCO

2301 West Paisano Drive
El Paso, Texas 79922

Prepared By:



Hydrometrics, Inc.®

consulting scientists, engineers and contractors



**VOLUME
I of IV**

July 2000

ASARCO

SWR # 31235
CAS # 9629 *BW*
PROJ. MGR. _____

El Paso Plant
L. W. Castor, Unit Manager

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Enforcement Division
Corrective Action Section

Executive Director
C/O Brad Wilkinson
Enforcement Division
Texas Natural Resource Conservation Commission
Austin, TX 78753

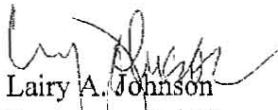
**RE: Phase II Remedial Investigation Report Submittal
ASARCO Incorporated
El Paso Facility
Docket No. 96-0212-MLM-E; SWR No. 31235; Permit No. WQ 02321
Agreed Order**

Dear Mr. Wilkinson:

As required by Ordering Provision No. 6 of the above referenced Agreed Order, enclosed are two copies of the Remedial Investigation Phase II Report for the El Paso Facility of ASARCO Incorporated. This report was prepared by Hydrometrics, Incorporated, Asarco's contractor on this project.

Do not hesitate to contact me at (915) 541-1819, if you have any questions regarding this report.

Sincerely,


Lairy A. Johnson
Environmental Manager

c: Archie Clouse - TNRCC, El Paso (1)
Don Robbins - ASARCO, Inc. (1)
R. Keith Hopson - Brown McCarroll & Oaks Hartline, L.L.P. (1)
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Tom Klempel - Hydrometrics, Tucson (1)
Kent Lang - Arcadis Geraghty & Miller (1)

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Corrective Action Section

Prepared for:

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El Paso, Texas 79922

Prepared by:

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July 10, 2000

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SECTION 1.0

INTRODUCTION

**ASARCO EL PASO COPPER SMELTER
REMEDIAL INVESTIGATION REPORT
PHASE II
EL PASO, TEXAS**

1.0 INTRODUCTION

This report summarizes information collected and evaluated as part of a remedial investigation and general plan for corrective action for the ASARCO Incorporated (Asarco) El Paso Copper Smelter (Facility) in El Paso, Texas pursuant to, and in accordance with, an Agreed Order (Docket No. 96-0212-MLM-E; TNRCC, 1996). An initial remedial investigation (Phase I RI) was conducted to characterize soil, surface water and groundwater at the Facility (Hydrometrics, 1998).

This Phase II RI Report provides additional site characterization data and a logical interpretation of the occurrence and distribution of chemical constituents in soil, surface water and groundwater. Corrective actions presented in the Phase I RI are reconsidered in this Phase II Report using additional site characterization and Facility operations data. Corrective action alternatives and measures presented in this report meet corrective action goals and objectives established for the project (Hydrometrics, 1998) to achieve appropriate risk reduction standards.

All work for the Phase II RI was performed in accordance with the Texas Natural Resource Conservation Commission (TNRCC) approved RI Work Plan (Hydrometrics, 1996). Quarterly monitoring was performed at the Facility from August 1997 to February 2000. Phase II RI activities were initiated upon receipt/approval of the Phase I RI Report (Hydrometrics, 1998) in June 1999. This report includes sampling results from May 1998 to February 2000. Modifications were incorporated in this document in accordance with

TNRCC comments on the Phase I RI and the TNRCC Consistency Document (TNRCC, 1998).

1.1 PROJECT OBJECTIVES

Project objectives are based on requirements in the Agreed Order (TNRCC, 1996), and from the baseline risk assessment included with the Phase I RI Report (Hydrometrics, 1998), and information provided in this Phase II Report.

The specific objectives of the Phase II RI are summarized as follows:

- Identification and further delineation of source areas and materials with actual or potential impacts to soil, surface water and groundwater. Constituents of Concern (COCs) are arsenic, cadmium and lead, as identified in the Phase I RI.
- Develop data to support the design and implementation of corrective action alternatives and measures to achieve appropriate risk reduction standards.

Primary corrective action objectives for the project are:

- Reduce the potential for exposure to metals by Facility workers and the public.
- Minimize the potential for transport of metals to groundwater.
- Minimize metal concentrations in the American Canal and Rio Grande River (Rio Grande) resulting from the migration of metals in groundwater and/or wind blown dust from the Facility.

1.2 BACKGROUND INFORMATION

Background information pertaining to specific Remedial Investigation and general Facility information is presented in the following sections.

1.2.1 Remedial Investigation Specific

During 1994 and 1995, the TNRCC conducted a multimedia inspection of the Facility. Based on the results of the multimedia inspection, Asarco entered into an Agreed Order in 1996. A Phase I RI was conducted from February 1997 through June 1998 and a Phase I RI Report (Hydrometrics, 1998) was submitted to TNRCC in October, 1998. The Phase I RI Report presented the results of soil, surface water and groundwater investigations and a general proposal for corrective action for remediation of impacted areas to meet the risk reduction standards of the TNRCC.

On June 25, 1999, Asarco received comments from TNRCC on the Phase I RI Report. A Phase II RI was conducted in 1999 and 2000 in response to TNRCC comments and supplemental data requirements identified in the Phase I RI Report. This document presents the results of additional soil, surface water and groundwater investigations and updates the general proposal for corrective action for the Facility.

1.2.2 General Facility Background Information

The Asarco Facility is in the City of El Paso, El Paso County, Texas (Figure 1-1). A map of the Facility is in Exhibit 1. The Asarco Facility has been in operation for over 100 years. At various times during the past, the Facility has produced lead, copper, cadmium, zinc and antimony. Figure 1-2 presents a flow diagram describing the most recent copper production processes at the Facility. The last production of metals other than copper ceased in 1992.

Former lead, cadmium, zinc and antimony smelting facilities are currently in various stages of demolition and/or remodeling for reuse. The entire Facility was temporarily placed on a three-year Care and Maintenance Program (temporary cessation) in February 1999. Prior to cessation of copper production, the Facility produced approximately 140,000 tons of copper per year. Table 1-1 summarizes historic Facility operations, actions and reports to date.

The following is a summary of the physical and environmental setting of the Asarco Facility (a more detailed description is provided in the Phase I RI Report):

- Land use adjacent to the Facility consists of commercial, industrial, manufacturing and residential.
- The area climate is considered arid and consists of very low relative humidity, low precipitation, hot summers and mild winters.
- The type of vegetation in the area ranges from flood plain shrubs and trees near the Rio Grande to vegetation typically found in the Chihuahuan Desert at higher elevations.
- The seasonal wind directions are characterized as being predominately from the southeast during June through October, and predominately from the northwest during November through May.
- The annual lake evaporation for the area is estimated to be 72 inches/year. Pan evaporation tests indicate evaporation rates greater than 100 inches/year.
- Precipitation averages about 8 inches annually, with 75 percent of this precipitation occurring between April and September (Jaco, 1971).
- The Facility is located in the Rio Grande Valley at an elevation approximately 3,600 feet above mean sea level (msl).
- The surficial geology of the region is controlled by three mountain ranges (the Franklin Mountains, the Hueco Mountains and the Sierra Juarez Range) and the Rio Grande Rift.
- The path of the Rio Grande in this region corresponds to the north-south trend of the extensional Rio Grande Rift. The rift valley is composed of river sediments and alluvial debris that have eroded from the western slope of the Franklin Mountains.
- Surface Geology of the Facility area consists of a mix of colluvial and fluvial sediments.
- The Hueco Bolson is the principal aquifer in the El Paso area. Structurally, it is a basin created by the down-dropped block between the Franklin Mountains and the Hueco Mountains and subsequently filled with lacustrine and fluvial deposits.

- The primary source of drinking water for the region is extracted from the poorly sorted, irregularly stratified fluvial deposits, which outcrop over most of east El Paso and range from 400 to 1,300 feet thick.
- The near surface aquifer beneath the Facility is classified as a Category II; TDS concentrations between 3,000 and 10,000 ppm.
- There are two surface water bodies to the west of the Asarco Facility:
 1. The Rio Grande.
 2. The American Canal, a canal used by the United States to remove its allotment of water from the Rio Grande.

The Phase I RI included ten Investigation Areas (IAs). Additional investigations were recommended as part of the Phase I RI to further delineate soil, surface water and groundwater impacts at the Facility. The Phase I RI established a model for metals distribution at the Facility in soils and groundwater. These site-specific characteristics were then used to conduct a feasibility analysis of corrective actions appropriate to mitigate impacts. A general proposal for corrective actions at the Facility was provided in the Phase I RI, which included capping, excavation, and on-site containment of impacted source materials. Based on the Phase I and Phase II RIs, prescribed corrective action alternatives and measures will eliminate or reduce potential impacts to groundwater and achieve the corrective action objectives.

The Phase II RI refines estimates of the location, area and volume of source areas and materials, and further categorizes these materials in accordance with the approach established in the Phase I RI. This report presents the findings of the Phase II investigations and supports the general proposal for corrective action plan for the Facility identified in the Phase I RI. No significant changes to general conclusions presented in the Phase I RI were derived as a result of the Phase II RI.

As part of the Phase II RI, additional soil and groundwater samples were collected from the original ten IAs as identified as part of the Phase I RI, and four new IAs. The additional IAs are described in detail in subsequent sections of this Phase II RI Report. Information collected during the Phase I and Phase II RIs indicate that groundwater flow and associated metals migration in the area is significantly influenced by infilled arroyos underlying the Facility.

1.3 REGULATORY SUMMARY AND RELATED WORK

The Asarco Facility operates under four Facility permits issued by the TNRCC, and one issued by the EPA. These permits are listed in Table 1-2. Certain wastes are managed within active Solid Waste Management Units (SWMUs) consistent with TNRCC Notice of Registration Number 31235. The Asarco Facility active SWMUs are listed in Table 1-3.

Additional environmental activities at the Facility (other than work associated with the Phase II RI) include the following:

- A Storm Water Collection and Reuse System (Dames & Moore, 1998) was constructed during the period 1998 through 2000. These upgrades addressed corrective action measures for many Facility IAs. The storm water control improvements are summarized in Sections 3.0 and 4.0 of the Phase I RI Report, and in this Phase II RI Report.
- Operation and maintenance of the diesel recovery systems at the Facility (see Table 1-1) is on going. With the addition of a new dual phase extraction system (March 1999), diesel recovery progresses at the Diesel No. 2 Remediation site (LPST ID # 95987). The estimated extent of liquid-phase diesel measured at the site in February 2000 is in Figure 1-3. As of May 1, 2000, approximately 11,000 gallons of diesel have been recovered and approximately 175,000 gallons of groundwater have been treated. The Diesel No. 1 recovery system is currently inactive, with TNRCC closure

approval anticipated in the near future. These diesel recovery projects are discussed in detail in the Phase I RI Report.

Asarco is evaluating legal provisions to efficiently achieve the objectives for the project. One of these options involves consolidating placement of impacted materials on-site. The Area of Contamination (AOC) concept allows areas of widespread contamination to be considered a RCRA land disposal unit allowing waste management within the AOC without triggering RCRA land disposal restrictions or minimum technology requirements. As discussed in more detail in Section 4.1.3.3, the AOC concept is applicable to both current operations, and the proposed general plan for corrective actions at the Facility, in that it allows simplified management of impacted materials on-site to achieve the corrective action goals established in the baseline risk assessment (Hydrometrics, 1998) as part of the Phase I RI.

1.4 PREVIOUS RI INVESTIGATIONS

An RI Work Plan (Hydrometrics, 1996) was originally prepared to ensure the compliance of RI activities with TNRCC requirements presented in the Texas Administrative Code, Title 30, Chapter 335, Subchapter S, risk reduction standards. The general RI technical approach taken to meet TNRCC risk reduction standards includes the following elements:

- Identification of sources contributing to potential soil, surface water and groundwater impacts.
- Identification of potential contaminant pathways and receptors.
- Evaluation of risk-based critical values (risk reduction standards).
- Assessment of the exposure of human and environmental receptors to contaminants.
- Recommendations for corrective action to achieve risk reduction standards.

In the absence of specific TNRCC guidance, the RI Work Plan was prepared in general accordance with the United States Environmental Protection Agency (EPA) guidance for RI work plans contained in the Resource Conservation and Recovery Act (RCRA) corrective action plan (US EPA, 1994a). Other supporting guidance documents included Guidance for the Data Quality Objectives Process (US EPA, 1994b).

The Phase I RI was conducted from February 1997 through May 1998. In the Phase I investigation, field data were collected to support an evaluation of the feasibility of corrective actions (Hydrometrics, 1998). Included in the Phase I RI Report (Hydrometrics, 1998) were recommendations for supplemental investigations required to further characterize the original ten IAs and four new IAs.

Following submittal of the Phase I RI Report, TNRCC provided comments which relate to additional investigations included in the Phase II RI (TNRCC, 1999). TNRCC comments, along with Asarco's responses, have been addressed in the Phase II RI Report, and are located in Appendix A.

The Phase II RI focuses on collection and analysis of additional soil, surface water, and groundwater data associated with the original ten IAs and the addition of four new IAs. The design of supplemental investigations is based on logical interpretations of existing data and is designed to increase the understanding of the distribution of metals in source areas and materials, and to support the development of corrective action measures. Phase I groundwater monitor wells and surface water sample locations established as part of the Phase I RI were also sampled during the Phase II RI.

In accordance with TNRCC discussions subsequent to the submittal of the Phase I RI Report, the primary chemical constituents of concern (COCs) for soil and water addressed as part of the Phase II RI are:

- Arsenic (As)

- Cadmium (Cd)
- Lead (Pb)
- Selenium (Se)

These primary COCs have been verified based on the conclusions of the Phase I RI investigation (Sections 3.0 and 5.0). These COCs were regularly found to occur at the Facility at significantly elevated concentrations. Arsenic is considered to be the primary COC in groundwater at the Facility. Arsenic, cadmium, and lead are considered to be primary COCs in soil.

Selenium occurs in detectable concentrations in soils and groundwater near background levels throughout the Facility and adjacent areas. Although selenium is not considered a primary COC for the Facility, it remains an analyte that is monitored. Areas with elevated concentrations of selenium generally also have elevated concentrations of arsenic. As described in Section 4.5, Hydrometrics has initiated a baseline investigation of trace metal concentrations in naturally occurring geologic formations in the vicinity of the Facility to improve the understanding of the relationship between observed concentrations of metals at the Facility.

As part of the Agreed Order, ten IAs were designated by the TNRCC based on historical and current Facility operations and the results of the 1994 and 1995 multimedia inspection and sampling events. The Phase I RI Report included field-sampling and evaluation information for the following ten areas of concern, or IAs:

- IA-1 Converter Building/Baghouse Area.
- IA-2 Boneyard/Slag Area.
- IA-3 Acid Plants 1 and 2 Area.
- IA-4 Front Slope/Western Facility Boundary Area.
- IA-5 Historic Smeltertown Area.

- IA-6 Groundwater (not depicted on Exhibit 1 and Figures in this report because all Facility areas are included; Discussions associated with other IAs also include detailed groundwater characteristics).
- IA-7 Surface Water (includes the Rio Grande and American Canal).
- IA-8 Bedding and Unloading Buildings Area.
- IA-9 On-site Process Ponds Areas.
- IA-10 Facility Entrance Area.

Environmental investigations conducted at the Facility prior to the Phase I RI are summarized in the Phase I RI Report (Hydrometrics, 1998), and included the following:

- Process Pond areas (Nos. 1, 5 and 6).
- Diesel Release Investigations (Nos. 1 and 2; refer to Figure 1-3).
- Acid spill investigation on front slope below Acid Plant No. 1 (1995).
- Storm Water Control and Reuse investigations.

1.5 PHASE II RI INVESTIGATION AREAS

The Phase I IAs listed in Section 1.3 were modified in response to the results of the Phase I RI and TNRCC comments. Four new IAs were created. The original IA-2 was sub-divided, creating two additional IAs, as shown on Exhibit 1. These new IAs are:

- IA-11 Arroyos East of I-10.
- IA-12 Ephemeral Pond and Pond Sediment Storage Area.

Elevated concentrations of COCs observed in groundwater during the Phase I RI prompted further investigations in the southern portion of the Facility. These new IAs are:

- IA-13 Sample Mill Area.
- IA-14 South Terrace Area.

These four new IAs were developed based on historical and current Facility operations and Phase I RI results. The ten IAs investigated as part of the Phase I RI and the four new IAs investigated as part of the Phase II RI are described in more detail in Table 1-4. All Phase I and Phase II RI IAs are shown on Exhibit 1.

1.6 PHASE II RI WORK PLAN TASKS

Consistent with the Phase I RI, the tasks undertaken in this Phase II RI were developed to identify metal impacted source areas and materials, groundwater flow pathways, and the vertical and horizontal extent of COCs. The objectives and methodology used in the Phase II RI are consistent with the RI Work Plan developed for the project (Hydrometrics, 1996).

The Phase II RI was implemented subsequent to the review and acceptance of the Phase I RI Report by TNRCC in June 1999. This Phase II RI Report includes data from on-going monitoring initiated during the Phase I RI. The period of record is from August 1998 to February 2000. The Phase II RI Report includes a summary of the Phase II RI investigation results.

Consistent with previous investigations, the following constituents were analyzed in addition to the COCs arsenic, cadmium, lead and selenium. Laboratory reports associated with the testing are reported in this document:

- Soil and Groundwater
 - Chromium (Cr)
 - Copper (Cu)
 - Iron (Fe)
 - Zinc (Zn)

- Groundwater
 - pH
 - Specific conductivity (SC)
 - Total dissolved solids (TDS)

Pursuant to the TNRCC Consistency Document (TNRCC, 1998) two procedural changes were incorporated for use in the Phase II RI:

1. Groundwater samples were analyzed for total metals rather than dissolved metals. Groundwater samples were analyzed for dissolved metals, during the Phase I RI. Observations made thus far during the RI indicate that dissolved metal concentrations are comparable to total concentrations.
2. Adoption of TNRCC approved filtering protocol for sampling groundwater.

Additional waste constituents in soil and groundwater at the Facility include organic chemicals associated with diesel fuel. As noted in the Phase I RI, the characterization of these constituents, and associated corrective actions, are being addressed as part of corrective actions (see Section 1.3).

Descriptions of sampling and analysis protocols provided in the RI Work Plan (Hydrometrics, 1996) include the following:

- Sampling equipment and techniques.
- Procedures for taking measurements of water level elevations in the monitor wells.
- Procedures for detecting any phase-separated liquids and their thickness, if present.

- Well evacuation procedures, including purged water or water quality prior to sampling and handling.
- Sampling and analysis protocol for field measurements.
- Procedures for decontaminating sampling equipment between sampling events.
- Disposal of field-generated waste.
- Sample handling and preservation techniques, including chain of custody documentation.
- Sampling quality assurance/quality control (QA/QC) procedures.

1.7 PHASE II RI REPORT ORGANIZATION

This Phase II RI Report provides data to supplement those provided in the Phase I RI Report. Please refer to the Phase I RI Report (Hydrometrics, 1998) for additional background information concerning the history of the Facility, the environmental setting, and other information. The Phase I RI Report also presents the risk-based assessment for the Facility, RI characterization data and corrective action evaluations for the period from February 1997 through June 1998. Data from this previous investigative period are included with this Phase II RI Report where appropriate to evaluate long-term trends, or to support current conclusions.

The Phase II RI Report is organized into the following sections:

- **Section 1.0:** Presents Phase II RI background information, current regulatory considerations, summary of previous investigations, Phase II RI IAs and organization of the report.
- **Section 2.0:** Presents Phase II RI soil, surface water and groundwater investigation results.

- **Section 3.0:** Complements the Phase I RI conclusions by discussing the relationship between smelter operations and potential contaminant source areas and materials. Source materials are characterized according to concentrations of COCs, volume of impacted material, visual characteristics, observed or potential impacts to surface water and groundwater, and potential concern for exposure scenarios.
- **Section 4.0:** Complements the Phase I RI information by presenting a general proposal for corrective action. This proposal includes an overview of corrective action processes and alternatives, selected corrective action alternatives and associated cost estimates, and a schedule to assure appropriate remediation in compliance with Texas Administrative Code, Title 30, Chapter 335, Subchapter S, risk reduction standards. A detailed description of all corrective action technologies is presented in the Phase I RI Report.
- **Section 5.0:** Presents conclusions based upon the information gathered during the Phase II RI investigation.
- **Section 6.0:** Lists the references cited in the report.

SECTION 2.0

REMEDIAL INVESTIGATION RESULTS

2.0 REMEDIAL INVESTIGATION RESULTS

This section presents a general summary of the Phase II RI data collected at the Facility in 1998 through 2000. These data supplement previously collected Phase I RI data collected in 1997 and 1998 (Hydrometrics, 1998). All samples were collected and analyzed in accordance with procedures established in the RI Work Plan (Hydrometrics, 1996) and the TNRCC Consistency Document (TNRCC, 1998). Section 3.0 presents additional discussion about soil, surface water and groundwater data collected at the Facility specific to the characterization of each IA.

The Phase II RI was conducted to better delineate soil, surface water and groundwater characteristics and impacts at the Facility. The Phase II RI included an expansion of investigations in the original ten IAs and the addition of four IAs. The results of the Phase II RI provide improved estimates for the location and volume of affected source materials in the initial ten IAs. The results of the Phase II investigation also provide an assessment of source areas and potential groundwater impacts in the four new IAs.

The investigation data collected during the Phase II RI reinforced general conclusions formulated during the Phase I RI. In particular, the additional data regarding groundwater preferential flow associated with infilled arroyos was further substantiated.

Soil, surface water and groundwater samples were collected during the Phase II RI at the IAs listed in Table 1-4. These IAs include those identified in the Phase I RI Report, with some modifications based on the conclusions of the Phase I RI investigation and subsequent TNRCC comments. Soil samples were collected from soil borings, some of which were converted to monitor wells. Samples were collected under the direction of Hydrometrics personnel, with laboratory analyses performed by the Asarco Technical Services Center certified laboratory in Salt Lake City, Utah.

Table 2-1 summarizes the number of borings, monitor wells and soil samples installed or collected during Phase I and Phase II RI activities. Analytical parameters for soil and water samples are in Table 2-2. Pursuant to comments provided by the TNRCC, and the TNRCC Consistency Document, total metal analyses were used for the Phase II RI groundwater and surface water samples beginning with the August 1999 sampling event. Validation of analytical data was performed by Hydrometrics using EPA guidelines. Data validation reports are in Appendix J.

Phase II RI soil results are presented as an overview in this section, and are discussed in greater detail for each IA in Section 3.0. Surface water data are discussed separately for the Rio Grande and American Canal, and the unlined on-site ponds. Groundwater quality data are discussed for monitoring locations developed during Phase II RI activities and for on-going monitoring of Phase I RI monitor wells.

Lithologic logs and well construction details for Phase II RI borings and monitor wells are presented in Appendix C. Phase II RI summary tables and selected Phase I RI data, are presented in Appendices D (soil data), F (surface water data), G (groundwater level data), and H (groundwater quality data). Laboratory and associated data validation reports are presented in Appendices I and J, respectively.

2.1 SOIL INVESTIGATION RESULTS

Table 2-3 provides a statistical summary of Phase II RI and Phase I RI soil chemical analysis results for soil investigations. Phase I and Phase II RI soil sample locations are in Exhibit 1.

2.1.1 Field Activity Summary

A total of 88 borings were drilled and sampled as part of the Phase II RI to supplement the 115 borings advanced during the Phase I RI (Table 2-1). Locations of the borings are shown on Exhibit 1. Boring depths range from 5 to 80 feet below ground surface (bgs). Twenty-six of the borings were completed as monitor wells. Eighteen of the borings were surface samples (less than 5 feet deep). Slag was logged, but not sampled. With the exception of the

surface samples, all Phase II borings were advanced to groundwater. This was a modification to previous Phase I borings. Advancing borings to groundwater provided a further evaluation of the potential for soils and associated source materials in the IAs to impact groundwater. Drilling methods used were sonic, hollow-stem auger, geoprobe and hand auger.

As summarized in Table 2-1, a total of 655 Phase II RI soil samples were collected in addition to the 471 soil samples collected during the Phase I RI. Soil samples were analyzed using x-ray fluorescence spectrometry (XRF) methods for total arsenic, cadmium, chromium, copper, iron, lead, selenium and zinc. Sample results reported herein include those used as Quality Assurance/Quality Control (QA/QC) samples. QA/QC samples were collected at a rate of five-percent, or one QA/QC sample per 20 samples. Laboratory QA/QC procedures required confirmation analysis of 1 in 20 samples collected using Waste Extraction Test (WET) chemistry methods for total metals analysis using Hydrofluoric Acid (HF) digestion.

2.1.2 Summary of Soils Results

The minimum, maximum and average concentrations of analyzed parameters for soil samples collected during the Phase I and the Phase II RI are summarized in Table 2-3. In Table 2-3, the detection limit for a non-detected constituent was used to calculate the average concentrations.

Minimum metal concentrations were below the respective detection limits, with the exception of iron. Iron was detected at higher concentrations than other metals, and ranged from 3,000 mg/kg to 140,000 mg/kg. Average metal concentrations in soils are summarized as follows:

- Arsenic: 483 mg/kg.
- Cadmium: 202 mg/kg.
- Chromium: 90 mg/kg.
- Copper: 2,669 mg/kg.

- Iron: 25,222 mg/kg.
- Lead: 1,731 mg/kg.
- Selenium: 27 mg/kg.
- Zinc: 1,342 mg/kg.

Hydrostratigraphic units encountered during the Phase II RI verified and further delineated the units identified during the Phase I RI. Monitor wells EP-84, EP-86 and EP-87 (Phase I RI) are considered the most representative background monitor wells, because they are the farthest northeast from Facility activities (see Exhibit 1). Using the analytical results from Phase I RI monitor wells EP-84, EP-86, and EP-87 (Hydrometrics, 1998) to represent background concentrations for the Facility area in soils and alluvial materials, it appears arsenic, cadmium and selenium occur above background levels. The concentration ranges of Arsenic, Cadmium and Lead for monitor wells EP-84, EP-86, and EP-87 are as follows:

- Arsenic: ranged from 0.006 mg/l to 0.052 mg/l.
- Cadmium: ranged from less than the detection limit of 0.005 mg/l to 0.007 mg/l.
- Lead: ranged from less than the detection limit of 0.003 mg/l to 0.046 mg/l.

Chromium, copper, iron, lead, and zinc were detected all at naturally occurring concentrations, with the exception of iron, which is present at higher concentrations.

Another source of comparable background concentrations in soils is a study published by the US Geological Survey (USGS, 1984), which presents analytical results of soils collected throughout the United States. Based on this study, average concentrations of the eight metals of concern at the Facility are higher than typical nationally averaged background concentrations, with the exceptions of iron and chromium, which are only slightly higher. No average value was established for soil pH and cadmium during the USGS study.

Data from the Phase II investigation further support the conclusions presented in the Phase I RI Report (Hydrometrics, 1998). The primary COCs at the Facility were found to be arsenic, cadmium and lead. Concentrations are generally highest in soils very near the land surface, as illustrated on depth distribution graphs for Phase II RI soil data in Appendix E. The distribution of these metals in Facility soils is distributed throughout areas of current and past Facility operations.

2.2 SURFACE WATER INVESTIGATION RESULTS

A list of surface water analytical parameters for the Phase II RI is in Table 2-2. Surface water sample locations are in Exhibit 1. Tables 2-4 through 2-8 present a summary of Phase I RI and Phase II RI surface water chemical analysis results.

2.2.1 Background Information

There are two prominent surface water bodies in the vicinity of the Facility (Exhibit 1, Figure 2-1):

- The Rio Grande, which serves as the international boundary between the United States and Mexico.
- The American Canal, which is used by the United States to remove water from the Rio Grande.

Surface water flow and quality in the Rio Grande near the vicinity of the Facility are subject to the following influences:

- Effluent discharged from the sewage disposal facility (Northwest Waste Water Treatment Facility) located northwest of Smeltertown, upstream of the Facility.

- The American Dam, which diverts part of the Rio Grande to the American Canal. The American Canal removes the United States allocation of water from the Rio Grande.
- The International Dam located south of the University of Texas at El Paso, which diverts water from the American Canal to the Franklin Canal; it is also the location at which Mexico removes water from the Rio Grande.
- The Haskell R. Street Municipal Waste Water Treatment Facility located on Delta Street approximately 1 mile downstream of the Facility.
- Seasonal irrigation releases to the Rio Grande upstream of the Facility occur from the Elephant Butte Reservoir, as regulated by the Elephant Butte Irrigation District.

As discussed in the Phase I RI Report, three unlined on-site water ponds (Ponds 1, 5 and 6) and storm water evaporation ponds, near the southeast Facility boundary and near the Facility entrance, are shown on Exhibit 1. In the past, Pond 1 was used for storage of river water. Pond 5 was used to store fresh water from the City of El Paso and was used mainly as a source for dust suppression activities. Acid Plant cooling tower blowdown, contact and non-contact cooling water, storm water and city water were stored in Pond 6 for recycling and make-up water.

In 2000, the Storm Water Collection and Reuse System was completed at the Facility. This surface water control system redirected by upgraded surface drainage to a new lined storm water pond and an existing lined collection pond, and eliminated the need for Ponds 1, 5 and 6. Ponds 1, 5 and 6 are no longer being utilized and are dry or are being dewatered. Ponds 1, 5 and 6 are being evaluated as part of the RI process for use as on-site repositories for disposal of impacted soils at the Facility.

Hydrometrics sampled Pond 6 surface water quality between August 1998 and February 2000 as part of the Phase II RI. Ponds 1 and 5 were sampled quarterly from August 1997 until they were dry. Pond 5 was dry by August 1998 and Pond 1 was dry by September 1999. The ephemeral storm water collection pond (near monitor well EP-78 in IA-12) has been dry during all but two quarterly sampling events from August 1997 through February 2000.

2.2.2 Field Activity Summary

Hydrometrics sampled surface water in the American Canal and in the Rio Grande as part of the Phase II RI. This information was used to supplement Phase I RI information, and data from the International Boundary Water Commission (IBWC, 1999). IBWC sample locations are discussed in Section 2.2.3 and are shown on Figure 2-1.

Hydrometrics sampled surface water locations in the Rio Grande and American Canal quarterly between August 1998 and February 2000. These data supplement Phase I RI data collected by Hydrometrics between August 1997 and May 1998. Three sample locations (SEP-1, SEP-3 and SEP-7) are in the American Canal. Seven sampling locations (SEP-2, SEP-4, SEP-9, SEP-10, SEP-11, SEP-12 and SEP-13) are in the Rio Grande (Figure 2-3). Permanent rods located three to five feet from the Rio Grande are surveyed and used as reference points to measure water elevations during sample events. After a flood event in November 1998, the control points north of SEP-2 were relocated to monitor wells EP-112 and EP-113. The permanent reference points are a short distance from the corresponding sample locations within the canal and river. Therefore, the locations in Figure 2-3 indicate permanent rod locations.

2.2.3 IBWC Rio Grande Water Quality Results

IBWC collected water quality data on a weekly basis (for reasons unrelated to the RI) for the period 1995 through December 1999 for two locations on the Rio Grande (Figure 2-1):

1. Courchesne Bridge, which is located upstream of the site, approximately 9.5 miles above the Haskell R. Street Waste Water Treatment Facility.

2. Across from Bowie High School football field, which is located downstream from the site and about 1.5 miles above the Haskell R. Street Waste Water Treatment Facility.

Though the Bowie High School location is significantly downgradient from the Facility, it is the closest IBWC sampling location to the Facility. The data from this location is discussed in general. The Courchesne Bridge location is the upgradient sampling point on the Rio Grande closest to the Facility.

Parameters tested by the IBWC at each location included dissolved oxygen (DO), pH, biochemical oxygen demand (BOD), fecal coliform, chloride, TDS, sulfate, SC, total hardness, ammonia, turbidity and temperature. The Phase II RI and Phase I RI IBWC analytical results for Courchesne Bridge, Bowie High School and average concentrations are summarized in Tables 2-4, 2-5 and 2-6, respectively, with data previously reported for the Phase I RI. Water quality parameters as a function of time are presented for Courchesne Bridge and Bowie High School in Figures 2-4, 2-5, 2-6 and 2-7.

The average surface water parameter concentrations in the Rio Grande at the Courchesne Bridge from IBWC data for the period January 1997 through December 1999 were (Table 2-4, Figure 2-4 and Appendix F):

- DO: 9.3 mg/l.
- pH: 7.9.
- BOD: 3 mg/l.
- Fecal Coliform: 885 colony-forming units per 100 ml.
- Chloride: 145 mg/l.
- TDS: 779 mg/l.
- Sulfate: 271 mg/l.
- SC: 1,244 micromhos per centimeter ($\mu\text{mhos/cm}$).

- Total Hardness: 292 mg/l.
- Ammonia: 0.15 mg/l.
- Turbidity: 122.3 NTUs.
- Temperature: 56.2° F.

For the same IBWC data period, the average surface water parameter concentrations in the Rio Grande, at the sample location across from Bowie High School, were (Table 2-5, Figure 2-5 and Appendix F):

- DO: 9.3 mg/l.
- pH: 8.0.
- BOD: 3.2 mg/l.
- Fecal Coliform: 1,014.6 colony-forming units per 100 ml.
- Chloride: 145.6 mg/l.
- TDS: 777.8 mg/l.
- Sulfate: 256.6 mg/l.
- SC: 1,242.8 μ mhos/cm.
- Total Hardness: 285.5 mg/l.
- Ammonia: 0.2 mg/l.
- Turbidity: 153.2 NTUs.
- Temperature: 60.5° F.

The surface water quality results at both IBWC locations are similar, an indication there is little additional influence on general water quality characteristics in the reach of the Rio Grande between the two sampling points.

Graphs illustrating the analytical results of single IBWC sampling events during August of each year for the period of record, and for each sampling location, are in Figures 2-6 and 2-7. Average chemical constituent concentrations at both IBWC locations are summarized in

Table 2-6. The averages were calculated using samples collected during the weekly monitoring events between January 1997 and December 1999.

2.2.4 Hydrometrics-Collected Rio Grande Water Quality and Sediment Results

Water quality data collected by Hydrometrics within the Rio Grande (sample locations SEP-9, SEP-10, SEP-11, SEP-2, SEP-12, SEP-13, and SEP-4, upstream to downstream) are presented in Appendix F. The surface water sample locations are in Figure 2-3.

Samples were analyzed in the field for DO, pH, SC and temperature. Laboratory analyses parameters are in Table 2-2. The analytical results associated with the Hydrometrics sampling efforts during both Phase I and Phase II RIs are summarized in Tables 2-7 and 2-8.

The following is a summary of surface water sampling results, from samples collected by Hydrometrics, in the Rio Grande for Phase I and Phase II RIs:

- pH: ranged from 6.84 to 8.86.
- DO: ranged from 3.7 mg/l to 11.4 mg/l.
- SC: ranged from 197 μ mhos/cm to 2,390 μ mhos/cm.
- TDS: ranged from 526 mg/l to 2,069 mg/l.
- TSS: ranged from 7.5 mg/l to 500 mg/l.
- Calcium: ranged from 58 mg/l to 117 mg/l.
- Magnesium: ranged from 12 mg/l to 32 mg/l.
- Sodium: ranged from 97.0 mg/l to 334 mg/l.
- Potassium: ranged from 6.6 mg/l to 16 mg/l.
- Total alkalinity: ranged from 162 mg/l to 180 mg/l.
- Bicarbonate: ranged from 178 mg/l to 306 mg/l.
- Carbonate: ranged from 1 mg/l to 17 mg/l.
- Sulfate: ranged from 131 mg/l to 598 mg/l.
- Chloride: ranged from 67 mg/l to 315 mg/l.

- Fluoride: ranged from 0.57 mg/l to 0.90 mg/l.
- Nitrate and nitrite (as nitrogen): ranged from 0.10 mg/l to 6.5mg/l.

The following is a summary of dissolved metal concentrations, from samples collected by Hydrometrics, in the Rio Grande for Phase I and Phase II RIs:

- Arsenic: ranged from less than the detection limit of 0.005mg/l to 0.011 mg/l.
- Cadmium: all less than the detection limit of 0.005 mg/l.
- Chromium: all less than the detection limit of 0.01 mg/l.
- Copper: all less than the detection limit of 0.025 mg/l.
- Iron: ranged from less than the detection limit of 0.1 mg/l to 0.18 mg/l.
- Lead: all less than the detection limit of 0.003 mg/l.
- Selenium: all less than the detection limit of 0.005 mg/l.
- Zinc: ranged from less than the detection limit of 0.02 mg/l to 0.035 mg/l.

Total recoverable metal concentration ranges, from samples collected by Hydrometrics, are summarized as follows:

- Arsenic: ranged from less than the detection limit of 0.005 mg/l to 0.055 mg/l.
- Cadmium: all less than the detection limit of 0.005 mg/l.
- Chromium: ranged from less than the detection limit of 0.01mg/l to 0.012 mg/l.
- Copper: all less than the detection limit of 0.025 mg/l.
- Iron: ranged from 0.15 mg/l to 15 mg/l.
- Lead: ranged from less than the detection limit 0.003mg/l to 0.014 mg/l.
- Selenium: ranged from less than the detection limit of 0.005 mg/l to 0.006 mg/l.
- Zinc: ranged from less than the detection limit of 0.02 mg/l to 0.051 mg/l.

Total metal concentrations, from samples collected by Hydrometrics, are summarized as follows:

- Arsenic: from less than the detection limit of 0.005 mg/l to 0.024 mg/l.
- Cadmium: less than the detection limit of 0.005 mg/l.
- Chromium: less than the detection limit of 0.01mg/l.
- Copper: less than the detection limit of 0.025 mg/l.
- Iron: ranged from 0.17 mg/l to 1.2 mg/l.
- Lead: less than the detection limit of 0.003 mg/l to 0.013 mg/l.
- Selenium: less than the detection limit of 0.005 mg/l to 0.008 mg/l.
- Zinc: less than the detection limit of 0.02 mg/l to 0.067 mg/l.

Most of the metal results from the Rio Grande samples are less than detection limits. Only two constituents (TDS and pH) appear to be elevated. The results reported herein for the Rio Grande upgradient of the Facility are also elevated, indicating that concentrations of constituents are at background concentrations relative to the Facility. No other exceedences of MCLs pursuant to TNRCC guidelines (Appendix F) were observed in the in the Rio Grande during the Phase II RI.

Collection of streambed sediments at Rio Grande surface water sample locations was initiated in August of 1999. A summary of sediment analysis results are in Table 2-9. Arsenic concentrations ranged from <10 mg/kg (detection limit) to 21.0 mg/kg. Cadmium concentrations ranged from <10 mg/kg to 15 mg/kg. Lead concentrations ranged from 12.0 mg/kg to 160.0 mg/kg. The elevated lead concentrations may be the result of several upgradient sources including industrial, municipal and agricultural discharges to the Rio Grande.

No streambed sediments were collected from the American Canal at designated surface water sampling locations during the Phase II RI. This was due to high water volume flows in the canal, which made it too dangerous to collect sediment samples.

2.2.5 Rio Grande Flow and Adjacent Well Data

A detailed discussion of water table elevations adjacent to the Rio Grande and flow in the Rio Grande was provided in the Phase I RI Report. Water table elevations measured during the Phase II RI verify Phase I observations and are briefly summarized in this section. IBWC maintains a database with mean daily flow measurements at three points in the Rio Grande. Flow data, measured in mean daily discharge in cubic meters per second, is available for the following locations (Figure 2-1) and time periods:

- The Courchesne Bridge (9.5 miles upstream of the Facility) for the period 1889 through December 1999.
- The Pump House below the American Dam for the period 1938 through December 1999.
- The American Dam diversion for the American Canal for the period 1938 through December 1999.

Data from 1995 through 1998 were considered for the Phase I RI Report. Rio Grande mean daily flow data for the period of June 1998 through December 1999 are in Table 2-10, and in Figure 2-8.

As reported in the Phase I RI Report, the upgradient measurement location at Courchesne Bridge has the highest mean daily flow rates. Between Courchesne Bridge and the American Canal, additional sources of flow to the Rio Grande in the Facility area include the Northwest Waste Water Treatment Facility, approximately one mile northwest and upstream of the

Facility. The downstream location at the Pump House has the lowest mean daily flow rates as influence by the American Dam diversion.

At the American Dam, the United States diverts water from the Rio Grande to the American Canal and then to the Haskell R. Street Waste Water Treatment Facility. The highest flow volumes occurred in July and August 1999. During this period, the mean daily discharge volumes were as much as 96.5 cubic meters per second at Courchesne Bridge.

To be consistent with the Phase I RI Report, groundwater elevation data for wells adjacent to the Rio Grande (i.e., wells EP-4 through EP-7) and in wells in the historic Smeltertown area (i.e., wells EP-60 through EP-66) were compared to the Rio Grande flow data. Table 2-11 presents the groundwater elevation data for 1995 through 1999. Figures 2-9 and 2-10 graphically illustrate the water level measurements in wells EP-4 through EP-7 and EP-60 through EP-66, respectively.

Consistent with the results reported in the Phase I RI Report, Phase II RI data indicate groundwater elevations relate directly to changes in flow in the Rio Grande. This correlation is evidenced by the higher water levels in the adjacent wells during August, following the higher discharge volumes in the Rio Grande. Lower water levels in January and February also follow a period of decreased discharge volumes in the Rio Grande.

2.2.6 Hydrometrics-Collected American Canal Surface Water Sampling Results

Hydrometrics sampled the American Canal as part of the Phase II RI at locations SEP-7, SEP-1 and SEP-3, consistent with the Phase I RI. The samples were analyzed for the parameters in Table 2-2. Analytical results for Phase I RI and Phase II RI sample events are summarized in Tables 2-7 and 2-8.

The following is a summary of general quality analytical results for samples, collected by Hydrometrics, from the American Canal:

- pH: ranged from 7.54 to 8.79.
- DO: ranged from 3.6 mg/l to 16.5 mg/l.
- SC: ranged from 249 μ mhos/cm to 6,200 μ mhos/cm.
- TDS: ranged from 582 mg/l to 3,979 mg/l.
- TSS: ranged from 12 mg/l to 565 mg/l.
- Calcium: ranged from 60 mg/l to 225 mg/l.
- Magnesium: ranged from 12 mg/l to 94 mg/l.
- Sodium: ranged from 101 mg/l to 965 mg/l.
- Potassium: ranged from 6 mg/l to 54 mg/l.
- Total alkalinity: ranged from 172 mg/l to 180 mg/l.
- Bicarbonate: ranged from 204 mg/l to 342 mg/l.
- Carbonate: ranged from below the detection limit of 1 mg/l to 11 mg/l.
- Sulfate: ranged from 156 mg/l to 1,839 mg/l.
- Chloride: ranged from 64 mg/l to 679 mg/l.
- Fluoride: ranged from 0.64 mg/l to 2.1 mg/l.
- Nitrate and nitrite (as nitrogen): ranged from 0.13 mg/l to 12 mg/l.

The following is a summary of dissolved metal concentrations in water samples, collected by Hydrometrics, from the American Canal:

- Arsenic: ranged from less than the detection limit of 0.005 mg/l to 0.81 mg/l.
- Cadmium: ranged from less than the detection limit of 0.005 mg/l to 0.008 mg/l.
- Chromium: less than the detection limit of 0.01 mg/l.
- Copper: less than the detection limit of 0.025 mg/l.

- Iron: less than the detection limit of 0.1 mg/l.
- Lead: ranged from less than the detection limit of 0.003 mg/l to 0.004 mg/l.
- Selenium: ranged from less than the detection limit of 0.005 mg/l to 0.2 mg/l.
- Zinc: ranged from less than the detection limit of 0.02 mg/l to 0.024 mg/l.

The following is a summary of total recoverable metal concentrations in water samples, collected by Hydrometrics, from the American Canal:

- Arsenic: ranged from less than the detection limit of 0.005 mg/l to 1.6 mg/l.
- Cadmium: ranged from less than the detection limit of 0.005 mg/l to 0.019 mg/l.
- Chromium: ranged from less than the detection limit of 0.01mg/l to 0.011 mg/l.
- Copper: ranged from less than the detection limit of 0.025 mg/l to 0.043 mg/l.
- Iron: ranged from less than the detection limit of 0.1 mg/l to 14 mg/l.
- Lead: ranged from less than the detection limit of 0.003 mg/l to 0.015 mg/l.
- Selenium: ranged from less than the detection limit of 0.005 mg/l to 0.36 mg/l.
- Zinc: ranged from less than the detection limit of 0.02 mg/l to 0.044 mg/l.

The following is a summary of total metal concentrations in water samples, collected by Hydrometrics, from the American Canal:

- Arsenic: ranged from less than the detection limit of 0.005 mg/l to 0.007 mg/l.
- Cadmium: less than the detection limit of 0.005 mg/l.
- Chromium: less than the detection limit of 0.01 mg/l.
- Copper: less than the detection limit of 0.025 mg/l.
- Iron: ranged from 0.19mg/l to 1.2 mg/l.
- Lead: ranged from less than the detection limit of 0.003 mg/l to 0.006 mg/l.

- Selenium: less than the detection limit of 0.005 mg/l.
- Zinc: ranged from less than the detection limit of 0.02 mg/l to 0.067 mg/l.

Metal concentrations measured in the American Canal during the Phase II RI were generally less than detection limits. However, arsenic, cadmium, iron and selenium concentrations exceeded MCLs in the American Canal during the Phase I RI, but only during periods of flow with depths of two inches or less, and were not considered to be representative of concentrations in water during normal operation of the canal. These very low flows occurred during the fourth quarter 1997 and first quarter 1998 monitoring events and were due to construction upgrades to the canal downgradient of the Facility. During this period, water was not permitted in the canal and the majority of the river flow was directed into the Rio Grande at the American dam.

2.2.7 On-Site Pond Water Quality

Ponds 1, 5 and 6 on the Facility were sampled quarterly from August 1997 through May 1998 as part of the Phase I RI, and from August 1998 through February 2000, or until the ponds were dry, as part of the Phase II RI. Water sample results for Ponds 1, 5 and 6 are depicted graphically in Figures 2-11a, 2-11b and 2-11c. Ponds 1, 5 and 6 were decommissioned between 1998 and 2000 upon completion of the storm water collection reuse system. Pond 5 was dry by August of 1998, and Pond 1 was dry by September of 1999. Pond 6 is presently being de-watered.

Concentration ranges for general chemical constituents in water samples, collected by Hydrometrics, from Ponds 1, 5 and 6 are summarized as follows:

- pH: ranged from 6.7 to 9.2.
- DO: ranged from 4.1 mg/l to 12.3 mg/l.
- SC: ranged from 975 μ mhos/cm to 215,000 μ mhos/cm.
- TDS: ranged from 644 mg/l to 147,412 mg/l.

- TSS: ranged from 1.8 mg/l to 1,703 mg/l.
- Calcium: ranged from 35 mg/l to 850 mg/l.
- Magnesium: ranged from 3.2 mg/l to 3,445 mg/l.
- Sodium: ranged from 154 mg/l to 42,350 mg/l.
- Potassium: ranged from 6.3 mg/l to 4,074 mg/l.
- Bicarbonate: ranged from 21 mg/l to 587 mg/l.
- Carbonate: ranged from 0.1 mg/l to 35 mg/l.
- Sulfate: ranged from 193 mg/l to 80,035 mg/l.
- Chloride: ranged from 137 mg/l to 24,148 mg/l.
- Fluoride: ranged from 0.91 mg/l to 121 mg/l.
- Nitrogen: ranged from 0.05 mg/l to 1,112 mg/l.

Concentrations of dissolved metals in water samples, collected by Hydrometrics, from Ponds 1, 5 and 6 are summarized as follows:

- Arsenic: ranged from 0.005 mg/l to 0.82 mg/l.
- Cadmium: ranged from 0.005 mg/l to 0.008 mg/l.
- Chromium: less than the detection limit of 0.01 mg/l.
- Copper: less than the detection limit of 0.025 mg/l.
- Iron: less than the detection limit of 0.1 mg/l.
- Lead: ranged from 0.003 mg/l to 0.004 mg/l.
- Selenium: ranged from less than the detection limit of 0.005 mg/l to 0.2 mg/l.
- Zinc: ranged from 0.02 mg/l to 0.025 mg/l.

Concentrations of total recoverable metals in water samples, collected by Hydrometrics, from Ponds 1, 5 and 6 are summarized as follows:

- Arsenic: ranged from 0.005 mg/l to 1.6 mg/l.

- Cadmium: ranged from less than the detection limit of 0.005 mg/l to 0.019 mg/l.
- Chromium: ranged from less than the detection limit of 0.01 mg/l to 0.011 mg/l.
- Copper: ranged from less than the detection limit of 0.025 mg/l to 0.043 mg/l.
- Iron: ranged from less than the detection limit of 0.1 mg/l to 14 mg/l.
- Lead: ranged from less than the detection limit of 0.003 mg/l to 0.021 mg/l.
- Selenium: ranged from less than the detection limit of 0.005 mg/l to 0.36 mg/l.
- Zinc: ranged from less than the detection limit of 0.02 mg/l to 0.068 mg/l.

Concentrations of total metals in water samples collected from Ponds 1, 5 and 6 are summarized as follows:

- Arsenic: ranged from 0.270 mg/l to 2.1 mg/l.
- Cadmium: ranged from 0.170 mg/l to 286 mg/l.
- Chromium: less than the detection limit of 0.01 mg/l.
- Copper: ranged from 0.560 mg/l to 7.1 mg/l.
- Iron: ranged from less than the detection limit of 0.1 mg/l to 0.640 mg/l.
- Lead: ranged from 0.120 mg/l to 1.8 mg/l.
- Selenium: ranged from 0.014 mg/l to 11 mg/l.
- Zinc: ranged from 0.440 mg/l to 58 mg/l.

A discussion of Ponds 1, 5 and 6 relative to the Rio Grande was presented in the Phase I RI Report (Hydrometrics, 1998). Based on groundwater and pond water sample results, water in the ponds may have been a source of metals to the groundwater. A discussion of pond sediments, which are considered a potential source of metals to the groundwater, is presented in Section 3.10.2.

2.3 GROUNDWATER INVESTIGATION RESULTS

A statistical summary of Phase I RI and Phase I RI groundwater sample analysis results is in Table 2-12. Analytical parameters for groundwater samples is in Table 2-2. Monitor well locations are in Exhibit 1.

2.3.1 Background Information

As part of the Phase I RI, the geology of the facility area was assessed. The investigation utilized maps, reports and other reference materials from Asarco's engineering department and subsurface information collected during remedial investigation fieldwork and data collected during previous investigations and remedial activities. The aquifer units at the facility in order of youngest to oldest (generally shallow to deep) are described as follows:

- Rio Grande Alluvial Aquifer (Smeltertown Area): Consists of reworked colluvial and terrace deposits. In the upper 20 feet, composition of the unit is predominately sand, silts and clays. This unit is reported to be 86 feet thick in El Paso Canyon (Slichter, 1905).
- Arroyo Colluvial (Facility Area and East of I-10): The colluvial fill in these arroyos on the Facility Site generally consists of well-graded silty sands, gravels, cobbles and boulders. Some portions of the unit contain cement of "caliche" calcium carbonate (Lovejoy, 1976). Locally, this unit is estimated to be 300-400 feet thick in the El Paso Canyon. In the vicinity of the Facility, this unit is estimated to be 150 to 200 feet thick.
- Bedrock (Campus Andesite and Areas beneath the Arroyo Colluvial and Rio Grande Alluvial Aquifer): The bedrock unit consists of Tertiary andesites (laccolith), Cretaceous sandstones, shales, limestones and siltstones. The primary porosity of these units is expected to be very low. However, fractures and solution features in limestone units may enhance the hydraulic conductivity in zones of heavy faulting or in solution zones.

The Phase I RI Report (Hydrometrics, 1998) provides a detailed discussion about the hydrogeologic characteristics of the Facility area. The Phase II RI provided data to further delineate and verify these characteristics. The geologic and hydraulic characteristics, which influence groundwater beneath the Facility are summarized as follows:

- The alluvial aquifer located underneath the El Paso Facility is composed primarily of interbedded and mixed sand, gravels, boulders and bedrock that are thinnest at the bedrock flanks to the east and thicken westward toward the Rio Grande.
- Alluvial groundwater is derived primarily from the Rio Grande recharge and considered separate from the Hueco and Mesilla Bolsons.
- The alluvial aquifer is considered saline, with a total dissolved solid (TDS) concentration ranging from 3,000 mg/l to 10,000 mg/l.
- General groundwater flow direction is from the east-northeast to the west-southwest.
- The depth of groundwater at the Facility is 40 to 60 feet below ground surface (bgs), depending on the elevation of the Facility above the floodplain (30 to 50 feet).
- Aquifer elevations fluctuate as much as 3 feet in conjunction with the amount of water in the Rio Grande.
- There is minimal recharge into the aquifers from precipitation.
- Hydraulic conductivities ranged from 2.5×10^{-4} cm/sec to 6×10^{-3} cm/sec in monitor wells tested at the Facility.
- The average gradient across the Facility is 0.013 (foot per foot).
- Based on the groundwater gradients indicated by the groundwater elevation maps and on results of the analytical sampling, it appears that the preferred pathway for groundwater flow at the site is via the former arroyos.

- Areas with elevated metal concentrations are detected within the buried arroyos, and areas associated with former storm water controls and Facility operations.
- Groundwater in the vicinity of the former unlined process ponds appears to be impacted by elevated metal concentrations.
- The risk based assessment for the on-Facility Diesel 2 groundwater remediation project classifies the alluvial aquifer as a Category II beneficial use aquifer with a water supply well within 0.5 miles of the Facility. The water supply wells are located upgradient of the Facility.
- Fate and transport modeling done by Hydrometrics indicated recharge from process ponds increases the rate of constituent migration in groundwater.
- Fate and transport modeling forecasts that it would take between 280 to 540 years for COCs to reach the Rio Grande.

Five significant former arroyos are located at the Facility (Figure 2-2):

1. Parker Brothers Arroyo.
2. Ponds 5 and 6 Arroyo.
3. Pond 1 Arroyo.
4. South Terrace Area Arroyo.
5. Acid Plant Arroyo.

The arroyos have been filled over time with a variety of materials, including slag cooled-in-place, re-deposited slag, crushed rock, brick, metal, concrete fragments, and native soils. The arroyos influence the direction of seepage flow from surface runoff. Storm runoff from the Facility is now controlled by the recently completed Storm Water Collection and Reuse System (Dames and Moore, 1998). These infilled arroyos form preferential flowpath ways beneath the Facility for groundwater and associated metal concentrations, as indicated by

groundwater troughs and associated elevated concentrations of COCs in the areas of former arroyos.

2.3.2 Field Activity Summary

Monitor wells EP-93 through EP-118 (total of 26) were installed as part of the Phase II RI to supplement the 23 wells installed during the Phase I RI (Table 2-1). Phase II RI monitor well depths range from 13 to 82 feet bgs. Wells were installed using sonic drill rig and hollow stem auger methods, and are located in the IAs in Table 2-1. Phase I and Phase II RI monitor well locations are in Exhibit 1.

All construction, development and sampling of monitor wells was consistent with the RI Work Plan. Laboratory reports are in Appendix I, and groundwater sample data are summarized in tables in Appendix H.

2.3.3 Distribution of COCs in Groundwater

The primary COCs (arsenic, cadmium, and lead) for the Facility were elevated in groundwater samples collected at the Facility during the Phase II RI. Groundwater at the Facility is not used for drinking water. The groundwater analytical results associated Phase I RI and Phase II RI sampling events are summarized in Table 2-12. Detailed analytical results are in Appendix H.

General water quality analytical results for groundwater samples, collected by Hydrometrics, are summarized as follows:

- pH: ranged from 5.3 to 8.7.
- DO: ranged from 0.03 mg/l to 12.1 mg/l.
- SC: ranged from 170 μ mhos/cm to 23,900 μ mhos/cm.
- TDS: ranged from 78 mg/l to 20,923 mg/l.
- TSS: ranged from <1 mg/l to 30,410 mg/l.

- Calcium: ranged from 8.3 mg/l to 960 mg/l.
- Magnesium: ranged from 1.1 mg/l to 501 mg/l.
- Sodium: ranged from 14 mg/l to 5,246 mg/l.
- Potassium: ranged from 2 mg/l to 858 mg/l.
- Total alkalinity: results ranged from 37 mg/l to 1,900 mg/l.
- Bicarbonate: ranged from 1 mg/l to 2,684 mg/l.
- Carbonate: ranged from less than 1 mg/l to 64.8 mg/l.
- Sulfate: ranged from 26 mg/l to 13,167 mg/l.
- Chloride: ranged from 5.3 mg/l to 3,600 mg/l.
- Fluoride: ranged from 0.47 mg/l to 33 mg/l.
- Nitrate and nitrite (as nitrogen): ranged from 0.05 mg/l to 294 mg/l.

Dissolved metal concentrations in groundwater samples, collected by Hydrometrics, are summarized as follows:

- Arsenic: ranged from less than the detection limit of 0.005 mg/l to 464 mg/l.
- Cadmium: ranged from less than the detection limit of 0.005 mg/l to 43 mg/l.
- Chromium: ranged from less than the detection limit of 0.01 mg/l to 0.24 mg/l.
- Copper: ranged from less than the detection limit of 0.025 mg/l to 5.6 mg/l.
- Iron: ranged from less than the detection limit of 0.1 mg/l to 2,381 mg/l.
- Lead: ranged from less than the detection limit of 0.003 mg/l to 0.13 mg/l.
- Selenium: ranged from less than the detection limit of 0.005 mg/l to 7 mg/l.
- Zinc: ranged from less than the detection limit of 0.02 mg/l to 1,900 mg/l.

Total metal concentrations in groundwater samples, collected by Hydrometrics, are summarized as follows:

- Arsenic: ranged from less than the detection limit of 0.005 mg/l to 221 mg/l.
- Cadmium: ranged less than the detection limit of 0.005 mg/l to 13 mg/l.
- Chromium: ranged less than the detection limit of 0.01mg/l to 0.24 mg/l.
- Copper: ranged less than the detection limit of 0.025 mg/l to 11 mg/l.
- Iron: ranged less than the detection limit of 0.1 mg/l to 868 mg/l.
- Lead: ranged less than the detection limit 0.003 mg/l to 10 mg/l.
- Selenium: ranged less than the detection limit of 0.005 mg/l to 5.7 mg/l.
- Zinc: ranged less than the detection limit of 0.01 mg/l to 420 mg/l.

2.3.4 Chemical Comparisons

Groundwater quality data collected during the Phase II RI are similar to results observed during the Phase I RI. Several monitor wells showed improvement in water quality constituents as compared to Phase I RI results. These changes in water quality will be discussed in Section 3.0. The following comparisons are based on groundwater quality in arroyos at the Facility that significantly influence groundwater flow paths beneath the Facility.

Pond 1 Arroyo

Concentrations of arsenic, lead and cadmium in groundwater samples collected from monitor wells EM-2, EM-4, EP-12, EP-14, EP-29, EP-35 and EP-43 downgradient of Pond 1 during the Phase II RI are similar to Phase I RI data. Pond 1 was a fresh water storage pond constructed in an arroyo located on the western property boundary and on the northern edge of the South Terrace Area. The arroyo downstream of the pond was filled with slag to support Facility operations. The water in the pond was from the Rio Grande and was utilized for general Facility water supply. Water collected from Pond 1, and groundwater collected from wells in the area, have similar chemical characteristics. The differences in water quality

between Pond 1 and monitor wells are attributed to evaporation of pond water, which causes increased pH, salinity (i.e., increased potassium and sodium concentrations) and generally increased concentrations of common ions. The pond geochemistry also has been affected (potential addition of metals and other constituents) by the water conveyed to the ponds that had accumulated in the area of the bedding and unloading facility due to excessive dust suppression activities and storm water runoff.

Ponds 5 and 6 Arroyo

Ponds 5 and 6 were constructed at the head of an arroyo drainage. The arroyo downstream of Ponds 5 and 6 was backfilled with smelter debris and slag. These ponds were used as process storage and makeup water. Pond water quality characteristics are substantially different from groundwater collected in the vicinity of the ponds. There are elevated COCs in groundwater collected downgradient from the ponds.

Monitor wells EP-116 and EP-117 were installed downgradient of Ponds 5 and 6 during the Phase II investigation. These wells show similar or higher concentrations of arsenic and lead than those wells closer to the ponds. This could be the result of differing concentrations in the ponds during past operations. Other contaminant sources in the vicinity of the Acid Plant may be contributing to the higher concentrations in wells more distant from the ponds.

South Terrace Area Arroyo

This arroyo is approximately in the middle of the South Terrace Area. Prior to being filled with slag, a Facility entrance was in this arroyo. Based on groundwater sample data, it is inferred that the groundwater quality impacts observed in monitor wells downgradient of the South Terrace Area are derived from the same source. No additional monitor wells were installed in this area during the Phase II investigations.

Acid Plant Arroyo

The area of the Acid Plant arroyo extends from the Facility's former Zinc operations area to the western property boundary. This arroyo has been filled with smelter debris and slag.

Data from some monitor wells in this IA have measurable amounts of diesel. Groundwater quality in these wells is affected by an upgradient diesel spill (see Section 1.0). Groundwater quality is largely affected by spills originating from the Acid Plant. One additional monitor well (EP-114) was installed downgradient of the Acid Plant as part of the Phase II RI. Concentrations of arsenic and cadmium are similar in EP-114 and EP-49.

Parker Brothers Arroyo

Parker Brothers Arroyo (named for the former owners of a slag processing operation in this area) is the western confluence of two other arroyos that extend from the flank of the Franklin Mountains. During Phase II, monitor wells EP-93, EP-94, EP-95, EP-96, EP-97, EP-98, EP-108 and EP-109 were installed to supplement Phase I results. Most COCs are below detection or below MCL values for groundwater. However, several trace metals exhibit elevated concentrations. One such exception is EP-78 immediately downgradient of an ephemeral pond which intermittently collects storm water from the arroyos. Average dissolved and total concentrations of arsenic at this location are 5.71 mg/l and 4.9 mg/l, respectively. It appears that the ephemeral pond is impacting groundwater quality.

2.3.5 Groundwater Elevations and Arroyo Flowpaths

Groundwater elevations across the Facility during the Phase II RI are comparable to those observed during the Phase I RI. Installation of additional wells and the temporary shut-down of some Facility operations altered the groundwater elevation maps for monitoring events between August 1999 and February 2000. Additional wells allowed better definition of groundwater elevations in areas previously unmapped. With the temporary Facility shut down, probable sources of artificial recharge were minimized, notably in the vicinity of EP-26. Groundwater elevation maps for Phase II monitoring events are in Figures 2-12 through 2-18.

As observed during the Phase I RI, groundwater flow paths appear to be significantly influenced by buried arroyos beneath the Facility. Supplemental monitor wells in the arroyos east of I-10, and in the arroyos downgradient of the Facility, further support this observation.

Maps of average dissolved and total concentrations of arsenic, cadmium and lead in surface water and groundwater are in Figures 2-19 through 2-24.

Notable differences in COC concentrations at selected locations can be attributed to a change from dissolved to total metal analyses of the water samples that occurred in August 1999. Figures 2-19 through 2-24 include groundwater elevation contours for February 2000, and the center lines of the five significant arroyos on the Facility. The centerlines are based on topography prior to construction of the Facility (see Figure 2-2).

There is a strong correlation between groundwater flow paths and the alignments of the arroyos and metal concentrations in groundwater. Phase I RI and Phase II RI data support the conclusion that the highest concentrations of arsenic, cadmium and lead in groundwater are largely associated with wells within the arroyo flow paths downgradient from source areas.

SECTION 3.0

RELATIONSHIP BETWEEN SMELTER OPERATIONS AND POTENTIAL SOURCE AREAS AND MATERIALS

3.0 RELATIONSHIP BETWEEN SMELTER OPERATIONS AND POTENTIAL SOURCE AREAS AND MATERIALS

This section provides an expanded description of materials associated with the fourteen IAs based on Phase I and Phase II RI results. As discussed in Section 2.0, the Phase II RI provides additional soil, surface water and groundwater data to supplement Phase I RI information (Hydrometrics, 1998). Phase II RI data were used to refine the extent of elevated metal concentrations, and to further evaluate the release mechanisms and exposure pathways of COCs. Information presented in this section of the report advances concepts to further develop corrective action objectives, corrective action alternatives and corrective action measures presented in Section 4.0.

Table 3-1 provides details regarding the status of individual IAs. Appendices D and H present summaries of analytical data for soil and groundwater, respectively. Average chemical constituent concentrations in soils as a function of depth, for both Phase I and Phase II RI data, are graphically presented in Appendix E. Groundwater level measurement data are in Appendix G.

3.1 OVERVIEW

As described in the Phase I RI Report, materials associated with potential source areas are separated into the following three source material categories based on metal concentrations, distribution and volume of materials, visual characteristics, impacts to water resources, and degree of potential toxicity. The material categories for the Facility are as follows:

Category I: Category I materials are residual by-products typically associated with specific current and past Facility operations. Based on the results of the remedial investigation, Category I materials are associated with distinctly elevated concentrations of metals in underlying groundwater.

Category I materials include but are not limited to the following:

- Sulfuric acid.
- Acid Plant scrubber water/solids (from leaks, etc.).
- Acid Plant water treatment facility filter cake.
- Liquid leakage from process gas flues going to the Acid Plants.
- Leachate from Sulfuric Acid Reacting with slag fill material.
- Cottrell dusts (Reverb, Roaster, Converter, ConTop, Sinter Facility).
- Spray Chamber dusts (Reverb, Roaster, Converter, ConTop).
- Converter Building ventilation baghouse dust.
- Baggouse and other dusts from former Lead Plant and Sinter Operations.
- Feed materials, including lead and copper concentrates, speiss and matte.
- Fine materials in the Slag Storage Area.

Category II: Category II materials are large volumes of residual by-products with lower COC concentrations than Category I materials. Category II materials also include smelter debris such as brick, flues and other materials from demolition of smelter facilities taken out of commission in the past which have residual concentrations of metals. Based on the results of the RI, Category II materials do not currently represent a source of metals to the underlying groundwater, but could become a potential source in the future if conditions at the surface are not properly managed.

Category III: Category III materials are copper slag and fumed lead slag. These are largely inert materials with no anticipated human health or environmental impacts.

As discussed in Section 1.0, the Phase II RI data submitted in this report serve to supplement the data presented in the Phase I RI, (Hydrometrics, 1998) and to verify or extend evaluations and conclusions presented in the Phase I RI document. The rationale for the distribution and evaluation of Category I, II and III materials was provided in the Phase I RI Report. Key points developed during the Phase I RI are summarized as follows:

Primary COCs - Arsenic, cadmium and lead were determined to be the primary COCs for this project because they occur in soil and groundwater at elevated concentrations. Selenium, another COC identified in the Phase I RI, which impacts soil and groundwater to a lesser degree. At some locations, the occurrence of elevated concentrations of COCs observed in groundwater may be related to former and/or current Facility operations. Other metals and indicator parameters were monitored in soils, surface water and groundwater at the Facility. Elevated concentrations of COCs were not observed in nearby off site surface water bodies (the Rio Grande and American Canal) during the Phase II RI.

Selection of Phase II RI Sample Locations - The primary objective of the Phase II RI is to provide supplemental data to support an evaluation of the location and extent of Category I, II and III materials. Specifically, the Phase II RI focused on the identification of Category I materials to be excavated and disposed of in on-site lined repositories, and Category II materials to be capped in place.

The purpose of this investigation was also to collect data to support the design of corrective action measures. Field investigations were designed such that results can be used to choose locations for subsequent samples. This phased approach uses the following components:

- Visual identification of features associated with former smelter operations.
- The relationship of soil and operational elements, former arroyos, and potential groundwater impacts at the Facility.

- Evaluation of the estimated volumes of source material(s) associated with Facility IAs.
- Laboratory testing to evaluate both the vertical and horizontal estimated boundaries of the potentially impacted areas of the Facility.

Groundwater, Arroyos and Source Materials - The Phase I RI Report, and Section 2 of this report, describe the flow of groundwater beneath the Facility area is influenced by former arroyos, or drainages. These arroyos are infilled with alluvial and smelter related materials, which have a higher hydraulic conductivity than the native rocks and soils which form the original natural topography.

Evidence obtained during the RI shows that these arroyos function as pathways for preferential groundwater flow, including water table elevation data (see Section 2.0), original topographic data (Section 1.0), and the occurrence and distribution of COCs (Section 2.0 and this section). Changes in COC groundwater concentrations from the Phase I RI period to the Phase II RI period in groundwater beneath the Facility, may be attributed to:

- Decommissioning of ponds and other smelter components.
- Temporary cessation of smelter operations.
- Capping and other storm water control elements recently implemented at the Facility.

The key points described above are discussed in the following sections as they relate to the characterization of each of the IAs. A summary of each IA that includes a description of source materials, estimated areas and volumes of source materials, and remedial status is in Table 3-1.

The potential for impacts from many of the identified source areas at the Facility have been eliminated or reduced by removal or capping of source materials. These activities have been performed in conjunction with the implementation of the Storm Water Control and Reuse System, operational changes, or other institutional control elements (see Table 3-1). Areas and volumes of source materials subject to corrective action measures, and the status of the proposed corrective actions shown in Table 3-1 are discussed in Section 4.0 of this report.

3.2 CONVERTER BUILDING/BAGHOUSE AREA (IA-1)

Information concerning the Converter Building/Baghouse Area (IA-1), including background data, soil and groundwater impacts, and a summary is presented in the following sections.

3.2.1 Background Information

IA-1 is located south of the Acid Plant Mist Precipitator Building and west of the Converter Building Ventilation Baghouse (Exhibit 1 and Figure 3-1). This IA includes the Medford Sump, which is used to control storm/process water from the Spray Chamber and the Converter Building Ventilation Baghouse facilities. The Medford Sump accumulates by-products of the smelter operation. These by-products accumulate in the Medford Sump area, and are considered to be a source of metals to groundwater via the underlying back-filled arroyo.

IA-1 was characterized during the Phase I RI with two existing monitor wells (EP-51 and EP-52), five borings (surface to 5 feet bgs) and surface soil samples. Metal concentrations at 5 feet bgs (the total depth of the borings) did not decrease, therefore, three additional borings were advanced to groundwater, and additional monitor wells in the vicinity of Medford Sump and in the Arroyo were added, as part of the Phase II RI.

The Medford Sump was reconstructed in 1999 as part of the Facility Storm Water Control and Reuse System previously discussed. During construction activities, material was removed from an area measuring approximately 20 feet wide by 40 feet long by 15 feet deep (about 444 cy) as part of the reconstruction of the Medford Sump (Figure 3-1). This

excavation eliminated Category I source material in IA-1. Excavated soils were transported and disposed of at a permitted off-site hazardous waste landfill.

The majority of IA-1 is capped by asphalt or buildings, which limits downward migration of surface fluids. These improvements, along with implemented or planned operational improvements, have eliminated or greatly reduced soil and groundwater impacts in this IA.

3.2.2 Soil

IA-1 soils are characterized with borings BH-1, BH-2 and EP-100. In the Phase I RI the soils in this area were characterized by soil borings SSIA1-1 through SSIA1-5. A total of 38 soil samples were collected from IA-1 during the Phase II RI (see Table 2-1), from three borehole locations (Figure 3-1). Boring EP-100 was completed as a monitor well. Phase II RI soil sample analysis results for IA-1 are summarized in Table 3-2.

IA-1 soils are characterized as gravelly, silty and clayey fine sands overlain by fill materials, composed of gravelly sand and debris. The soils and subsurface materials in this IA have been disturbed, reworked, altered and amended during the 100 plus years of operations at the Facility. Topographically low areas were filled in with soils, rock, slag or smelter debris, and re-graded in successive layers as Facility operations expanded and changed over time.

The results of the Phase II RI soil sample analysis reflect similar trends as those observed during the Phase I RI. Arsenic and lead appear to be the primary soil COCs, with concentrations ranging from 10 mg/kg to 2,300 mg/kg for arsenic and 10 mg/kg to 1,900 mg/kg for lead. Average concentrations of COCs are 175 mg/kg for arsenic, 72.6 mg/kg for cadmium and 305 mg/kg for lead. The highest metals concentrations in soils observed during the Phase II RI were lower than the highest concentrations observed in the Phase I samples. This is consistent with the heterogeneous composition of the soils and fill materials accumulated in IA-1, as well as in other IAs.

The general trend observed for concentrations of metals in soils in IA-1 is for the highest concentrations to occur within the first 1 to 5 feet bgs, and then decrease with depth. The highest concentrations of metals observed were near Medford Sump. Borings immediately outside the Medford Sump area have significantly lower metal concentrations.

3.2.3 Groundwater

Groundwater samples for IA-1 were collected from Phase I monitor wells EP-51 and EP-52, and from Phase II monitor wells EP-100 and EP-115 (Figure 3-1). A summary of groundwater monitoring results for IA-1 is in Table 3-3.

Groundwater flows from east to west across this area, and occurs at a depth of approximately 50 feet bgs. The primary hydrogeologic feature of IA-1 is a slag and soil backfilled arroyo. The arroyo is approximately 200 feet long, 200 feet wide, and 60 feet deep. The arroyo appears to channel and control unsaturated and to some extent, saturated groundwater flow beneath the Facility in this area. Relatively higher concentrations of metals in groundwater also appear to be associated with this, and other area arroyos underlying the Facility.

Arsenic, cadmium and lead are all COCs in groundwater associated with IA-1. The Phase II RI monitor wells generally show lower concentrations of COCs than those installed during Phase I. Average total arsenic, cadmium and lead concentrations for EP-100 are 0.033 mg/l, and 0.009 mg/l, respectively, and for EP-115 are 0.270 mg/l, 0.645 mg/l and 0.100 mg/l, respectively. For EP-51, average total arsenic, cadmium and lead concentrations are 0.773 mg/l, 0.033 mg/l, and 0.026 mg/l, respectively, and for EP-52, total arsenic, cadmium and lead concentrations are 1.29 mg/l, 0.68 mg/l and 0.567 mg/l, respectively.

Generally, average arsenic and cadmium concentrations in groundwater are an order of magnitude less than the corresponding Phase I RI average concentrations, indicating that the recent sump reconstruction and storm water improvements are having a positive effect. The temporary cessation of operations at Facility Acid Plants may have also been beneficial. The average lead concentration in groundwater increased slightly for the period of record.

3.2.4 Summary

Selected soils in IA-1 have been impacted by Facility processes, and have contributed to associated groundwater impacts. Arsenic, cadmium and lead are the principal COCs. Associated soils in IA-1 had elevated concentrations of arsenic and lead. Recent storm water control improvements have been implemented and, including removal of some Category I materials. Operational controls consisting of Acid Plant repairs leaks and improved procedures have eliminated or reduced process solution releases in the area. As shown on Figure 3-1 and presented in Table 3-1, most of the Category II materials in IA-1 are currently capped.

With the storm water improvements and soil excavation implemented in IA-1, this source has been eliminated or greatly reduced, as evidenced by the lower Phase II metal concentrations observed at monitor well EP-51. With the addition of the asphalt cap in IA-1, the area now serves to control or isolate Category II materials from contact with future storm/process waters. As will be discussed in Section 4.0, these improvements, in combination with source material removal, will eliminate or reduce the potential for metals to migrate to the groundwater.

3.3 BONEYARD/SLAG AREA (IA-2)

Information concerning the Boneyard/Slag Area (IA-2), including background data, soil and groundwater impacts, and a summary is presented in the following sections.

3.3.1 Background Information

The Phase II RI focuses on the current IA-2, (Figure 3-2), which includes the former Boneyard area. The remaining areas covered in the Phase I RI subarea 2 has been subdivided into IA-11 (Arroyos East of I-10), and IA-12 (Ephemeral Pond and Pond Sediment Storage Area).

IA-2 is a boneyard (heavy equipment storage yard) in a slag storage area (Exhibit 1, Figure 3-2). Materials previously stored at the boneyard included drums of mixed materials, mist eliminator candles, saddles, fiberglass reinforced flues, plastic saddles and other miscellaneous equipment. These materials have been removed. The area is located above a back-filled arroyo. The slag storage was active until February 1999 when smelting operations were temporarily halted. Adjacent to and upgradient of the slag area is an acid storage area.

As part of the Phase I RI, IA-2 was characterized with one existing monitor well (EP-53), the construction of seven new monitor wells (EP-75, EP-76, EP-78, EP-79, EP-81, EP-83 and EP-85), six soil borings advanced to groundwater and, two surface soil samples (surface to 3 feet bgs). IA-2 was separated into two subareas during the Phase I RI. It was determined that subarea 1 and 2 of IA-2 would require further investigation as part of the Phase II RI.

3.3.2 Soil

IA-2 was characterized in Phase II RI with borings BH2-1, BH2-3, BH2-4, BH2-5, BH2-6, BH2-7 and EP-99. In the Phase I RI, the soils in this area were characterized by soil borings SSIA2-1, EP-75 and EP-76. A total of 35 soil samples were collected from IA-2 during the Phase II RI (see Table 2-1) from seven borehole locations (Figure 3-2). As with the Phase I RI, only soil samples beneath the slag were collected from boreholes beginning at depths of 35 and 45 feet, respectively. Depth of soil sampling was a function of the thickness of the slag, which was logged but not sampled. Phase II RI soil sample analysis results for IA-2 are summarized in Table 3-4.

IA-2 soils are characterized as gravely silty and clayey sands overlain by slag and smelter debris materials. The soils and subsurface materials in IA-2 have been disturbed, reworked, altered and amended during the 100 plus years of operations at the Facility. Topographically low areas were filled in with soils, rock, slag or Smelter debris, and re-graded in successive layers as Facility operations expanded and changed through time. Previously a layer of soil

material approximately 1 foot thick was placed on the former lead slag area to provide a level heavy equipment storage yard (the Boneyard area in IA-2).

The results of the Phase II RI soil investigation have trends similar to those observed during the Phase I RI. COC concentrations in IA-2 are relatively less than those associated with IA-1. Impacts from COCs in IA-2, which are arsenic and cadmium, appear minimal. Average concentrations of COCs are 214 mg/kg for arsenic, 184 mg/kg for cadmium and 37.6 mg/kg for lead. Arsenic, cadmium and lead concentrations range from 10 mg/kg to 3,700 mg/kg, 10 mg/kg to 1,600 mg/kg, and 10 mg/kg to 790 mg/kg, respectively.

Elevated metal concentrations occurred primarily in the first foot bgs at borings SSIA2-2 and EP-76 as first outlined in the Phase I RI Report. An area of approximately 30,222 square feet was excavated to 1 foot bgs in this area as part of corrective action measures outlined in the Phase I RI Report subsequent to the Phase I RI. The excavated materials were transported and disposed of in a permitted off-site hazardous waste landfill.

Subsequent to the removal of surficial soils in the Boneyard, lead slag excavated for the new storm water pond in IA-14 as part of the Storm Water Control and Reuse System construction was placed in this area. This increased the general elevation of the slag deposition area by approximately 15 feet since the Phase I RI.

Materials with elevated concentrations of COCs beneath the slag at depths between 35 and 65 feet bgs were identified during the Phase I RI. Several additional borings were advanced in IA-2 to characterize these materials. Concentrations of arsenic and cadmium are elevated in the area of Boring BH-2-6, underlying the slag at a depth of 9 to 42 feet bgs. The highest concentration of metals is arsenic at a depth of 15-17 feet bgs for BH-2-6 is 3,700 mg/kg. The majority of arsenic, cadmium and lead concentrations in IA-2 are below 100 mg/kg.

As was observed during the Phase I RI, elevated values of COCs may be associated with Acid Plant sludge historically stored in this area and/or the possibility of leaks from the Bulk