Texas Custodial Trust

2301 West Paisano Drive • El Paso, Texas 79922

Supplemental Remedial Investigation Report

STATE OF TEXAS
ROBERT A. MONGRAIN
GEOLOGY
4447
LICENSED
PROFESSIONAL GEOSCIENTIST

Former ASARCO Smelter Site
El Paso, Texas

November 2013

Report Prepared By:

Malcolm Pirnie, Inc.

211 North Florence
Suite 202
El Paso, Texas 79901
Tel: (915) 533-9025

6835001

MALCOLM PIRNIE

Table of Contents

TABLES

FIGURES

APPENDICES

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ROBERT A. MONGRAIN
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ACRONYMS AND ABBREVIATIONS

AA	Assessment Area
amsl	above mean sea level
AOI	analytes of interest
ASARCO	ASARCO LLC
bgs	below ground surface
BRA	baseline risk assessment
BTEX	benzene, toluene, ethylbenzene, and xylenes
COC	constituents of concern
Contop-Reverb area	Contop-Reverb-Converter Building/Baghouse IA and Electrostatic Precipitation Area
CSM	Conceptual Site Model
DC	direct current
°F	degrees Fahrenheit
GSI	groundwater and surface water interaction
GW-Ind	groundwater standard for industrial use (RRS3)
I-10	U.S. Interstate 10
IA	Investigation Area
IBWC	International Boundary and Water Commission
K	hydraulic conductivity
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MSC	Medium Specific Concentrations
NAD 83	North American Datum of 1983
NAPL	non-aqueous phase liquid
PCB	polychlorinated biphenyl
PCL	protective concentration levels
ppm	parts per million
PRB	passive reactive barrier
PVC	polyvinyl chloride
RAP	Remedial Action Plan
RAWP	Remedial Action Work Plan
Report	Supplemental Remedial Investigation Report
RI	Remedial Investigation
RRR	Risk Reduction Rules (30 TAC 335)
RRR GW_{Res}	Risk Reduction Rules residential groundwater values
RRS3	Risk Reduction Standard 3
SAI-Ind	soil/air ingestion standard for industrial use (RRS3)

SAI-Res	soil/air ingestion standard for residential use (RRS3)
Site	the former ASARCO LLC Smelter Site located in El Paso, Texas
SPLP	Synthetic Precipitation Leaching Procedure
SSE	selective sequential extraction
SVOC	semi-volatile organic compound
SWCRS	Storm Water Collection and Reuse System
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TCLP	Toxicity Characteristic Leaching Procedure
TNRCC	Texas Natural Resources Conservation Commission
TPDES	Texas Pollutant Discharge Elimination System
TPH	total petroleum hydrocarbons
TRRP	Texas Risk Reduction Program (30 TAC 350)
Trust	Texas Custodial Trust
TSWQS	Texas Surface Water Quality Standards
TxDOT	Texas Department of Transportation
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
ZVI	zerovalent iron

Executive Summary

This Supplemental Remedial Investigation (RI) Report (Report) has been prepared by Malcolm Pirnie for the Texas Custodial Trust (Trust) to summarize data collected to date and present a comprehensive environmental dataset to provide the basis for future remediation activities at the former ASARCO LLC (ASARCO) Smelter Site located in El Paso, Texas (the Site).

The Site is no longer an active industrial facility. Under the terms of the Environmental Custodial Trust Agreement dated December 9, 2009, the Trust is responsible for conducting, managing, and/or funding the implementation of environmental actions at the Site. The Trust evaluated the results of previously completed RI activities and concluded that supplemental RI activities would be necessary to provide additional data on which to base remediation requirements, future use scenarios, and to preserve flexibility in considering redevelopment options. Conclusions from this evaluation will be used to inform and evaluate the development of a revised remedial strategy in a subsequent Remedial Action Plan.

This Report is intended to:

- Document the Trust's rationale for further investigation, including changes in regulatory approach and future intended land use which resulted in supplemental RI activities and the preparation of this Report (Section 1.2);
- Document the remedial actions conducted to date (Section 1.5);
- Describe how the supplemental RI activities and previous RI activities are combined to provide a complete assessment of Site conditions (Section 2);
- Summarize the supplemental RI activities conducted by the Trust (Section 3);
- Present a comprehensive environmental dataset that compiles data collected by ASARCO, the Trust, the Texas Commission on Environmental Quality (TCEQ), the United States Environmental Protection Agency (USEPA), and others for the Site (Section 4);
- Delineate the nature and extent of constituents of concern (COCs) and analytes of interest (AOIs) that exceed the risk-based assessment levels developed for the Site, and define the final COC list (Section 4); and

- Identify specific areas where COCs and AOIs are present in soil, groundwater and/or surface water for the purpose of defining areas for evaluation of future remedial activities (Sections 4 and 5).

Most structures at the Site have been demolished and some remedial activities are underway. Land use in the vicinity of the property includes mixed industrial, commercial and residential. Since the plant has been almost entirely demolished, it is no longer appropriate to define areas for remedial planning based on plant operational areas. Consequently, Assessment Areas (AAs) were designated based on probable exposure pathways and historical arroyo boundaries. Screening standards for each media were determined based on potential future land uses within each AA and in a manner consistent with the previous RIs approved by TCEQ.

Analysis of results of previous and supplemental RI activities, compared to the screening standards developed for the Site, indicates that the Site has been adequately characterized to support identification and implementation of final remedial actions.

The soils of the Site consist of fill and a mix of native alluvium and colluvium. Fill material consists of slag, native soil, and other anthropogenic materials such as concrete and asphalt. Concentrations of COCs and AOIs above relevant criteria have been observed in both fill material and native soil. The nature and extent is delineated to the screening standards for all COCs and AOIs.

Groundwater at the Site occurs within an unconfined alluvial aquifer with a saturated thickness ranging from approximately 8 to 60 feet underlain by a regional, lower permeable bedrock unit. Groundwater in the alluvial aquifer flows west and southwest through the Site toward the Rio Grande. There is negligible hydraulic connection between bedrock and the alluvial aquifer. Bedrock groundwater is not impacted by Site COCs or AOIs. Groundwater at the Site is not used as a drinking water source. Alluvial water supply wells are not affected by impacted groundwater from the Site. Concentrations of COCs and AOIs in groundwater have been delineated to below screening standards or to the physical extents of each arroyo, with the exception of arsenic concentrations. Additional field work will be completed in the south arroyo of the East Property AA to delineate concentrations of arsenic and inform remedy selection.

The Site surface water has been characterized and delineated site-wide and with respect to all appropriate COCs and AOIs. The primary surface water bodies near the Site are the American Canal and the Rio Grande, which constitute a single AA. With the exception of arsenic in the American Canal and iron in the Rio Grande, concentrations of COCs at the most downstream sampling locations are below background concentrations or the applicable screening standards.

1. Introduction

This Supplemental Remedial Investigation (RI) Report (Report) has been prepared by Malcolm Pirnie for the Texas Custodial Trust (Trust) to summarize data collected to date and present a comprehensive environmental dataset to provide the basis of decisions for future remediation activities at the former ASARCO LLC (ASARCO) Smelter Site located in El Paso, Texas (the Site). Site remedial actions are being conducted by the Trust, which is acting as the property Trustee on behalf of the Trust beneficiaries: the Texas Commission on Environmental Quality (TCEQ) and the United States Environmental Protection Agency (USEPA).

1.1. Objective

Substantial investigation and remediation activities have been conducted at the Site since the early 1990s. As discussed in the April 2011 Remedial Action Work Plan (RAWP; Malcolm Pirnie, 2011a), much of the investigative work was complete at the time the RAWP was prepared; however, the Trust identified data gaps where further investigation was required. This Report, therefore, has been prepared with the following objectives:

- Provide documentation of the Trust's rationale for further investigation, including changes in regulatory approach and future intended land use which resulted in supplemental RI activities and the preparation of this Report (Section 1.2);
- Summarize the remedial actions conducted to date (Section 1.5);
- Describe how the supplemental RI activities and previous RI activities will be combined to provide a complete assessment of Site conditions (Section 2);
- Summarize the supplemental RI activities conducted by the Trust (Section 3);
- Present a comprehensive environmental dataset that compiles data collected by ASARCO, the Trust, TCEQ, USEPA, and others for the Site (Section 4);
- Delineate the nature and extent of constituents of concern (COCs) and analytes of interest (AOIs) that exceed the risk-based assessment levels developed for the Site, and define the final COC list (Section 4); and
- Identify specific areas where COCs and AOIs are present in soil, groundwater and/or surface water for the purpose of defining areas for evaluation of future remedial activities (Sections 4 and 5).

1.2. Regulatory Approach

The Site remedy envisioned during the formation of the Trust and the rationale behind changes in the regulatory approach to Site remediation are summarized below, along with proposed documents to be prepared in support of future Site activities.

1.2.1. Expert Report and Agreed Remedy

The current agreed remedy to be implemented by the Trust is outlined in the 2009 Expert Report prepared by TCEQ (2009). The agreed remedy includes the following actions:

- Asphalt capping 75.5 acres on the plant property;
- Constructing an additional landfill cell;
- Moving 279,611 cubic yards of soil to the new onsite landfill;
- Excavating material located east of U.S. Interstate 10 (I-10) and placing the material in the new onsite landfill;
- Installing 80 extraction wells and a 3,000-foot slurry wall along the plant slope parallel to U.S. Highway 85 (Paisano Drive);
- Fencing the east side of the property; and
- Continuing groundwater treatment and monitoring for 50 years.

1.2.2. Revised Land Use

The agreed remedy presented in the 2009 Expert Report (TCEQ, 2009) was based on the assumption that the smelter would remain operational. The potential for redevelopment of selected areas of the Site, therefore, was not considered. In consideration that the smelter was to close permanently, the Trust was obliged to reconsider the scope and purpose of the agreed remedy. Also, the Trust determined the Site had potential for redevelopment under residential and/or industrial/commercial land use scenarios. This determination was made in consultation with the City of El Paso, Texas (City of El Paso, 2012). As a result, the proposed changes in future land use triggered a re-evaluation of Site COCs, AOIs, and supplemental RI activities as documented in this Report. Conclusions from the re-evaluation will be used to guide decision-making and evaluate the revised remedial strategy for the Remedial Action Plan (RAP).

Data collected to date are considered in the selection of an expanded list of COCs using criteria relevant for the revised future land use and remedial strategy (Section 2.3).

1.2.3. Supporting Documentation

This Report documents the supplemental RI activities and nature and extent of COCs and AOIs across the Site. The Trust will prepare additional documents updating the conceptual site model (CSM), describing revised exposure pathways, developing protective concentration levels (PCLs), and proposing a revised remedy consistent with anticipated land use that is protective of human health and the environment. These reports are described below in Table 1-1, along with an anticipated schedule

Table 1-1 Regulatory Document Summary

Document	Document Objectives	Proposed Schedule
Supplemental RI Report (this Report)	• Delineate the nature and extent of COCs and AOIs • Define areas (soils, groundwater or surface water) that need to be evaluated as part of the final remedy	Fourth Quarter 2013
Letter Requesting Move to TRRP	• Update the Site to current TCEQ regulatory program (TRRP)	First Quarter 2014
CSM, Pathway Evaluation and PCLs Development	• Define sources of COCs in environmental media, mechanisms of release, and potentially complete exposure pathways for each AOI at the Site • Update exposure pathway evaluation in accordance with proposed land use and TRRP rules • Define PCLs that must be addressed for each environmental medium (soil, groundwater, surface water) in the RAP	First Quarter 2014
RAP	• Develop a specific plan for corrective actions (final remedy) for each of the potential exposure media (soil, groundwater, surface water)	Second Quarter 2014

Notes:

TRRP: Texas Risk Reduction Program (30 Texas Administrative Code [TAC] 350)

1.3. Site Background

The Site covers an area of approximately 430 acres within the city limits of El Paso, Texas (Figure 1-1). The property is bisected by I-10 and U.S. Highway 85 (Paisano Drive). There are small non-contiguous properties in the Site vicinity.

Over the course of years, the Site has been home to several smelting operations: a lead smelting plant began operations in 1887; following a fire, the plant was reconstructed in 1902. In 1910 a plant was constructed to produce copper by smelting concentrates. Lead and copper smelting activities were expanded in the 1930s and a Godfrey roaster was added for the production of cadmium oxide. A zinc plant was added in 1948 and an antimony plant and sinter plant with unloading and bedding systems were added in the 1970s.

In 1982, ASARCO began closing plant components, starting with the zinc plant. The lead plant was closed in 1985 and some structures were remodeled as a mobile equipment shop and storage/pilot plant. The antimony plant ceased operation in 1986. In 1992, the cadmium plant closed (Hydrometrics, 1998). The copper smelter continued to operate until February 1999.

From 1992 to 1997, ENCYCLE/Texas Inc., an ASARCO subsidiary located in Corpus Christi, Texas, transported materials to the ASARCO smelter facility. These materials included hazardous waste, referred to collectively as the ENCYCLE materials. The ENCYCLE materials were fed into the copper smelting process to recycle the metals content. A review of all available documents provided by USEPA and TCEQ related to the ENCYCLE materials is presented in Appendix A.

In 2005, ASARCO declared Chapter 11 Bankruptcy. As part of the bankruptcy proceedings between ASARCO, the U.S. Department of Justice and the State of Texas, an agreed remedy was developed for the Site and documented in the 2009 Expert Report prepared by TCEQ (2009). The Trust was established in December 2009 to oversee the cleanup and eventual sale of the property.

1.3.1. Land Use

The Site is no longer an active industrial facility: most structures have been demolished and remedial activities are being conducted. Upon completion of remedial activities the Site will be available for redevelopment. Land use in the vicinity of the property includes mixed industrial, commercial and residential, as indicated below (Figure 1-2).

- East of the Site: Residential, light industrial and commercial, land owned by the University of Texas El Paso;
- South of the Site: Railroad tracks, American Canal, light industrial and commercial;
- West of the Site: Railroad tracks, International Boundary and Water Commission (IBWC) American Dam office, industrial (brick manufacturer), U.S.-Mexico border; and
- North of the Site: Commercial, industrial (concrete plant), and residential.

1.4. Environmental Setting

The environmental setting for the Site and surrounding areas is described below, including geography and topography, soils, surface water and groundwater, groundwater use, land use, and climate.

1.4.1. Geography and Topography

The Site is located in El Paso County within the Rio Grande Valley floodplain in the Basin and Range Physiographic Province of western Texas, in the Rio Grande (or El Paso) Canyon between the Franklin Mountains to the northeast and the Cerro De Cristo Rey to the southwest in Mexico. North of the Site, the Rio Grande flows southeastward through the Mesilla Basin (Bolson). Approximately 2 miles upstream of the Site, the valley narrows and forms El Paso Canyon. This canyon is approximately 3 miles long and widens into the Hueco Bolson about 1 mile downstream from the Site.

The City of El Paso is located at an elevation from 3,600 feet above mean sea level (amsl) in the floodplain of the Rio Grande to greater than 7,000 feet amsl in the mountainous terrain of the Franklin Mountains. The center of the Site is located within the Rio Grande Valley floodplain at an elevation of approximately 3,700 feet amsl near the river. Elevations on the Site property increase from west to east, with the highest elevation of 4,140 feet amsl in the southeastern portion of the property.

1.4.2. Soils

The predominant soil in the vicinity of the Site is the Delnorte-Canutillo Association hilly soil. This soil type is characterized by nearly level to steep soils that are: 1) shallow or very shallow, overlying caliche; or 2) deep and gravelly throughout (USDA, 1971).

The surface soils of the Site consist of fill and a mix of sediments generated from erosion of the Campus Andesite and the Franklin Mountains and fluvial sediments from the Rio Grande, with areas of extensive fill. Fill material has been found to comprise slag, native soil, and other anthropogenic materials such as concrete and asphalt.

1.4.3. Surface Water

The two primary surface water features are located west of the Site and are the Rio Grande and the American Canal. The American Canal is used to divert a portion of the surface water flow from the Rio Grande to water users in the United States. The Rio Grande is used to deliver water to water users in Mexico. Water is released from Elephant Butte Reservoir to the Rio Grande and American Canal during spring and summer and is used for irrigation and drinking water purposes. During fall and winter, flows in the Rio Grande decrease significantly as water is no longer released from Elephant Butte Dam by IBWC.

The Rio Grande is a gaining stream as it flows along the Site; however, it can also recharge groundwater to the floodplain during short periods when the river stage increases. Groundwater levels can fluctuate seasonally by approximately 1 to 3 feet in response to stage changes in the Rio Grande, as discussed below.

In addition to the Rio Grande and the American Canal, there are three stormwater collection ponds operated as part of the onsite Stormwater Collection and Reuse System (SWCRS) and one active ephemeral drainage (Parker Brothers Arroyo) onsite that are typically dry except during, or immediately after, precipitation events (Figure 1-3). Historically there four additional ephemeral arroyos (Pond 5 and 6, Pond 1, South Terrace Area and Acid Plant) which have been filled as part of the smelter expansion. The onsite SWCRS is operated as a zero discharge facility.

Within the SWRCS, stormwater is collected from a network of onsite sumps and directed to three onsite stormwater ponds that have approximately 12,000,000 gallons of capacity. Stormwater captured by this network evaporates and is only discharged through the onsite outfall, located upstream of the American Dam, if the stormwater discharge limits are met. If the discharge limits are not met, water is treated to and then discharged to the outfall. To date, treatment of the water has not been required. Water quality limits are set in the Site Texas Pollutant Discharge Elimination System (TPDES) Multi-Sector General Permit No. TXR050000 as part of the Trust's permit (Permit No. TXR05Y986).

1.4.4. Groundwater Hydrogeology

Groundwater at the Site occurs within an unconfined alluvial aquifer with a saturated thickness ranging from approximately 8 to 60 feet underlain by a regional, less-permeable bedrock unit. Groundwater in the alluvial aquifer flows west and southwest through the Site toward the Rio Grande. Groundwater from the Site ultimately discharges to the Rio Grande and sections of the American Canal.

The arroyos described above convey much of the groundwater flow through the Site and have a significant impact on groundwater recharge and transport of COCs and AOIs. Seasonal fluctuations of up to 8 feet are observed along the Parker Brothers Arroyo due to enhanced groundwater recharge from ponded stormwater. High water table conditions occur in July and August due to increased precipitation, with low water table conditions occurring from November through February as precipitation decreases. Groundwater can be found at a depth of 8 to 10 feet below ground surface (bgs) at the west of the Site in the Rio Grande floodplain and at a depth of 50 to 60 feet bgs in the eastern portion of the Site.

Alluvial Aquifer

The primary hydrogeologic unit at the Site is an unnamed alluvial aquifer, which includes the upland portion of the Site and the Rio Grande floodplain. The upland alluvial system is defined by the depositional history of the former arroyos that were backfilled during Plant operations. The former arroyos eroded the bedrock surface and created a highly variable depositional setting and significant spatial variation in the hydraulic characteristics of the alluvial groundwater system. The drainage divides of the former arroyos and their significance for Supplemental RI activities are discussed in Section 2.1.

Recharge to the alluvial aquifer is primarily from precipitation and there is significant seasonal variability. Recharge amounts are greatest in arroyos, where groundwater flow from each drainage basin is focused. During high flow conditions the Rio Grande and, to a lesser extent, the American Canal, also recharge the alluvial groundwater for short periods. Additional information on the alluvial aquifer is presented in Appendix B1 and the groundwater and surface water interaction (GSI) at the Site is discussed in detail in Appendix C.

Depth to groundwater in the alluvial aquifer ranges from between 8 to 10 feet bgs to 50 feet bgs corresponding to groundwater elevations ranging from approximately 3,790 feet amsl at the east of the Site, to 3,720 feet amsl in the Rio Grande floodplain. The occurrence of saturated alluvium is discontinuous across the Site due to variations in the bedrock elevation as well as significant decreases in hydraulic conductivity in areas where primarily fine-grained sediments are found.

Bedrock Groundwater

A review of regional bedrock groundwater is presented in Appendix B2 and historic water-level data from monitoring wells screened within the bedrock is presented in Appendix D. The bedrock unit acts as an aquitard (Alvarez and Buckner, 1980) and has limited hydraulic connection with the overlying alluvium where the majority of groundwater flow occurs. As described in Appendix B2 there is negligible hydraulic connection between the bedrock and alluvial aquifers and the bedrock groundwater is not expected to have been impacted by Site COCs or AOIs.

1.4.5. Groundwater Use

Groundwater at the Site is not used as a drinking water source or any other use. Alluvial water supply wells are not affected by impacted groundwater from the Site.

1.4.6. Climate

The climate in the El Paso area is arid, characterized by very low precipitation and relative humidity. Winters are cool; summers are hot and dry. Temperatures range from above 100 degrees Fahrenheit (°F) in the summer months to below freezing temperatures in the winter. Sand and dust storms occur during the spring, which is the windiest season.

Precipitation averages about 8 inches annually, with most of the precipitation occurring between April and September. Most of the precipitation occurs in the form of intense storms with high intensity precipitation over relatively short time intervals. The annual evaporation rate for the area is approximately 72 inches per year (USDA, 1971).

1.5. Previous Investigations and Completed Remedial Activities

This section summarizes remedial investigation activities conducted between 1997 and 2003 (Phases I through IV), along with a description of the Baseline Risk Assessment (BRA) completed in 2001. A comprehensive topographical survey was also completed in 2011 to provide a consistent datum for future activities.

Based on the results of the RI investigations and the BRA, a letter from TCEQ dated May 20, 2005 provided conditional approval (TCEQ, 2005) of ASARCO's Corrective Action Proposal (ASARCO, 2005) and remedy implementation began in 2005. Remedy implementation to date has included disposal and landfill placement of Category I, and identification and management of Category II and III materials (as defined in Section 1.5.4), excavation of material from Parker Brothers Arroyo, and removal of non-aqueous phase liquid (NAPL) and impacted groundwater from the Diesel 2 Plume Area.

1.5.1. Remedial Investigation Phases I through IV

ASARCO conducted RI Phases I through IV between 1997 and 2003 to assess soil and groundwater impacts in response to an Agreed Order dated August 29, 1996 issued by the Texas Natural Resources Conservation Commission (TNRCC, 1996; TNRCC is the predecessor agency to TCEQ). ASARCO also conducted remedial investigations in accordance with the TCEQ Leaking Petroleum Storage Tank cleanup program in response to the release of diesel fuel at two locations at the Site.

The four phases of RI activities were completed in accordance with the Texas Risk Reduction Rules (RRR) Risk Reduction Standard 3 (RRS3) for nonresidential (industrial/commercial) property use (30 TAC 335, Subchapter S). RRS3 requires media cleanup to be protective of human health and the environment and provides for closure through remediation with controls (i.e., an alternative to clean closure). The following elements were adopted in completing the RI work:

- Identification of COC and AOI sources;
- Identification of potential COC and AOI pathways and receptors;

- Evaluation of risk-based critical values (risk reduction standards);
- Assessment of the exposure of human and environmental receptors to contaminants; and
- Recommendations for corrective action to achieve risk reduction standards.

Additional descriptions of the environmental work previously conducted by ASARCO are provided in the RAWP (Malcolm Pirnie, 2011a) and in each of the RI Reports previously prepared for the Site (Hydrometrics, 1998, 2000, 2001, and 2003). This report is not intended to provide a discussion of the Phase I through IV RI activities, but does include a summary of the results in Section 2 and incorporates the data into Section 4.

1.5.2. Baseline Risk Assessment

A BRA was completed in 1998 (Hydrometrics, 1998) and updated in 2001 following TNRCC review and comments to include data obtained from two additional phases of investigation (Hydrometrics, 2001).

The BRA was completed, in accordance with the TNRCC risk reduction standards and USEPA guidelines, including: 1) identification of mechanisms of release for COCs from impacted media to the environment; 2) identification of fate and transport mechanism from impacted media to environmental exposure media; 3) identification of complete exposure routes for COCs in exposure media to human receptors (ingestion, inhalation, and dermal absorption); 3) estimation of present and potential future cancer risks and toxicity hazards; and 4) provide preliminary, media-specific cleanup levels that are protective of human health and the environment.

Background concentrations and TNRCC's published soil/air ingestion standard for industrial use (SAI-Ind) were used as comparison values for onsite surface soils. Comparison values for the Floodplain Investigation Area surface soils were based on background concentrations and TNRCC's published soil/air ingestion standard for residential use (SAI-Res). When published SAI-Ind Risk Reduction Standards were not available, standards were calculated following applicable RRR guidelines. No published values were available for cadmium or zinc; therefore, onsite surface standards were calculated according to the appropriate TCEQ guidelines. Fresh water chronic standards were developed for Rio Grande surface water in accordance with the Texas Administrative Code 307 Surface Water Quality Standard guidance for comparison with USEPA maximum contaminant levels (MCLs). The soil, groundwater and surface water standards developed during the BRA have been carried through this supplemental RI to provide consistent comparison values.

Comparison values for groundwater identified in the BRA were based on background concentrations, MCLs, and fresh water chronic standards (as there is potential for groundwater to impact surface water resources). Comparison values for surface water identified in the BRA were based on background concentrations, MCLs, and fresh water chronic standards. Surface water in the American Canal was compared against MCLs and background levels, while the fresh water chronic standards are only applied to the Rio Grande.

Complete details of the BRA can be found in Volume III and IV of the RI (Hydrometrics 2001 and 2003).

1.5.3. Site Survey

In April 2011, a comprehensive topographic survey was completed to delineate Site features and establish a consistent datum for future Site activities. The survey data were also necessary to establish consistent elevations to evaluate groundwater and surface water interactions in the vicinity of the American Canal.

The survey included groundwater Site monitoring wells, as well as the American Canal and the water elevation in the canal. The survey was conducted and reported in Texas State Plane, Central Zone (North American Datum of 1983 [NAD 83]) coordinates. Historical data from previous Site activities were adjusted to this new datum. Historical Site topographic contours based on this datum (NAD 83) are shown in Figure 2-2.

The survey data collected from the American Canal were used to correct data collected from the IBWC gauging station on the American Canal.

1.5.4. Soil Remedial Activities

In accordance with the agreed remedy, soils and other solid materials at the Site were divided into Categories I, II, and III, as defined in the RAP as below.

- Category I: soils and solids identified to contain elevated concentrations of COCs and located in an area where they have the potential to affect human health and the environment.
- Category II: soils and solids identified as containing elevated concentrations of COCs but at levels that will not impact groundwater if managed properly.
- Category III: materials that are inert and contain low, if any, concentrations of COCs and, therefore, do not pose a threat to human health.

The sections below summarize the remedial activities for each of these three categories.

1.5.4.1. Category I Material

Remediation activities for Category I materials included the addition of a fourth Category I landfill (Cell 4), which was designed for a capacity of approximately 200,000 cubic yards of material. Construction of the Cell 4 liner, located within Parker Brothers Arroyo, began in November 2011 and was finalized in June 2013 (Figure 1-4). Material to be placed in the Cell 4 landfill has been identified, as summarized in Table 1-2 and Figure 1-4. The filling of Cell 4 began in September 2013.

1.5.4.2. Category II Material

Since Category II materials are not expected to impact groundwater, it was proposed that these materials be either:

- Left in place and capped to prevent direct contact, wind mobilization, infiltration and subsequent COC and AOI migration; or
- Moved to a location on the Site that will be capped to prevent direct contact, wind mobilization, infiltration, and subsequent COC and AOI migration.

A summary of the Category II remedial actions is presented in the RAWP (Malcolm Pirnie, 2011a). Portions of the Site containing Category II materials were capped with an asphaltic cover between 2005 and 2009. Approximately 130,000 cubic yards of Category II material (slag and impacted soils) were excavated from Parker Brothers Arroyo and stockpiled onsite to be used as fill for building basements and to provide initial subgrade for the plant property.

1.5.4.3. Category III Material

Category III materials do not pose a threat to human health and the environment; consequently, remedial actions have not been conducted in association with them.

1.5.5. Parker Brothers Arroyo

To provide stormwater conveyance through the Parker Brothers Arroyo during remedial construction, an Interim Channel design was developed and submitted to TCEQ in November 2011 (Malcolm Pirnie, 2011b). The design included excavating approximately 110,000 cubic yards of impacted material and constructing a new stormwater conveyance channel that meets the City of El Paso hydraulic design requirements (Figure 1-3). To date, approximately 100,000 cubic yards of impacted material (up to 23 feet in depth) have been excavated from the Interim Channel area.

A field demonstration of Zerovalent Iron (ZVI) Passive Reactive Barriers (PRBs) was designed and constructed in 2012 to verify PRB effectiveness and to provide data to support the full-scale design of additional PRBs as part of the final groundwater remedy.

The demonstration plan was submitted to TCEQ and USEPA in April and June 2012 (Malcolm Pirnie, 2012a and 2012b) and TCEQ approval was granted on June 13, 2012. The field demonstration includes one PRB located in the eastern-most portion of Parker Brothers Arroyo (PRB-1), and another located downgradient in an incised alluvial channel bounded by bedrock outcrops (PRB-2); these locations are shown on Figure 1-5.

The PRBs were constructed from September to October 2012 and are 8 feet thick (parallel to groundwater flow) and between 15 and 20 feet in depth; they are designed to span the entire saturated thickness of the aquifer, and comprise a total of 650 tons of ZVI and 1,500 tons of clean sand. Monitoring began in May 2012 and will continue as part of the final groundwater remedy.

1.5.6. Diesel 2 Area

The Diesel 2 area (Figure 1-6) contains diesel impacts to groundwater. Monitoring is currently conducted on a semi-annual basis for NAPL and on an annual basis for benzene, toluene, ethylbenzene and xylenes (BTEX). An extraction system operated from 1999 until May 2011 (Malcolm Pirnie, 2012c). The Diesel 2 area was closed in October 2013 with approval from TCEQ (TCEQ, 2013). The associated groundwater monitoring wells will be plugged and abandoned to complete the site closure.

In February 2012, a pilot test was conducted to determine whether high-pressure vacuum extraction would be an appropriate technology for removing the remaining NAPL. The results indicated that limited recovery of NAPL was possible under this method. Details are provided in the 2012 annual report.

2. Supplemental RI Methodology

The following sections describe the approach used to determine final Site COCs based on an evaluation of the current Site COCs and AOIs. The final Site COCs will be used to determine areas where remedy evaluation needs to be conducted. This Section includes a discussion of relevant investigation areas (IAs), assessment areas (AAs), and assessment criteria.

2.1. Investigation and Assessment Areas

The previous investigations and data gap investigations summarized in Section 1.5 and described more fully in Section 3 were conducted based on IAs and historical Site operations. This approach was appropriate for the purpose of creating targeted investigations for specific COCs and AOIs; however, since the plant has been demolished, it is no longer suitable to include the operational plant areas in remedial planning for the purposes of assessing and implementing a remedial alternative that is protective of human health and the environment. Consequently, AAs have been designated based on probable exposure pathways and historical arroyo boundaries. The data have been assessed in order to determine final COCs for each AA (Section 4) and these designations will be used for all future reporting and Site activities.

The previous IA classification defined a total of 20 IAs (Figure 2-1). The new AA classification defines 10 primary AAs (Figure 2-2):

- East Property
- East Mountain
- La Calavera
- Parker Brothers Arroyo
- Acid Plant Arroyo
- Ponds 5 and 6 Arroyo
- Pond 1 Arroyo
- South Terrace Arroyo
- Plant Entrance Arroyo
- Floodplain

In addition, two secondary AAs are located within the Parker Brothers Arroyo AA: the Fines Pile/Ephemeral Pond and the Boneyard.

2.2. Constituents of Concern and Analytes of Interest

Site COCs defined in the RAWP (Malcolm Pirnie, 2011a) include arsenic, cadmium, chromium, copper, iron, lead, selenium, zinc, total dissolved solids, pH and specific conductivity. Additional AOIs were identified during a comprehensive review of Site data and with the assistance of ex-ASARCO Workers (Malcolm Pirnie, 2011a). A complete list of COCs and AOIs identified for Site soils, groundwater, and surface water is presented in Table 2-1.

2.3. Screening Standards

Screening standards for AAs were determined based on the proposed future land uses shown below and in a manner consistent with the previous RIs.

- Residential:
  - East Property
  - East Mountain
  - La Calavera
- Industrial/Commercial:
  - Parker Brothers Arroyo
  - Acid Plant Arroyo
  - Pond 1 Arroyo
  - Ponds 5 and 6 Arroyo
  - South Terrace Arroyo
  - Floodplain

It should be noted that future land use designations are consistent with the conceptual land uses outlined in the City of El Paso Comprehensive Plan (City of El Paso, 2012). In areas of potential residential development, screening standards were based on residential soil and groundwater standards, consistent with the exposure pathways previously defined by ASARCO in Phase I through IV of the RI and the BRA. In areas of potential industrial/commercial development, assessment goals were based on the soil, groundwater, and surface water standards that were previously presented in the Phase I through IV RI documents (Hydrometrics, 1998, 2000, 2001, and 2003).

Screening standards for soil, groundwater, and surface water are based on the exposure pathway analysis presented in the Phase I through IV RI documents and are in compliance with RRS3.

Soil screening standards were based on TCEQ Medium Specific Concentrations (MSC) for residential land use (SAI-Res) and for commercial land use (SAI-Ind); these screening standards are presented in Table 2-2. Groundwater standards are based on the USEPA MCLs and are shown in Table 2-3. Where an MCL was not available for a selected COC or AOI, the TCEQ MSC (groundwater standard for industrial use [GW-Ind]) values were used for groundwater.

Surface water standards are presented in Table 2-4 and are based on the designated use for each surface water body. The American Canal, a concrete lined channel, diverts water from the Rio Grande to the City of El Paso, is used for drinking water and irrigation purposes. The state designated water uses of the Rio Grande are domestic water supply, non-contact recreation, and limited aquatic life. The screening standards for the American Canal are based on the USEPA MCLs and the screening standards for the Rio Grande are based on the USEPA MCLs as well as the aquatic life criteria for freshwater (evaluated by 30 TAC 307, Texas Surface Water Quality Standards [TSWQS]).

Additional relevant screening standards for soil, groundwater and surface water are presented in Tables 2-2 through 2-4 addressing risk-based Tier 1 PCLs presented in the TRRP. The risk-based levels were used to refine the final COC list for the Site. For groundwater and surface water, constituents with concentrations above the secondary MCL, if used, were not defined as final Site COCs.

2.4. Data Organization

This Report includes all data collected by ASARCO, the Trust, TCEQ, USEPA, Texas Department of Transportation (TxDOT) and other entities during Phase I through IV RI activities and during supplemental RI activities associated with the Trust property and potential remedy evaluation. The data are presented as follows:

- Section 3 *Supplemental RI Activities* describes the supplemental RI activities conducted following the change in proposed future land use. The discussion is organized according to IA classification to reflect the rationale for sample collection and COC and AOI selection.
- Section 4 *Nature and Extent of Site Constituents of Concern* presents the results of all data collected during Phase I through IV RI activities and during supplemental RI activities according to media type (soil, groundwater, surface water). The data were analyzed according to AA to reflect exposure pathways and provide a suitable framework for the future assessment and implementation of the final remedial activities. The data were assessed against screening standards to delineate the nature and extent of impacts and determine the relevant COCs for the Site.

- Appendices E and F present soil sampling locations and soil analytical data, respectively. Soil boring logs are presented in Appendix G.
- The appendices listed below present groundwater and surface water data collected since the Trust took over the semi-annual Site-wide monitoring in 2010 and historical data collected by ASARCO between 1990 and 2010.

- Appendix G – Groundwater monitoring well construction logs
- Appendix H – Groundwater and surface water sampling locations
- Appendix I-1 – RI related groundwater samples collected by the Trust
- Appendix I-2 – RI related groundwater samples collected by ASARCO
- Appendix I-3 – RI related surface water samples collected by the Trust
- Appendix I-4 – RI related surface water samples collected by ASARCO
- Appendix J-1 - Laboratory Analytical Reports
- Appendix J-2 - Data Usability Summary Reports

3. Supplemental RI Activities

This section describes supplemental RI activities conducted following the change in proposed future land use. The discussion is organized according to AA or IA classification to reflect the rationale for sample collection and COC and AOI selection. The analytical suite associated with the COCs and AOIs for each medium are presented in Table 2-1. The results of data collected during supplemental RI activities are discussed in Section 4.

3.1. Soils and Solid Material

Supplemental RI activities were conducted in 2011 and 2012 to complete characterization of the nature and extent of impacted material at the Site in light of the change in proposed future land use and to eventually select the final remedy for soils. "Impacted materials" were defined as soils impacted by plant operations or other solid materials, such as slag, which exhibit elevated concentrations of COCs and AOIs. The supplemental RI activities were conducted based on AA or IA classifications and/or historical Site operations (Figure 2-1) and are summarized in Table 3-1.

The following sections summarize the supplemental RI activities, including the objectives, locations, methods, and analyses completed for each IA. The field sampling and analytical activities were performed according to procedures described in the RAWP (Malcolm Pirnie, 2011a) and as described in the relevant reports for each AA or IA (Appendices K through Q).

3.1.1. East Mountain AA

Historical soil data provided by ASARCO indicated the potential for fugitive dust and stack emissions from historical operations to impact surface soils in the East Mountain AA. The data did not delineate the extent of impacts; therefore, additional sampling and analysis of surface soil was performed to address this data gap.

A total of 19 surface soil samples were collected on May 26, 2011 in the East Mountain IA from the locations shown on Figure 3-1 and described in Table 3-1. Surface soil samples were collected as described in RAWP and analyzed for COCs and AOIs as defined in Table 2-1.

3.1.2. East Property AA

The East Property AA was historically used for the disposal of slag, as discussed in Appendix L1, and other materials, including building debris and construction materials.

These materials were typically deposited in a discrete area on the property (Figure 3-2). Windborne dust from smelter activities may also have impacted this area.

Additional data collection was conducted within the East Property AA to address data gaps associated with the composition and placement of slag and waste material disposal areas, as well as to delineate surface soil impacts (Table 3-1). Data collection activities included surface soil sampling, soil borings, test pit excavation and geophysical studies. The geophysical and geotechnical borings were conducted to determine the geologic structure of the groundwater bearing units to evaluate potential remedial options (which will be discussed in later reports). The following sections summarize the work completed during these investigations, and a full description is presented in Appendix L.

3.1.2.1. Surface Soil Sampling

A grid-based surface soil investigation was conducted in August 2012. The layout of the sampling grid is shown in Figure 3-2. Samples were collected using the method described in Appendix L1 and were analyzed for selected COCs and AOIs as defined in Table 3-1.

3.1.2.2. Soil Borings

Eight soil borings (designated EPA-01 through EPA-08, Figure 3-2) were advanced in the East Property IA in June 2011. Soil boring depths ranged from 20 to 54 feet bgs. At each boring, recovered soils were logged, including observations of groundwater if encountered. Samples were collected using the method described in Appendix L1 and were analyzed for selected COCs and AOIs shown in Table 3-1.

3.1.2.3. Test Pit Excavation

Test pits were excavated in August 2012, in conjunction with the surface soil sampling program. The test pit locations are shown on Figure 3-2. Samples were collected using the method described in Appendix L1 and were analyzed for selected COCs and AOIs as defined in Table 3-1.

3.1.2.4. Geophysical Surveys

In March 2011 a direct current (DC) electrical resistivity survey was conducted to confirm lithology and delineate the depth to bedrock. The resistivity survey consisted of one 400 foot survey line (Line D) and one 540 foot survey line (Line E), as shown on Figure 3-2, that were generally oriented south to north. The depth of penetration of the geophysical method was to approximately 150 to 200 feet bgs. Additional discussion of the geophysical survey is included in Appendix L2.

3.1.3. Parker Brothers Arroyo AA

Data collection activities—including soil boring sampling, test pit installation, geophysical and seismic surveys, and soil leachability analysis—were conducted in the Parker Brothers Arroyo AA to further delineate the extent of soil impacts and occurrence of slag, as well as to determine the leachability of these materials to assess potential risks to groundwater, as summarized in the sections below and Table 3-1.

The Parker Brothers Arroyo AA includes the Fines Pile, Ephemeral Pond, and the Boneyard sub-areas shown on Figure 2-1; targeted investigations in these areas are discussed separately in Sections 3.1.3.1 and 3.1.3.2. Detailed reports for these subareas are provided in Appendices M and N.

3.1.3.1. Park Brothers Arroyo AA (Excluding the Fines Pile, Ephemeral Pond and Boneyard Areas)

The supplemental RI activities completed in the Parker Brothers Arroyo AA are discussed in this section, excluding targeted activities completed within the Parker Brothers Arroyo sub-areas (Fines Pile, Ephemeral Pond and Boneyard). These supplemental RI activities were completed to further assess the extent of slag and delineate soil impacts, as well as to determine the leachability of slag and soil material to better assess the potential risks to groundwater at the Site. Activities completed within this AA included soil borings, test pit excavation, geophysical and seismic surveys and soil leachability analysis (Table 3-1).

Soil Borings

Fifteen soil borings (designated PBA-1 through PBA-15) were advanced in the Parker Brothers Arroyo during June and July 2011. Soil boring depths ranged from 5 to 45 feet bgs. Soil samples were collected for geotechnical and chemical analysis from selected depth intervals, as described in Table 3-1. In November and December 2011, three additional soil borings (designated PBA-16 through PBA-18) were advanced to depths ranging from 41 to 55 feet bgs. In addition, one rock core was completed to 54 feet bgs near the center of the proposed landfill. Soil boring locations are presented on Figure 3-3 and logs are included in Appendix G.

Test Pit Excavation

Thirty test pits (designated TP-1 through TP-30) were excavated during April and May 2011 to determine the extent of slag and the depth to native material across the Parker Brothers Arroyo. Test pits ranged in depth from 3 to 13.5 feet. Two samples were collected from each test pit (one from slag and one from alluvium material) and analyzed as described in Table 3-1.

Five additional test pits were excavated (designated LFTP-A through LFTP-E) in October 2011. Analyses for total metals (Table 3-1) were conducted in the field using X-ray fluorescence methods as part of a correlation study to verify that these methods were sufficient as a field screening method (Malcolm Pirnie, 2012d); analytical samples were collected at the slag-alluvium interface, 1 foot below the interface, 2 feet below the interface, and 3 feet below the interface. Test pit locations are presented on Figure 3-3 and logs are provided in Appendix G.

Geophysical Survey

In March 2011 a DC electrical resistivity survey was conducted to confirm lithology and delineate the depth to bedrock. The resistivity survey included three 540 foot survey lines (Lines A, B and C), as shown on Figure 3-3, that were oriented south to north. The geophysical depth of penetration was to approximately 150 to 200 feet bgs. Additional discussion of the geophysical survey is included in Appendix Q.

Seismic Survey

Hydro Geophysics Inc. conducted two seismic refraction surveys, in the locations shown on Figure 3-3, in the Parker Brothers Arroyo on October 25 and 26, 2011 to improve the understanding of area geology, evaluate the rippability of the native materials, and characterize the geologic interfaces. The survey included two lines, one oriented east to west and the second oriented north to south, with a combined length of approximately 1,800 feet. The geophysical investigation is summarized in Appendix Q.

Sequential Extractions Analysis

Nine selective sequential extraction (SSE) tests were conducted on soil samples collected from the Parker Brothers Arroyo to better understand the association of solid-phase Site COCs and AOIs within the soil matrix. The test results are presented in Appendix R.

3.1.3.2. Boneyard (Portion of the Parker Brothers Arroyo AA)

Slag in the Boneyard area is a residual byproduct of primarily lead smelting and was poured as molten material in large piles in the Boneyard. Slag material excavated from the stormwater pond installation was placed on top of poured slag. The Boneyard slag storage area was active as an equipment and materials storage area until February 1999, when smelting operations ceased (Hydrometrics, 1998). Soil boring and test pit excavation activities were conducted in the Boneyard to further delineate the extent of soil impacts and occurrence of slag, as described in Appendix M and Table 3-1 and as summarized in the section below.

Soil Borings

Seven soil borings were advanced in the Boneyard, two in June 2011 and five in November and December 2011 (Figure 3-3). Soil boring depths ranged from 25 feet bgs (BY-07) to 78.5 feet (BY-03) bgs. Soil boring logs are included in Appendix G. Soil samples were analyzed for COCs and AOIs as described in Table 3-1.

Test Pit Excavation

Test pits were excavated in five locations (TPBY-01, TPBY-01A, TPBY-02, TPBY-03, and TPBY-04) in the Boneyard on May 4, 2011 (Figure 3-3) to characterize and classify soils/solids. The test pits were excavated to depths ranging from approximately 3 to 13 feet bgs. Test pit excavation logs are included in Appendix G. Soil samples were analyzed for COCs and AOIs as described in Table 3-1.

3.1.3.3. Fines Pile and Ephemeral Pond (Portions of the Parker Brothers Arroyo AA)

The Fines Pile is the storage location for slag fines that resulted from the crushing and screening of poured slag for use as railroad ballast, roofing material and abrasives. The Ephemeral Pond is adjacent to and immediately south of the Fines Pile. The Ephemeral Pond is a depression within the Parker Brothers Arroyo that ponds water during and after significant precipitation events. The Ephemeral Pond was formed as a result of nearby construction activities and the established railroad grade, which functions as a dam and inhibits stormwater drainage. The Ephemeral Pond was used for historical slag disposal and other plant debris, such as brick, conveyor belts, and wood (Hydrometrics, 1998).

Data collection activities, including soil boring sampling were conducted in the Fines Pile and Ephemeral Pond areas to further delineate the extent of soil impacts and occurrence of slag as described in Appendix M and summarized in Table 3-1. Toxicity Characteristics Leaching Procedure (TCLP) and Synthetic Precipitation Leaching Procedure (SPLP) testing were conducted to assess the potential for elevated concentrations of COCs and AOIs to leach to groundwater.

Soil Borings

As part of the supplemental RI a total of six soil borings were advanced in the Fines Pile (designated FP-SB01 through FP-SB04) and Ephemeral Pond (designated EPH-01 and EPH-02) areas during June through August 2011. Boring logs are provided in Appendix G. Samples were analyzed for total metals in soil, as well as leachability profiles using TCLP and SPLP, as described in Table 3-1.

3.1.4. Plant Area IAs

The Plant Area was historically divided into ten IAs based on historical operations at the Site, as shown on Figure 2-1. Supplemental RI activities were conducted in these areas to address data gaps identified by the Trust or based on recommendations made by ex-ASARCO Workers, or to address data gaps identified as a result of the change in proposed future land use; data collection activities are summarized below in Sections 3.1.4.1 and 3.1.4.2, respectively.

Plant Area IA supplemental RI activities were conducted on August 8 and 9, 2011 and October 19, 20, and 24, 2011 with the sampling activities and analytical suite summarized in Table 3-1. Specific details regarding sampling methods and analytical results are described in the September 2011 *Interim Data Gap Report – Soil Sampling* (ARCADIS, 2011) and the July 2012 *Interim Data Gap Report – October 2011 Sampling Event* (ARCADIS, 2012), which are provided in Appendices O and P. The data collected during these supplemental RI investigations have been incorporated into the data from Phase I to IV RI activities, and the results are discussed in Section 4.

3.1.4.1. Ex-ASARCO Worker Group Sampling

During Site visits in June 2010 and March 2011, ex-ASARCO Workers provided information (Malcolm Pirnie, 2011c and 2012c) that suggested additional sampling should be conducted in 6 of the 14 Plant IAs. The IAs (Figure 2-1) suggested by the ex-ASARCO Workers for additional sampling included the:

- Ponds 1, 5 and 6 IA (Transformer Staging Area)
- Ephemeral Pond and Pond Sediment Storage IA (Wastewater Treatment Plant Sludge Disposal Area)
- Former Zinc and Cadmium Plant IA (including the Liquid Mercury Collection Area, Anode Pour Area and Drum Holding Area)
- Bedding and Unloading Building IA

Data collection activities in these areas were designed to address delineation of COCs and AOIs in soil by collecting and analyzing samples of surface soil or soil from boreholes.

Ponds 1, 5 and 6 IA-9

The Transformer Staging Area is located in the Ponds 1, 5 and 6 Area IA and was identified by ex-ASARCO Workers as an area of potential polychlorinated biphenyl (PCB) impacts. Two soil boring locations (TSA-SB01 and TSA-SB02; Figure 3-4) were sampled on August 9, 2011. Four samples were collected from each borehole at depths of 0.5, 1.5, 3.5, and 5.0 feet bgs and were analyzed for PCBs (Table 3-1). Soil boring logs are included in Appendix G.

Ephemeral Pond and Pond Sediment Storage IA-12

The Wastewater Treatment Plant Sludge Disposal Area, located within the Ephemeral Pond and Pond Sediment Storage IA (Figure 3-4), was identified by the ex-ASARCO Workers as an area where sludge from annual maintenance conducted between 1984 and 1986 was disposed. One soil boring (WWTP-SB01; Figure 3-4) was advanced adjacent to the haul road to further delineate the area. Two samples were collected at depths of 5 and 10 feet bgs and were analyzed for metals (Table 3-1). Soil boring logs are included in Appendix G.

Former Zinc and Cadmium Plant IA-17

The former Zinc and Cadmium Plant IA (Figure 3-4) was identified by ex-ASARCO Workers as an area with potential elevated metal concentrations. Six soil borings (ZCP-SB01 through ZCP-SB06; Figure 3-4) were advanced on October 20, 2011; soil boring depths ranged from 5 to 20 feet bgs. Nineteen samples were collected at depths of 0.5, 1.5, 3.5, and 5.0 feet bgs and were analyzed for metals and hexavalent chromium (Table 3-1). Soil boring logs are included in Appendix G.

The former Liquid Mercury Collection Area is located within the Former Zinc and Cadmium Plant IA (Figure 3-4) was identified by ex-ASARCO Workers as an area with potential elevated concentrations of mercury. Two soil borings (LM-SB01 and LM-SB02) were advanced on October 19, 201. No free mercury was observed in the soil borings, no samples were collected. Soil boring logs are included in Appendix D.

The former Anode Pour Area is located within the Former Zinc and Cadmium Plant IA (Figure 3-4) and was identified by ex-ASARCO Workers as an area where ENCYCLE material had been stored. Two soil borings locations (APA-SB01 and APA-SB02; Figure 3-4) were advanced on October 19, 2011. Eight samples were collected at depths of 0.5, 1.5, 3.5, and 5.0 feet bgs and were analyzed for metals, volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) (Table 3-1). Soil boring logs are included in Appendix G.

The former Drum Holding Area, also located within the Former Zinc and Cadmium Plant IA (Figure 3-4), was identified by ex-ASARCO Workers as an area where 55-gallon drums had been stored and were observed to contain oil and possibly PCBs. The drums were crushed at this location and then recycled through the smelting process to recover metal content. During the crushing process, ex-ASARCO Workers observed oil leaking from the drums onto soil. Twelve samples were collected from three soil borings (DDA-

SB01 through DDA-SB03; Figure 3-4) on October 19, 2011 and were analyzed for total petroleum hydrocarbons (TPH) and PCBs (Table 3-1). Soil boring logs are included in Appendix G.

Bedding and Unloading Building IA

The Bedding and Unloading Building IA (Figure 3-4) was identified by ex-ASARCO Workers as an area where dust or other metal-containing media may have been released to the surrounding soils from the Bedding Building air handling equipment and where additional soil data collection may be necessary due to the potential for material from ENCYCLE to remain. Seven soil borings and two grab samples (BB-SB01 through BB-SB03, UB-SB01 through UB-SB04, and UB-SS01 and UB-SS02) were advanced on August 8, 2011 and 12 soil boring samples and three surface soil samples were collected (Figure 3-4) and analyzed for metals, VOCs and SVOCs (Table 3-1). Soil boring logs are presented in Appendix G.

3.1.4.2. Data Gap Sampling

As an outcome of the change in proposed future land use for the Site, data gaps were identified in 2 of the 14 Plant IAs – the Former Lead and Sinter Plant IA and the Convertor Building/Baghouse IA (Table 3-1). Supplemental RI activities were conducted in these areas to address the data gaps.

Former Lead and Sinter Plant IA

To confirm the results of previous soil samples collected from beneath the concrete/paving cap in the Former Lead Smelter Area, three soil borings were advanced (LS-SB01 through LS-SB03; Figure 3-4) on October 21, 2011 and five soil samples were collected for the analyses described in Table 3-1. Soil boring logs and analytical data are included in Appendices G and F, respectively.

Convertor Building/Baghouse IA

The Contop-Reverb-Converter Building/Baghouse IA and Electrostatic Precipitator Area (Contop-Reverb area) located in the Converter Building/Baghouse IA (Figure 3-4) was identified an area requiring further characterization of metal concentrations in surface soils. Six surface samples (CON-SB01 through CON-SB06; Figure 3-4) were collected on October 24, 2011 and analyzed for metals as described in Table 3-1.

3.2. Groundwater

ASARCO conducted preliminary evaluations of the nature and extent of groundwater impacts between 1996 and 2009 during the Phase I through IV RI activities. These investigations included the installation of 23 monitoring wells during Phase I, 27 monitoring wells during Phase II, 13 monitoring wells during Phase III, and five monitoring wells during Phase IV. Currently, 33 of these locations are actively monitored as part of the interim semi-annual Site monitoring program. In addition, hydraulic testing was completed during 2011, as described in Appendix B-1.

3.2.1. Interim Site Groundwater Monitoring Program

As described in the RAWP (Malcolm Pirnie, 2011a), continued monitoring of groundwater is warranted to evaluate Site conditions and support the design of final groundwater remedies. The interim Site monitoring program consists of semi-annual sampling of groundwater monitoring wells selected to provide a Site-wide understanding of groundwater conditions and to provide data for key areas of interest.

The 33 monitoring wells included in the interim Site monitoring program are depicted on Figure 3-5. Additional monitoring wells were added to interim Site monitoring events to evaluate data gaps or support the CSM. Semi-annual sampling events are scheduled to coincide with seasonal variability of the Rio Grande and American Canal and seasonal precipitation events. Five interim Site monitoring events have been completed by the Trust since September 2010:

- Fall 2010: September 2010
- Spring 2011: February through March 2011
- Fall 2011: August through September 2011
- Spring 2012: February through March 2012
- Fall 2012: August through September 2012

Samples collected during these events were analyzed for COCs and AOIs, as described in Table 2-1.

Prior to spring 2011, groundwater monitoring was performed using a three-well volume purge approach; during the spring 2011 monitoring event, a subset of eight monitoring wells were sampled using two alternative sampling methods (low-flow and Hydra-Sleeve™) A description of the methods is provided in Appendix S. A statistical comparison of the data concluded that the three sampling methods yield comparable results and there were no statistically significant differences among data sets associated with each the three sampling methods. Based on this statistical comparison and other implementation considerations (i.e., Hydra-Sleeve ™ can provide only a limited sample volume), the low-flow method has been approved by TCEQ for use in subsequent monitoring events since fall 2011 and will be used for future monitoring events. The statistical data comparison and the detailed comparative evaluation are included in Appendix S.

3.2.2. Hydraulic Investigation

Hydraulic data from low-flow sampling during the interim Site monitoring in fall 2011 was used to estimate hydraulic conductivity (K) values for select monitoring wells. The methodology and well locations are discussed in Appendix B1. This Appendix also includes a compilation of historical hydraulic conductivity estimates and methodology from activities conducted prior to 2010 and the Trust.

3.2.3. Supplemental RI Activities

In addition to the interim Site groundwater monitoring conducted on a routine basis, supplemental RI activities were conducted to further address groundwater data gaps resulting from the change in proposed future land use. These supplemental activities focused on the Parker Brothers Arroyo and Floodplain IAs.

3.2.3.1. Parker Brothers Arroyo AA (Excluding the Boneyard, Fines Pile and Ephemeral Pond)

During 2011 field activities, eight boreholes (PBA-02 through PBA-13; Figure 3-6) were completed in the Parker Brothers Arroyo AA as temporary 2-inch polyvinyl chloride (PVC) monitoring wells to collect groundwater samples. After installation, the temporary wells remained in the ground for approximately 12 to 24 hours to allow groundwater levels to stabilize. Groundwater samples were collected for analysis as described in Table 2-1, and depth to water was measured. Temporary well construction logs are included in Appendix G. After sampling, all temporary monitoring wells were removed and bore holes were grouted from the bottom up using Type I/II Portland cement bentonite grout mixture.

In addition, TxDOT installed a temporary monitoring well (ASARCO-4) and sampled it during June 2011 (LCA Environmental, 2011).

3.2.3.2. Boneyard, Fines Pile and Ephemeral Pond (Portions of the Parker Brothers Arroyo AA)

During 2011 field activities, three temporary 2-inch PVC monitoring wells were installed at soil boring locations FP-01, EPH-01, and EPH-02, as shown in Figure 3-6, in the Boneyard, Fines Pile and Ephemeral Pond areas of the Parker Brothers Arroyo AA (Appendix H). Groundwater samples were collected for analysis as described in Table 2-1. Temporary well construction logs are included in Appendix G. After sampling, the temporary wells were removed and the bore holes grouted from the bottom up using Type I/II Portland cement.

3.2.3.3. Floodplain AA

Three nested groundwater monitoring wells (MW-9S/D, MW-10S/D, and MW-11S/D) were installed in the Floodplain AA on IBWC property (Figure 3-5). The monitoring wells were sampled in March 2012 and during the semi-annual groundwater sampling event in August 2012. Groundwater samples were analyzed as described in Table 2-1.

3.3. Surface Water

The primary surface water bodies around the Site are the American Canal and the Rio Grande. These surface water bodies constitute a single IA and have been monitored since 1998. An Interim Surface Water Monitoring Program was implemented in fall 2010 to collect additional surface water data to inform future remedial activities, which is described below.

3.3.1. Interim Site Surface Water Monitoring Program

The interim Site monitoring program for surface water consists of semi-annual sampling of surface water monitoring locations, selected to provide an understanding of current surface water conditions in the American Canal and the Rio Grande.

Semi-annual sampling dates are scheduled based on the seasonal operation of the American Dam, and are timed to coincide with groundwater monitoring events. Five interim Site monitoring events have been completed by the Trust since September 2010:

- Fall 2010: September 2010
- Spring 2011: February through March 2011
- Fall 2011: August through September 2011
- Spring 2012: February through March 2012
- Fall 2012: August through September 2012

This monitoring is performed at 11 surface water stations: three on the American Canal and eight on the Rio Grande (Figure 3-7). Samples collected during these events are analyzed for COCs and AOIs as described in Table 2-1.

3.3.2. Supplemental RI Activities

In addition to the interim Site surface water monitoring conducted on a routine basis, a survey and assessment of the Site drainage infrastructure was conducted in September 2011 to better understand Site drainage mechanisms and further address data gaps resulting from the change in proposed future land use.

4. Nature and Extent of Site Constituents of Concern

The following sections summarize the results of data collected as part of Phase I through IV RI activities (conducted between 1997 and 2003) and during the supplemental RI activities (conducted in 2011 and 2012). The data are presented according to media type (soil [Section 4.1], groundwater [Section 4.2], and surface water [Section 4.3]). These media were analyzed according to Site AAs (Figure 2-2), which designate probable exposure pathways. The Custodial Trust Agreement specifies in Section 2.2 that the Trust is responsible for environmental activities on the Site. In order to delineate the nature and extent of Site impacts and to determine relevant COCs for each AA, RI data were assessed against the screening standards described in Section 2.3.

4.1. Current Distribution of COCs and AOIs in Soil

The soils of the Site consist of fill and a mix of native alluvial and colluvial sediments as discussed in Section 1.4.2. Fill material has been observed to comprise slag, native soil, and other anthropogenic materials such as concrete and asphalt. Concentrations of COCs and AOIs above relevant criteria have been observed in both fill material and native soil. The distribution of these COCs and AOIs is discussed in subsequent sections

As discussed in Section 2.1, the soil data were analyzed in terms of AAs, which are designated based on exposure pathways and historical arroyo boundaries. The AA classification defines 10 primary AAs and two secondary AAs as shown on Figure 2-2. The screening levels used in this analysis were either the SAI-Res (East Property, East Mountain and La Calavera AAs) or the SAI-Ind as discussed in Section 2.3. The analytical suite for each AA is provided in Table 4-1.

Complete soil analytical data and boring logs from all phases of RI activities are provided in Appendix F and H respectively, and the locations of soil samples collected during all phases of RI activities are presented on Figure 4-1. A summary for each AA is provided in Tables 4-2 through 4-11. These tables provide a summary of key statistics (maximum, minimum and average concentrations and standard deviation) for each COC and AOI within that AA. In addition, the tables present the number of non-detect concentrations versus the number of concentrations above detection, and the percentage of the samples where concentrations above the relevant screening level were observed. Where concentrations were detected above the relevant screening level, that constituent will be defined as a COC for future remedial Site activities.

The data are also shown on Figures 4-2 to 4-53. Where appropriate, figures display data for offsite locations immediately outside the boundary or the relevant AA in order to illustrate delineation. However, only onsite locations were used in calculating the key summary statistics for each AA. Delineation on a Site-wide basis is presented at in Section 4.1.11

4.1.1. East Mountain AA

Soil samples collected in the East Mountain AA during all Phases of RI activities were analyzed for COCs (metals) and AOIs (metals) as shown in Table 4-1. One additional sample was analyzed for thallium. A summary of the analytical data is presented in (Table 4-2). Concentrations of all COCs, AOIs and thallium were either below detection or the SAI-Res standard with the exception of:

- Antimony
- Arsenic
- Lead
- Mercury

A total of 35 samples were collected for antimony analysis (Figure 4-2). Concentrations ranged from non-detect to a maximum value of 137 milligrams per kilogram (mg/kg) observed at AMSS-05. Only one sample from the 0 to 0.5 feet bgs interval at AMSS-05 had antimony concentrations exceeding the SAI-Res.

A total of 42 samples were collected for arsenic analysis (Figure 4-3); 38 samples had concentrations of arsenic exceeding the SAI-Res standard, primarily within the 0 to 0.5 feet bgs interval.

A total of 42 samples were collected for lead analysis (Figure 4-4); 20 had lead concentrations exceeding the SAI-Res standard. This includes a maximum value of 5,570 mg/kg at AM-SS05. Concentrations of lead in soil in the East Mountain AA are less widespread than arsenic concentrations, and are primarily present within the 0 to 0.5 feet bgs interval.

A total of 35 samples were collected for mercury analysis (Figure 4-5); 23 had mercury concentrations exceeding the SAI-Res standard, with a maximum concentration of 1.82 mg/kg observed at E140-44 in the 0 to 0.5 feet bgs interval. The distribution of mercury is less widespread than arsenic, and concentrations exceeding the SAI-Res standard are confined to surface soils in the 0 to 0.5 feet bgs interval.

Concentrations exceeding the SAI-Res standard within the East Mountain AA can be attributed to airborne deposition caused by emissions from smelter operations or windblown ores and concentrates that were stored at the south end of the plant. The distribution of COCs exceeding the SAI-Res standard within the East Mountain AA have been characterized and the soil sampling network (Figure 4-1) is sufficient to understand the distribution of metal concentrations in this AA. **The East Mountain AA will be retained for evaluation of remedial alternatives.**

4.1.2. East Property AA

Soil samples collected in the East Property AA during all Phases of RI activities were analyzed for COCs (metals) and AOIs (metals, VOCs, SVOCs and pesticides) as shown in Table 4-1. One additional sample was analyzed for thallium. A summary of the analytical data is presented in (Table 4-3). Concentrations of all COCs, AOIs and thallium were either below detection or the SAI-Res standard with the exception of:

- Antimony
- Arsenic
- Cadmium
- Copper
- Lead
- Mercury
- Selenium

The distribution of the chemicals exceeding the residential standards is associated with the at least one of the following:

- Slag or other waste material as documented in Appendix T;
- Deposition of chemicals from emissions caused by smelter operations;
- Deposition of windblown ores or concentrations from the Site.

The distribution of antimony in soil is shown on Figure 4-6. Concentrations of antimony exceeded the SAI-Res standard in 7 of 73 samples, all from the 0 to 5 foot bgs soil interval and all associated with waste piles, or historical slag placement within this AA.

The distribution of arsenic in soil is shown on Figures 4-7 and 4-8. Concentrations exceeding the SAI-Res standard were observed in 107 of 354 samples, with the highest concentrations (the maximum being 15,600 mg/kg) associated with waste piles, slag disposal areas, and the former landfill area on the East Property AA. Concentrations of arsenic exceeding the SAI-Res standard were also observed in surface soil intervals less than 1 foot bgs outside these areas, due to the deposition of airborne dust. Additional delineation of arsenic is required on the eastern end of the southern arroyo. This work will be conducted as part of the remedial selection activities.

The distribution of cadmium in soil is shown on Figures 4-9 and 4-10. Concentrations exceeding the SAI-Res standard were observed in 30 of 354 samples and are primarily associated with slag deposits, waste piles and the landfill in this AA. Cadmium concentrations exceeding the SAI-Res standard correspond to areas of elevated arsenic concentrations.

The distribution of copper in soil is shown on Figures 4-11 and 4-12. Concentrations of copper exceeding the SAI-Res standard were observed in 15 of 354 samples and are associated with the former landfill and waste piles on the East Property.

The distribution of lead in soil is shown on Figures 4-13 and 4-14. Concentrations of lead exceeding the SAI-Res standard were observed in 72 of 354 samples and are primarily associated with waste piles, the landfill, and slag placement. Some exceedances within the surface soils (0 to 0.5 feet bgs interval) are also due to the deposition of airborne dusts. Additional delineation of lead is required on the eastern end of the southern arroyo. This work will be conducted as part of the remedial selection activities.

The distribution of mercury in soil is shown on Figure 4-15. Concentrations of mercury exceeding the SAI-Res standard were observed in 31 of 73 samples, with the maximum concentration of 458 mg/kg observed at WP-SS2A. Exceedances of mercury are associated with waste piles and dust emissions from the smelter site and are confined to surface soils.

The distribution of selenium in soil is shown on Figures 4-16 and 4-17. Concentrations of selenium exceeding the SAI-Res standard were observed in 2 of 354 samples at WP-SS2A and WP-SS2B. Selenium concentrations exceeding the SAI-Res are limited to surface soil (0 to 0.5 feet bgs) in a known waste pile location.

The distribution of the COCs and AOIs exceeding the SAI-Res standard within the East Property AA have been characterized and the soil sampling network (Figure 4-1) is sufficient to understand the distribution of COC and AOI concentrations exceeding the SAI-Res standard. These concentrations are associated primarily with historical waste or slag placement areas (Appendix T) and the landfill on the East Property AA. Outside of these identified slag placement and landfill areas, concentrations exceeding the SAI-Res standard in surface soils (less than 0 to 1 foot bgs interval) are associated with deposition of airborne emissions.

The East Property AA is retained for evaluation of remedial alternatives. As part of additional remedial activities on the East Property, the Trust will collect additional surface soil samples in the south arroyo to delineate the extent of arsenic and lead.

4.1.3. Parker Brothers Arroyo AA

Soil samples collected in the Parker Brothers Arroyo AA during all Phases of RI activities were analyzed for COCs (metals) and AOIs (metals, VOCs and TPH), as well as thallium manganese and hexavalent chromium , as shown in Table 4-1. A summary of the analytical data is presented in (Table 4-4). Concentrations of all COCs and AOIs were either below detection or the SAI-Ind standard with the exception of:

- Antimony
- Arsenic
- Cadmium
- Copper
- Lead
- Mercury

The distribution of these chemicals above the industrial/commercial standards is primarily associated with the placement of slag materials above the native material and directly below the slag material. Additional details are provided below.

The distribution of antimony sampling is shown on Figure 4-18. Concentrations of antimony exceeding the SAI-Ind standard were observed in 6 of 185 samples and were confined to the Boneyard sub-area in the 0 to 22 feet bgs interval. Concentrations of antimony ranged from non-detect to a maximum concentration of 1,990 mg/kg observed at TPBY-3 in the 3 to 3.5 feet bgs interval. The presence of antimony in the Parker Brothers Arroyo AA is associated with historical slag and debris placement in the Boneyard sub-area.

The distribution of arsenic in soil for sample locations remaining after channel excavation is shown on Figures 4-19 and 4-20. Out of 457 samples, concentrations of arsenic exceeding the SAI-Ind were observed in 89 samples, at depths up to 48 feet bgs, ranging from non-detect to a maximum concentration of 4,830 mg/kg at TPBY-1 in the 12 foot bgs interval. Concentrations of arsenic greater than the SAI-Ind are associated with the Fines Pile and Boneyard sub-areas, and other areas within the Parker Brothers Arroyo where historical slag placement occurred.

The distribution of cadmium in soil is shown on Figures 4-21 and 4-22. Concentrations of cadmium exceeding the SAI-Ind standard were observed in 4 of 457 samples in the Fines Pile and Boneyard sub-areas or areas of historical deposition of slag. The highest cadmium concentration (2,100 mg/kg) was observed at RI1-BH1 in the 40 foot bgs interval.

The distribution of copper in soil is shown on Figures 4-23 and 4-24. Concentrations of copper exceeding the SAI-Ind standard were observed in only 1 of 457 samples (TPBY-3 in the 3 to 3.5 foot bgs interval) within the Boneyard sub-area where molten slag and debris placement occurred.

The distribution of lead in soil within the Parker Brothers Arroyo AA is shown on Figures 4-25 and 4-26. Concentrations of lead exceeding the SAI-Ind standard were observed in 83 of 457 samples, with a maximum concentration of 24,400 mg/kg at TPBY-1 in the 12 foot bgs interval within the Fines Pile and Boneyard sub-areas and/or areas of historical slag deposition.

The distribution of mercury in soil is shown on Figure 4-27. Concentrations of mercury exceeding the SAI-Ind standard were observed in 31 of 73 samples, with a maximum concentration of 458 mg/kg observed at WP-SS2A. Concentrations of mercury above the SAI-Ind standard are present in the surface soil intervals and associated with slag deposition and dust emissions.

The distribution of COCs exceeding the SAI-Ind standard within the Parker Brothers Arroyo AA and its sub-areas (the Boneyard, Fines Pile, and Ephemeral Pond) has been characterized and the soil sampling network (Figure 4-1) is sufficient to understand the distribution of COC and AOI concentrations. Concentrations exceeding the SAI-Ind standard are primarily located in the Fines Pile and Boneyard and are associated with the molten and processed slag deposition activities that occurred in these areas. Within these areas, the concentrations of metals have been delineated to the groundwater table or to bedrock. **Parker Brothers Arroyo will be retained for evaluation of remedial alternatives.**

4.1.4. Plant Entrance Arroyo AA

Soil samples collected in the Plant Entrance Arroyo AA during all Phases of RI activities were analyzed for COCs (metals), as shown in Table 4-1. A summary of the analytical data is presented in (Table 4-5). Concentrations of all COCs were either below detection or the SAI-Ind standard with the exception of:

- Arsenic

- Lead

The maximum concentration of arsenic in soil within the Plant Entrance AA was 1,300 mg/kg, and concentrations exceeding SAI-Ind standard were observed in eight samples (Figure 4-28) within the southern portion of the Plant Entrance AA. These concentrations correlate to areas of historical ore and concentrate or slag placement (Appendix T) and are present in the 0 to 2 feet bgs interval.

The maximum concentration of lead in soil within the Plant Entrance AA was 9,600 mg/kg, and concentrations exceeding the SAI-Ind standard were observed in 11 samples (Figure 4-29) within the 0 to 2 feet bgs interval. Concentrations of lead exceeding the SAI-Industrial Criteria are associated with the historical placement of ores and concentrates or slag.

Lead and arsenic exceedances of the SAI-Ind standard are observed concurrently in areas of historical ore and concentrate or slag placement. With the exception of the very southern portion of the Plant Entrance AA, the distribution of arsenic and lead concentrations in soil exceeding the SAI-Ind standard within the Plant Entrance Arroyo AA has been characterized and the soil sampling network (Figure 4-1) is sufficient to delineate COC and AOI concentrations to SAI-Ind. This area is delineated to the groundwater table. **The Plant Entrance Arroyo AA will be retained for evaluation of remedial alternatives.**

4.1.5. South Terrace Arroyo AA

Soil samples collected in the South Terrace Arroyo AA during all Phases of RI activities were analyzed for COCs (metals) and AOIs (metals, VOCs, SVOCs and pesticides) as shown in Table 4-1. A summary of the analytical data is presented in (Table 4-6). Concentrations of all COCs and AOIs were either below detection or the SAI-Ind standard with the exception of:

- Arsenic
- Cadmium
- Copper
- Lead
- Mercury

Based on the boring logs and the evaluation of historical aerial photographs, the concentrations of these chemicals are primarily associated with the historical placements of ores and concentrates or slag over native material.

The distribution of arsenic in soil is shown on Figure 4-30. Concentrations exceeding the SAI-Ind standard were observed in 38 of 177 samples, with a maximum concentration of 15,000 mg/kg. Arsenic concentrations exceeding the SAI-Ind standard are distributed along the central portion of the South Terrace AA in the vicinity of the railroad tracks, which correspond to areas of historical ore and concentrate placement (Appendix T). Exceedances are present in the 0 to 5 feet bgs interval; however, one location (EP-70) had elevated concentrations at depths of 35 to 41 feet bgs. This area is thought to be located within or close to an arroyo which was subsequently filled with slag and waste material.

The distribution of cadmium in soil is shown on Figure 4-31. Concentrations exceeding the SAI-Ind standard were observed in 3 of 177 samples, with a maximum concentration of 2,200 mg/kg. Cadmium concentrations exceeding the SAI-Ind standard are restricted to the 0 to 2 feet bgs interval in the vicinity of the former railroad tracks, which is associated with historical ore and concentrate placement.

The distribution of copper in soil is shown on Figure 4-32. Concentrations exceeding the SAI-Ind standard were observed in 4 of 177 samples, with a maximum concentration of 190,000 mg/kg. Copper concentrations exceeding the SAI-Ind standard are limited to intervals less than 1 foot bgs in the vicinity of the former railroad tracks, which is associated with historical ore and concentrate placement.

The distribution of lead in soil is shown on Figure 4-33. Concentrations exceeding the SAI-Ind standard were observed in 31 of 177 samples, with a maximum concentration of 51,000 mg/kg. Lead concentrations exceeding the SAI-Ind standard follow a distribution similar to arsenic concentrations and are restricted to the 0 to 5 feet bgs interval in the vicinity of the former railroad tracks.

The distribution of mercury in soil is shown on Figure 4-34. Concentrations exceeding the SAI-Ind standard were observed in 4 of 8 samples, with a maximum concentration of 10.8 mg/kg. Mercury concentrations exceeding the SAI-Ind standard are restricted to the vicinity of the former railroad tracks at depths of less than 1.5 feet bgs.

Arsenic, cadmium, copper, lead and mercury concentrations exceeding the SAI-Ind standard are associated with historical ore and concentrate placement, either at the surface, or in areas where slag was used as fill material. The soil sampling network (Figure 4-1) is sufficient to characterize COC and AOI concentrations exceeding the SAI-Ind standard in the South Terrace Arroyo AA. The soil sampling network has delineated the concentrations of metals to the groundwater table and to the spatial extent of the arroyo. **The South Terrace Arroyo AA will be retained for the evaluation of remedial actions.**

4.1.6. Pond 1 Arroyo AA

Soil samples collected in the Pond 1 Arroyo AA during all Phases of RI activities were analyzed for COCs (metals) and AOIs (metals, SVOCs and pesticides) as shown in Table 4-1. Two additional samples were analyzed for cyclohexanone. A summary of the analytical data is presented in (Table 4-7). Concentrations of all COCs, AOIs and cyclohexanone were either below detection or the SAI-Ind standard with the exception of:

- Arsenic
- Cadmium
- Lead
- Mercury

The distribution of arsenic in soil is shown on Figure 4-35. Concentrations exceeding the SAI-Ind standard were observed in 39 of 238 samples, with the maximum concentration of 6,600 mg/kg (observed at SS-IAB22 in the 0 to 1 foot bgs interval). Arsenic concentrations exceeding the SAI-Ind standard are within the 0 to 5 feet bgs interval and are associated with the historical placement of slag or fill material.

The distribution of cadmium in soil is shown on Figure 4-36. A concentration exceeding the SAI-Ind standard was observed in only 1 of 232 samples (BH8-4), with a concentration of 2,600 mg/kg in the 0 to 1 foot bgs interval.

The distribution of lead in soil is shown on Figure 4-37. Concentrations of lead exceeding the SAI-Ind standard were observed in 50 of 238 samples, with a maximum concentration of 29,000 mg/kg. Lead concentrations exceeding the SAI-Ind standard in the Pond 1 Arroyo are within the 0 to 5 feet bgs interval and show a distribution similar to arsenic.

The distribution of mercury in soil is shown on Figure 4-38. Concentrations of mercury exceeding the SAI-Ind standard were observed in 9 of 28 total samples, with a maximum concentration of 5.35 mg/kg. Mercury concentrations exceeding the SAI-Ind standard are within the 0 to 5 feet bgs interval, concurrent with elevated arsenic and lead concentrations.

Concentrations of arsenic, lead and mercury in the Pond 1 Arroyo AA are limited to the 0 to 5 feet bgs interval and can be attributed to historical plant activities; this area was used for receiving, handling, and storing incoming feed material and slag. Slag was placed to level the slope along the western boundary of the Site (Appendix T) which has contributed to elevated lead and arsenic concentrations at these locations. A single cadmium concentration exceeding the SAI-Ind standard was observed in surface soil in the vicinity of the railroad tracks at the south-eastern portion of the Pond 1 Arroyo AA where historical ore and concentrate was placed. The soil sampling network (Figure 4-1) is sufficient to characterize COC and AOI concentrations above the SAI-Ind standard in the Pond 1 Arroyo AA. The arroyo has been delineated to the groundwater table and the spatial extents of the arroyo. **The Pond 1 Arroyo AA will be retained for the evaluation of remedial actions.**

4.1.7. Ponds 5 and 6 Arroyo AA

Soil samples collected in the Ponds 5 and 6 Arroyo AA during all Phases of RI activities were analyzed for COCs (metals) and AOIs (metals, VOCs, SVOCs and pesticides) as well as thallium as shown in Table 4-1. A summary of the analytical data is presented in (Table 4-8). Concentrations of all COCs, AOIs and thallium were either below detection or the SAI-Ind standard with the exception of:

- Antimony
- Arsenic
- Cadmium
- Lead
- Mercury

The distribution of antimony in soil is shown on Figure 4-39. Concentrations exceeding the SAI-Ind standard were observed in 3 of 21 samples, with a maximum concentration of 738 mg/kg. Antimony concentrations exceeding the SAI-Ind standard are within the found in surface soils (0 to 0.5 foot bgs interval) in isolated locations impacted by historical smelter activities.

The distribution of arsenic in soil is shown on Figure 4-40. Concentrations exceeding the SAI-Ind standard were observed in 53 of 284 samples, with a maximum concentration of 20,000 mg/kg. Arsenic concentrations exceeding the SAI-Ind standard are found with variable distribution and depth across this AA. Arsenic concentrations at depths greater than 10 feet bgs are associated with the former pond areas and the historical arroyos where slag was used to even out the topographic surface (Appendix T). Outside of these areas, arsenic concentrations are primarily restricted to surface soil, less than 5 feet bgs. Arsenic concentrations exceeding the SAI-Ind standard along and immediately adjacent to the western boundary of the Ponds 5 and 6 Arroyo AA are associated with historical placement of slag material used to level the topographic surface (Appendix T).

The distribution of cadmium in soil is shown on Figure 4-41. Concentrations exceeding the SAI-Ind standard were observed in 13 of 270 samples, with a maximum concentration of 11,000 mg/kg. Cadmium concentrations exceeding the SAI-Ind standard are restricted to two primary areas: the center of the Ponds 5 and 6 Arroyo AA at BH9-6-22 and BH-9-6-23 within the 0 to 2 feet bgs interval; and the south-western corner of the AA at BH13-1, BH13-2 and EP-101 within depths up to 21 feet bgs.

The distribution of lead in soil is shown on Figure 4-42. Concentrations exceeding the SAI-Ind standard were observed in 58 of 284 samples (Table 4-8), with a maximum concentration of 71,000 mg/kg. Lead concentrations exceeding the SAI-Ind standard are widely distributed across the Ponds 5 and 6 Arroyo AA. The locations correlate with areas where arsenic concentrations exceed the SAI-Ind; however, there is a greater density of elevated lead concentrations in the central to western portion of the Ponds 5 and 6 Arroyo AA in the vicinity of the former lead plant. Lead concentrations exceeding the SAI-Ind standard are present at a more shallow depth interval overall than arsenic and are also typically within the 0 to 5 feet bgs interval.

The distribution of mercury in soil is shown on Figure 4-43. Concentrations exceeding the SAI-Ind standard were observed in 15 of 22 total samples, with a maximum concentration of 9.37 mg/kg. Mercury concentrations exceeding the SAI-Ind standard are widely distributed and are present at depths up to 5 feet bgs.

In addition to the COCs and AOIs described above, eight samples from two locations (APA –SB01 and APA-SB02) were also collected for pH analysis. The pH values ranged from 6.97 to 8.74 standard units, suggesting that the soils tested were not impacted by historical acid spills.

Concentrations of metal COCs at the Ponds 5 and 6 Arroyo AA are widely distributed. Antimony, cadmium, lead and mercury concentrations are present at depths occur in surface soils, less than 5 feet bgs, and are linked to historical plant operations, wastewater pond locations and slag placement. Arsenic concentrations are present at depths greater than 5 feet bgs and can be attributed to areas where slag was used as fill material, such as in the historical arroyos. The soil sampling network (Figure 4-1) is sufficient to characterize COC and AOI concentrations exceeding the SAI-Ind standard in the Ponds 5 and 6 Arroyo AA. The arroyo has been delineated to the groundwater table and the spatial extents of the arroyo. **The Ponds 5 and 6 Arroyo AA will be retained for the evaluation of remedial actions.**

4.1.8. Acid Plant Arroyo AA

Soil samples collected in the Acid Plant Arroyo AA during all Phases of RI activities were analyzed for COCs (metals) and AOIs (metals, PCBs and TPH) as well as hexavalent chromium and pH as shown in Table 4-1. A summary of the analytical data is presented in (Table 4-9). Concentrations of all COCs, AOIs and other analytes were either below detection or the SAI-Ind standard with the exception of:

- Antimony
- Arsenic
- Cadmium
- Lead
- Mercury

The distribution of antimony in soil is shown on Figure 4-44. Concentrations exceeding the SAI-Ind standard were observed in 3 of 19 samples, with a maximum concentration of 1,760 mg/kg observed at CON-SS03 in the 0 to 0.5 feet bgs interval. Elevated antimony concentrations are restricted to surface soils (less than 0.5 feet bgs) in the former Contop-Reverb area and the former Zinc Plant.

The distribution of arsenic in soil is shown on Figure 4-45. Concentrations exceeding the SAI-Ind standard were observed in 71 of 171 samples, with a maximum concentration of 25,300 mg/kg observed at CON-SS03 in the 0 to 0.5 feet bgs interval. Arsenic concentrations exceeding the SAI-Ind standard are widely distributed across the central to western portion of this AA at depths up to 57 feet bgs (BH3-6). Elevated arsenic concentrations are associated with historical slag deposition across the western portion of this AA (Appendix T).

The distribution of cadmium in soil is shown on Figure 4-46. Concentrations exceeding the SAI-Ind standard were observed in 6 of 171 samples, with a maximum concentration of 3,460 mg/kg observed at CON-SS03 in the 0 to 0.5 feet interval. Cadmium concentrations exceeding the SAI-Ind standard are restricted to the 0 to 1.5 feet bgs interval.

The distribution of lead in soil is shown on Figure 4-47. Concentrations exceeding the SAI-Ind standard were observed in 53 of 171 samples, with a maximum concentration of 43,700 mg/kg observed at CON-SS03 in the 0 to 0.5 feet interval. Lead concentrations exceeding the SAI-Ind standard are primarily distributed across the western portion of this AA where historical slag was placed (Appendix T) and correspond to areas where elevated arsenic concentrations are also found. Lead concentrations exceeding the SAI-Ind are restricted to the 0 to 5 feet bgs interval.

The distribution of mercury in soil is shown on Figure 4-48. Concentrations exceeding the SAI-Ind standard were observed in 18 of 19 samples with maximum concentrations of 24.5 mg/kg and 43.2 mg/kg observed at CON-SS-03 and CON-SS05, respectively, in the former Contop-Reverb area in the southern portion of the AA. Mercury concentrations exceeding the SAI-Ind standard correspond to areas of elevated arsenic and lead concentrations and locations of historical slag placement.

Arsenic, lead and mercury concentrations exceeding the SAI-Ind standard are associated with historical slag placement, particularly at depths greater than 5 feet bgs and along the western boundary of the AA. Antimony and cadmium concentrations exceeding the SAI-Ind are limited in extent and are restricted to surface soils (less than 1.5 feet bgs). The soil sampling network (Figure 4-1) is sufficient to understand the distribution of COC and AOI concentrations exceeding the SAI-Ind standard in the Acid Plant Arroyo AA. The arroyo has been delineated to the groundwater table and the spatial extents of the arroyo. **The Acid Plant Arroyo AA will be retained for the evaluation of remedial actions.**

4.1.9. La Calavera AA

Soil samples collected in the La Calavera AA during all Phases of RI activities were analyzed for COCs (metals) and AOIs (metals, VOCs, SVOCs and pesticides) as shown in Table 4-1. A summary of the analytical data is presented in (Table 4-10). Concentrations of all COCs and AOIs were either below detection or the SAI-Res standard with the exception of:

- Arsenic
- Lead
- Mercury

The distribution of arsenic in soil is shown on Figure 4-49. Concentrations exceeding the SAI-Res standard were observed in 18 of 33 samples, with a maximum concentration of 655 mg/kg. Concentrations of arsenic exceeding the SAI-Res standard are present in surface soils (less than 0.5 feet bgs), and are associated with airborne dust emissions.

The distribution of lead in soil is shown on Figure 4-50. Concentrations exceeding the SAI-Res standard were observed in only three samples restricted to the south-western portion of the La Calavera AA, with a maximum concentration of 1,820 mg/kg.

Concentrations of lead exceeding the SAI-Res standard are present at depths in surface soils (less than 0.5 feet bgs), and are associated with airborne dust emissions.

One sample (WP-SS5; Figure 4-51) was collected from the 0 to 0.5 bgs interval in the eastern part of the La Calavera AA and analyzed for mercury. This sample exceeded the SAI-Res standard; the concentration is associated with the waste pile present at this location. The only sample collected for mercury analysis was above the SAI-Res standard (WP-SS5; Figure 4-51). This sample was collected from the surface soil (less than 0.5 feet bgs) in the eastern part of the La Calavera AA, and is associated with the waste pile present at this location.

The soil sampling network (Figure 4-1) is sufficient to understand the distribution of COC and AOI concentrations above the SAI-Res standard in La Calavera AA. Arsenic and lead concentrations exceeding the SAI-Res standard are associated with historical airborne dust emissions. Mercury concentrations exceeding the SAI-Res are associated with waste pile placement; the waste pile has been slated for removal and additional conformation samples will be collected in conjunction with this activity. **The La Calavera AA will be retained for evaluation of remedial actions to meet residential standards.**

4.1.10. Floodplain AA

Soil samples collected in the Floodplain AA during all Phases of RI activities were analyzed for COCs (metals) as shown in Table 4-1. A summary of the analytical data is presented in (Table 4-11). Concentrations of all COCs and AOIs were either below detection or the SAI-Ind standard with the exception of:

- Arsenic
- Lead

The distribution of arsenic in soil is shown on Figure 4-52. Concentrations exceeding the SAI-Ind standard were observed in only two samples: BH5-12 within the 0 to 1 foot interval, located slightly outside of the south-western boundary of the AA; and SSIA5-1 within the 0 to 2 feet bgs interval with a maximum concentration of 240 mg/kg, located in the southern portion of the AA.

The distribution of lead in soil is shown on Figure 4-53. Concentrations of lead exceeding the SAI-Ind standard were observed in 16 samples of 136, with a maximum concentration of 4,200 mg/kg at SSIA5-1. Lead concentrations in soil exceeding the SAI-Ind standard are distributed across the Floodplain AA, but are primarily restricted to depths less than 3 feet bgs.

The distribution of arsenic and lead concentrations exceeding the SAI-Ind standard within the Floodplain AA has been characterized and the soil sampling network (Figure 4-1) is sufficient to understand the distribution of COC and AOI concentrations exceeding the SAI-Ind standard. Concentrations exceeding the SAI-Ind standard are present in surface soils, typically at depths less than 1 foot bgs, and are likely associated with airborne emissions or construction debris. **The Floodplain AA will be retained for evaluation of remedial actions to meet residential standards.**

4.1.11. Soil Delineation

As discussed in Sections 4.1.1 to 4.1.10, the following COCs and AOIs were detected above the relevant screening standards at Site AAs:

- Antimony
- Arsenic
- Cadmium
- Copper
- Lead
- Mercury
- Selenium

The Site-wide distribution of these COCs and AOIs are shown on Figures 4-54 through 4-60 and are discussed below.

Antimony concentrations (Figure 4-54) exceeding the screening standard are associated with the presence of slag or smelter related wastes and materials. Antimony exceedances are restricted to the East Property AA, Parker Brothers Arroyo AA, Acid Plant Arroyo AA and Ponds 5 and 6 Arroyo AA. Antimony concentrations at the Site have been delineated to the relevant screening standard. **Antimony will be evaluated as part of the remedy selection for soils.**

Arsenic (Figure 4-55) is the most wide-spread COC in Site soils. Concentrations of arsenic exceeding the screening standard are associated with ores and concentrates, slag, smelter related wastes, or areal deposition of dust from smelter operations. The location of elevated concentrations of arsenic at the Site has been delineated with the exception of: concentrations of arsenic on the eastern boundary of the East Property AA. Additional soil sampling as part of the remedy selection will be conducted in these areas as part of the remedy selection to determine an appropriate remedy. **Arsenic will be the primary chemical evaluated as part of the remedy selection for soils.**

Cadmium concentrations (Figure 4-56) exceeding the screening standard are associated with the presence of slag or smelter related waste and materials. Cadmium exceedances are primarily restricted to areas of slag and smelter related waste on the East Property AA, with sporadic detection only in other areas where slag and smelter related wastes were placed. The concentrations of cadmium are delineated. **Cadmium will be evaluated as part of the remedy selection for soils.**

Copper concentrations (Figure 4-57) exceeding the screening standard are associated with the presence of ores and concentrates or slag and smelter waste materials. Exceedances are primarily restricted to slag and smelter waste disposal on the East Property AA, with additional sporadic exceedances in the South Terrace Arroyo AA where concentrate and waste material were placed during historical plant activities. **Concentrations of copper are delineated and will be evaluated as part of the remedy selection for soils.**

Lead concentrations (Figure 4-58) exceeding the screening standard are associated with the presence of smelter related material: ores and concentrates, slag, Property smelter related wastes, or aerial deposition of ores/concentrates. Elevated lead concentrations at the Site are also associated with elevated arsenic concentrations and have been delineated with the exception of the south arroyo on the East Property. **Lead will be evaluated as part of the remedy selection for soils.**

Mercury concentrations (Figure 4-59) exceeding the screening standard are associated with the presence of smelter related materials: ores and concentrates, slag, smelter related waste, or areal deposition of dust from smelter operations. **Mercury will be evaluated as part of the remedy selection for soils.**

Selenium concentrations (Figure 4-60) exceeding the screening standard were observed at only two sample locations that are associated with smelter related wastes. The concentrations of selenium have been delineated at the site. **Selenium will be evaluated as part of the remedy selection for soils.**

4.2. Current Distribution of COCs and AOIs in Groundwater

Groundwater at the Site is present within an unconfined alluvial aquifer, which is underlain by a regional, less permeable bedrock unit. Groundwater in the alluvial aquifer flows west into the Rio Grande floodplain, ultimately discharging to the Rio Grande (Figure 4-61), however, there is also some seasonal groundwater discharge to sections of the American Canal.

The underlying bedrock surface at the Site has been eroded by the former arroyos in the upland areas of the Site (east to west oriented features) and the Rio Grande floodplain geomorphology. In upland areas where bedrock is shallow (less than 15 feet) or outcrops, the alluvium is unsaturated. Alternatively, where bedrock is deeper (greater than 15 feet) from erosional incision of the former arroyos, saturated alluvial conditions exist. This bedrock structure has resulted in a system where groundwater flow is focused to these erosional features (channels). The channel size and amount of groundwater flow generally correspond to the watershed size of the former arroyo drainage; the largest bedrock incisions are observed in Parker Brothers Arroyo.

A description of the hydrogeology of the alluvial aquifer and bedrock, including estimates of hydraulic conductivity, is provided in Appendices B-1 and B-2.

Groundwater data from the five semi-annual monitoring events completed since September 2010 are presented in this section. Monitoring was completed during:

- Fall 2010: September 2010
- Spring 2011: February through March 2011
- Fall 2011: August through September 2011
- Spring 2012: February through March 2012
- Fall 2012: August through September 2012

Groundwater samples were analyzed for the COCs and AOIs presented in Table 2-1 and were screened using the standards shown in Table 2-3. As stated in the RAWP (Malcolm Pirnie, 2011a), the Site will be remediated under the TRRP rules once the RI is complete. Where the screening standard shown in Table 2-1 was higher than the appropriate TRRP standard (i.e., for zinc and cobalt), concentrations in excess of the TRRP standard were identified to ensure COCs were correctly identified for potential future land use and remedial design.

All groundwater analytical data collected by ASARCO (prior to fall 2010) and by the Trustee (post fall 2010) are presented in Appendices I-1 and I-2. The data collected by the Trustee are summarized in Table 4-12 which provides a summary of key statistics (maximum and minimum values, mean, and standard deviation) for each groundwater COC and AOI. In addition, Table 4-12 presents the number of groundwater non-detect concentrations and concentrations exceeding screening standards. Where concentrations were detected above the relevant screening standard, that constituent was defined as a COC for future Site activities. Site-wide groundwater analytical results for these COCs are presented in Figures 4-62 through 4-76. Based on the data screening, the following metal COCs and AOIs were detected above groundwater screening standards and are recognized at Site COCs:

- Antimony concentrations at the Site exceed the screening standard of 0.006 milligrams per liter (mg/L) at 18 locations during the Interim Site monitoring with a maximum concentration of 2.91 mg/L detected at EP-49 during fall 2010 (Figure 4-62).
- Arsenic is the most widespread COC at the Site; it exceeds the screening standard of 0.01 mg/L in all AAs except for the East Mountain and La Calavera AAs. The mean concentration is 6.61 with a maximum concentration of 84.1 mg/L detected at EP-49 during fall 2010 (Figure 4-63).
- Cadmium concentrations at the Site exceed the screening standard of 0.005 mg/L at 10 locations during the Interim Site monitoring with a maximum concentration of 2.27 mg/L detected at EP-116 during fall 2010 (Figure 4-64).
- Chromium concentrations at the Site exceed the screening standard of 0.1 mg/L at four locations during the Interim Site monitoring with a maximum concentration of 4.46 mg/L detected at EP-51 during fall 2010 (Figure 4-65).
- Copper concentrations at one location (EP-116) exceed the screening standard of 1.3 mg/L with a maximum concentration of 27.5 mg/L detected during fall 2010 (Figure 4-67).
- Lead concentrations at the Site exceed the screening standard of 0.015 mg/L at nine locations during the Interim Site monitoring with a maximum concentration of 1.04 mg/L detected during fall 2010 (Figure 4-69).
- Mercury concentrations at the Site exceed the screening standard of 0.002 mg/L at two locations during the Interim Site monitoring with a maximum concentration of 0.00714 mg/L detected at EP-52 during spring 2012 (Figure 4-71).
- Molybdenum concentrations at the Site exceed the screening standard of 0.51 mg/L at 11 locations during the Interim Site monitoring with a maximum concentration of 11.9 mg/L detected at EP-75 during spring 2011 (Figure 4-70)
- Nickel concentrations at the Site exceed the screening standard of 2.0 mg/L at two locations during the Interim Site monitoring with a maximum concentration of 5.07 mg/L detected at EP-52 during fall 2011 (Figure 4-72).
- Selenium concentrations at the Site exceed the screening standard of 0.05 mg/L at 16 locations during the Interim Site monitoring with a maximum concentration of 6.72 mg/L detected at EP-75 during spring 2011 (Figure 4-74).
- Thallium concentrations at the Site exceed the screening standard of 0.002 mg/L at 18 locations during the Interim Site monitoring with a maximum concentration of 1.24 mg/L detected at EP-75 during spring 2011 (Figure 4-75).

Additionally, the following water quality AOIs were observed at concentrations above the screening standard:

- Fluoride concentrations at the Site exceeded the screening standard of 4.0 mg/L at 17 locations during the Interim Site monitoring with a maximum concentration of 54 mg/L detected at EP-54 during spring 2011 (Figure 4-68).
- Nitrate concentrations at the Site exceeded the screening standard of 10.0 mg/L at 14 locations during the Interim Site monitoring with a maximum concentration of 248 mg/L detected at EP-52 during spring 2011 (Figure 4-73).
- Nitrite concentrations at one location, EP-54, exceeded the standard of 1.0 mg/L with a maximum concentration of 7.09 mg/L detected during fall 2011.

In addition to the summary tables, the data for the fall 2012 monitoring event are presented on Figures 4-62 to 4-76. Comprehensive historical data from Site samples are presented in Appendix D. The distribution of each COC and AOI from the remaining Site monitoring events (fall 2010, spring 2011, fall 2011, and spring 2012) can be found in Appendix U.

Some COCs and AOIs are present in multiple AAs across the Site while other COCs and AOIs are isolated in "hot spots". The COC and AOI distribution in groundwater within each AA is discussed in the following sections.

4.2.1. East Mountain AA

The East Mountain AA (Figure 2-2) is defined as an erosional remnant of an elongate igneous pluton designated the Campus Andesite. The Campus Andesite contained intruded sedimentary rocks that have since been eroded, leaving a series of rocky hills cut by moderate to steep surface drainages. The East Mountain is predominantly andesite bedrock outcrops, with colluvium and a thin veneer of soils present within the drainages. **No alluvial aquifer exists on the East Mountain AA, and groundwater data are not collected for this AA.**

4.2.2. East Property AA

The East Property AA includes the two former arroyos on the eastern side of I-10 which comprised part of the drainage for the Parker Brothers Arroyo (Figure 2-2). These two arroyos have been altered by Site activities on the East Property AA. The northern arroyo includes a concrete stormwater basin adjacent to I-10 to collect and route stormwater under I-10 and into the Parker Brothers Arroyo. The southern drainage exits through a culvert and passes beneath I-10. During precipitation events, stormwater collects in these arroyo drainages and infiltrates to the alluvial groundwater system.

Groundwater samples were collected from monitoring wells EP-84 and EP-95 (Figure 3-5). The proposed land-use in the East Property AA is residential; therefore, groundwater analytical results were screened against USEPA MCLs. Additionally, RRR residential groundwater values (RRR GW_{Res}) are also considered for constituents where the RRR-residential standard is less than USEPA MCLs (i.e., cobalt, molybdenum, nickel and zinc; Table 4-13). The distribution of metal COCs and AOIs were all below the groundwater screening standards during the most recent sampling event, with the exception of arsenic and lead concentrations at EP-84 (Appendix I). **Additional groundwater work is scheduled for the East Property AA during the development of remedial alternatives.**

4.2.3. Parker Brothers Arroyo AA

The Parker Brothers Arroyo AA is located at the northern end of the Site (Figure 2-2). The Parker Brothers Arroyo was backfilled with fill and slag materials (Appendix K) during the operational period of the Site. This AA has been the focus of remedial activities conducted to date including slag material, channel construction and ZVI PRBs as discussed in Section 1.5.5.

The depth to bedrock and saturated alluvial thickness in Parker Brothers Arroyo were key to the design of the Field Demonstration PRBs. The saturated extent of the alluvial aquifer and the bedrock surface in the Parker Brothers Arroyo AA are presented on Figures 4-77 and Figures 4-78, respectively. This understanding allowed the interpretation of the alluvial aquifer extent as depicted on Figure 4-77; specifically the northern terminus of the saturated alluvium as defined by dry borings PBA-SB16, PBA-SB01, PBA-SB11, PBA-SB09, and PBA-SB04. This geologic delineation supported the final design of the Category 4 Landfill and the PRBs.

The Parker Brothers Arroyo includes two of the primary areas of groundwater impacts at the Site: the Fines Pile/Ephemeral Pond area and the Boneyard sub-area. The distribution of COCs and AOIs in these two areas are discussed in detail in Appendices M and N.

Groundwater sampling within the Parker Brothers Arroyo AA was completed at monitoring wells EP-120, EP-78, EP-85, EP-75, EP-54, EP-147, OBS-1, and EP-81 (Figure 3-5). Monitoring well EP-85 was abandoned during remedial construction activities in 2012 and EP-147 was used as a replacement well during fall 2012 sampling and will be used for future monitoring events. The following COCs and AOIs exceed screening criteria in the Parker Brothers Arroyo AA:

- Metals: Antimony, Arsenic, Cadmium, Lead, Molybdenum, Selenium, Thallium and Zinc

- Water Quality Parameters: Fluoride and Nitrate

Additionally, EP-75 is located in the Boneyard sub-area and is a localized "hot-spot" and exhibited the highest molybdenum, selenium and thallium concentrations observed during the Interim Site monitoring. **The Parker Brothers Arroyo AA will be retained for evaluation of remedial actions.**

4.2.4. Plant Entrance Arroyo AA

Although monitoring wells EP-89 and EP-110 (Figure 4-63) are located in the Plant Entrance Arroyo AA (Figure 2-2), these locations are not included in the Interim site monitoring program. Historically, concentrations in samples collected from these monitoring wells have been below detection for all COCs and AOIs. While, arsenic concentrations observed at nearby monitoring locations EP-71 and EP-7, arsenic concentrations exceed the screening standard of 0.01 mg/L, the historical data (August 2009) from EP-89 and EP-110 provide delineation to the South (Figure 4-63). **No additional delineation of the Plant Entrance Arroyo AA is necessary.**

4.2.5. South Terrace Arroyo AA

The South Terrace Arroyo (Figure 2-2) was backfilled with clean fill and slag materials (Appendix T) during the operational period of the Site. The major surface feature in this AA is the stormwater pond, which is lined and does not influence groundwater.

Monitoring well EP-71 is the only monitoring location where data are currently collected in the South Terrace Arroyo AA (Figure 3-5). Monitoring well EP-20 is located immediately west of the South Terrace Arroyo AA at the toe of the AA boundary slope and is in the former arroyo flow path; therefore, it provides an indication of COCs and AOIs in the AA. An additional monitoring well, EP-72, was sampled and analyzed for COCs and AOIs during spring and fall 2012 to evaluate the current COC and AOI distribution east of the stormwater pond. The following COCs and AOIs exceed screening standards in the South Terrace Arroyo AA:

- Metals: Arsenic, Cadmium, Selenium, and Thallium
- Water Quality Parameters: Nitrate

The South Terrace Arroyo will be retained for evaluation of remedial alternatives.

4.2.6. Acid Plant Arroyo AA

The Acid Plant Arroyo AA is located in the central portion of the Site (Figure 2-2) where numerous process operations occurred during smelter operational history. As an outcome, a number of COCs and AOIs exceeding screening standards are within this AA:

- Metals: Antimony, Arsenic, Cadmium, Chromium, Lead, Mercury, Molybdenum, Nickel, Selenium, and Thallium
- Water Quality Parameters: Fluoride, Nitrate and Nitrite

In the Acid Plant Arroyo AA, ongoing groundwater monitoring is conducted at monitoring wells EP-49, EP-51 and EP-52 (Figure 3-5); due to historical operations these wells exhibit the highest concentrations of antimony, arsenic, chromium, and mercury. Further the elevated concentrations of chromium, lead, mercury and nickel are very limited in extent suggesting these higher concentrations are isolated "hot-spots". **The Acid Plant Arroyo AA will be retained for the evaluation of remedial actions.**

4.2.7. Pond 1 Arroyo AA

The Pond 1 Arroyo AA is located in the central portion of the Site (Figure 2-2). Within the Pond 1 Arroyo AA, groundwater samples are collected from monitoring wells EP-68, and EP-12 (Figure 3-5). Monitoring well EP-4 is located immediately west of the Pond 1 Arroyo AA at the downgradient slope of this AA and within the former arroyo flow path. Therefore, this location provides an indication of COC and AOI concentrations discharging from the AA. In addition, EP-14, EP-35 and EM-02 were sampled and analyzed for COCs and AOIs during spring and fall 2012 to further delineate current extent of impacts. The following COCs and AOIs exceed screening standards in the Pond 1 Arroyo AA:

- Metals: Arsenic, Selenium and Thallium
- Water Quality Parameters: Nitrate

The Pond 1 Arroyo AA will be retained for the evaluation of remedial actions.

4.2.8. Ponds 5 and 6 Arroyo AA

The Ponds 5 and 6 Arroyo AA is located in the central portion of the Site (Figure 2-2). The monitoring well network includes EP-77 and EP-13 (Figure 3-5). Monitoring well EP-116, located immediately west of the Ponds 5 and 6 Arroyo AA at the toe of the AA boundary slope and within the former Ponds 5 and 6 arroyo flow path. In addition to EP-116, downgradient offsite monitoring well EP-117 was sampled and analyzed for COCs and AOIs during spring and fall 2012. The following COCs and AOIs exceed screening standards in the Ponds 5 and 6 Arroyo AA:

- Metals: Antimony, Arsenic, Cadmium, Copper, Lead, Mercury, Molybdenum, Selenium and Thallium
- Water Quality Parameters: Fluoride and Nitrate

Cadmium, copper and lead groundwater concentrations at EP-116 were the highest observed on Site during the Interim Site monitoring. These isolated groundwater impacts at this location are associated with soil impacts observed at the toe of the slope in the immediate vicinity (Figures 4-34 and 4-35) and not associated with groundwater from the upgradient areas of Ponds 5 and 6. **The Ponds 5 and 6 Arroyo AA will be retained for the evaluation of remedial actions.**

4.2.9. La Calavera AA

The La Calavera AA is an area north of Parker Brothers Arroyo that is proposed for future residential land use as discussed in Section 2.3 (Figure 2-2). Monitoring location EP-86 is the only monitoring well located in the La Calavera AA (Appendix H). This monitoring well has historically been sampled, but has not been part of the ongoing groundwater sampling program. However, during the most recent sampling event for this AA in fall 2009, the arsenic concentration was 0.017 parts per million (ppm). **The La Calavera AA will be retained to evaluate remedial actions. EP-86 will be added to the current groundwater monitoring program to further evaluate the presence of arsenic in groundwater at this AA.**

4.2.10. Floodplain AA

The Floodplain AA is on the western, downgradient side of the Site (Figure 2-2). The Floodplain AA is located between Paisano Drive and the American Canal. Groundwater samples are collected from the following monitoring wells in the Floodplain AA (Figure 3-5):

- EP-122
- EP-119
- EP-58
- EP-62
- EP-135
- EP-132

In addition, the following locations are not within the Floodplain AA (as defined by property boundary) but are in the floodplain and are included in the groundwater sampling program. New groundwater monitoring wells for this AA (MW-9S/D through MW-11S/D, shown on Figure 3-6) are discussed in Section 3.2.3.3.

- MW-1
- MW-9S/D

- MW-10S/D
- MW-11S/D
- MW-2
- EP-133
- EP-4
- EP-6
- EP-7

The following COCs and AOIs exceed screening standards in the Floodplain AA:

- Metals: Antimony, Arsenic, Chromium, Molybdenum, Selenium and Thallium
- Water Quality Parameters: Fluoride and Nitrate

The Floodplain AA will be retained for the evaluation of remedial actions.

4.2.11. Groundwater Delineation

As discussed above in Section 4.2, the following metal COCs and AOIs were detected above groundwater screening standards:

- Antimony
- Arsenic
- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Molybdenum
- Nickel
- Selenium
- Thallium

Additionally, the following water quality COCs and AOIs were observed at concentrations above the screening standard: fluoride, nitrate and nitrite. These COCs and AOIs, along with cobalt and zinc, which were observed at concentrations above the relevant TRRP standards, will continue to be evaluated at groundwater compliance monitoring points for each of the seven AAs where concentrations in groundwater above the relevant screening levels have been observed.

Concentrations of COCs and AOIs in groundwater east of I-10 have been delineated to below the screening standard or, due to the lack of groundwater present in the andesite bedrock outcrops in the East Mountain AA, the physical extents of each arroyo, with the exception of arsenic concentrations. **Additional field work will be completed in the south arroyo of the East Property AA to delineate concentrations of arsenic and inform remedy selection.**

The remaining AAs are delineated to the physical extents of each arroyo. **La Calavera AA will EP-86 will be added to the groundwater monitoring program to further delineate arsenic concentrations.** In the Floodplain AA, which is west of and downgradient to the Site, groundwater COC and AOI concentrations are delineated to the physical extent of the groundwater bearing units immediately upgradient of the American Canal or Rio Grande.

4.3. Current Distribution of COCs and AOIs in Surface Water

The primary surface water bodies at the Site are the American Canal and the Rio Grande, as discussed in Section 1.4.3. These surface water bodies each constitute separate AAs, depending on the final water use for each, as described in Section 2.3. Surface water monitoring has been ongoing since 1998.

Monitoring is performed at 11 surface water stations: three on the American Canal and eight on the Rio Grande (Figure 3-7). Samples collected during these events are analyzed for the surface water specific COCs and AOIs described in Table 2-1.

Surface water sampling is conducted on a semi-annual basis, with final sampling dates scheduled based on the seasonal operation of the American Dam and to coincide with groundwater monitoring events. Five semi-annual sampling events have been conducted since September 2010.

Surface water analytical data are screened against the criteria shown in Table 2-4. All surface water analytical data collected since September 2010 are presented in Appendices I-3 and I-4 and summarized in Tables 4-14 through 4-17. Theses tables provide a summary of key statistics (maximum and minimum values, mean, and standard deviation) for each COC and AOI. Where a concentration was detected above the relevant screening standard, that constituent was defined as a COC, as discussed in Section 2.3. Additional data for the specific COCs identified for the Rio Grande and

American Canal are provided in Tables 4-14 through 4-17. In addition to the summary tables, the data are also shown on Figures 4-79 to 4-84 and discussed for each AA below.

4.3.1. Rio Grande

During the five semi-annual sampling events completed since September 2010, arsenic, iron, selenium, magnesium, manganese, chloride and nitrate were detected at concentrations above the relevant screening standard (Tables 4-14 and 4-15). Concentrations of COCs and AOIs in the Rio Grande are influenced by seasonal flow changes. During low flow conditions, elevated concentrations of COCs and AOIs are observed. When flow conditions are high, concentrations decrease. The distribution of these COCs and AOIs are discussed below.

Concentrations of arsenic during the last five monitoring events at the eight surface water monitoring locations are presented on Figure 4-79. Arsenic concentrations measured during the spring sampling events (February through March 2011 and 2012) exceeded the screening standard at all surface water sampling locations along the Rio Grande except for SEP-9. Concentrations of arsenic did not exceed the screening standard at any location during the three fall sampling events. Therefore, accounting for the spring-fall fluctuations, arsenic distribution and concentrations have remained stable since September 2010.

Chloride concentrations exceeding the screening standard were observed at all eight monitoring locations along the Rio Grande (Table 4-15; Figure 4-80). The highest chloride concentrations were observed during the spring sampling events, and the data showed some seasonality. Concentrations of chloride at upstream location SEP-9 were similar to concentrations observed at other monitoring locations along the Rio Grande.

Concentrations of iron exceeding the screening standard were observed at all eight locations along the Rio Grande (Tables 4-14 and 4-15; Figure 4-81). The data shows seasonal fluctuation, with the highest concentrations of iron observed during the fall monitoring events. Concentrations of iron are relatively consistent for each event for locations along the length of the Rio Grande.

Magnesium, manganese, and selenium concentrations exceeding the screening standard were observed at six of the eight locations along the Rio Grande, with only SEP-1 and SEP-9, located on the upstream edge of the Site having concentrations of these COCs are consistently below the screening standard or detection (Tables 4-14 and 4-15; Figure 4-82, Figure 4-84 and Figure 4-85).

Nitrate concentrations were only analyzed in surface water samples collected during the fall 2010 and fall 2011 sampling events, as presented on Figure 4-83. Nitrate concentrations at all eight monitoring locations were below the screening standard (10 mg/L) during all sampling events, except for SEP-10 during the fall 2010 sampling event. The concentration of nitrate at this location was 131 mg/L. Concentrations of nitrate at SEP-10 during the subsequent fall 2011 sampling event were below detection.

In addition, molybdenum was also identified as a COC for the Rio Grande. Concentrations of all COCs and AOIs in surface water were the subject of an additional comparison against the TRRP GW-Res screening standards. As stated in the RAWP (Malcolm Pirnie, 2011a) the Site will be remediated under the TRRP rules once the RI is complete. A comparison of the screening standard and the corresponding TRRP standard was completed to ensure COCs were correctly identified for future remediation. During this assessment, molybdenum, arsenic and nitrate were observed at concentrations exceeding the TRRP standard. Molybdenum will be assessed further through future monitoring programs in the Rio Grande.

4.3.2. American Canal

During the five semi-annual sampling events completed since September 2010 for three locations along the American Canal, only arsenic was detected at concentrations exceeding the relevant screening standard (Tables 4-16 and 4-17). Like the Rio Grande, concentrations of COCs and AOIs in the American Canal are influenced by seasonal flow changes. During low flow conditions, elevated concentrations of COCs and AOIs are observed. When flow conditions are high, concentrations decrease. The distribution of these COCs and AOIs are discussed below.

4.3.3. Surface Water Delineation

As discussed above, the following COCs and AOIs were detected above the relevant screening standards in surface water samples:

- Arsenic
- Chloride
- Iron
- Magnesium
- Manganese
- Nitrate
- Selenium

Concentrations of these COCs and AOIs have been delineated to the screening standard at the most downstream sample location on the American Canal (SEP-6) with the exception of arsenic, iron and chloride. Concentrations of arsenic and chloride at SEP-6 have been below with background concentrations in the Rio Grande detected at upstream monitoring location SEP-9, and arsenic and chloride have been delineated to background concentrations in the Rio Grande. Concentrations of iron at SEP-6 have been below background concentrations in the Rio Grande, with the exception of the fall 2012 result of 8.04 mg/L, which is very close to the background concentration of 7.2 mg/L. The fall 2012 iron result for the downstream SEP-6 (8.04 mg/L) was less than the iron concentration in the two upstream monitoring locations SEP-1 (8.93 mg/L) and SEP-9 (9.51 mg/L). Concentrations of molybdenum have been below the relevant screening standards and the TRRP standards at downstream monitoring location SEP-6.

Concentrations of COCs and AOIs in the American Canal have been delineated to the screening standard at the most downstream sampling location (SEP-3) with the exception of arsenic. Concentrations of arsenic at SEP-3 exceeded the screening standard on two occasions during spring 2011 and 2012, but were below the screening standard during other sampling events. Therefore, accounting for seasonal fluctuation, concentrations of arsenic appear stable. **Arsenic concentrations in the American Canal will continue to be monitored.**

5. Conclusions

5.1. Introduction

This Report has been prepared by Malcolm Pirnie for the Trust to summarize data collected to date and present a comprehensive environmental dataset to inform future activities at the former ASARCO Smelter Site located in El Paso, Texas. Site investigations have been performed within the footprint of the Site consistent with the published objectives in Section 2.2 of the 2009 Custodial Trust Agreement including conducting, managing, and/or funding the implementation of environmental actions at the Site.

The Site is no longer an active industrial facility. Structures have been demolished and remedial activities are underway. Land use in the vicinity of the property includes mixed industrial, commercial and residential. The Trust evaluated the results of previously completed RI activities and concluded that supplemental RI activities would be necessary to provide additional data on which to base future use scenarios and to preserve flexibility in considering redevelopment options.

Much of the required investigative work was complete at the time the RAWP (Malcolm Pirnie, 2011a) was prepared; however, the Trust identified areas where further investigation was necessary due to changes in regulatory approach and future intended land use. Further investigation was undertaken to completely delineate the nature and extent of COCs and AOIs that exceed the assessment levels developed for the Site, and define the final COC list, which is presented in Tables 5.1 through 5.3 (found on pages 5-5 through 5-7). All AAs in which previous and supplemental RI activities have been completed are presented in Figure 2-2.

Analysis of results of previous and supplemental RI activities compared to risk-based assessment levels developed for the Site indicates that the Site has been characterized and documentation is adequate to support identification and implementation of final remedial actions. Additional surface soil sample collection is required in the East Property AA for arsenic and lead, and one groundwater sample is required in the La Calavera AA to complete delineation activities. These activities will be completed as part of the remedy selection or remedy.

The investigation has also identified specific areas where COCs and AOIs are present in soil, groundwater and surface water for the purpose of defining areas for evaluation of future remedial activities. Conclusions from this evaluation will be used to inform and evaluate the development of a revised remedial strategy in the subsequent Remedial Action Plan.

5.2. Remedial Activities Completed or Underway

TCEQ provided conditional approval of ASARCO's Corrective Action Proposal and remedy implementation began in 2005. Remedy implementation to date has included disposal and landfill placement of Category I, identification and management of Category II and III materials (see category definitions below), excavation of material from Parker Brothers Arroyo, installation of PRBs and a slurry wall, and removal of NAPL and impacted groundwater from the Diesel 2 Plume Area.

5.2.1. Soil Remediation

5.2.1.1. Soil Categories (I, II and III)

In accordance with the agreed remedy, soils and other solid materials at the Site were divided into Categories I, II, and III, as defined below.

- Category I: soils and solids identified to contain elevated concentrations of COCs and located in an area where they have the potential to affect human health and the environment.
- Category II: soils and solids identified as containing elevated concentrations of COCs but at levels which will not impact groundwater if managed properly.
- Category III: materials that are inert and contain low, if any, concentrations of COCs and, therefore, do not pose a threat to human health.

5.2.1.2. Category I Material Remediation

Remediation activities for Category I materials included the addition of a fourth Category I landfill (Cell 4), which was designed for a capacity of approximately 200,000 cubic yards of material. Construction of the Cell 4 liner, located within Parker Brothers Arroyo, began in November 2011 and was finalized in June 2013 (Figure 1-4).

5.2.1.3. Category II Material Remediation

Since Category II materials are not expected to impact groundwater, it was proposed that these materials be either:

- Left in place and capped to prevent direct contact, wind mobilization, infiltration and subsequent COC or AOI migration; or
- Moved to a location on the Site that will be capped to prevent direct contact, wind mobilization, infiltration, and subsequent chemical migration.

Portions of the Site containing Category II materials were capped with an asphaltic cover between 2005 and 2009. Approximately 130,000 cubic yards of Category II material (slag and impacted soils) were excavated from Parker Brothers Arroyo and stockpiled onsite to be used as fill for building basements and to provide initial subgrade for the plant property.

5.2.1.4. Category III Material

Category III materials do not pose a threat to human health; consequently, remedial actions have not been conducted in association with them.

5.2.1.5. Water Management in Parker Brothers Arroyo

To provide storm water conveyance through the Parker Brothers Arroyo during remedial construction, an Interim Channel design was developed and submitted to TCEQ in November 2011 and approved December 2011. The design includes excavation of approximately 110,000 cubic yards of impacted material and construction of a new storm water conveyance channel that meets the City of El Paso hydraulic design requirements (Figure 1-5). To date, approximately 100,000 cubic yards of impacted material (up to 23 feet deep) have been excavated from the Interim Channel area.

5.2.2. Groundwater Remediation

Active remediation of groundwater at the Site has been undertaken in two areas, as described below.

5.2.2.1. Parker Brothers Arroyo

A field demonstration of two ZVI PRBs was implemented in 2012 to verify PRB effectiveness and provide data to support the full-scale design of additional PRBs as part of the final groundwater remedy if necessary. The PRBs were constructed to span the entire saturated thickness of the aquifer. While more long term data is required, initial performance monitoring results indicate that the PRBs are functioning as designed (Figure 1-5).

5.2.2.2. Diesel 2 Area

An extraction system operated from 1999 until May 2011. In February 2012, a pilot test was conducted to determine whether high-pressure vacuum extraction would be an appropriate technology for removing the remaining NAPL. The results indicated that limited recovery of NAPL was possible under this method. The Diesel 2 area was closed in October 2013with approval from TCEQ.

5.3. Supplemental RI

5.3.1. Investigation and Assessment Areas

Since the plant has been almost entirely demolished, it is no longer appropriate to define areas for remedial planning based on plant operational areas. Consequently, AAs (Figure 2-2) were designated based on probable exposure pathways and historical arroyo boundaries.

5.3.2. Screening Standards

Screening standards were determined based on the proposed future land uses and in a manner consistent with the previous RIs and are presented in Tables 2-2 through 2-4. A BRA was completed in 1998 and updated in 2001 in accordance with the TNRCC risk reduction standards and USEPA guidelines, including: 1) identification of mechanisms of release for COCs from impacted media to the environment; 2) identification of fate and transport mechanism from impacted media to environmental exposure media; 3) identification of complete exposure routes for COCs in exposure media to human receptors (ingestion, inhalation, and dermal absorption); 3) estimation of present and potential future cancer risks and toxicity hazards; and 4) provide preliminary, media-specific cleanup levels that are protective of human health and the environment.

5.3.3. Results

5.3.3.1. Distribution of COCs and AOIs in Soil

The Site has been characterized and delineated to the appropriate criteria. Soil samples were analyzed for COCs and AOIs presented in Table 2-1 and screened using the standards shown in Table 2-2. Where concentrations were detected above the relevant screening standard, constituents were defined as COCs for evaluation in the subsequent RAP.

The soils of the Site consist of fill and a mix of native alluvium and colluvium. Fill material consists of slag, native soil, and other anthropogenic materials such as concrete and asphalt. Concentrations of COCs and AOIs above relevant criteria have been observed in both fill material and native soil.

Elevated concentrations of COCs and AOIs are associated with slag deposition, disposal of ore concentrates, and deposition of other material from historical plant operations. AAs at which concentrations exceed the relevant criteria are shown in the table below.

Table 5-1 COCs in Soil Exceeding Relevant Screening Standards

Assessment Area	Screening Standard	Identified COCs[1]
East Property	SAI - Res	Antimony; Arsenic; Cadmium; Copper; Lead; Mercury; Selenium
East Mountain	SAI - Res	Antimony; Arsenic; Lead; Mercury
Parker Brothers Arroyo	SAI - Ind	Antimony; Arsenic; Cadmium; Copper; Lead; Mercury
South Terrace Arroyo	SAI - Ind	Arsenic; Cadmium; Copper; Lead; Mercury
Plant Entrance Arroyo	SAI - Ind	Arsenic; Lead
Acid Plant Arroyo	SAI - Ind	Antimony; Arsenic; Cadmium; Lead; Mercury
Ponds 5 and 6 Arroyo	SAI - Ind	Antimony; Arsenic; Cadmium; Lead; Mercury
Pond 1Arroyo	SAI - Ind	Arsenic; Cadmium; Lead; Mercury
La Calavera	SAI - Res	Arsenic; Lead; Mercury
Floodplain	SAI - Ind	Arsenic; Lead

Notes:
[1]Analytes exceeded the Relevant Screening Standard
SAI-Ind = Soil MSC for Industrial Use Based on Inhalation, Ingestion, and Dermal Contact
SAI-Res = Soil Medium Specific Concentration for Residential Use Based on Inhalation, Ingestion, and Dermal Contact

5.3.3.2. Distribution of COCs and AOIs in Groundwater

The Site groundwater has been characterized and delineated site-wide and with respect to all appropriate COCs and AOIs. Groundwater samples were analyzed for COCs and AOIs presented in Table 2-1 and screened using the standards shown in Table 2-3. Where concentrations were detected above the relevant screening standard, constituents were defined as COCs for evaluation in the subsequent RAP.

Concentrations of COCs and AOIs in groundwater have been delineated to below screening standards or to the physical extents of each arroyo, with the exception of arsenic concentrations. Additional field work will be completed in the south arroyo of the East Property AA to delineate concentrations of arsenic and inform remedy selection.

Groundwater at the Site occurs within an unconfined alluvial aquifer with a saturated thickness of approximately 8 to 60 feet underlain by a regional, less-permeable bedrock unit. Groundwater in the alluvial aquifer flows west and southwest through the Site toward the Rio Grande. There is negligible hydraulic connection between the bedrock and alluvial aquifers and the bedrock groundwater is not expected to have been impacted by Site COCs or AOIs. Groundwater at the Site is not used as a drinking water source. There are no alluvial water supply wells affected by impacted groundwater from the Site.

AAs at which concentrations exceed the relevant criteria are shown in the table below.

Table 5-2 COCs in Groundwater Exceeding Relevant Screening Standards

Assessment Area	**Screening Standard**	**Identified COCs[1]**
East Property	MCL/GW-Ind	Antimony; Arsenic; Cadmium; Lead; Fluoride
East Mountain	MCL/GW-Ind	N/A
Parker Brothers Arroyo	MCL/GW-Ind	Antimony; Arsenic; Cadmium; Cobalt; Lead; Molybdenum; Selenium; Thallium; Zinc; Fluoride; Nitrate
Plant Entrance Arroyo	MCL/GW-Ind	Arsenic [2]
South Terrace Arroyo	MCL/GW-Ind	Arsenic; Cadmium; Thallium; Selenium; Nitrate
Acid Plant Arroyo	MCL/GW-Ind	Antimony; Arsenic; Cadmium; Chromium; Cobalt; Lead; Mercury; Nickel; Molybdenum; Selenium; Thallium; Zinc; Fluoride; Nitrate
Pond 1 Arroyo	MCL/GW-Ind	Arsenic; Thallium; Selenium; Nitrate
Ponds 5 and 6 Arroyo	MCL/GW-Ind	Antimony; Arsenic; Cadmium; Copper; Lead; Mercury; Molybdenum; Selenium; Thallium; Fluoride; Nitrate
La Calvera	MCL/GW-Ind	None
Floodplain	MCL/GW-Ind	Antimony; Arsenic; Chromium; Molybdenum; Selenium; Thallium; Fluoride; Nitrate

Notes:
[1]Analytes exceeded the Relevant Screening Standard.
[2]No groundwater monitoring locations exist in the Plant Arroyo AA, however, data from nearby monitoring locations suggest arsenic may be present above the screening standards.

GW-Ind = Commercial/Industrial Standard for Groundwater
MCL = Maximum Contaminant Level, USEPA National Primary Drinking Water Standard
N/A = Not applicable. No alluvial aquifer exists in this AA

5.3.3.3. Distribution of COCs and AOIs in Surface Water

The Site surface water has been characterized and delineated site-wide and with respect to all appropriate COCs and AOIs. Surface water samples were analyzed for the COCs and AOIs presented in Table 2-1 and screened using the standards shown in Table 2-4. Where concentrations were detected above the relevant screening standard, constituents were defined as COCs for evaluation in the subsequent RAP.

The primary surface water bodies at the Site are the American Canal and the Rio Grande, which constitute a single AA. COCs detected above the relevant screening standards in surface water samples are shown in the table below. With the exception of arsenic, concentrations of all these COCs at the most downstream sampling locations are consistent with background concentrations and are not due to Site-related impacts.

Table 5-3 COCs in Surface Water Exceeding Relevant Screening Standards

Assessment Area	Screening Standard	Identified COCs[1]
Rio Grande	MCL/TAC 307	Arsenic; Chloride; Iron; Magnesium; Molybdenum[2]; Nitrate; Selenium
American Canal	MCL	Arsenic; Magnesium

Notes:
[1]Analytes exceeded the Relevant Screening Standard
[2] Compared to the Texas Risk Reduction Groundwater-Residential screening standards

MCL = Maximum Contaminant Level, USEPA National Primary Drinking Water Standard
TAC 307 = Texas Administrative Code 307 Texas Surface water Quality Standards, Freshwater Chronic Criteria

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