Acid Storage area south of the Boneyard area. The Acid Plant sludge would be characterized as having high metals concentrations due to the process operations of the Acid Plants and not as a result of their contact with slag. The Acid, which may leak from the Bulk Acid Storage facility, would be characterized as clean (food grade) acid containing no metals may or may not have been in contact with slag.

Although only moderately elevated concentrations of COCs were observed in this zone, these materials may be Category I, and may contribute to groundwater impacts observed in this IA. The infiltration of acid from the adjacent storage facility flowing through the slag filled Arroyo may be a source of metals to the groundwater in this IA as discussed in the Phase I RI Report. As discussed in Section 4.5, additional soils investigations for IA-2, discussed in Section 4.5, will be required to ascertain the extent of metals and the specific nature and origin of source materials.

3.3.3 Groundwater

Groundwater samples were collected from IA-2 monitor wells EP-53, EP 75, EP-76 and EP-99 (Figure 3-1). A summary of Phase II RI groundwater monitoring results for IA-2 is in Table 3-5.

Groundwater in IA-2 is encountered at approximately 55 feet bgs, and generally flows east to west. The Boneyard overlies the head of a slag-backfilled arroyo, which appears to act as a preferential path for groundwater flow. The arroyo, which drains to the Oglebay Norton Inc. (formerly Parker Brothers Inc.) slag-crushing/recycling operations area, and which drains to the Rio Grande, is referred to as the Parker Brothers Arroyo (see Figure 2-2).

Groundwater COC concentrations reported for Phase II RI were similar to those reported during the Phase I RI. Arsenic is the primary groundwater COC in IA-2. Arsenic concentrations were highest in EP-53 and lower in upgradient wells (EP-75 and EP-76). For monitor well EP-53, average total arsenic and cadmium concentrations are 47.33 mg/l and 1.15 mg/l, respectively. Average total arsenic and cadmium concentrations for EP-75 are

15.00 mg/l, and 0.005, respectively, and for EP-76 are 1.50 mg/l and 0.005 mg/l, respectively, and for EP-99 are 5.40 mg/l and 0.005 mg/l, respectively.

3.3.4 Summary

Primary COCs in soil and groundwater in IA-2 are arsenic and cadmium. Slag (Category III material) is the predominant material near the surface in IA-2, and does not represent a source of metals to the groundwater. As shown on Figure 3-2 and presented in Table 3-1, Category I materials have been identified in IA-2 near the surface. IA-2 contained Category I impacted materials in the area of BH2-4 (Figure 3-2). During the Phase II RI, Category I materials were excavated from the surface area around borings EP-76 and SSIA2-2 and were transported and disposed of in a permitted off-site hazardous waste landfill, minimizing future potential groundwater impacts from the surface layer.

Below slag, some impacted soils have been identified in the area near EP-75, EP-76 and BH 2-6 at depths ranging from 35 to 65 feet bgs and 9 to 17 feet bgs, respectively. The historic storage/leaks of Acid Plant solids and liquids in this area may represent a potential source of COCs to groundwater. Further investigation is required to evaluate the extent of Category I materials in this zone in this IA (see Section 4.5).

3.4 ACID PLANT 1 AND 2 AREA (IA-3)

Information concerning the Acid Plant 1 and 2 Area (IA-3), including background data, soil and groundwater impacts, and a summary is presented in the following sections.

3.4.1 Background Information

IA-3 includes Acid Plants 1 and 2, which are in the northwestern portion of the Facility property (Figure 3-3, Exhibit 1). The Acid Plants are used to remove sulfur dioxide from gases generated during the copper smelting process, producing sulfuric acid as a by-product. Acid Plants 1 and 2 are located on a graded surface over the Acid Plant Arroyo, which is filled with slag.

The primary source of impacts to soil and groundwater in IA-3 were water and acid that originated from Acid Plant process components. These fluids have been eliminated or greatly reduced with the implementation of operational controls consisting of the upgrading and lining of sumps, and grading and paving as part of storm water control improvements. Acid Plants 1 and 2 are currently not operational during the temporary smelter shutdown.

IA-3 was characterized during the Phase I RI with four existing monitor wells (EP-25, EP-49, EP-54, and EP-55), one new monitor well (EP-73) and ten surface soil borings (surface to 5 feet bgs). The Phase I RI metal concentrations at 5 feet bgs (the total depth of the borings), did not decrease as a function of depth. Therefore, eight additional borings to groundwater and a monitor well at the mouth of the Arroyo were proposed for the Phase II RI.

3.4.2 Soil

Representative borings in IA-3 are BH3-1 through BH3-8. In the Phase I RI, the soils in this area were characterized by soil borings SSIA3-1 through SSIA3-10. A total of 55 soil samples were collected from IA-3 during the Phase II RI (see Table 2-1), from eight borehole locations (Figure 3-1). Phase II RI soil sample analysis results for IA-3 are summarized in Table 3-6.

IA-3 soils are characterized as silty sands and gravels overlain by slag, smelter debris and soil fill material. The soils and subsurface materials in IA-3 have been disturbed, reworked, altered and amended during the 100 plus years of operations at the Facility. Topographically low areas were filled in with soils, rock, slag or smelter debris and re-graded in successive layers as Facility operations expanded and changed over time.

Elevated concentrations of COCs in IA-3 are localized and intermittent. Arsenic, cadmium and lead are the primary COCs. The results of the Phase II RI soil sample analysis reflect similar trends as those observed during the Phase I RI. Average concentrations of COCs are 178 mg/kg for arsenic, 58 mg/kg for cadmium and 247 mg/kg for lead. Arsenic concentrations in the Phase II samples ranged from nondetectable to 2,100 mg/kg, and lead values ranged from nondetectable to 3,800 mg/kg. Cadmium concentrations ranged from nondetectable to 560 mg/kg. The maximum arsenic and lead concentrations were observed in borehole BH3-5, and the highest cadmium concentration was observed in the first one-foot interval of borehole BH3-2.

Some areas have soil impacts to depths up to five feet bgs, and others exhibit elevated concentrations of COCs at depths ranging from about 40 to 60 feet bgs. The deeper intervals occur below slag (Category III) materials. The majority of elevated metal concentrations occur in the area of Borings BH3-5 and SSIA3-10 at depths of 0 to 4.5 feet bgs. The highest concentration of COCs is lead at a depth of 0 to 1.5 feet bgs for SSIA3-10 is 22,000 mg/kg. Metal concentrations decrease in borings more distant from this location. This material overlies slag in most of IA-3.

3.4.3 Groundwater

Groundwater samples from IA-3 were collected during the Phase I RI from monitor wells EP-25, EP-49, EP-52, EP-54, 55 and EP-73, and during Phase II from monitor wells EP-25, EP-49, EP-52, EP-54, EP-55, EP-73 and EP-114. A summary of groundwater monitoring results (averaged over four monitoring events) for IA-3 is in Table 3-7.

The groundwater flow direction in IA-3, which is generally from east to west, appears to be influenced by an arroyo originating in IA-3. The depth to groundwater in IA-3 is approximately 50 to 70 feet bgs. The arroyo, which is referred to as the Acid Plant Arroyo (see Figure 2-3), is backfilled with slag, smelter debris, and soil. It is also part of the Diesel No. 2 Remediation Site (see Section 1.0 and Figure 1-3).

The primary groundwater COCs in IA-3 are arsenic, cadmium and lead. Phase II RI monitor well EP-114 generally shows higher concentrations of COCs than those installed during the Phase I RI. Total arsenic concentrations average 56 mg/l. Total cadmium concentrations average 1.35 mg/l. Total lead concentrations average 0.63 mg/l. The highest concentrations of COCs in IA-3 groundwater occur at monitor well EP-114, with concentrations ranging from 1.42 mg/l cadmium to 166.0 mg/l arsenic. Monitor well EP-114 is completed at the lower end of a former arroyo, a feature that appears to influence the accumulation of metals.

3.4.4 Summary

The former periodic release of low pH/high metal fluids associated with the gas cleaning and sulfuric acid from the Acid Plants has resulted in elevated concentrations of metals, particularly arsenic, in groundwater below IA-3. With the storm water improvements and operational controls in this area, this source has been eliminated or greatly reduced. Impacts to groundwater in IA-3 resulting from localized areas where fluids formerly accumulated are classified as Category II materials (Figure 3-3). Much of the Category II area is currently capped.

At depths greater than 30 to 50 feet bgs below slag, some impacted soil has been identified. Because the source at the surface has been reduced through elimination of leaking and ponding fluids, and the area is below slag (Category III material) area, additional capping of the area should eliminate or reduce the potential for metals to migrate to the groundwater.

3.5 FRONT SLOPE/WESTERN FACILITY BOUNDARY AREA (IA- 4)

Information concerning the Front Slope/Western Facility Boundary Area (IA-4), including background data, soil and groundwater impacts, and a summary is presented in the following sections.

3.5.1 Background Information

IA-4 includes the western boundary of the Facility and is referred to as the Front Slope (Figure 3-4, Exhibit 1). The Front Slope is composed partially of poured slag, and forms a relatively steep slope between smelter facilities and Paisano Drive. At the base of the slope is a long flat area, which is the easement for the Burlington Northern & Santa Fe Railway.

Based on the results of the Phase I RI investigation and subsequent TNRCC comments, the following six subareas of concern were identified within IA-4:

- Subarea IA-4.1 - Downslope of the Acid Plants.
- Subarea IA-4.2 - Downslope of Medford Sump (Converter building/Bag house Area).
- Subarea IA-4.3 - Downslope of the Closed Lead Plant Baghouse.
- Subarea IA-4.4 - Downslope of the Sinter Facility Gas Cleaning and Sample Mill.
- Subarea IA-4.5 - Downslope of (Diesel I) Pond 1.
- Subarea IA-4.6 - Downslope of the South Terrace.

These six subareas are located above back-filled arroyos, most of which are downgradient of Facility components described in other IAs, including Acid Plants 1 and 2 and the Converter Building/Baghouse Area. The former Lead Plant is also upgradient of IA-4, and is part of another separate investigation effort. Storm water and operational control improvements implemented in these upgradient IAs have greatly reduced the potential for future impacts to soil and groundwater in this area. Source materials listed for the subareas in IA-4 in Table 3-1, are associated with former Facility operations, the source of which has been corrected as part of Facility improvements.

The soils and subsurface materials in IA-4 have been disturbed, reworked, and otherwise altered during the history of Facility operations. Topographically low areas were filled in with soils, rock, slag or smelter debris, and re-graded in successive layers as Facility operations expanded and changed over time.

IA-4 was characterized during the Phase I RI with three existing monitor wells (EP-13, EP-20, and EP-29), constructing three new monitor wells (EP-70, EP-71 and EP-72) and 30 surface soil borings (surface to 5 feet bgs). Because the Phase I RI did not target the mouths of the plant Arroyos, six additional borings to groundwater and four new monitor wells were proposed for the Phase II RI to better characterize IA-4.

Phase II RI soil sample analysis results for IA-4 are summarized in Table 3-8. Locations of the borings and monitor wells are in Figure 3-4. A summary of groundwater monitoring results for IA-4 is in Table 3-9.

3.5.2 Downslope of the Acid Plants 1 & 2 (Investigation Subarea 4.1)

Information concerning investigation subarea 4.1, including background data, soil and groundwater impacts, is presented in the following sections.

3.5.2.1 Soil

The soils of the area downslope of the Acid Plants (IA-4.1) are characterized by Phase II RI soil borings BH4-6 and EP-114. In the Phase I RI, the soils in this area were characterized by soil borings SSIA4-1 and SSIA4-2. These borings were placed to delineate materials in the former arroyo. A total of 11 soil samples were collected from this subarea of IA-4.1 during the Phase II RI (see Table 2-1) from two borehole locations, one of which was completed as a monitor well.

IA-4.1 soils are characterized as silty sands and gravels and fill material that have been impacted by runoff and spills from Facility process activities from up slope. The majority of elevated metal concentrations occur at depths of 0 to 5 feet bgs. The highest concentration of COCs observed in Phase I and Phase II soil borings, is lead at 1,200 mg/kg in SSIA4-2 at a depth of about 1.5 feet bgs.

Soil results for the Phase II RI indicate lower concentrations than was observed during the Phase I RI. Arsenic and lead appear to be the primary COCs, with concentrations ranging from 18 mg/kg to 690 mg/kg for arsenic, and 64 mg/kg to 2,800 mg/kg for lead. Average concentrations of COCs are 212 mg/kg for arsenic, 109 mg/kg for cadmium and 632 mg/kg for lead. In the area downslope of the Acid Plants, the highest concentrations of COCs occur within the first one to five feet bgs.

3.5.2.2 Groundwater

Groundwater samples collected from this subarea of IA-4.1 during Phase II RI are from monitor well EP-114 (Figure 3-4). The primary groundwater COCs in IA-4.1 downslope of Acid Plants 1 and 2 are arsenic and lead. Total arsenic concentrations average 166 mg/l. Total cadmium concentrations average 1.42 mg/l. Total lead concentrations average 3.31 mg/l. Elevated concentrations of COCs indicate that there are impacts to groundwater in this subarea.

Groundwater in this subarea generally flows from east to west, and occurs at a depth of approximately 14 feet bgs. Groundwater quality and flow in subarea IA-4.1 is influenced by the Acid Plant Arroyo. This arroyo is similar to other arroyos at the Facility that have been backfilled during historic Facility operations. This arroyo is in-filled with poured slag and smelter debris and may provide a path for preferential flow of metals to groundwater.

3.5.3 Downslope of Medford Sump (Investigation Subarea 4.2)

Information concerning investigation subarea 4.2, including background data, soil and groundwater impacts, is presented in the following sections.

3.5.3.1 Soil

Subarea IA-4.2 is downslope and west of the Converter Building/Bag House and Medford Sump in IA-1. The soils in the area downslope of the Medford Sump are characterized in Phase II by soil borings BH4-5 and EP-115, which was completed as a monitor well. In the Phase I RI, the soils in this area were characterized by soil borings SSIA4-3, SSIA4-4 and SSIA4-5. A total of 13 soil samples were collected from subarea IA-4.2 during the Phase II RI (see Table 2-1, Figure 3-4, Exhibit 1).

Subarea IA-4.2 soils are characterized as silty sands and gravels overlain by fill materials that have been impacted by runoff and spills from Facility process activities from up slope. The highest concentration of COCs observed in Phase I and Phase II soil borings is lead at a depth of 0 to 1 feet bgs for SSIA4-5 is 23,000 mg/kg.

Arsenic and lead are primary soil COCs in this subarea, with concentrations ranging from 130 mg/kg to 4,200 mg/kg for arsenic and 470 mg/kg to 8,600 mg/kg for lead. Average concentrations of COCs are 1,575 mg/kg for arsenic, 557 mg/kg for cadmium and 3,691 mg/kg for lead. The results of the Phase II RI soil sample analysis reflect similar trends as those observed during the Phase I RI. As with the area downslope of the Acid Plants, concentrations of COCs downslope of the Medford Sump occur primarily within the first one to five feet bgs.

Elevated concentrations of COCs in soils downslope of Medford Sump are attributed to former practices associated with the Medford Sump area which resulted in ponding of fluids of the area (see Section 1.1.1). This source has been eliminated or greatly reduced as part of recent storm water control improvements.

3.5.3.2 Groundwater

Groundwater samples collected from this subarea of IA-4.2 from Phase II monitor well EP-115 (Figure 3-4). Arsenic and cadmium are the primary groundwater COCs in this subarea. Total arsenic concentrations average 0.27 mg/l, and total cadmium concentrations average 0.645 mg/l. Total lead concentrations average 0.10 mg/l. Elevated concentrations of COCs indicate that there are impacts to groundwater in this subarea.

Groundwater in this subarea generally flows from east to west, and occurs at a depth of approximately 14 feet bgs. The Acid Plant Arroyo is similar to other arroyos at the Facility that have been backfilled during historic Facility operations. This arroyo is in-filled with poured slag and smelter debris. The arroyo in this area may provide a preferential conduit for water flow and metals migration.

3.5.4 Downslope of Lead Plant (Investigation Subarea 4.3)

Information concerning investigation subarea 4.3, including background data, soil and groundwater impacts, is presented in the following sections.

3.5.4.1 Soil

Soils in the area downslope from the former Lead Plant are characterized by Phase II RI soil boring BH4-4, and borings EP-116 and EP-117 that were completed as a monitor wells. The monitor wells were located to further delineate groundwater COCs and associated source materials. In the Phase I RI, the soils in this area were characterized by soil borings SSIA4-6 through SSIA4-10. A total of 20 soil samples were collected from this subarea of IA-4.3 during the Phase II RI (see Table 2-1), from three borehole locations (Figure 3-4, Exhibit 1).

Subarea IA-4.3 soils are characterized as silty sands and gravels overlain by fill materials. Phase II RI soil analysis results have trends similar to those observed during the Phase I RI. Arsenic and lead appear to be the primary COCs, with concentrations ranging from 100 mg/kg to 18,000 mg/kg for arsenic and 110 mg/kg to 40,000 mg/kg for lead. Average concentrations of COCs are 4,960 mg/kg for arsenic, 587 mg/kg for cadmium and 11,021 mg/kg for lead. At the three borings, elevated concentrations extend to depths greater than 12 feet bgs.

The majority of elevated metal concentrations occur in the area of Borings EP-116 and SSIA4-7, at depths of 0 to 5 feet bgs. The highest concentration of COCs is lead, with a concentration of 40,000 mg/kg at a depth of 0 to 1 feet bgs for SSIA4-7. Metal concentrations decrease in borings increasingly distant from this location.

This subarea of IA-4 is downslope of the former closed Lead Plant Baghouse. Lead Plant flue and Baghouse dust likely contributes to elevated concentrations of COCs in this subarea.

3.5.4.2 Groundwater

Groundwater samples collected from subarea IA-4.3 are from EP-116 and EP-117 (Figure 3-4). The primary groundwater COCs in IA-3 are arsenic and lead. Total arsenic concentrations average 6.05 mg/l. Total cadmium concentrations average 1.40 mg/l. Total lead concentrations average 4.10 mg/l. The highest concentrations of groundwater COCs occur at monitor well EP-117, with concentrations ranging from 1,450 mg/l total cadmium to 8.5 mg/l total arsenic. Elevated concentrations of COCs indicate that there are impacts to groundwater in this subarea.

Groundwater in this subarea generally flows from east to west, and occurs at a depth of about 14 feet bgs. Subsurface flow from Ponds 5 and 6 Arroyo formerly influenced groundwater flow in this subarea via an arroyo. Similar to other arroyos at the Facility, it was backfilled during historic Facility operations. This arroyo is in-filled with poured slag, smelter debris, soil and rock fill.

3.5.5 Downslope of Sinter Gas Cleaning and Sample Mill (Investigation Subarea 4.4).

Information concerning investigation subarea 4.4, including background data, soil and groundwater impacts, is presented in the following sections.

3.5.5.1 Soil

In the Phase I RI, the soils in this area were characterized by soil borings SSIA4-11 through SSIA4-14, (Figure 3-4). During the Phase II RI, the subarea was characterized by soil borings BH4-3 and EP-118, with EP-118 being completed as a monitor well. A total of eight soil samples were collected from subarea IA-4.4 during the Phase II RI (see Table 2-1) from two borehole locations (Figure 3-4, Exhibit 1).

Subarea IA-4.4 soils are characterized as silty sands and gravels overlain by fill materials. The area around soil boring BH4-3 is a slag filled arroyo. The slag extends from the surface to seven feet below ground surface, and extends up slope to the active Plant surface area.

The highest concentration of a COC is lead at 10,000 mg/kg in EP-118 at a depth of 0 to 1 feet bgs.

Phase II RI soil analytical results have trends similar to those observed during the Phase I RI. Arsenic and lead appear to be the primary COCs, with concentrations ranging from 54 mg/kg to 1,300 mg/kg for arsenic and 390 mg/kg to 10,000mg/kg for lead. Average concentrations of COCs are 423 mg/kg for arsenic, 117 mg/kg for cadmium and 3,534 mg/kg for lead. Elevated concentrations are primarily in the first five feet bgs.

Subarea IA-4.4 is northwest and downslope of the Sample Mill Area. Concentrates and dust transported in storm water and historic deposition of fugitive dust from the Facility are the probable source materials in this subarea.

3.5.5.2 Groundwater

Groundwater samples collected from subarea IA-4.4 are from Phase II monitor well EP-118 (Figure 3-4). The primary groundwater COCs in IA-4.4 are arsenic and lead. Total arsenic concentrations in EP-118 average 0.325 mg/l. Total cadmium concentrations average 0.040 mg/l. Total lead concentrations average 1.34 mg/l.

Groundwater downslope of the Sample Mill flows generally from east to west, and occurs at a depth of approximately 14 feet bgs. The Sample Mill Arroyo influences this subarea. This arroyo is similar to other arroyos at the Facility, which has been backfilled during historic Facility operations. This arroyo is filled with poured slag, smelter debris and fill material. It appears that groundwater may be impacted by source materials associated with the Sinter Facility Gas Cleaning and Sample Mill area. Elevated concentrations of COCs indicate that there are impacts to groundwater in this subarea.

3.5.6 Downslope of Pond 1 (Investigation Subarea 4.5)

Information concerning investigation subarea 4.5, including background data, soil and groundwater impacts, is presented in the following sections.

3.5.6.1 Soil

Subarea 4.5 was characterized during the Phase I RI by soil borings SSIA4-15 through SSIA4-21 (Figure 3-4). During the Phase II RI, soil boring BH4-2 was advanced and sampled in subarea IA-4.5 downslope of the Diesel 1/Pond 1 Area. A total of seven soil samples were collected from subarea IA-4.5 during the Phase II RI (see Table 2-1).

IA-4.5 soils are characterized as silty sands and gravels overlain by fill materials. The majority of elevated metal concentrations occur in the area of Borings BH4-2, SSIA4-15 and SSIA4-16, at a depth of 0 to 3 feet bgs. The highest concentration of COCs is lead at 6,800 mg/kg for SSIA4-15 at a depth of 0 to 1 feet bgs. Metal concentrations decrease in borings increasingly distant from this location.

Phase II RI soil sample analysis reflect results have trends similar to those observed during the Phase I RI. Arsenic and lead appear to be the primary soil COCs, with concentrations ranging from 13 mg/kg to 760 mg/kg for arsenic, and 36 mg/kg to 6,500 mg/kg for lead. Average concentrations of COCs are 311 mg/kg for arsenic, 142 mg/kg for cadmium and 2,352 mg/kg for lead. Metal concentrations are elevated primarily in the first 5 feet bgs. Phase I RI near-surface concentrations of arsenic in soils (0 to 2 inches bgs) ranged from 52 mg/kg to 480 mg/kg, and lead ranged from 560 mg/kg to 6,800 mg/kg.

The area downslope of the Pond 1 Area was originally an arroyo that was filled with slag, smelter debris and fill material in order to increase the useable Facility area. This area was historically used as a construction staging area. The primary potential source of metals in soil downslope of the Pond 1 Area is concentrate and dust transported in storm water and the historic deposition of fugitive dust from the Facility.

3.5.6.2 Groundwater

Groundwater samples collected from subarea IA-4.5 are from EP-29 and EP-35 (Figure 3-4). The primary groundwater COC in IA-4.5 is arsenic. Total arsenic concentrations average

0.539 mg/l. Total cadmium concentrations average below the detection limit. Total lead concentrations average 0.014 mg/l. The highest concentrations of groundwater COCs occur at monitor well EP-35, ranging from below detection for cadmium to 0.790 mg/l total arsenic.

Groundwater in the Pond 1 subarea generally flows from east to west, at a depth of about 14 feet bgs. The Pond 1 Arroyo, which influences groundwater flow in this subarea, is similar to other arroyos at the Facility that have been backfilled during historic Facility operations. This arroyo is in-filled with poured slag, smelter debris and fill material. Elevated concentrations of COCs indicate that there are impacts to groundwater in this subarea.

3.5.7 Downslope of South Terrace Area (Investigation Subarea 4.6)

Information concerning soil and groundwater investigations for subarea 4.6, including background data, soil and groundwater impacts, is presented in the following sections.

3.5.7.1 Soil

In the Phase I RI, the soils in the area downslope of the South Terrace Area were characterized by soil borings SSIA4-22, SSIA4-23, SSIA4-24, SSIA4-25, SSIA4-26, SSIA4-27 and SSIA4-28 (Figure 3-4). During the Phase II RI, soil boring BH4-1 was advanced and sampled in subarea IA-4.6 downslope of the South Terrace Area. A total of seven soil samples were collected from subarea IA-4.6 during the Phase II RI (see Table 2-1).

The analytical results of the Phase II RI soil samples reflect similar trends as those observed during the Phase I RI. Arsenic and lead appear to be the primary soil COCs, with concentrations ranging from 11 mg/kg to 340 mg/kg for arsenic, and 97 mg/kg to 3,700mg/kg for lead. Average concentrations of COCs are 194 mg/kg for arsenic, 65.7 mg/kg for cadmium and 2,814 mg/kg for lead. Metal concentrations are elevated primarily in the first five feet bgs. Phase I near-surface concentrations of arsenic in soils (0 to 2 inches bgs) ranged from 120 mg/kg to 380 mg/kg, and lead ranged from 1,800 mg/kg to 9,400 mg/kg.

Subarea IA-4.6 soils are characterized as silty sands and gravels overlain by fill materials. The highest concentration of COCs is lead at 9,400 mg/kg for SSIA4-25 at a depth of 0 to 1 feet bgs. Metal concentrations decrease in borings at distance from this location.

The area downslope of the South Terrace was originally an arroyo, and part of the original entrance to the Facility. This area was historically used as storage for ore and concentrates and as a construction staging area. The primary potential source of metals in soil downslope of the South Terrace Area is fugitive dust from concentrates previously stored in the area.

3.5.8 Groundwater

Groundwater samples collected from this subarea of IA-4 during the Phase II RI were from monitor well EP-20. The primary groundwater COCs in IA-4.6 are arsenic and cadmium. Total arsenic concentrations average 0.770 mg/l. Total cadmium concentrations average 0.033 mg/l. Total lead concentrations average 0.003 mg/l.

Groundwater in the South Terrace subarea flows from northeast to southwest, at a depth of approximately 14 feet bgs. The South Terrace Arroyo, which influences groundwater flow in this subarea, is similar to other arroyos at the Facility that have been backfilled during historic Facility operations. This arroyo is filled with slag, smelter debris and fill material. Elevated concentrations of COCs indicate that there are impacts to groundwater in this subarea.

3.5.9 Summary

IA-4, which consists of six subareas that comprise the western boundary of the Facility, is composed mostly of poured slag and fill materials that form a relatively steep slope between smelter facilities above it and the long, relatively flat area at the base of the slope. This area is downgradient from other IAs in which potential source areas and materials have been identified and corrective actions will be, or have been, implemented.

Groundwater impacts have occurred in IA-4 associated with the preferential flow paths associated with the backfilled arroyos. The primary COCs in groundwater are arsenic, cadmium and lead. Most of these groundwater impact areas are most likely related to other upgradient IAs other than IA-14. There are localized areas of impacted soils in IA-4, with arsenic and lead being the principal COCs.

Source materials within each of the subareas in IA-4 are classified in Table 3-1 and depicted on Figure 3-4. Category I and III materials exist in this IA. Category III materials are represented by slag covered portions of the front slope. Category I materials are represented by soils with elevated metals at the toe of the front slope occupying the easement for Burlington Northern and Santa Fe Railroads. This area includes the zones associated with arroyos, and zones in between arroyos, which may also be a source for elevated metals in groundwater.

With additional controls to be implemented in the future, sources will be further reduced. IA-4 groundwater COC concentrations are also expected to be reduce with these improvements. As will be discussed in Section 4.0, these improvements, in combination with source material removal, will eliminate or reduce the potential for metals to migrate to the groundwater.

3.6 HISTORIC SMELTERTOWN AREA (IA- 5)

Information concerning the Historic Smeltertown Area (IA-5), including background data, soil and groundwater impacts, and a summary is presented in the following sections.

3.6.1 Background Information

Historic Smeltertown is located west of the Facility boundary and Paisano Drive (Figure 3-5, Exhibit 1). This area was used until 1,972 as private housing for Facility employees and their families. This area is presently vacant, and is the site of the Diesel 2 remedial project described in Section 1.0.

IA-5 was characterized during the Phase I RI with ten existing monitor wells (EP-57, EP-58, EP-59, EP-60, EP-61, EP-62, EP-63, EP-64, EP-65, and EP-66), one new monitor well (EP-80), 19 surface soil borings (surface to 5 feet bgs) and four soil borings to groundwater. Because the Phase I RI did not sample the soils on the land that lies between the Rio Grande and the American Canal, three additional monitor wells were proposed as part of the Phase II RI.

3.6.2 Soil

A total of 15 soil samples were collected from IA-5 during the Phase II RI (see Table 2-1), from three borehole locations (Figure 3-5), all of which were completed as monitor wells. In the Phase I RI the soils in this area were characterized by 81 soil samples from 19 soil borings (SSIA5-1 through SSIA5-19), one of which (EP-80) was completed as a monitor well. Phase II RI soil sample analysis results for IA-5 are summarized in Table 3-10.

Soils in IA-5 consist of silty and clayey very fine sands associated with the Rio Grande, overlaid by gravelly sand and debris fill material. The majority of elevated metal concentrations occur in the area of Borings SSIA5-1 and SSIA5-3, at a depth of 0 to 1.5 feet bgs. The highest COC concentration is lead at a depth of 0 - 1.5 feet bgs for SSIA5-1 at 4,200 mg/kg. Metal concentrations decrease in borings increasingly distant from these locations.

Lead appears to be the primary COC for IA-5. Average arsenic, cadmium and lead concentrations in IA-5 are 33.1 mg/kg, 17.47 mg/kg and 404 mg/kg respectively. The highest measured lead concentration is at boring EP-112, which ranges in concentration from 16 mg/kg to 1,500 mg/kg within the first five feet bgs.

The three Phase II RI soil borings, EP-111, EP-112 and EP-113 are located approximately 20 feet from the bank of the Rio Grande on land that lies between the Rio Grande and the American Canal. Phase II RI soil analysis results have similar trends as was observed during the Phase I RI. Metal concentrations in IA-5 soils are generally much lower than in other IAs, and are primarily limited to the first three feet bgs.

3.6.3 Groundwater

Groundwater samples from IA-5 were collected from Phase I monitor wells EP-57, EP-58, EP-59, EP-60, EP-61, EP-62, EP-63, EP-64, EP-65, EP-66 and EP-80, and from Phase II monitor wells EP-111, EP-112 and EP-113 (Figure 3-5). A summary of groundwater monitoring results for IA-5 is presented in Table 3-11.

In IA-5, groundwater occurs at 9 to 13 feet bgs and flows generally toward the Rio Grande. The observed variations in concentrations of COCs in groundwater are attributed in part to geology. Aquifer materials in the middle portion of IA-5 tend to have a clayey composition, which may inhibit the migration or accumulation of metals in groundwater. Groundwater flow direction is generally to the west and southwest. Arsenic measured in IA-5 monitor wells, in particular, EP-66, may originate from upgradient source areas.

Arsenic and lead appear to be the primary COCs in groundwater, and only occur at elevated concentrations in selected subareas of IA-5. The Phase II RI monitor wells generally show lower concentrations of COCs than those installed during Phase I. Average total arsenic, cadmium and lead concentrations are 1.24 mg/l, 0.005 mg/l and 0.009 mg/l, respectively. As observed during Phase I RI, concentrations of COCs in groundwater are not uniform across IA-5. Monitor wells EP-57, EP-58 and EP-59, EP-111, which are closest to the Facility, and wells EP-62 and EP-66, which are the greatest distance from the active Plant (Figure 3-5), have the highest concentrations of arsenic. The remaining wells (EP-60, EP-61, EP-63, EP-64, EP-65, EP-112, and EP-113) have lower concentrations of arsenic.

3.6.4 Summary

Arsenic and lead concentrations in IA-5 soils are elevated in surficial soils (1 to 2 feet bgs) in selected areas, and tend to decrease rapidly with depth. As depicted in Figure 3-5, there are four localized areas in IA-5 with Category II materials, and one localized area with Category I.

Groundwater in IA-5 is locally impacted by arsenic, and to a lesser extent, lead. It is anticipated that with the implementation of proposed corrective action measures for IA-5 described in the Phase I RI Report, and with subsequent remediation of areas upgradient to IA-5, groundwater quality will improve.

3.7 GROUNDWATER (IA-6)

IA-6 includes groundwater resources characterized as part of the Remedial Investigation. Site groundwater characteristics are discussed in detail in Section 2.3 of this report. Groundwater characteristics and associated potential sources of groundwater impacts are discussed for specific IAs in other parts of this section.

3.8 SURFACE WATER (IA-7)

IA-7 includes naturally occurring surface water bodies (i.e., American Canal and Rio Grande). Surface water characteristics are discussed in detail in Section 2.2 of this report. Although some isolated occurrences of elevated non-metal water quality parameters have been detected in the American Canal and in the Rio Grande under special circumstances, there have been no MCL exceedences.

3.9 BEDDING AND UNLOADING BUILDINGS AREA (IA-8)

Information concerning the Bedding and Unloading Building Area (IA-8), including background data, soil and groundwater impacts, and a summary is presented in the following sections.

3.9.1 Background Information

IA-8 consists of the Unloading and Bedding Buildings, railroad spurs and associated switching facilities in the central portion of the Facility (Figure 3-6). Historically, a variety of Facility raw materials, products and by-products have been handled and/or stored in this area, many of which are classified as Category I and II materials. Much of the Category I and II materials are currently overlain by railroad tracks and associated Facility components.

In some areas of IA-8, dust suppression (area misting/watering) of materials was performed as part of Facility operations. Runoff, as a result of dust suppression may have generated a source of metals. Operational improvements discussed in Section 4.0 have reduced the potential adverse effects from the watering process and additional material handling improvements will minimize future potential effects. Portions of IA-8 are located above two back-filled arroyos.

IA-8 was characterized during the Phase I RI with one existing monitor well (EP-15), three new monitor wells (EP-67, EP 70 and 72) and 31 surface soil borings (surface to 5 feet bgs). In the Phase I RI, metal concentrations in 5 feet borings decreased as a function of boring depth. However, there was limited groundwater information for IA-8 and four additional borings to groundwater and five monitor wells were proposed as a part of the Phase II RI. Soil and groundwater samples collected from the Phase II investigations were used to further evaluate metals distribution with depth and spacial groundwater conditions in IA-8.

3.9.2 Soil

A total of 136 soil samples were collected from IA-8 during the Phase II RI (see Table 2-1), from nine borehole locations (Figure 3-6, Exhibit 1), five of which were completed as monitor wells (BH8-1, BH8-2, BH8-3, BH8-4 and EP-103, EP-104, EP-105, EP-106 and EP-107). The Phase I RI in IA-8 included 31 soil borings (SSIA8-1 through SSIA8-31) producing 110 soil samples. Phase II RI soil sample analysis results for IA-8 are summarized in Table 3-12.

The soils of IA-8 have been exposed to industrial materials handling and processing activities. The Pond 1 Arroyo associated with IA-9 (see Figure 2-3) formerly occupied the southern portion of IA-8. This arroyo was filled with slag to create more surface for historical Facility expansion. Slag appears to be from 10 to 30 feet thick in IA-8 as logged in soil borings BH8-1, BH8-2 and BH8-3.

Five areas within IA-8 have elevated concentrations of metals in soils. High concentrations of COCs generally occur in 0 to 3 feet bgs and decrease substantially below 5 feet bgs. IA-8 Phase II RI soil analysis results had trends similar to those observed during the Phase I RI. Arsenic, cadmium and lead appear to be the primary COCs, with concentrations ranging from 5 mg/kg to 6,600 mg/kg for arsenic, 5 mg/kg to 2,600 mg/kg for cadmium and 7 mg/kg to 29,000 mg/kg for lead. Average concentrations of COCs are 166 mg/kg for arsenic, 45.8 mg/kg for cadmium and 6,923 mg/kg for lead.

3.9.3 Groundwater

Groundwater samples from IA-8 were collected from Phase I monitor wells EP-15, EP-67, EP-70 and EP-72, and from Phase II monitor wells EP-103, EP-104, EP-105, EP-106 and EP-107 (Figure 3-6). A summary of groundwater monitoring results (averaged over four monitoring events) for IA-8 is in Table 3-13.

Groundwater in IA-8 occurs at a depth of about 60 feet bgs, and flows generally from east to west. Groundwater impacts are observed in monitor wells EP-70 and EP-72 in the southwestern portion of the IA near the front Facility entrance, and EP-104 and EP-105 located near the unloading area of IA-8. EP-70 and EP-72 are completed in the upper reaches of the arroyo once used as an entrance to the Facility, which has since been backfilled with slag. Process Facility components in IA-8 are not constructed over the backfilled arroyos like the components in IA-1, IA-2 and IA-3. Therefore, metals are less likely to migrate and accumulate in groundwater beneath the facilities of IA-8.

The primary groundwater COCs in IA-8, are arsenic and lead. The Phase II RI monitor wells generally show higher concentrations of COCs, than those installed during Phase I. Total arsenic concentrations average 0.062 mg/l. Total cadmium concentrations average 0.005 mg/l. Total lead concentrations average 0.012 mg/l. The highest concentrations of groundwater COCs occur at monitor well EP-70, with concentrations ranging from 0.008 mg/l for total cadmium to 0.705 mg/l for total arsenic. EP-105 averaged 0.350 mg/l of total arsenic.

3.9.4 Summary

IA-8 has elevated concentrations of metals in the upper three to five feet of the soil, with arsenic, cadmium and lead being the primary COCs. Although concentrations of metals are relatively high, the underlying groundwater has not been impacted to the extent observed for other IAs having similar soil concentrations.

Based on results and observations discussed in this section, soils in five portions of IA-8 are classified as Category I materials, and may contribute to groundwater impacts observed at monitor wells EP-70, EP-72 and EP-105 and downgradient groundwater. As shown in Figure 3-6 and presented in Table 3-1, Category II materials also exist in IA-8. Some of the Category II area is currently capped.

Below slag, at depths greater than 10 to 30 feet bgs, some impacted soils exist. Because the source has been reduced and the area is below slag (Category III material), additional excavation and capping of the area will likely eliminate or reduce the potential for COCs in this area to migrate to the groundwater.

With the recent completion of the Storm Water Collection and Reuse System and other operational improvements in IA-8, and planned capping and soil excavation, potential sources of metals to groundwater have been greatly reduced. Additional capping and soil excavation activities discussed in Section 4.0 will serve to further eliminate potential impacts to groundwater and soils.

3.10 PONDS 1, 5 AND 6 (IA-9)

Information concerning the Ponds 1, 5 and 6 (IA-9), including background data, soil and groundwater impacts, and a summary is presented in the following sections.

3.10.1 Background Information

As discussed in the Phase I RI Report, the Facility has three unlined on-site ponds, referred to as Pond 1, Pond 5, and Pond 6 (Figure 3-7, Exhibit 1). Historically these ponds were part of Facility operations. The recently constructed Storm Water Collection and Reuse System has eliminated the need for Ponds 1, 5 and 6 as water impoundments at the Facility. Other associated storm water control elements include installation of curbs or berms and paving of selected areas to eliminate area runoff into the ponds. Asarco proposes to line and use the depressions from Ponds 1, 5 and 6 to construct on-site containment facilities for Category I material.

The current status of these ponds is as follows:

- **Pond 1:** Implementation of storm water control upgrades has eliminated the need to impound storm water in the pond. Pond 1 is currently dry.
- **Pond 5:** Currently dry.
- **Pond 6:** Implementation of storm water control upgrades has eliminated the need to impound storm water in the pond. Pond 6 is currently being de-watered and is anticipated to be dry in 2000.

The three ponds were constructed in naturally occurring arroyos that formerly existed at the Facility. Topographically low areas were used to make ponds by damming the lower ends of arroyos. Pond 1 is located in a small-scale arroyo (Pond 1 Arroyo), Pond 5 and Pond 6 were built within different dendritic branches of the same arroyo (Ponds 5 and 6 Arroyo).

IA-9 was characterized during the Phase I RI with seven existing monitor wells (EP-14, EP-29, EP-12, EM-4, EM-2, EP-35, and EP-43) to characterize the Pond 1 Arroyo, and five existing monitoring wells (EM-5, EM-6, EP-56, EP-26 and EP-66) and one new monitor well (EP-77) to characterize the Ponds 5 and 6 Arroyo. Because the ponds were in use and contained water at the time of the original Phase I RI, investigation of the sediments had to be delayed.

Since the Phase I RI, Pond 5 sediments have been sampled and analyzed. Pond 1 and 6 sediments remain to be sampled. In addition, two new monitor wells were proposed as part of the Phase II RI to further evaluate the hydraulic connection between Pond 5 and 6, and their related Arroyo.

3.10.2 Pond Sediment

Table 3-14A presents analytical results of eight pond sediment soil borings samples collected from Pond 1 during the Phase II RI (BH9-5-1 through BH9-5-7). During the Phase I RI, sediment samples were also collected. Pond sediment analytical results are in Table 3-14B. Arsenic, lead and cadmium are COCs in the pond sediments.

Pond 1 sediments have average arsenic, cadmium, and lead concentrations of 3,000 mg/kg, 1,367 mg/kg and 4,700 mg/kg respectively. Pond 5 sediments have average arsenic, cadmium, and lead concentrations of 2,350 mg/kg, 1,250 mg/kg, and 33,500 mg/kg, respectively. Pond 6 sediments have average arsenic, cadmium, and lead concentrations of 4,530 mg/kg, 1,367 mg/kg, and 13,400 mg/kg, respectively.

The water in the ponds (currently only Pond 6) represent a potential source of metals and may influence the mobility of metals in sediments. However, the inherent low hydraulic conductivity characteristics of the sediments serve to inhibit downward movement of fluids.

3.10.3 Pond Water

A total of 14 water samples were collected from Ponds 1, 5, and 6 as part of the Phase II RI. Only one of the samples was collected for Pond 5 because it was drained and dried as part of the storm water improvement activities. Water samples were also collected from the three ponds during the Phase I RI. A summary of the Pond 1, 5 and 6 testing results are in Table 3-14C. Average concentrations for total recoverable arsenic, lead and cadmium are 0.52 mg/l, 5.05 mg/l and 0.45 mg/l, respectively. Ponds 1 and 5 now contain no water and the pond sediments are drying. Pond 6 is presently being dewatered through pumping and evaporation.

3.10.4 Soil

IA-9 soils are characterized as silty sands and gravels overlain by very fine grained pond sediments. The pond areas were formerly natural arroyos that were dammed by fill materials composed of soil, rock, slag, and smelter debris. Based on data collected and evaluated as part of the Phase I and Phase II RIs, the primary source of groundwater impacts in IA-9 is water that was formerly in the Ponds. Because this potential source has been eliminated, soils underlying the ponds are Category II materials.

3.10.5 Groundwater

Groundwater samples collected from IA-9 were collected from Phase I and Phase II monitor wells (Figure 3-7). A summary of groundwater monitoring results for IA-9 are presented in Table 3-15 for Pond 1, and in Table 3-16 for Ponds 5 and 6. Groundwater quality is discussed for each pond as follows:

- **Pond 1:** The Pond 1 Arroyo is characterized by RI monitor wells EP-12, EP-14, EP-29, EM-4, EM-2, EP-35, and EP-43. Concentrations were lower during the Phase II RI than during the Phase I RI, attributed to decommissioning of the pond. Arsenic appears to be the primary groundwater COC.

Total arsenic concentrations average 1.067 mg/l. Total cadmium concentrations average 0.005 mg/l. Total lead concentrations average 0.011 mg/l. The highest concentrations of groundwater COCs occur at monitor well EP-12, with concentrations ranging from 0.005 mg/l for total cadmium to 2.55 mg/l total arsenic. Total arsenic in groundwater was also high at EP-14 (1.67 mg/l) located downgradient in the arroyo and at EM-2 (1.43 mg/l) located next to upper portion of Pond 1.

- **Ponds 5 and 6:** The Ponds 5 and 6 Arroyo is characterized by Phase I RI monitor wells EM-5, EM-6, EM-7, EP-26, EP-56 and EP-77 and Phase II RI monitor wells EP-116 and EP-117. Arsenic and lead appear to be the primary COCs.

  Total arsenic concentrations average 3.02 mg/l. Total cadmium concentrations average 0.54 mg/l. Total lead concentrations average 1.13 mg/l. The highest concentrations of groundwater COCs occur at monitor well EP-117 and EP-116, with total arsenic at 8.50 mg/l and 3.60 mg/l respectively. These monitor wells are at the lower end of the arroyo, at the bottom of the front slope area. At the upper end of the arroyo, next to Pond 6, Monitor Wells EM-5 and EM-7 had total arsenic concentrations of 2.40 mg/l and 1.84 mg/l, respectively.

3.10.6 Summary

Groundwater associated with IA-9 Ponds 1, 5 and 6 appears to be impacted, with the principal COC being arsenic for Pond 1, and arsenic and lead for Ponds 5 and 6. The COCs migrate to groundwater through backfilled arroyos underlying the pond areas. The low hydraulic conductivity characteristics of the fine-grained pond sediments serve to inhibit downward percolation.

The impact that the IA-9 ponds have on the groundwater is now reduced because of recent storm water control improvements implemented at the site and the associated decommissioning of the ponds. Pond sediments are classified as Category I materials, with arsenic, cadmium and lead being the main COCs. Sediments from the ponds may be reprocessed if the acceptance criteria are met. The underlying soils in the area of these ponds are characterized as Class II materials, because the primary source of groundwater impacts, the former pond water, has been eliminated. These areas will be capped by the on-site repositories planned for these locations.

3.11 FACILITY ENTRANCE AREA (IA-10)

Information concerning the Facility Entrance Area (IA-10), including background data, soil and groundwater impacts, and a summary is presented in the following sections.

3.11.1 Background Information

IA-10 is at the southern boundary of the Facility and includes the vehicle entrance to the Facility, and a storm water drain system consisting of a sump, a lift pump, and an interceptor trench that crosses the Facility entrance road (Exhibit 1, Figure 3-10). As with other Facility IAs, the soils in IA-10 have been altered during the history of Facility operations. The area is located above a partially back-filled arroyo.

Recent storm water control improvements in IA-10 included reconstruction of the front entrance roadway and storm water sump, area re-grading and the addition of concrete pavement with curb and gutters. Storm water runoff now can not enter the American Canal or leave the Facility at this location.

IA-10 was characterized as part of the Phase I RI with one new monitor well (EP-89) and 8 surface soil borings (surface to 5 feet). Because the Storm Water Collection and Reuse project was slated to begin shortly after submittal of the Phase I RI Report, and the majority of the corrective actions have been implemented, additional soil borings in Phase II were not deemed necessary. However, to further quantify and delineate groundwater quality at the Facility entrance, one additional monitor well was proposed as part of the Phase II RI.

3.11.2 Soils

A total of seven soil samples were collected from IA-10 during the Phase II RI (see Table 2-1) from one borehole location (Figure 3-8), which was completed as a monitor well. During the Phase II RI, soil boring EP-110 was advanced and sampled to five feet below groundwater level in IA-10 (Figure 3-7). The Phase I RI in IA-10 included nine borings and 34 soil samples. Phase II RI soil sample analysis results for IA-10 are summarized in Table 3-17.

The soils in IA-10 are mostly silty sands and gravels that have undergone some grading for road development and installation of a railroad grade and bridge. The Facility entrance road alignment and drainage system take advantage of a natural arroyo referred to as the Facility Entrance Arroyo. The dimensions of the arroyo are approximately 60 feet wide by 30 feet deep. This arroyo has been in-filled with soil and rock materials.

Arsenic and lead are the predominant COCs in IA-10. Arsenic, cadmium and lead concentrations average 128 mg/kg, 33.1 mg/kg, and 937.9 mg/kg, respectively. Arsenic and lead concentrations range from 11 mg/kg to 490 mg/kg and 43 mg/kg to 3,100 mg/kg, respectively. The highest concentration of COCs occurs at SSENT-1 at a depth of 0 to 1 feet bgs with a lead concentration of 5,700 mg/kg. Elevated concentrations of COCs are primarily in the first four feet bgs.

The data gathered from both Phase I and Phase II of the RI indicate that elevated metal concentrations are generally limited to the surface and tend to decrease rapidly with depth. The source of metals in the surface soils, in IA-10, is probably storm water transported sediments, which are now controlled with recent completion of the storm water control upgrades.

3.11.3 Groundwater

Groundwater samples collected from IA-10 were collected from monitor wells EP-89 and EP-110 (Figure 3-8). A summary of groundwater monitoring results for IA-10 is presented in Table 3-18.

Groundwater in IA-10 flows generally from north to south, and occurs at a depth of about 15 feet bgs. The movement of groundwater in this IA is likely controlled by the partially filled arroyo. Groundwater associated with IA-10 does not contain significantly elevated concentrations of COCs. Total arsenic concentrations average 0.008 mg/l. Total cadmium concentrations average 0.005 mg/l. Total lead concentrations average 0.012 mg/l.

3.11.4 Summary

The Facility Entrance Area (IA-10) has elevated metals in surface soils, with arsenic and lead being the primary COCs. These elevated concentrations are attributed to sediment accumulation in storm water runoff, in the vicinity of the historic storm water sump at the entrance. With the recent completion of the Storm Water Collection and Reuse System, which included reconstruction of the storm water sump entrance and roadway with curb and gutters, this source is now controlled. Therefore, IA-10 no longer represents a source of COCs to the groundwater.

Soil in IA-10 is classified as Category II material, as presented in Table 3-1 and shown in Figure 3-8. Most of the Category II area is currently capped as part of recently completed storm water control upgrades.

3.12 ARROYOS EAST OF I-10 (IA-11)

Information concerning the Arroyos East of I-10 (IA-11), including background data, soil and groundwater impacts, and a summary is presented in the following sections.

3.12.1 Background Information

The Arroyos east of I-10 comprise IA-11 (Figure 3-9, Exhibit 1). This area was originally part of IA-2 (Boneyard/Slag Area) during the Phase I RI. This area was formerly used for storage of Facility construction materials and demolition debris. The majority of IA-11 is undisturbed natural area with occasional dirt roads, flood control works including two reservoirs or drainage basins, and two dam structures. The predominant topographic features in IA-11 are two open arroyos, which converge with the Facility and underlie other downgradient Facility IAs. These are referred to as the Northern and Southern Arroyos of IA-11.

Historically the Southern Arroyo in this IA has been used as slag pour and storage areas by the Facility. In addition, the Northern Arroyo has been used historically to store Facility slag, construction materials and demolition debris. Both these areas are no longer used by the Facility for storage or disposal purposes.

IA-11 was characterized as part of the Phase I RI with three monitor wells (EP-83, EP-4 and EP-87) originally used to evaluate subarea two of IA-2. This area is now designated as IA-11. Due to the limited information obtained in IA-11 during the Phase I RI, additional surface soil borings, soil borings to groundwater and monitor wells were proposed as part of the Phase II RI.

3.12.2 Soils

A total of 127 soil samples were collected from IA-11 during the Phase II RI (see Table 2-1) from 22 borehole locations (Figure 3-9), six of which were completed as groundwater monitor wells. In the Phase I RI, the soils in this area were characterized by three soil borings (EP-83, EP-84 and EP-87). Phase II RI soil sample analysis results for IA-11 are summarized in Table 3-19.

The soils in Arroyos East of I-10 are mostly silty sands and gravel. The area has been disturbed by past Facility activities associated with the pouring and handling of slag. These sediments overlie a rock formation. Two arroyos cross IA-11 from east to west. Downgradient of IA-11, these arroyos enter IA-12 (Ephemeral Pond and Pond Sediment Storage Area).

During the Phase II RI, soil borings in IA-11 were advanced in areas near where Facility materials were deposited. Arsenic and lead are the principal soil COCs in one area of the Northern Arroyo of the IA associated with a deposition area. Arsenic, cadmium, and lead concentrations in areas other than this material deposit area average 27.12 mg/kg, 11.78 mg/kg and 176 mg/kg, respectively. Average concentrations of COCs in IA-11 are 569 mg/kg for arsenic, 187 mg/kg for cadmium and 2,040 mg/kg for lead. Generally elevated concentrations of COCs in IA-11 occur within the first five feet bgs. One exception is EP-93, in which elevated levels of lead occur to a depth of 20 feet bgs.

The majority of elevated metal concentrations occur in this area of Borings EP-93, EP-94, SSIA11-6, SSIA11-7 and SSIA11-8, at a depth of 0 to 5 feet bgs. The highest concentration of lead was 54,000 mg/kg for EP-93 at a depth of 4 to 5 feet bgs. The majority of arsenic, cadmium and lead concentrations in IA-11, other than in the northern material deposit area and central area of the southern arroyo, are below 50 mg/kg.

3.12.3 Groundwater

Groundwater samples from IA-11 were collected from Phase I RI monitor wells EP-83, EP-84, EP-87, and from Phase II RI monitor wells EP-93, EP-94, EP-95, EP-96, EP-97 and EP-98 (Figure 3-9). A summary of groundwater monitoring results (averaged over four monitoring events) for IA-11 are presented in Table 3-20.

Groundwater in IA-11 generally flows from east to west, with the primary control features being the two arroyos. These arroyos both originate further upgradient than the northern Facility boundary.

Arsenic and lead are the primary groundwater COCs in IA-11. The Phase II RI monitor well concentrations are generally commensurate with concentrations of COCs observed in monitor wells installed during the Phase I RI. Only minor concentrations of COCs occur in groundwater in IA-11. Total arsenic concentrations average 0.033 mg/l. Total cadmium concentrations average 0.006 mg/l. Total lead concentrations average 0.026 mg/l. The highest concentration observed is for total arsenic at monitor well EP-97 (0.150 mg/l). No source material has been identified in this area. The source of elevated concentrations of metals may be from the degradation process of naturally occurring geologic formations of local Andesite, marley shale and limestone formations, and high silica bearing rock found historically on the Facility and in the surrounding area, or from unknown off-site sources.

3.12.4 Summary

The northern and southern Arroyos East of I-10 consist of a relatively undisturbed zone with localized areas of high metals concentrations that may be result of the historic use of the area for storage of Facility slag, construction materials and demolition debris.

The primary soil COCs are arsenic and lead. There is only minor influence from the surface materials on the groundwater in IA-11. As shown in Figure 3-9, one area in IA-11 has Category II materials, associated with the northern material deposit area. An area in the southern arroyo East of I-10 as shown on Figure 3-9 is Category I material. The extent of this area will be determined with additional investigations. An investigation will be conducted to determine baseline concentrations of metals in naturally occurring geologic materials at the Facility.

3.13 EPHEMERAL POND AND POND SEDIMENT STORAGE AREA (IA-12)

Information concerning the Ephemeral Pond and Pond Sediment Storage Area (IA-12), including background data, soil and groundwater impacts, and a summary is presented in the following sections.

3.13.1 Background Information

The Ephemeral Pond and Pond Sediment Storage Area which comprise IA-12 is west of I-10, and IA-10 (Figure 3-10, Exhibit 1). This area was originally part of IA-2 (Boneyard/Slag Area) during the Phase I RI. IA-12 is the site of a slag-crushing/recycling operation (Oglebay Norton Inc., formerly Parker Brothers). Union Pacific and Burlington Northern Santa Fe Railroads rail lines form the western boundary.

The Ephemeral Pond consists of a catch basin or closed depression in a backfilled Arroyo (Northern Arroyo from IA-11), created by the railroad grade in the slag storage area. This feature receives local storm runoff at times. The Ephemeral Pond is dry most of the time. In the past pond sediments have been excavated from Pond 6 and stored in the southern portion of IA-12 at the southwest corner of the intersection of I-10 and the Facility roadway to IA-11.

IA-12 was characterized as part of the Phase I RI with of three new monitor wells (EP-78, EP-79 and EP-82) used originally to evaluate subarea two of the original IA-2, now designated as IA-12. Due to the limited information obtained in this IA during the Phase I RI, additional soil borings to groundwater and monitor wells were proposed to further delineate the new IA-12 as part of the Phase II RI.

3.13.2 Soils

A total of 41 soil samples were collected from IA-12 during the Phase II RI (see Table 2-1), from 11 borehole locations (Figure 3-10), two of which were subsequently completed as monitor wells. Four borings were advanced in this area during the Phase I RI. Phase II RI soil sample analysis results for IA-12 are summarized in Table 3-21.

The soils and subsurface materials in IA-12 have been locally disturbed by Facility operations. Presently, a layer of slag material ranging from less than one foot to greater than 40 feet thick overlies native soils. The slag material largely fills an arroyo that is referred to as the Parker Brothers Arroyo. The slag is being processed (recycled) for use as industrial abrasive and as railroad ballast.

Arsenic, cadmium and lead appear to be COCs in one localized area near EP-109 in the Ephemeral Pond area. Average concentrations of COCs observed in Phase II borings for IA-12, are 283 mg/kg for arsenic, 223 mg/kg for cadmium and 2,055 mg/kg for lead.

Concentrations in the Ephemeral Pond area ranged from 10 mg/kg to 3,400 mg/kg for arsenic, from 10 mg/kg to 3,400 mg/kg for cadmium and 10 mg/kg to 23,000 mg/kg for lead. Elevated concentrations of COCs generally occur in the first five feet bgs in this area. Soil COC concentrations in the Pond Sediment Storage area ranged from 10 mg/kg to 120 mg/kg for arsenic, from 10 mg/kg to 51 mg/kg for cadmium and 10 mg/kg to 130 mg/kg for lead.

3.13.3 Groundwater

Groundwater samples were collected from IA-12 from Phase I RI monitor wells EP-78, EP-79 and EP-82, and from Phase II monitor wells EP-108 and EP-109 (Figure 3-10). A summary of groundwater monitoring results (averaged over four monitoring events) for IA-12 is in Table 3-22.

The groundwater flow direction is generally from east to west in IA-12, and occurs at a depth ranging from 15 feet bgs to 45 feet bgs. Although the closed depression has mostly been dry since the initiation of the remedial investigation, metals concentrations in samples of soil and groundwater (EP-78) collected from this area are elevated. In the area where elevated concentrations of COCs in soil are observed near EP-109, no impacts are observed in groundwater. The highest concentration of arsenic in groundwater is in monitor well EP-78, which is downgradient of the closed depression. Water samples from the closed depression (SEP-14) were collected during the RI in November of 1998 and August of 1999. The ephemeral pond is usually dry.

Arsenic is the primary COC in groundwater. The Phase II RI monitor wells generally show higher concentrations of the COC than those installed during the Phase I RI. Total arsenic concentrations average 1.19 mg/l. Total cadmium concentrations average less than the detection limit of 0.005 mg/l. Total lead concentrations average 0.008 mg/l. The highest concentrations of groundwater COCs occur at monitor well EP-78 (Ephemeral Pond), with concentrations ranging from 4.6 mg/l to 5.2 mg/l for total arsenic and less than the detection limit of 0.003 mg/l to 0.007 mg/l for total lead.

3.13.4 Summary

Groundwater impacts have been identified in IA-12, although direct soil source materials have not been identified for most of the IA. Arsenic is the primary groundwater COC. An area in the North-Central portion of IA-12 will require further investigation in order to identify potential source areas.

The Pond Sediment Storage Area in the eastern portion of IA-12 has been identified as potential source material. This material is contained in a discrete, bermed, deposition area. At this time, there are no definable groundwater impacts. The Pond Sediment Storage Area is designated Category I materials as depicted In Figure 3-10.

3.14 SAMPLE MILL AREA (IA-13)

Information concerning the Sample Mill Area (IA-13), including background data, soil and groundwater impacts, and a summary is presented in the following sections.

3.14.1 Background Information

The Sample Mill Area is located southwest of the Lead Plant Area (Figure 3-11) and was historically used as a leach facility to remove chlorine from Lead Baghouse dusts prior to their addition as feed material. The area is located above a small back-filled arroyo. The Phase I RI utilized one existing well (EP-13) to evaluate this IA as a portion of IA-4. For the Phase II RI, this area was changed to IA-13.

As a result of groundwater quality data collected from EP-13 during the Phase I RI, additional groundwater investigations were recommended, one additional soil boring to groundwater and four new monitor wells were added in IA-13 as part of the Phase II RI.

Implementation of recent storm water control upgrades within IA-13, which include extensive re-grading and paving (capping), eliminated or minimized the potential for downward migration of COCs to the groundwater.

3.14.2 Soils

A total of 47 soil samples were collected from IA-13 during the Phase II RI (see Table 2-1), from three borehole locations (Figure 3-1), two of which were completed as groundwater monitor wells. No borings were advanced in IA-13 during the Phase I RI. Phase II RI soil sample analysis results for IA-13 are summarized in Table 3-23.

IA-13 soils are characterized as silty and clayey sands and gravels overlain by fill material, slag and smelter debris materials. The soils and subsurface materials in IA-13 have been disturbed, reworked, and otherwise historically altered. Topographically low areas were filled in with soils, rock, slag or smelter debris, and re-graded in successive layers as Facility operations expanded and changed over time. Presently, a layer of soil material approximately one foot thick overlies lead slag to a depth of 19 feet bgs in the southern portion of IA-13. In the northern portion of the investigation area there is 15 feet of slag underlying five feet of soil fill material. The slag was historically used to fill arroyos and build up the front slope area (Figure 2-3).

Arsenic, cadmium and lead are soil COCs in IA-13. Average concentrations of COCs are 1,336 mg/kg for arsenic, 1,503 mg/kg for cadmium and 7,433 mg/kg for lead. Arsenic concentrations ranged from 10 mg/kg to 8,000 mg/kg. Cadmium ranged from 10 mg/kg to 11,000 mg/kg, and lead concentrations ranged from 10 mg/kg to 42,000 mg/kg. COCs occur primarily in the first five to ten feet bgs. The majority of elevated metal concentrations occur in the area of Borings EP-101 and EP-102, at a depth of 0 to 5 feet bgs. The highest concentration of a COC is lead at 4,200 mg/kg at EP-101 at a depth of 1 to 2 feet bgs.

3.14.3 Groundwater

Groundwater samples collected from IA-13 were collected from Phase I RI monitor well EP-13, and from Phase II monitor wells EP-101, EP-102 and EP-113. (Figure 3-11). A summary of groundwater monitoring results (averaged over four monitoring events) for IA-13 is in Table 3-24.

The groundwater flow direction is generally from northwest to southwest in IA-13 and occurs at a depth of approximately 60 feet bgs. Lower concentrations of COCs observed upgradient in monitor well EP-102, indicate that this location may be used as an upgradient groundwater monitoring location for this IA. Impacts to groundwater in well EP-13 are likely a result of source materials in the Sample Mill Area. The small backfilled arroyos beneath IA-13 may serve as a preferential flow conduit for groundwater.

In IA-13, arsenic, cadmium and lead are COCs in groundwater. The Phase II RI monitor wells show lower concentrations of arsenic than those obtained during the Phase I RI. Total arsenic concentrations average 10.1 mg/l. Total cadmium concentrations average 0.34 mg/l. Total lead concentrations average 0.34 mg/l. The highest concentrations of COCs groundwater occur at monitor well EP-13. Concentrations ranged from 31 mg/l to 38 mg/l for total arsenic, and 0.009 mg/l to 0.01 mg/l for total lead. Monitor well EP-101 also had elevated total arsenic concentrations ranging from 4.5 mg/l to 7.2 mg/l and cadmium concentrations ranging from 0.72 mg/l to 0.78 mg/l.

3.14.4 Summary

The Sample Mill Area (IA-13) soils have been impacted by Facility processes, with arsenic, cadmium and lead being the principal soil COCs. The backfilled arroyos underlying IA-13 may provide preferential pathways for sources of metals in soils to groundwater, with arsenic, cadmium and lead being the primary groundwater COCs. As depicted in Figure 3-11, all of IA-13 is classified as Category I materials.

3.15 SOUTH TERRACE AREA (IA-14)

Information concerning the South Terrace Area (IA-14), including background data, soil and groundwater impacts, and a summary is presented in the following sections.

3.15.1 Background Information

Expansion of the investigation into this area was proposed in the Phase I RI Report in response to the historical uses of this area. The South Terrace Area is in the southwestern portion of the Facility (Figure 3-12), and consists of a flat area that has historically been utilized for the storage of concentrates, silica fluxes, and temporary storage of Facility equipment. Within the central portion of the South Terrace Area is an arroyo that has been back-filled with slag. A nineteenth century topographic map indicates the South Terrace Arroyo was approximately 500 feet wide and 800 feet long (Figure 2-3). Historically, concentrates were stored in this area.

The soils and subsurface materials in IA-14 have been disturbed, reworked, and otherwise altered over time. Topographically low areas were filled in with soil, rock, slag or smelter debris, and re-graded in successive layers as Facility operations expanded and changed over time. Presently, a layer of soil material overlies lead slag to a depth of 13 to 20 feet bgs under portions of IA-14.

Recent storm water control improvements implemented in IA-14 include extensive backfilling, grading, paving (capping), and construction of a storm water collection impoundment effectively (capping underlying soils).

3.15.2 Soils

A total of 52 soil samples were collected from IA-14 during the Phase II RI (see Table 2-1) from three borehole locations (Figure 3-1). Phase II RI soil sample analysis results for IA-14 are summarized in Table 3-25.

IA-14 soils are characterized as silty sands and gravels overlain by fill materials that include slag and smelter debris. The majority of elevated metal concentrations occur in the area of Boring BH14-2, at a depth of 0 to 3 feet bgs. The highest COC concentration is at BH14-2, at a depth of 2 feet bgs for lead (4,400 mg/kg). Metal concentrations decrease in borings increasingly distant from this location. The majority of arsenic, cadmium and lead concentrations in IA-14 are below 20 mg/kg, with higher concentrations restricted to the upper three feet bgs.

Lead is the primary soil COC in IA-14. Average concentrations of COCs are 35.75 mg/l for arsenic, 21.1 mg/l for cadmium and 289 mg/l for lead. Lead concentrations ranged from 10 mg/kg to 4,400 mg/kg. Concentrations of COCs occur primarily within the first two feet bgs.

3.15.3 Groundwater

Groundwater samples collected from IA-14 were collected from Phase I RI monitor wells EP-20, EP-43, EP-70, EP-71 and EP-72 (Figure 3-12). A summary of groundwater monitoring results (averaged over four monitoring events) for IA-14 is in Table 3-26.

The groundwater flow direction is generally from northeast to southwest in IA-14, and occurs at a depth of approximately 60 feet bgs. Elevated concentrations of the COCs in groundwater occur both upgradient and downgradient of IA-14, which suggests (and is supported by two out of three borings) that few source materials exist in the soils of IA-14.

Arsenic is the primary COC in groundwater. Generally, concentrations of COCs in groundwater observed during the Phase II RI are lower than concentrations observed during the Phase I RI. Total arsenic concentrations average 0.508 mg/l. Total cadmium concentrations average 0.013 mg/l. Total lead concentrations average 0.008 mg/l. The highest concentrations of groundwater COCs occur at monitor well EP-20, with concentrations ranging from below detection for lead, to 0.917 mg/l for arsenic. Monitor wells EP-43 and EP-70 also had elevated total arsenic concentrations of 0.738 mg/l and 0.705 mg/l, respectively.

3.15.4 Summary

Recent improvements to the South Terrace Area (IA-14) included the removal of surface soil and excavation of lead and copper slag (stored in IA-2) to create the excavation for the new lined storm water pond for the Facility. The completed storm water pond and associated paved roadways provide an effective cap over the majority of the area, and serve to eliminate or reduce the potential for water to transport constituents to the groundwater in IA-14.

Generally, South Terrace Area soils are not impacted by Facility processes, with the exception of one minor area in the vicinity of BH 14-2. The underlying groundwater, which occurs in a preferential flow conduit formed by a backfilled arroyo, is impacted by COCs (primarily arsenic). Elevated concentrations in groundwater, upgradient and downgradient of IA-14, indicates that the source materials are upgradient of the South Terrace Area and in the Bedding and Unloading Buildings Area (IA-8). As depicted in Figure 3-12, the majority of IA-14 is classified as Category II material, with one minor area described as Category I material.

SECTION 4.0

GENERAL PROPOSAL FOR CORRECTIVE ACTION

4.0 GENERAL PROPOSAL FOR CORRECTIVE ACTION

Detailed discussions of corrective actions designed to address impacts at the Facility were first provided in the Phase I RI Report (Hydrometrics, 1998), in a general proposal for corrective action. The Phase I RI included characterization of source areas and materials, and groundwater beneath the Facility. Site specific characterization data supported the development of corrective action alternatives. The general proposal for preferred corrective actions for the Facility was developed to meet the established corrective action goals and objectives, to minimize risks, and achieve compliance with 30 TAC Chapter 335, Subchapter S, Risk Reduction Standard Number three (see Section 1.0).

This Phase II RI presents supplemental corrective action information based on the results of additional RIs, and recommendations provided in the Phase I RI Report. The Phase II RI general proposal for corrective action elaborates on corrective action measures the preferred alternatives established in the Phase I RI. The general criteria used in the Phase II RI to evaluate corrective action measures is the same as the Phase I RI, and includes the following key elements:

- Identify and evaluate elevated source materials based on Facility operations, and soil and groundwater characterization data (summarized in Section 3.0).
- The existence of former arroyos beneath the Facility which influence groundwater flow (summarized in Section 2.0).
- Evaluate regulatory issues such as aquifer classification and Area of Contamination (summarized in Section 1.0).

As discussed previously, a total of 14 IAs are now considered. Additional investigations will be required for specific IAs to better define corrective action measures. This work is described in Section 4.5.

Section 4.1 presents background information concerning proposed corrective actions for the Facility and how the Phase II RI information interrelates with that presented in the Phase I RI Report. The Phase II corrective action goals for the Facility are identical to those presented in the Phase I RI. Corrective action alternatives are provided in Section 4.1.3, and detailed descriptions of proposed corrective actions for each IA discussed in Section 4.2, based on an evaluation of effectiveness, implementability, and cost.

The proposed corrective action measures for each IA discussed in Section 4.2 are designed to achieve the corrective action objectives. The corrective action measures identified in this report are similar to those presented in the Phase I RI, with some variations in volumes and areas based on the Phase II RI results presented in Section 3.0.

Updated cost estimates for implementation of the proposed corrective actions are presented in Section 4.3, with support information provided in Appendix B. Sections 4.4 and 4.5 discuss the proposed corrective action measures implementation schedule and recommendations for additional investigations, respectively.

4.1 BACKGROUND INFORMATION

Background information presented in this section describes the corrective action evaluation approach used for the Facility. The broad range of corrective action alternatives considered in the Phase I RI are summarized followed by a discussion of preferred corrective action measures identified during the Phase I RI with support information provided by the Phase II RI.

4.1.1 Corrective Action Approach

The general proposal for corrective action includes a summary of risk assessment results from the Phase I RI and identifies corrective action goals and objectives. Preliminary corrective action goals were established to minimize risks at the Facility in accordance with the TNRCC risk reduction standards. A site-specific baseline risk assessment for the Facility was submitted with the Phase I RI Report. The objective of the risk assessment was to identify mechanisms for present and future exposure potential and releases of COCs to the environment from source materials at the Facility. The baseline risk assessment provided preliminary media-specific cleanup levels which are protective of human health and the environment.

Conclusions regarding risks, excerpted from Section 5.6 of Appendix L in the Phase I RI (Hydrometrics, 1998) and expanded to address subsequent TNRCC comments, are as follows:

- Elevated trace metal concentrations exceeding TNRCC risk reduction standards, as presented in the Facility baseline risk assessment, exist at the site.

- Elevated metal concentrations at the Facility do not pose imminent health threats because potential worker risks from exposure to soil are managed through an approved OSHA bio-monitoring program. There is no exposure to groundwater due to municipal restrictions on groundwater use, and metals concentrations in surface water are below health-based levels of concern (MCLs and Fresh Water Chronic Criteria).

- Cleanup objectives should focus on maintaining existing institutional controls and prevention of future impacts to the American Canal and the Rio Grande, consistent with the requirement of Texas Surface Water Quality Standards. MCLs are the applicable standard for the American Canal, while both MCLs and Fresh Water Chronic Criteria are applicable to the Rio Grande. Nondegradation and related load limitations (TMDLs) also apply.

- Possible sources of metals identified during low water flow in the American Canal should be further evaluated.

Corrective action objectives for Facility are as follows:

- Reduce the potential for exposure to metals by Facility workers and the public.
- Minimize the potential for transport of metals to groundwater.
- Prevent increases in metal concentrations in the American Canal and the Rio Grande resulting from the migration of metals in groundwater, surface water, and wind-blown dust from the Facility.

Corrective action alternatives and measures focus primarily on the elimination or control of source areas which impact groundwater in the arroyos. As discussed in Section 3.0, the results of the Phase I RI (and now the Phase II RI) indicate the principal source of COCs in soils to be related to historic smelter features and activities associated with Facility operations. Migration of COCs to groundwater is influenced primarily by the locations of arroyos that have been backfilled as part of Facility operations.

Facility improvements provide opportunities for management of operations and potential source materials, and reduce potential environmental risks. Specific Facility improvements which contribute to risk reduction include the following:

- The recently completed Storm Water Collection and Reuse Project, in IA-1, IA-2, IA-3, IA-4, IA-8, IA-9, IA-10, IA-13 and IA-14 which controls storm and Facility operation runoff, and prevents percolation of surface water into the subsurface, and associated potential metal transport to soil and groundwater.

- Recent and planned operational improvements in IA-1, IA-2, IA-3, IA-8, IA-9, IA-10, IA-13 and IA-14, which minimize the release of potential source materials and possible migration of metals into subsurface soils and groundwater.

These improvements, along with future corrective action measures are designed to remediate source areas and are integral parts of the overall plan for corrective action approach.

4.1.2 Corrective Action Alternatives Considered

The Phase I RI summarized information on performance, relative costs, applicability, efficiencies, operation and maintenance, and site-specific implementability of a wide range of remedial technologies for soil and groundwater applicable to the Facility. Specific remedial technologies for soil and groundwater presented in Section 4.2 of the Phase I RI Report include the following:

- **Soil**

  Isolation/containment
  Asphalt/concrete cap
  Clay and synthetic membranes
  Clean soil and vegetation
  Storm water control
  Excavation and removal
  Soil flushing/washing
  Chelation
  Electro-Osmosis
  Chemical neutralization/fixation/stabilization
  Chemical neutralization
  Siliceous chemicals
  Pozzolan processes
  Thermal destruction
  Vitrification stabilization.

- **Groundwater**

  Chemical pump and treat

  Isolation/containment

  Extraction and injection

  Interception and infiltration trenches

  Slurry walls

  Grout curtains

  Vibrating beam

  Concrete walls

  Clay walls

  Source isolation/removal

The broad range of corrective action alternatives listed above were evaluated for use at the Facility based on effectiveness, implementation, and cost. The following site specific characteristics were also included in the Phase I feasibility study:

- The use of the Area of Contamination (AOC) concept.
- Specific aquifer use in the Facility area.
- Facility operational influences on potential source areas.
- The preferential groundwater flow-paths associated with infilled arroyos beneath the Facility.
- Background chemical constituent concentrations, for example, selenium.

The following section provides more details about the preferred corrective action alternatives.

4.1.3 Identification of Preferred Corrective Action Alternatives

Components of the preferred corrective action alternatives for the Facility, as described in this section, include groundwater monitoring and remediation through corrective actions associated with overlying soils and source materials, containment of impacted soils, removal/disposal and institutional controls. Specific corrective action measures for each of the 14 IAs are discussed in Section 4.2.

4.1.3.1 Overview

The Phase I RI provided preferred corrective action alternatives for the Facility. In this Phase II RI Report, proposed corrective action technologies and process options are the same as those identified during the Phase I RI, with estimates of the areas and volumes of source materials refined based on results of the Phase II RI. No new remedial options are proposed. A brief summary of the preferred corrective action alternatives and related points, based on the Phase I and Phase II RIs, is provided in the following sections.

As described in a previous submittal (Hydrometrics, et. al. 2000), and in Section 1.2 of this report, Area of Contamination (AOC) is a concept by which certain broad areas of contamination may be considered a RCRA land disposal unit, without triggering RCRA land disposal restrictions or minimum technology requirements. This is an important concept for the Facility in that it provides a technically demonstrated, cost efficient means by which materials with similar COCs that cause similar impacts can be disposed of. Placement of materials in on-site repositories also fits in with current and future Facility operations, and reduces exposure risk associated with transportation activities.

Following a review of applicable regulations and case studies, the following points can be made regarding AOCs and the proposed on-site repositories at the Facility:

- Certain discrete or large contiguous areas of generally dispersed contamination can be equated to a RCRA landfill. Movement of waste within those areas would not be considered "placement" of wastes, and accordingly would not be considered land disposal. Therefore such areas would not trigger RCRA land disposal restrictions or minimum technology requirements.

- Advance approval at the federal level is not required for private parties to take advantage of the AOC concept, but EPA encourages parties to consult with the appropriate agency (be it state or federal) to ensure they implement the AOC concept appropriately.

- Depending on the site characteristics, one or more AOCs may be delineated. AOC guidance does not preclude utilizing one AOC that is bisected by a roadway, body of water, or the like. An entire site can be designated as an AOC if there is site-wide contamination. Asarco's proposed AOC comprises approximately 374 acres of Asarco's approximately 764 acres in El Paso (approximately 49% of Asarco's acreage).

- While it may be possible to subdivide a property into multiple AOCs, given the widespread areas of generally dispersed contamination, Asarco sees no advantage to such action. For example, attempting to align the ponds to be closed with discrete portions of the property could lead to a situation where one pond could be under-utilized and another pond would not have capacity to accept the remediation waste generated in that particular AOC.

The proposed AOC boundary for the Facility is in Figure 4-1. Figure 4-1 also shows Phase I RI, Phase II RI, and closed plant IAs.

All proposed corrective action measures involving excavation, consolidation, capping, or other alternatives will occur within the proposed AOC boundary including construction of synthetically lined repositories in the historical Ponds 1, 5, and 6. Figure 4-2 shows typical liner/cap details for the repositories. Further discussions of the on-site repositories are presented in Section 4.2.9.

4.1.3.2 Groundwater

Results of both Phase I and Phase II RIs indicate 'that groundwater does not appear to adversely impact surface water resources (American Canal and Rio Grande). The aquifer beneath the Facility is not used for municipal purposes because of it's relatively high TDS concentrations. Based on the results of the Phase I and Phase II RIs conducted at the Facility, the groundwater appears to have no influence on the Rio Grande or the American Canal, the pertinent surface water bodies associated with the Facility.

Because Asarco anticipates that groundwater quality will be improved through the excavation and/or isolation of source materials as described in this section, no corrective actions are proposed that would entail groundwater treatment. Corrective action alternatives for the Facility focus on mitigating impacts from source materials through institutional controls, excavation and containment, and capping.

As discussed in the Phase I RI (Hydrometrics, 1998), transport modeling of COCs in groundwater indicates that movement of metals in groundwater is very slow. Potential impacts to potable water sources is very low. Long term monitoring of groundwater and surface water will be performed as part of the corrective action measures to verify the effectiveness of the implemented corrective actions.

4.1.3.3 Containment

There are two containment alternatives applicable to corrective action at the Facility:

- **Capping** - Capping entails covering with Category II material source areas (see Section 3.0) with an engineered barrier to minimize the infiltration of surface water through soils. Capping will reduce potential impacts to groundwater, and minimize worker exposure.

  Capping systems could include clean soil/vegetation, geosynthetic liners (GCL), flexible membrane liners (FML), pavement, and concrete. These may be used as a single application or in combination depending on the type of operations/activities and conditions occurring/existent at a specific source area.

For example, a source area subject to heavy traffic would be capped with asphalt or concrete. An open area may be capped with a GCL and/or clean soil and vegetated. The foundation area of an acid plant might require a combination of concrete structures and a FML to contain leaks and eliminate the potential for fluids to infiltrate and percolate through subgrade materials. In some cases, existing buildings and paved or concrete roadways or storage areas currently provide a cap, and simple upgrades could increase their effectiveness as barriers.

- **Surface Control** - Surface control entails altering the topography and hydrology of the site to control surface water and minimize erosion. Construction of storm water system improvements (Storm Water Collection and Reuse Project, Dames and Moore, 1998) at the Facility has been completed. Details of the storm water control improvements specific to each IA are provided in Section 3.0 and later in this section.

  These improvements also include a lined impoundment, sumps, pumping systems, pipelines, and storage tanks. In conjunction with the construction of the Storm Water Collection and Reuse System, the existing ponds in IA-9, which are potential sources of metals to groundwater, will be allowed to dry, their sediments excavated, and closed. The excavated sediments will then be placed back in the repositories or processed for metals recovery. The new storm water control system effectively minimizes the infiltration of surface water through on-Facility soils, and the potential for off-Facility transport in runoff.

4.1.3.4 Removal/Disposal

Based on the results of the Phase I and Phase II RIs, source materials at the Facility identified as having the greatest potential to impact groundwater will be excavated and disposed of in on-site repositories. These materials are designated as Category I, and are associated with specific Facility operations as described in Section 3.0. Category I materials are typically present in the upper few feet of the surface, but may occur at greater depths in some cases. Exact delineations of these source materials will be determined as additional investigation and remedial design activities proceed.

Removal/disposal alternatives applicable to corrective action at the Facility are presented as follows. Details regarding volumes and areas, as well as on-site repository capacities are presented in Section 4.2. Summaries of corrective action activities are also provided in Table 3-1.

- **Excavation** - Excavation will be accomplished by conventional methods using earthmoving equipment, including backhoes, scrapers, front-end loaders, and trucks. The excavation of Category I materials effectively prevents direct exposure and minimizes migration of arsenic and metals from source materials to groundwater, compared to current conditions. Plans call for excavated Category I materials to be disposed of in on-site repositories.

- **On-site disposal** - As summarized in Section 1-1 of this report, the corrective action alternative for Category I materials consists of removal and disposal in lined on-site repositories. The use of the on-site repositories for disposal of Category I materials was identified in the Phase I RI Report as an effective and economical corrective action alternative.

4.1.3.5 Institutional Controls

Institutional controls applicable to corrective action at the Facility include the following:

- **Municipal restrictions on groundwater use** – Promulgated as aquifer use classifications
- **Deed restrictions** - Deed restrictions are legal mechanisms that prevent specific uses or activities on the property. The Asarco Facility is currently zoned for industrial with limited residential uses, as are adjacent properties.
- **Fencing and other access controls** - Access to the Facility is controlled. Security systems, which controls access at the Facility entrance, and a fence enclosing the property, limit access to only appropriately trained workers and supervised visitors.
- **Worker health and safety programs** – Federal regulations mandate Facility worker health and safety programs. These include protection against exposure to metals, including lead, cadmium, and arsenic for industrial application (29 CFR 19.10) and construction activities (29 CFR 1926).

Through health and safety policies and programs currently in effect at the Facility, the potential for exposure and health hazards is significantly reduced. The health and safety program includes required OSHA training and medical monitoring of "Contact Intensive" workers. Medical monitoring for lead, cadmium, and arsenic ensures that workers are not at risk.

In addition, the Facility has instituted an expanded contractor Health and Safety program. The program includes specific training regarding health and safety issues; respirator fit tests, and maintaining files regarding bio-monitoring of individual contractor employees.

4.2 SPECIFIC PROPOSED CORRECTIVE ACTION MEASURES

The following corrective action measures are listed for each of the 14 IAs at the Facility. Proposed corrective actions presented in the Phase I RI were further evaluated as part of this report. No significant changes in proposed corrective action measures have occurred between the Phase I and Phase II RIs. Further delineation of areas and volumes of source areas has occurred with associated implications to corrective action measures addressed.

The proposed corrective action measures represent a comprehensive plan to remediate adverse Facility impacts and meet the risk reduction standards identified in the Baseline risk assessment. Where applicable, the status of a given remedial action at the time of this report is provided. Table 3-1 presents a summary of the remedial elements associated with the IAs.

The corrective actions discussed below assume that the institutional controls presented in Section 4.1.3.4 will continue. For many of the IAs discussed below, recently implemented storm water control elements serve as caps for identified Category II materials. It is assumed for these asphalted areas, maintenance will be performed to insure the integrity of the cap in controlling potential percolation of water to the subsurface.

Preliminary cost estimates to implement the corrective actions in each IA are presented in 4.3. The schedule for implementation of the corrective action measures and proposed additional investigations are discussed in Sections 4.4 and 4.5, respectively.

4.2.1 Converter Building/Baghouse Area (IA-1)

A substantial amount of remedial work has been performed in IA-1. Seven corrective control measures were identified during the Phase I RI. These are listed below with their status following the Phase II RI:

Proposed Corrective Action	Status
1. Engineering/operational controls to reduce or eliminate the occurrence of releases from the Acid Plant operations.	Some work has been implemented.
2. Demolish and replace Medford sump.	Completed as part of the Storm Water Collection and Reuse Project.
3. Excavation of Category I Materials.	Completed as part of the Storm Water Collection and Reuse Project.
4. Backfill excavated areas with crushed copper slag. Grade area to improve surface drainage	Clean soil was used instead of crushed copper slag. Some has been completed.
5. Improve asphalt pavement cap over excavated areas and Category II areas.	Some work has been completed; because engineering/operational controls have been implemented, and the fluid sources have been eliminated, some Category I areas have been reclassified to Category II.
6. Disposal of Category I materials in on-site repositories.	Category I materials have been deposited at an off-site hazardous waste landfill.

A conceptual illustration of corrective action measures for IA-1 is in Figure 4-3. Additional soil and groundwater sampling in this area during the Phase II RI were used to further delineate Category I, II and III materials. Data collected since the recent implementation of corrective action measures indicate impacts to groundwater have been reduced.

In summary, the remaining corrective action measures or other Facility improvements to be implemented in IA-1 consist of the following:

- Implement remaining engineering/operational controls.

- Additional grading.
- Capping of remaining Category II materials.

4.2.2 Boneyard/Slag Area (IA-2)

Some remedial work has been performed in IA-2. Four corrective control measures were identified for this subarea during the Phase I RI. These are listed below with their status following the Phase II RI:

Proposed Corrective Action	Status
1. Debris clean up.	Debris has been cleaned up and operational changes have been implemented to selectively restrict debris deposition in this area in the future.
2. Surface drainage improvements.	Some work has been performed as part of the Storm Water Collection and Reuse Project.
3. Excavation of Category I materials.	Category I materials at the surface have been excavated.
4. Disposal of Category I materials in on-site repositories.	Category I materials have been deposited in a hazardous waste landfill.

A conceptual illustration of corrective action measures for IA-2 is in Figure 4-4. Additional soil and groundwater sampling in this area during the Phase II RI were used to further delineate Category I, II and III materials.

In summary, the remaining corrective action measures or other Facility improvements to be implemented in IA-2 include the following:

- Additional investigations concerning potential groundwater impacts from the adjacent acid storage tanks and the materials underlying slag at a depth of 35 to 65 feet bgs are needed (see Section 4.5). In this report these materials are assumed to be Category I.
- Excavation and/or capping of additional Category I/II materials below the slag, and deposition of Category I materials in on-site repositories.
- Additional surface drainage improvements.

4.2.3 Acid Plants 1 and 2 Area (IA-3)

Some remedial work has been performed in IA-3. Five corrective control measures were identified for this IA during the Phase I RI. These are listed below with their status following the Phase II RI:

Proposed Corrective Action	Status
1. Engineering/operational controls to reduce or eliminate the occurrence of releases from the Acid Plants.	Some have been implemented.
2. Line and resurface the floors of Acid Plants 1 and 2, and construct perimeter sill for secondary containment.	In progress.
3. Construct a lined secondary containment around Acid Plants.	To be performed.
4. Excavation of Category I materials (If required as part of secondary construction).	Category I materials not present; asphalt paving has been placed for containment in potential release areas, in conjunction with storm water control.
5. Disposal of Category I materials in on-site repositories.	Not applicable.

A conceptual illustration of corrective action measures for IA-3 is in Figure 4-5. As a result of additional soil samples collected during the Phase II investigation, it was decided that the material in IA-3 did not meet the criteria to be classified as Category I materials. Historical releases of sulfuric acid and other low pH fluids associated with the Acid Plants are the primary sources of Category I material and metals to the groundwater. Engineering/operational controls and surface capping will eliminate impacts from this source. Therefore, the control of these fluids will eliminate the source of metals to groundwater in IA-3. The Category I materials are now classified as Category II. It was also observed that much of the Category II materials in IA-3 have been capped by existing roads, buildings and new storm water control improvements.

In summary, the remaining corrective action measures or other Facility improvements to be implemented in IA-3 include the following:

- Remaining engineering/operational improvements.
- Improve asphalt pavement cap over existing areas.
- Capping of remaining Category II areas.

4.2.4 Front Slope/Western Facility Boundary Area (IA-4)

Seven corrective control measures were identified for this IA during the Phase I RI. These are listed below with their status following the Phase II RI:

Proposed Corrective Action	Status
1. Debris clean up.	Some work has been performed.
2. Excavation of Category I materials.	To be performed; Phase II RI results indicate more Category I materials than initially identified as part of the Phase I RI.
3. Backfill excavated areas with clean soil.	To be performed.

Proposed Corrective Action	Status
4. Utilize excavated soils for Facility construction fill.	To be performed.
5. Cap replacement soil and Category II areas with asphalt or gravel.	To be performed.
6. Drainage controls for slope areas.	To be performed.
7. Construct drainage collection system.	Recently implemented storm water control improvements prevent run on from upgradient Facility components; remaining areas remain to be addressed.

A conceptual illustration of corrective action measures for IA-4 is shown in Figure 4-6. As a result of additional soil samples collected during the Phase II investigation, Category II areas in IA-4 were reclassified as Category I.

In summary, the remaining corrective action measures or other Facility improvements to be implemented in IA-4 include the following:

- Continue debris cleanup.
- Excavation of Category I materials and deposition in on-site repositories.
- Backfill excavated areas with clean soil, and construct asphalt or gravel cap.
- Construct drainage collection system in downgradient portion of IA.

4.2.5 Historic Smeltertown Area (IA-5)

Five corrective control action measures were identified for IA-5 during the Phase I RI. These are listed below with their status following the Phase II RI:

Proposed Corrective Action	Status
1. Incorporate materials to bind metals and deep till soils with elevated metal concentrations in the surface 12 inches.	Some debris and surface material was removed in IA-5 in conjunction with construction of the Diesel No. 2 recovery system.
2. Excavate soils where metal concentrations are elevated at depths greater than 12 inches bgs to a total depth of 24 inches.	To be performed.
3. Backfill excavated areas with clean soil.	To be performed.
4. Utilize excavated soils for Facility construction fill.	To be performed.
5. Stabilize soils with native vegetation to minimize wind blown dust.	To be performed.

A conceptual illustration of corrective action measures for IA-5 is shown in Figure 4-7. As a result of additional soil samples collected during the Phase II RI, Category I and II areas were further delineated.

In summary, all five of the corrective action measures listed above remain to be completed. Additional corrective action measures for IA-5 may include redevelopment of the site for commercial or industrial use. In this case, site grading, storm water improvements, buildings, and paved parking areas, when designed and constructed in the context of a remedial approach, would provide a protective cap to isolate source materials and eliminate transport pathways.

4.2.6 Groundwater (IA-6)

Corrective action measures for IA-6 consists of long-term groundwater monitoring for 15 years. Groundwater is not used as a source of drinking water, and is not causing a measurable change in metal concentrations in the American Canal or Rio Grande.

Thus far in the Phase I and Phase II RIs, as much as 12 quarters of groundwater analytical data have been collected. Many monitoring locations at the Facility exhibit consistent trends in water quality.

Pursuant to the TNRCC Consistency Document (TNRCC, 1998), 20 quarters of sampling is recommended in order to have statistically valid data. As 20 quarters of monitoring data are completed at the Facility evaluations will be performed to make the monitoring program more efficient and focussed on specific impact areas that are being remediated. During this process, monitoring locations, chemical parameters and frequencies will be considered.

4.2.7 Surface Water (IA-7)

Corrective action measures for IA-7 consists of long-term surface water monitoring. Similar to long-term monitoring discussed above for groundwater, the surface water monitoring program will be reevaluated in the future for meeting the project objectives.

4.2.8 Bedding and Unloading Buildings Area (IA-8)

Seven corrective action measures were identified for IA-8 during the Phase I RI. These are listed below with their status following the Phase II RI:

Proposed Corrective Action	Status
1. Remove and replace railroad track.	To be performed.
2. Construct concrete slab (cap) to replace railroad ballast.	To be performed.
3. Construct asphalt/FML cap for Category II areas.	To be performed.
4. Construct drainage control features (Drainage collection system).	Some work has been performed as part of the recently implemented storm water control improvements.

Proposed Corrective Action	Status
5. Category II materials excavated (i.e. old ballast) as part of cap construction will be placed under the cap.	To be performed.
6. Excavation of Category I materials.	To be performed.
7. Disposal of Category I materials in on-site repositories.	To be performed.

A conceptual illustration of corrective action measures for IA-8 is shown in Figure 4-8. As a result of additional soil samples collected during the Phase II investigation, Category II areas were further delineated, and additional Category I materials were identified.

In summary, all seven of the corrective action measures listed above remain to be completed.

4.2.9 On-Site Ponds 1, 5 and 6 (IA-9)

Work has been performed associated with the ponds comprising IA-9 ponds. Six corrective control measures were identified for IA-9 during the Phase I RI. These are listed below with their status following the Phase II RI:

Proposed Corrective Action	Status
1. Excavate existing sediments (Category I material).	To be performed.
2. Dewater sediments.	Ponds are in the process of being drained or are dry; Pond 5 will available in 2000 to begin repository construction.
3. Recover copper and lead in sediments from Ponds 5 and 6 by recycling through smelter.	This will only be done if materials meet acceptance profile requirements.

Proposed Corrective Action	Status
4. Reshape ponds for repository Configuration.	Geotechnical investigation to support design has been started at Pond 5.
5. Construct repositories with appropriate top and bottom liner systems in reshaped ponds.	To be performed; see following section 4.2.9.1 concerning conceptual design details.
6. Create paved parking/staging area or green spaces on surface of closed repositories.	To be performed.

A conceptual illustration of corrective action measures for IA-9 is shown in Figure 4-9. Conceptual details of the proposed liner system to be used for the repositories are shown on Figure 4-2. The designs associated with the on-site repositories are developed using industry standard discharge control element.

The recent completion of the Storm Water Collection and Reuse System has eliminated storm water and other process fluids from entering the former unlined ponds and becoming a source of metals to groundwater. Ponds 1 and 5 have been dewatered and Pond 6 is currently being dewatered. Based on Phase II sediment sampling results, all pond sediments will be classified as Category I material to be reclaimed or disposed of in on-site repositories.

Converting the process ponds to lined repositories for disposal of excavated Category I materials makes use of existing depressions and reduces construction costs. The on-site repositories will only be used to dispose of Category I materials excavated from within the proposed AOC boundary of the Facility (see Figures 4-1 and 4-2). Wastes generated as part of ongoing normal smelter operations will not be disposed of in the proposed on-site repositories.

In summary, all seven of the corrective action measures listed above remain to be implemented. Preliminary activities have been initiated (draining, dewatering, geotechnical investigation) to facilitate use of the ponds as repositories for Facility Category I materials. Pond 5 will be available for repository construction in 2000.

4.2.9.1 On-Site Repository Design, Construction and Operation

The estimated volume of Category I materials as reported in this Phase II RI is 156,000 cy. The Phase I RI Report estimated volumes assumed minimum excavation of pond sediments. It is now assumed all pond sediments are classified as Category I, and will be excavated and placed in the repositories. Other factors that contribute to the increased amount of Category I materials at the Facility include refined estimates based on Phase II data, and additional materials delineated in IAs 2, 4, 8 and 11 through 14 during the Phase II RI. Quantities of Category I materials will be further refined as part of additional proposed investigations (see Section 4.5)

Design activities associated with the repositories will proceed with the flexibility as needed to alter capacities, if necessary, of the repositories as subsequent investigations proceed. Repository capacities may increase as a result of additional excavation in the bottom of the ponds. Over excavation requirements will be based on the results of future remedial design investigations. Design plans, specifications, and operating procedures for the on-site repositories will be prepared according to the results of remedial design investigations. Remedial design investigations will require soil borings to assess the geotechnical design parameters for the repositories.

A typical bottom liner system for the proposed repositories is in Figure 4-2. The bottom liner system is composed of a Flexible Membrane Liner (FML), overlying acceptable compacted subgrade materials. A Geosynthetic fabric or Geotextile will be placed above the FML on the repository bottom and side-slopes. The Geotextile will protect the FML from damage. Both the FML and Geotextile will be anchored along the perimeter of the repository with anchor trenches. Since Category I materials are not anticipated to generate leachate, and the top liner system will prevent moisture from entering the repository fill materials, the repositories will not require a leachate collection system.

The first 12 inches of Category I materials to be placed in contact with the Geotextile of the bottom liner system will be minus ½-inch. Mechanical screening may be required to achieve the minus ½-inch particle size distribution. The remaining repository volumes will be filled with compacted Category I materials with a maximum particle size of 3-inches. Some crushing and screening of over-sized materials may be required to achieve the minus three-inch size limit. Category I materials will be placed in the repositories at or below optimum moisture content to prevent the introduction of excessive moisture.

A typical top liner system for the repositories is shown in Figure 4-2. A Geotextile cushion will be placed on the top of the final 12 inches of Category I repository fill material. The final 12-inch layer of Category I materials will be minus ½-inch. The Geotextile layer will provide separation and prevent overlying materials from filtering into the repository fill.

The top liner system will include a barrier layer consisting of a FML and/or Geosynthetic Clay Liner (GCL). An additional Geotextile layer will be placed over the barrier layer. Above this Geotextile will be compacted materials similar to those used in the subgrade. The first 4-inches of the top-most materials will be minus 3/8-inch to protect the FML/GCL from puncture. There are three types of final surface treatments or caps proposed for the repositories (see Figure 4-2):

1. A minimum of 12 inches of topsoil.
2. A layer of Hot Mixed Asphaltic Concrete (HMAC).
3. A reinforced concrete slab on grade.

The selected surface treatment will be sloped to promote surface runoff. A Storm Water Control Plan will be developed and implemented for operation and maintenance of the repositories. storm water control measures include the use of diversion ditches, berms and site grading. Storm water control elements will also be used during construction of the repositories.

Filling of the repository is not expected to be a continuous operation. The repository fill will be protected with a temporary cover, which can be removed and stored during fill placement operations. The repository fill will be covered at the end of each day to prevent precipitation from entering the repository.

Once completed, the repositories will require monitoring and maintenance. A monitoring and maintenance plan will be prepared as part of remedial design. As a minimum, this plan will specify regular inspections, routine preventative maintenance, and compliance monitoring.

4.2.10 Facility Entrance Area (IA-10)

All four corrective action measures for IA-10 previously identified in the Phase I RI Report have been implemented, as summarized below:

Proposed Corrective Action	Status
1. Rebuild the first 200 feet of the Facility entrance road.	Completed, improvements controls surface runoff and minimizes percolation of water into the subsurface.
2. Demolish and replace existing sumps.	Completed, improvements are sufficient to handle the anticipated amounts of runoff.
3. Regrade area to divert water away from American Canal and to the new sumps.	Completed.
4. Landscape areas with gravel and native vegetation.	Completed, as part of erosion control.

A conceptual illustration of corrective action measures for IA-10 is shown on Figure 4-10. The recent completion of the Storm Water Collection and Reuse System includes rebuilding the Facility entrance road and replacing the runoff collection sump. These improvements have eliminated storm water and other runoff from entering the American Canal or becoming a source of metals to groundwater.

In summary, all applicable corrective action measures for IA-10 listed above have been implemented.

4.2.11 Arroyos East of I-10 (IA-11)

IA-11 was formerly a part of IA-2 during the Phase I RI, and is now a separate IA. This change was made based on the results of the Phase I RI and comments from the TNRCC. The following eight corrective action measures are identified as part of the Phase II RI:

Proposed Corrective Action	Status
1. Debris clean up.	To be performed.
2. Excavation of Category I materials.	To be performed.
3. Grade excavated areas to blend with existing topography and to achieve slope stability.	To be performed.
4. Disposal of Category I materials in on-site repositories.	To be performed.
5. Construct a protective cap (FML or GCL/drainage layer) over Category II materials.	To be performed.
6. Construct drainage controls to protect remediated areas.	To be performed.
7. Stabilize disturbed areas with vegetation to prevent erosion during storm events.	To be performed.
8. Institutional controls (fencing) to control public access.	To be performed.

A conceptual illustration of corrective action measures for IA-11 is shown in Figure 4-11. During the Phase II RI, a former Facility material deposition area (Category II) in the northern arroyo of IA-11 was delineated. The corrective action Measure for this feature is to minimize percolation of surface runoff with an engineered cap which may incorporate a GCL. In the southern arroyo of IA-11, elevated metal concentrations in groundwater were observed. A preliminary area of Category I materials has been delineated. Additional investigation is required to ascertain the extent of source materials. A baseline study of naturally occurring metals in soil and groundwater is currently being performed in the area of the Facility.

In summary, none of the eight corrective action measures listed above for IA-11 have been completed. Additional investigation (see Section 4.5) is required in this IA to further refine corrective action alternatives and measures.

4.2.12 Ephemeral Pond and Pond Sediment Storage Area (IA-12)

IA-12 was formerly a part of IA-2 during the Phase I RI, and is now a separate IA. This change was made based on the results of the Phase I RI and comments from the TNRCC. The following five corrective action measures are identified as part of the Phase II RI:

Proposed Corrective Action	Status
1. Excavation of Category I materials.	To be performed.
2. Disposal of Category I materials in on-site repositories.	To be performed.
3. Cap and Category II materials.	To be performed.
4. Grade and construct a lined storm water impoundment.	To be performed.
5. Construct drainage improvements such as channels and culverts to complement the storm water impoundment.	To be performed.

A conceptual illustration of corrective action measures for IA-12 is shown in Figure 4-12. During the Phase II RI, Category I materials were identified. Further investigation (see Section 4.5) is needed to delineate Category II material areas. The ephemeral pond area is likely a site where storm water runoff may percolate and there is potential for migration of metals to groundwater. For this reason, a lined storm water pond is being considered for this area. Design and permitting issues associated with a possible impoundment will be evaluated as part of future work.

In summary, none of the five corrective action measures listed above for IA-12 have been completed. Additional investigation (see Section 4.5) is required in this IA to further refine corrective action alternatives.

4.2.13 Sample Mill Area (IA-13)

Investigation Area 13 is a new area investigated as part of the Phase II RI pursuant to TNRCC comments following submittal of the Phase I RI Report. The following seven corrective action measures are identified for this area following the Phase II RI:

Proposed Corrective Action	Status
1. Remove and replace railroad track.	To be performed.
2. Excavation of Category I materials.	To be performed.
3. Backfill excavated areas with clean soil or crushed slag.	To be performed.
4. Disposal of Category I materials in on-site repositories.	To be performed.
5. Cap any Category II materials, if Identified.	Some capping performed as part of storm water control improvements.
6. Cap replacement soil area with asphalt/FML.	To be performed.
7. Construct concrete slab (cap) to replace railroad ballast.	To be performed.

A conceptual illustration of corrective action measures for IA-13 is shown in Figure 4-13. The recent completion of the Storm Water Collection and Reuse System, which includes grading and paving in this area, has improved drainage controls and reduces the potential transport of metals from source materials.

In summary, none of the five corrective action measures listed above for IA-12 have been completed. The potential for percolation of water into the subsurface has been reduced with recently implemented storm water control improvements.

4.2.14 South Terrace Area (IA-14)

IA-14 is a new area investigated as part of the Phase II RI pursuant to TNRCC comments following submittal of the Phase I RI Report. Much of IA-14 is now capped due to recently implemented storm water control improvements. The following four remaining corrective action measures are identified:

Proposed Corrective Action	Status
1. Excavation of Category I materials.	To be performed.
2. Backfill excavated areas with clean soil or crushed slag.	To be performed.
3. Disposal of Category I materials in on-site repositories.	To be performed.
4. Cap replacement soil area with asphalt or gravel.	To be performed.

A conceptual illustration of corrective action measures for IA-14 is shown in Figure 4-14. During the Phase II RI, Category I materials were identified. The corrective actions listed above are associated with one small remaining area of Category I materials. Storm water control improvements in IA-14 include construction of a storm water impoundment, and caps constructed as part of asphalt roads and drainage control elements.

In summary, the five corrective action measures listed above remain to be completed for the small amount of remaining Category I materials in IA-14.

4.3 CORRECTIVE ACTION MEASURE COST ESTIMATES

This section of the report provides preliminary cost estimates for corrective action measures described in the preceding sections for Investigation Areas 1 through 14. Cost estimates for Investigation Areas 1 through 10, initially developed based on the results of the Phase I RI, have been amended to reflect the results of the Phase II RI. Cost estimates for Investigation Areas 11 through 14 are based strictly on the results of the Phase II RI.

Cost estimates for corrective action measures are based on the results of remedial investigation (site characterization) studies and are conceptual. Additional soil investigations are required to refine quantities (i.e., areas and volumes) and associated costs. Therefore, all costs estimates are feasibility study level (order of magnitude) estimates for corrective action measures accurate to within plus or minus 25 to 30 percent. Estimated costs for corrective action measures are summarized in Table 4-1 for each Investigation Area. Estimated quantities and cost estimates for the IAs are in Appendix B.

Total estimated construction costs to implement the proposed conceptual corrective action measures is approximately $16,400,000 as shown in Table 4-1. This conceptual level estimate includes 30 percent for scope contingency and a ten-percent health and safety premium for projects of this nature. Annual inspections and operation and maintenance are estimated to cost $645,000 over a 15-year period.

Long-term surface water and groundwater monitoring (corrective measures for IAs 6 and 7) are estimated at $2,920,000 over an assumed period of 15 years.

4.4 CORRECTIVE ACTION MEASURES SCHEDULE

A detailed schedule for implementation of corrective action measures is presented in Exhibit 2. Corrective actions identified in Exhibit II include:

- Remedial activities to commence in 2000, including design and construction of a lined Category I material repository in the area of Pond 5 (IA-9), upon concurrence from TNRCC on the use of the AOC.
- Additional investigation of IAs to support remedial design.
- Remaining remedial activities.
- Closed Plant investigations, remedial design and remedial construction.

4.5 PROPOSED ADDITIONAL REMEDIAL INVESTIGATION ACTIVITIES

The Phase II RI provided supplemental characterization and corrective action information based on recommendations provided in Section 4.5 of the Phase I RI (Hydrometrics, 1998). Following completion of the Phase II RI, additional information for selected areas would prove useful to refine the proposed corrective action measures and associated costs, and to support remedial design.

This section provides recommendations for supplemental investigations for each IA based on the results of the Phase I and Phase II RIs. In addition to the investigative elements listed below, monitoring of groundwater and surface water will continue on a quarterly basis. A baseline investigation of naturally occurring trace metal concentrations in local bedrock formations surrounding the Facility is planned to commence later this year.

Borings and monitor wells will be advanced using protocols established for the project, including termination of borings at groundwater, unless otherwise indicated, and the collection of samples every five feet in materials other than slag.

Investigation Area 1 - Converter Building/Baghouse Area

As recommended in the Phase I RI Report, three soil borings were advanced in this investigation area during the Phase II RI, one of which was converted into a monitor well. These borings and monitor well were used to further characterize COCs in soil and groundwater. The primary source of impacts was the Medford Sump, which has been remediated. No additional characterization is planned for IA-1.

Investigation Area 2 - Boneyard/Slag Area

As recommended in the Phase I RI Report, six soil borings were advanced in this IA during the Phase II RI. These borings were used to determine the extent of elevated metal concentrations in soil and to identify the former material storage location underneath the lead slag.

Further investigation is required to delineate the extent of soil and groundwater impacts from the sludge historically deposited below the slag in IA-2, and to assess the contribution to these impacts from the adjacent acid storage area. Four additional borings are recommended in the slag Boneyard area, and four borings are recommended in the acid storage area. Two monitor wells are recommended to further evaluate groundwater impacts in this area.

As part of the corrective action program for IA-2, a feasibility study will be conducted to evaluate the best actions for the unconsolidated slag.

Investigation Area 3 - Acid Plants 1 and 2 Area

As recommended in the Phase I RI Report, eight soil borings were advanced in this IA during the Phase II RI. These borings were used to determine the extent of elevated metal concentrations in soil and to identify the former material storage location underneath the lead slag. No additional characterization is planned at this time for IA-3.

Investigation Area 4 – Front Slope/Western Facility Boundary Area

Investigations in IA-4 were conducted during the Phase II RI Report in response to TNRCC comments. Seventeen borings were advanced, and four monitor wells constructed. Soil and groundwater samples were collected to characterize Category I and II materials, and to support hydrogeologic evaluations. No further investigations are planned at this time.

Investigation Area 5 – Historic Smeltertown Area

As recommended in the Phase I RI Report, IA-5 was expanded, and three additional monitor wells were installed during the Phase II RI. These monitor wells were used to characterize the area between the American Canal and the Rio Grande. No additional characterization is planned at this time for IA-3.

Investigation Area 6 - Groundwater

Quarterly groundwater monitoring will continue to proceed as during the Phase I and Phase II RIs. Analytical parameters, sample locations and the frequency of sampling will be evaluated. Current groundwater monitoring locations are shown on Exhibit 1. Additional monitor wells discussed in this section will be added to the sampling program.

Investigation Area 7 - Surface Water

Quarterly surface water will proceed as during the Phase I and Phase II RIs. During the subsequent year of monitoring, the parameters and the frequency of sampling will be evaluated. Surface water monitoring locations are shown on Exhibit 1.

Investigation Area 8 - Bedding and Unloading Buildings Area

As recommended in the Phase I RI Report, nine additional borings were advanced in IA-8 for the purpose of further delineating Category I and II materials. An additional ten shallow borings are recommended following the phase II RI for the same purpose. Previous investigations indicate that source materials are limited to the first few feet bgs.

Investigation Area 9 – On-Site Ponds 1, 5 and 6

Future pond investigations will include characterization of the sediments, and completion of the remedial design. These investigations have been completed for Pond 5. Ponds 1 and 6 are to be investigated according to schedule.

Investigation Area 10 – Facility Entrance Area

As recommended in the Phase I RI Report, one additional monitor well was installed in IA-10 to of further characterize groundwater in this area. As discussed in the previous section, remedial activities have been completed in IA-10. No additional investigations are recommended.

Investigation Area 11 - Arroyos East of I-10

As recommended in the Phase I RI Report, 30 additional soil borings were advanced in IA-11, four of which were completed as monitor wells. The primary purpose of this additional investigation was to further characterize possible elevated concentrations of COCs in soil and groundwater in two principal arroyos in this IA.

At least 10 additional soil borings and three monitor wells are recommended for IA-11 to further characterize potential impacts. In addition, Hydrometrics will be conducting a baseline investigation of metal concentrations in soils and groundwater, to better understand potential impacts.

Investigation Area 12 – Ephemeral Pond and Pond Sediment Storage Area

As recommended in the Phase I RI Report, eleven additional soil borings were advanced in IA-12, one of which was completed as a monitor well. The purpose of this investigation was to further characterize possible elevated concentrations of COCs in soil and groundwater in the ephemeral pond and associated sediment storage areas. Thirteen additional borings are recommended in IA-12 to further delineate the extent of Category I and II materials. Four of these borings may be completed as monitor wells to characterize groundwater conditions in the area.