metals to migrate to the groundwater. Specific corrective actions will be discussed in detail in Section 4.0.

2.5.5 Historic Smeltertown Area (IA-5)

Background, soil, groundwater and summary information for the Historic Smeltertown Area is presented in the following sections.

2.5.5.1 Background Information

Historic Smeltertown is located in the west part of the Facility between Paisano Drive and the American Canal/Rio Grande (Exhibit 1, Figure 2-27). This area was used until 1972 as private housing for Asarco employees and their families. The buildings and roadways were demolished to grade in 1975. 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 previous Phases of the 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), four new monitor wells (EP-80, EP-111, EP-112 and EP-113), 19 surface soil borings (SSIA5-1 through SSIA5-19) and four soil borings to groundwater (RIBH-7 through RIBH-10). Additional investigations were not proposed for IA-5 in the Phase II Report, however, to further investigate the groundwater condition in this IA, five additional borings were advanced and completed as monitor wells (EP-119, EP-122, EP-127, EP-128 and EP-132) during Phase III RI. Results of this investigative phase are presented in the following sections.

2.5.5.2 Soil

During the Phase I and Phase II RIs, the soils in this area were characterized by 116 soil samples from 22 soil borings (SSIA5-1 through SSIA5-19, RIBH-7 through RIBH-10), four of which (EP-80, EP-111, EP-112 and EP-113) were completed as monitor wells. During Phase III RI, 31 additional soil samples were collected from this IA, from five borehole locations (Figure 2-27) all of which were completed as monitor wells (EP-119, EP-122, EP-127, EP-128 and EP-132.

Laboratory reports obtained from the Phase I and Phase II RIs, indicated arsenic, cadmium and lead concentrations ranging from bdl to 240 mg/kg, from bdl to 150 mg/kg, and from bdl to 4,200 mg/kg, respectively.

Laboratory reports of Phase III RI soil samples indicated arsenic, cadmium and lead concentrations ranging from 13 mg/kg to 1,566 mg/kg, from bdl to 1,031 mg/kg, and from 20 mg/kg to 6,225 mg/kg, respectively.

Lead appears to be the primary COC for IA-5. Soils in IA-5 consist of silty and clayey very fine sands associated with the Rio Grande, overlain 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. In general, metal concentrations decrease in borings increasingly distant from these locations. Other high isolated metal concentrations also were detected in EP-128. The highest measured lead concentration (6,225 mg/kg) was detected in boring EP-128 at the two to three feet interval.

The soil borings EP-127, EP-128 and EP-132 are located in an area that appears to be within the former Ponds 5 and 6 Arroyo, an area included under investigation of IA-15 and IA-16. The soil borings, EP-119, and EP-122 are located in an area that appears to be within the former Parker Brothers and Acid Plant Arroyos, an area included under investigation of IA-2 and IA-3. Phase III RI soil analysis results have similar trends to those observed during the previous RI phases. Metal .concentrations in IA-5 soils are generally much lower than in other IAs, and are primarily limited to the first three feet bgs.

A summary of IA-5 soil sample results for the three main COCs (arsenic, cadmium and lead) is in Table 2-26. The boundaries of IA-5 and all soil sampling locations are in Figure 2-27.

2.5.5.3 Groundwater

There are 14 monitoring wells (EP-57 to EP-66, EP-80, EP-119, EP-122, and EP-132) in IA-5 (Figure 2-27). Monitor wells EP-111 to EP-113, EP-127, and EP-128 were installed to monitor groundwater conditions along the Rio Grande. Groundwater in this area is shallow and typically ranges from 9 to 13 feet bgs. The groundwater flow direction in IA-5 is generally toward the Rio Grande; however, there are seasonal variations in flow directions in response to periods of high streamflow. During high water periods, the river loses water to the groundwater system and the hydraulic gradients reverse in the immediate vicinity of the river. Groundwater flow then shifts to the south, parallel to the river (see August 2001 potentiometric map in Figure 2-6). Once river levels decline, near river flow directions shift back toward the river.

Arsenic and lead are the primary COCs in groundwater in IA-5, and only occur at elevated concentrations in selected subareas. Dissolved arsenic concentrations are 2.1 mg/l to 2.2 mg/l at EP-59 and EP-122 at the northwest boundary of IA-5. Groundwater from the Parker Brothers Arroyo discharges to the Rio Grande alluvium in this area. These elevated arsenic concentrations extend southeast to EP-119 near the American Canal and then continue south to EP-62. Arsenic concentrations to the west of the American Canal are at background concentrations (0.013 mg/l) at EP-113 near the Rio Grande.

Arsenic concentrations from the Acid Plant Area drop almost two orders of magnitude (from 227 mg/l to 3.2 mg/l) between EP-114 and EP-58 in Smeltertown. These arsenic concentrations drop another 1 to 2 orders of magnitude across IA-4. The highest arsenic concentrations are at EP-63 to the southwest. Concentrations at EP-112 to the west along the Rio Grande are 0.030 mg/l. The highest dissolved arsenic concentrations (8.6 mg/l) are at EP-66 at the southern end of IA-5, and to the west of EP-116. Arsenic concentrations decrease to 2.5 mg/l at EP-127 to the southwest. Arsenic concentrations remain elevated to the south at EP-111 (0.98 mg/l) and EP-128 (0.74 mg/l) which are due west of the Ponds 5 and 6 Arroyo. A summary of Phase III RI groundwater quality results (metal analysis) for monitoring wells in IA-5 is presented in Table 2-27.

2.5.5.4 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.

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. Specific corrective actions for IA-5 will be discussed in detail in Section 4.0.

2.5.6 GROUNDWATER (IA-6)

IA-6 includes groundwater resources characterized as part of the RI. Site groundwater characteristics are discussed in detail in Section 2.3 of this Report. Groundwater characteristics and associated potential sources of impacts to groundwater are addressed for specific IAs elsewhere in this section of the Report.

2.5.7 SURFACE WATER (IA-7)

IA-7 includes man-made and naturally occurring surface water bodies (i.e., the American Canal and the Rio Grande). Surface water characteristics are discussed in detail in Section 2.4 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, for the most part, there have been no MCL exceedences.

2.5.8 Bedding and Unloading Building Areas (IA-8)

Background, soil, groundwater and summary information for the Bedding and Unloading Building Areas is presented in the following sections.

2.5.8.1 Background Information

IA-8 consists of the Unloading and Bedding Buildings; railroad spurs and associated switching facilities in the central portion of the Plant (Exhibit 1, Figure 2-28). Historically, a variety of Plant raw materials, products and by-products have been handled and/or stored in this area.

The soils of IA-8 have been exposed to industrial materials handling and processing activities. The Pond 1 Arroyo associated with IA-9 (Figure 2-29) formerly occupied the southern portion of IA-8. This arroyo was filled with slag to create more usable surface area for historic Plant 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 (Figure 2-28).

In some areas of IA-8, dust suppression (area misting/watering) of materials was performed as part of Plant operations. Runoff as a result of dust suppression may have contributed to collection 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). Phase II activities consisted of advancing four soil borings (BH8-1 through BH8-4) to groundwater and constructing five additional monitor wells, EP-103 through EP-108). Soil and groundwater samples collected from the Phase III investigations were used to further evaluate metals distribution with depth and spacial groundwater conditions in IA-8.

To properly delineate the extent of source material, eight additional shallow soil borings, BH8-5 through BH8-12, ranging in depth from 10 feet to 21 feet were installed during Phase III RI.

2.5.8.2 Soil

A total of 284 soil samples were collected during the Phase I and II RI activities. Data collected from these investigations suggests that arsenic and lead were the only metals of concern in this IA and that the impacted area was limited mainly to a depth no greater than 4 ft bgs. Analytical data from these investigations displayed maximum arsenic, cadmium, and lead concentrations of 6,600 mg/kg, 2,600 mg/kg, and 71,000 mg/kg, in a soil samples obtained at shallow depths from SSIA8-22, BH8-4, and SSIA8-43, respectively.

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. During Phase III RI, an additional 44 soil samples were collected from eight soil borings (BH8-5 through BH8-12). IA-8 Phase III RI soil analysis results had trends similar to those observed during the Phase I RI. Laboratory reports obtained from these samples indicated arsenic, cadmium, and lead concentrations ranging from bdl to 15,000 mg/kg, from bdl to 2,200 mg/kg, and from bdl to 51,000 mg/kg, respectively. The highest metal concentration was lead (51,000 mg/kg) and occurred in BH8-11 in a surficial soil sample (0 to one foot).

A summary of IA-8 soil sample results for the three main COCs (arsenic, cadmium and lead) is in Table 2-28. The boundaries of IA-8 and all sampling locations are in Figure 2-28.

2.5.8.3 Groundwater

There are eight monitoring wells in IA-8, which include EP-15, EP-67, EP-103, EP-104, EP-105, EP-106, and EP-107. (Figure 2-28). Groundwater is at a depth of about 60 feet below groundwater surface, and generally flows from east to west.

Groundwater impacts are observed in the southwestern portion of the IA near the Plant Entrance, and near the unloading area of IA-8. The primary groundwater COCs in IA-8 are arsenic and cadmium. The highest concentration of arsenic (0.94 mg/l) is at EP-105.

This well is located adjacent to a storm water collection system. This area was used as a water supply for dust suppression. Water from this basin is a likely source for impacts to groundwater.

The remainder of the IA-8 wells had less than 0.1 mg/l arsenic. It is important to note that elevated soil arsenic concentrations do not correlate directly with groundwater arsenic concentrations. For example, elevated arsenic in soil was observed at BH 8-4, which showed 6,100 mg/kg arsenic in the zero to one foot horizon. The comparatively low arsenic and metals concentrations in groundwater in this area are likely due to finer grained soils than the areas with backfilled arroyos (as in IA-1, IA-2 and IA-3). This combined with a significant unsaturated zone likely limits metals transport. Therefore, IA-8 has a lower potential for metals migration and accumulation in groundwater.

Cadmium is slightly elevated at EP-104 (0.014 mg/l). However, these cadmium concentrations do not appear to persist to downgradient wells which are all bdl for cadmium. Lead was detected at three locations in the TMs analysis. EP-104 showed the highest total lead with a concentration of 0.006 mg/l. The remaining detections were near the detection limit and no sites had detectable concentrations of dissolved lead.

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 will serve to further minimize potential impacts to groundwater and soils. A summary of Phase III RI groundwater quality results (metal analysis) for monitoring wells in IA-8 is presented in Table 2-29.

2.5.8.4 Summary

IA-8 has elevated concentrations of metals in the upper surficial soils to a depth of approximately three to five feet, with arsenic, cadmium and lead being the primary COCs. Although elevated concentrations of metals occur in portions of IA-8 from the surface to a relatively shallow depth (between 3 and 5 feet bgs), the non-affected soils at greater depth to groundwater do not provide evidence of transport of metals between the surface shallow soils and the groundwater. In addition, the underlying groundwater has not been impacted to the extent observed for other IAs having similar soil concentrations, confirming that the IA-8 soils are not a direct source material impacting groundwater.

Based on results and observations discussed in this section, the soils in IA-8 have ultimately been reclassified as Category II materials, because they have not and are not anticipated to impact the groundwater underlying this IA. The limits of Category II soils are shown in Figure 4-6.

Some of the Category II area is currently capped. With the recent completion of the Storm Water Collection and Reuse System and other operational improvements in IA-8, as well as the planned capping, potential sources of metals to impact groundwater have been greatly reduced.

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), as before the additional improvements and capping of the area will eliminate or reduce the potential for COCs in this area to migrate to the groundwater. Specific corrective actions for IA-8 will be discussed in detail in Section 4.0.

2.5.9 Ponds 1, 5 and 6 (IA-9)

Background, soil, groundwater and summary information for the Ponds 1, 5 and 6 is presented in the following sections.

2.5.9.1 Background Information

As discussed in the Phase I RI Report, the Facility has three unlined on-site ponds, referred to as Ponds 1, 5, and 6 (Exhibit 1, Figure 2-29). Historically these ponds were part of Plant operations. The recently constructed Storm Water Collection and Reuse System has eliminated the need for these ponds as water impoundments at the Plant.

Other associated storm water control elements include installation of curbs or berms and paving of selected areas to eliminate area runoff into the ponds.

Previously, Asarco proposed to line and use the depressions from Ponds 1, 5 and 6 to construct on-site containment facilities for Category I material. Upon further consideration of this proposal, Asarco has decided not to use the former ponds as on-site containment facilities for disposal of Category I material. The current proposal for these ponds consists of excavating the pond sediments (classified as Category I material) deposing these material into the on-site disposal cell, and backfilling the resulting excavations with Category III material and/or other suitable structural backfill 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:** Pond is no longer used as a storage basin for municipal water. Pond 5 is 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 dry.

The three ponds were constructed in naturally occurring arroyos that formerly existed at the Plant. 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 previous phase of the 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, EP-80, and EP-

66) and three new monitor wells (EP-77, EP-116 and EP-117) to characterize the Ponds 5 and 6 Arroyo (Figure 2-29).

Pond 5 sediments were sampled and analyzed as part of the Phase II RI. The sediments associated with Ponds 1 and 6 were a subject of the Phase III RI. In addition, three new monitor wells were installed as part of the Phase III RI. These wells (EP-124, EP-130 and EP-131) were installed to further evaluate the hydraulic connection between Ponds 5 and 6, and their related Arroyo as well as address the groundwater investigation for IA-4 and IA-15.

Investigation activities conducted in these ponds during the implementation of Phase I and II of the RIs included the collection of grab samples of sediment from each of the three ponds and the collection of shallow pond sediments from Pond 1 (BH9-5-1 through BH9-5-7).

Historically, all three ponds received storm water enriched with metals that accumulated sediments in the bottom of the ponds. In turn, these sediments became a source material for potential impact of groundwater. This material has been classified as a Category I material and has been considered a main source of metals detected in groundwater at the Facility. Therefore, in order to define the vertical and lateral extent of these pond sediments and support the Remedial Design, additional investigation for IA-9 was performed during Phase III RI.

2.5.9.2 Pond Soil-Sediments

A total of nine sediment samples were obtained from the three ponds and thirty six shallow soil samples were obtained from Pond 5 during the course of the Phase I and Phase II RI, respectively. Laboratory reports of sediments collected from the ponds indicated a maximum arsenic, cadmium and lead concentrations of 5,693 mg/kg, 1,522 mg/kg, and 63,330 mg/kg, respectively (Table 2-30). Information for Pond 5 sediments indicated that the sediment layer varied in thickness from approximately 4 feet at the southern end of the pond, to approximately 11 feet at the northern end of the pond.

Laboratory results of samples obtained from Pond 5 displayed maximum arsenic, cadmium and lead concentrations of 4,000 mg/kg, 1,300 mg/kg, and 31,000 mg/kg, respectively (Table 2-30). Impacted sediments occurred to depth ranging from 1 foot to 6 feet below the sediment surface in Pond 5.

During the Phase III RI, a total of 21 soil borings were installed in Pond 1, while 23 were installed in Pond 6. Four borings for Geotechnical purposes were installed around Pond 5. Borings for former Pond 1 were designated as BH9-1-1 through BH9-1-21 and ranged in depth from 2 feet to 11 feet. Borings for former Pond 6 were designated as BH-9-6-1 through BH9-6-23 and ranged in depth from 1 feet to 8 feet.

Phase III RI results for Pond 1 indicated that the associated sediment layer varied in depth from 4 feet around the perimeter on the bottom of the pond to approximately 8 feet near the center area of the pond. Pond 1 sediment samples had maximum total metal concentrations of 19,000 mg/kg for arsenic, 8,600 mg/kg for cadmium, and 35,000 mg/kg for lead. Impacted sediments occurred to depths that ranged from 1 foot to 8 feet below the sediment surface in Pond 1.

Phase III RI results for Pond 6 indicated that the associated sediment layer varied in depth from 1 foot around the perimeter on the bottom of the pond to approximately 8 feet near the center area of the pond. Pond 6 sediment samples had total maximum metal concentrations of 31,000 mg/kg for arsenic, 16,000 mg/kg for cadmium, and 120,000 mg/kg for lead. Impacted sediments occurred to depths that ranged from 1 foot to 8 feet below the sediment surface in Pond 6.

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 pond sediments are considered Category II materials.

A summary of IA-9 soil and sediment sample results for the three main COCs (arsenic, cadmium and lead) is in Table 2-30. The boundaries of IA-9 and all soil sampling locations are in Figure 2-29.

2.5.9.3 Pond Water

No water samples were collected from Ponds 1, 5, and 6 in Phase III RI activities. The ponds are currently dry and accordingly are no longer a potential significant source for continued impact to groundwater underlying IA-9.

2.5.9.4 Groundwater

There are five monitoring wells in the area of Ponds 5 and 6 that include: EM-5, EM-6 EP-77, EP-88, and EP-124 (Figure 2-29). Monitoring well EP-124 was installed during the Phase III investigation to replace former monitoring well EM-07, which went dry after the process ponds were decommissioned. There area also three monitoring wells in the area of Pond 1: EM-2, EM-4 and EP-12 (Figure 2-29). Depth to groundwater ranges from 17 to 45 feet bgs. Shallow water levels are present in the vicinity of the former ponds. Water levels have declined in this area following closure of the ponds. Water levels dropped 2 to 3 feet in monitoring wells in IA-9 from 2000 to 2001. Ground water flow directions in this area are to the west and appear to closely follow the trend of the Ponds 5 and 6 Arroyo.

Groundwater in the vicinity of Ponds 1, 5 and 6 is impacted with the principal COC being arsenic for Pond 1, and arsenic and lead for Ponds 5 and 6. Arsenic concentrations range from 0.025 mg/l to 10 mg/l with the highest concentrations in the vicinity of Pond 6 (see groundwater concentration map in Figure 2-9). The COCs appear to migrate to groundwater through backfilled arroyos underlying the pond areas. Dissolved arsenic concentrations in excess of 1.0 mg/l are evident following the arroyo trend to the west.

Dissolved lead was detected at monitoring well EP-124 at a concentration of 0.008 mg/l. Dissolved lead was not detected at any other monitoring wells in IA-9, although there were low level total lead detections at most of the locations. Cadmium concentrations were bdl.

Seepage from IA-9 ponds has been eliminated by the decommissioning of the ponds, as well as through recent storm water control improvements implemented at the Plant. A summary of Phase III RI groundwater quality results (metal analysis) for monitoring wells in IA-9 is presented in Table 2-31.

2.5.9.5 Summary

Groundwater associated with IA-9 Ponds 1, 5 and 6 appears to be impacted by metals. The principal COC is arsenic for Pond 1, and arsenic and lead for Ponds 5 and 6. Historically, the COCs migrate to groundwater through backfilled arroyos underlying the pond areas.

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 will require removal and may be reprocessed if the material acceptance criteria are met and/or placed in an engineered and constructed on-site disposal Facility.

The ponds are all currently dry and no longer used for containment of either storm and/or Plant process water. Therefore, these ponds no longer represent a significant potential source of metals to underlying groundwater. However, the reintroduction of water would increase the potential for these ponds to influence and/or promote the mobility of metals associated with the pond sediments. Conversely, the inherently low hydraulic conductivity of the sediments also serves to inhibit downward movement of fluids.

The underlying soils in the area of these ponds are characterized as Class II materials, because the primary source of groundwater impacts, the hydraulic head provided by the former pond water, has been eliminated. These areas will ultimately be capped once the Category I material is removed and the excavations are backfilled using either Category III material and/or other suitable structural fill. Specific corrective actions for IA-9 will be discussed in detail in Section 4.0.

2.5.10 Plant Entrance Area (IA-10)

Background, soil, groundwater and summary information for the Plant Entrance Area is presented in the following sections.

2.5.10.1 Background Information

IA-10 is at the southern boundary of the Facility and includes the vehicle entrance to the Plant, and a storm water drain system consisting of a sump, a lift pump, and an interceptor trench that crosses the Plant entrance road (Exhibit 1, Figure 2-30). As with other Plant IAs, the soils in IA-10 have been altered by historic Plant operations. The area is located above a partially back-filled arroyo.

Storm water control improvements, completed in 1999 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 Plant at this location.

IA-10 was characterized as part of the previous RI phases with two new monitor wells (EP-89 and EP-110) and eight surface soil borings (surface to 5 feet bgs). Because the Storm Water Collection and Reuse project has been completed and the majority of the corrective actions have been implemented, no additional investigations were proposed for IA-10 in the Phase III.

2.5.10.2 Soils

A total of forty-one soil samples were collected from IA-10 during the previous RI Phases (Figure 2-30) from eight surface sample locations (SSENT1 to SSENT8) and from the installation of two monitor wells (EP-89 and EP-110).

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 Plant entrance road alignment and drainage system take advantage of a natural arroyo referred to as the Plant 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. Laboratory results of surface soil samples indicated arsenic and lead concentrations ranging from 11 mg/kg to 750 mg/kg and 25 mg/kg to 5,700 mg/kg, respectively.

The data gathered from both Phase I and Phase II RIs 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.

A summary of IA-10 soil sample results for the three main COCs (arsenic, cadmium and lead) is in Table 2-32. The boundaries of IA-10 and all soil sampling locations are in Figure 2-30.

2.5.10.3 Groundwater

There are two monitoring wells in IA-10: EP-89 and EP-110 (Figure 2-8). Groundwater is at a depth of approximately 10 to 15 feet bgs in IA-10. The groundwater flow direction is from north to south. 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. August 2001 monitoring results show arsenic ranges from 0.012 to 0.013 mg/l, and cadmium and lead bdl. 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, any potential groundwater sources have been controlled. Therefore, IA-10 does not represent a source of COCs to the groundwater. A summary of Phase III RI groundwater quality results (metal analysis) for monitoring wells in IA-10 is presented in Table 2-33.

2.5.10.4 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 the 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 4-1 and shown in Figure 4-8. Most of the Category II area is currently capped as part of recently completed storm water control upgrades. Specific corrective actions will be summarized and discussed in detail in Section 4.0 for IA-10.

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

Background, soil, groundwater and summary information for the Arroyos East of I-10 is presented in the following sections.

2.5.11.1 Background Information

The Arroyos east of I-10 comprise IA-11 (Exhibit 1, Figure 2-31). This area was originally part of IA-2 (Boneyard/Slag Area) during the Phase I RI. This area was formerly used for storage of Plant construction materials and demolition debris. The majority of IA-11 is undisturbed natural area with occasional dirt roads, flood control works including two storm reservoirs or drainage basins, and two dam structures.

The predominant topographic features in IA-11 are two arroyos, which converge with the Plant and underlie other downgradient Plant 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 Plant. The Northern Arroyo has been used historically to store Plant slag, construction materials and demolition debris. Both these areas are no longer used by the Plant for storage or disposal purposes.

The soils in Arroyos East of I-10 are mostly silty sands and gravel. The Southern Arroyo area has been disturbed by past Plant 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).

IA-11 was characterized as part of Phase I and II RIs with nine monitor wells (EP-83, EP-84, EP-87, EP-93, EP-94, EP-95, EP-96, EP-97 and EP-98). Additional soil borings were proposed as part of the Phase III RI to further delineate the characteristics of IA-11 in the depositional area and in the Southern Arroyo area. Results of the Phase III RI are presented in the following sections.

2.5.11.2 Soils

Investigation activities conducted in this IA during the implementation of Phase I and II of the RIs included the installation of twenty-one soil borings (SSIA11-1 to SSIA11-18 and BH 11-2, BH-3, and BH-4) and nine monitoring wells (EP-83, EP-84, EP-87, EP-93, EP-94, EP-95, EP-96, EP-97, and EP-98).

A total of 174 soil samples were obtained during the course of these investigations. Data obtained from sampling activities indicated arsenic, cadmium, and lead are the COCs. Laboratory reports displayed maximum arsenic, cadmium, and lead concentrations of

15,000 mg/kg, 14,000 mg/kg, and 54,000 mg/kg, in soil samples obtained from SSIA11-6 (4 to 5 ft bgs) and EP-93 (4 to 5 ft bgs), respectively.

Although the concentrations observed in the above-mentioned samples substantially exceeded the TNRCC health-based soil air ingestion standards for the industrial commercial worker, the area impacted appeared to be limited in extent, bounded by SSIA11-2, SSIA11-6, SSIA1-7, SSIA11-8, EP-93, and EP-94. Soil data obtained from the majority of the soil borings displayed metal concentrations below regulatory limits.

Results obtained from the Phase I and Phase II RI activities suggested that there was only minor influence from the surface materials on the groundwater in this area. Based on these results, one area in IA-11, associated with the Northern Arroyo was classified as Category II materials. One small area, associated with the Southern Arroyo was classified as Category I material. To properly determine the vertical and horizontal extent of these Category I and Category II materials and to support any RD activity, additional investigation for IA-11 was proposed in the Phase II RI Report.

Investigation of soils in the Southern Arroyo included advancing ten borings designated as BH11-5 through BH11-14, ranging in depth from two feet to four feet bgs. Investigation to better classify and quantify materials in the non-permitted dump area included advancing eleven borings designated as BH11-15 through BH11-26, ranging in depth from 4 feet to 26 feet bgs. Monitor well EP-129 was also installed in support of the groundwater investigation and the background investigation in Phase III activities.

Laboratory reports of these samples indicated a maximum arsenic, cadmium, and lead concentration of 1,300 mg/kg, 440 mg/kg, and 12,000 mg/kg, obtained from boring BH11-15 from the one to two feet interval, respectively.

During the Phase III RI, soil borings in IA-11 were advanced in areas near where Plant materials were deposited. Soil borings BH11-5 through BH11-15 were conducted to further characterize the area surrounding the Phase II monitor well EP-97 in the Southern

Arroyo. Maximum arsenic and lead concentrations of 278 mg/kg and 1,700 mg/kg respectively, were encountered in BH11-8 and BH11-8, respectively. In general, concentrations observed in the Phase III RI followed the trend of the finding in the Phase II RI. Concentrations encountered in the Southern Arroyo are much lower than those encountered in the Northern Arroyo and in other IAs.

Phase III RI soil borings in IA-11 were advanced in the area where Plant materials were historically deposited. Soil borings BH11-16 through BH11-25 were conducted to delineate the vertical and horizontal extents of the historic depositional area located near the Northern Arroyo.

Arsenic and lead are the principal soil COCs in one area of the Northern Arroyo of the IA associated with a historic deposition area. This depositional area received residual discarded debris associated with the Plant. Arsenic, cadmium, and lead concentrations in areas of this deposit area range from bdl to 15,000 mg/kg, bdl to mg/kg and 14,000 mg/kg, bdl to 54,000 mg/kg, respectively.

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 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.

A summary of IA-11 soil sample results for the three main COCs (arsenic, cadmium and lead) is in Table 2-34. The boundaries of IA-11 and all soil sampling locations are in Figure 2-31.

2.5.11.3 Groundwater

IA-11 has nine monitoring wells that include: EP-83, EP-84, EP-93, EP-94, EP-95, EP-96, EP-97, EP-98, EP-129 (Figure 2-31). EP-129 was installed as part of the Phase III investigation as an upgradient well. Depth to groundwater is highly variable ranging from 6 to 60 feet bgs depending on the location of the wells relative to the arroyos.

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 highest arsenic concentrations are at EP-97 with dissolved arsenic of 0.14 mg/l. The remaining sites show lower arsenic concentrations ranging from 0.007 mg/l at EP-126 to 0.044 mg/l at EP-96. Dissolved lead was detected at two locations, EP-97 (0.017 mg/l lead) and EP-84 (0.013 mg/l). No Plant related source material has been identified in this area to account for these trends. There were low-level arsenic increases evident at a number of wells in this IA during 2001 (i.e. EP-83, EP-94, EP-95 and EP-96). These low-level increases may simply reflect normal variability due to low precipitation trends. A summary of Phase III RI groundwater quality results (metal analysis) for monitoring wells in IA-11 is presented in Table 2-35.

2.5.11.4 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 Plant 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 4-9, one area in IA-11 has Category I materials, associated with the debris comprising the northern material deposit area. The limits of the Category I materials have been determined in the Phase III RI activities and the material will be required to be excavated and placed in the on-site disposal cell.

An area in the Southern Arroyo East of I-10 in the vicinity of EP-97 has minor elevations of COCs; major impacts have not been associated with this area. Therefore, the materials in this area are no longer considered Category I materials. This area will remain under continued observation as part of the on-going RI monitoring. The investigation into concentrations of metals in naturally occurring geologic materials in and near the Plant discussed in the Phase II RI Report, has been studied under the new IA-20 to be discussed later in this section. Specific corrective actions for IA-11 will be summarized and discussed in detail in Section 4.0.

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

Background, soil, groundwater and summary information for the Ephemeral Pond and Pond Sediment Storage Area is presented in the following sections.

2.5.12.1 Background Information

The Ephemeral Pond and Pond Sediment Storage Area which comprise IA-12 is west of I-10, and IA-11 (Exhibit 1, Figure 2-32). This area is the site of a slag-crushing/recycling operation (Oglebay Norton Inc., formerly Parker Brothers). Union Pacific and Burlington Northern Santa Fe Railroads 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, but is dry most of the time. In the past, pond sediments were 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 Plant roadway to IA-11.

IA-12 was characterized as part of the previous phases of the RI with six new monitor wells (EP-78, EP-79, EP-82, EP-86, EP-108 and EP-109) and 10 (shallow and deep) soil borings (RIBH1, and BH12-1to BH12-9). Due to the limited information obtained in the previous RI phases, additional soil borings to groundwater and monitor wells were advanced to further characterize IA-12 during the Phase III RI.

The soils and subsurface materials in IA-12 have been locally disturbed by Plant operations. Presently, a layer of slag material ranging from less than 1 foot, to greater than 40 feet thick overlies native soils in the IA-12 area. The slag material largely fills an arroyo that is referred to as the Parker Brothers Arroyo. The slag is being processed (recycled) by a lessee (Oglebay Norton) for sale as industrial abrasive or as railroad ballast.

To properly define the vertical and horizontal extent of Category I materials identified during Phase I and Phase II RIs, 32 additional soil borings were installed during Phase III RI. Results of the Phase III RI are presented in the following sections.

2.5.12.2 Soils

A total of seventy-nine soil samples were collected from ten soil borings and six monitoring wells during Phase I and Phase II RIs. Data obtained from these investigative phases indicated arsenic, cadmium, and lead are the COCs in IA-12. Laboratory reports indicate maximum arsenic, cadmium, and lead concentrations of 4,400 mg/kg, 3,400 mg/kg, and 23,000 mg/kg, respectively, in soil samples obtained from RIBH1 and BH12-4.

Although the concentrations observed in the above-mentioned samples substantially exceeded the TNRCC health-based soil air ingestion standards for the industrial/commercial worker, the areas impacted appeared to be two distinct localized areas. One area is located in the southern portion of IA-12, near EP-109 (Pond Sediment Storage Area) and the area is other located in the north-central section of the area, near RIBH1 (Ephemeral Pond Area).

To properly define the vertical and horizontal extent of Category I materials, eleven borings designated as BH12-10 through BH12-22, ranging in depth from 23 feet to 56 feet bgs, were installed during Phase III RI to investigate the soils beneath the slag pile adjacent to the Ephemeral Pond. In addition, to better quantify Category I material in the Pond Sediment Storage Area, eleven borings designated as BH12-23 through BH12-38, ranging in depth from 6 feet to 18 feet bgs were installed. Three monitor wells, EP-120, EP-121, and EP123 were also constructed as part of the Phase III RI.

A total of 112 soil samples were collected from IA-12 during the Phase III RI (Tables 2-1 and 2-36). Analytical data gathered from these samples confirmed arsenic, cadmium and lead as the COCs in this IA. Concentrations of COCs observed during Phase III RI within IA-12, ranged from bdl to 3,200 mg/kg for arsenic, from bdl to 3,200 mg/kg for cadmium and from bdl to 28,000 mg/kg for lead.

A summary of IA-12 soil sample results for the three main COCs (arsenic, cadmium and lead) is in Table 2-36. The boundaries of IA-12 and all soil sampling locations are in Figure 2-32.

2.5.12.3 Groundwater

There are seven groundwater monitoring wells in this IA that include: EP-78, EP-79, EP-108, EP-109, EP-120, EP-121 and EP-123 (Figure 2-32). EP-120, EP-121 and EP-123 were installed during the Phase III RI to access potential historical point sources in the slag pile area of IA-12. The depth to groundwater in IA-12 ranges from 15 feet to 45 feet bgs. Water levels were lower than normal during the August 2001 monitoring event. The groundwater flow direction in this area is generally from east to west.

Arsenic is the primary COC in groundwater. Although the closed depression that constitutes IA-12 has mostly been dry since the initiation of the RI, metals concentrations in samples of soil and groundwater collected from this area are elevated. The highest concentration of arsenic in groundwater (dissolved arsenic of 3.4 mg/l) is in monitor well EP-78, which is downgradient of the closed depression. EP-108 and EP-123, upgradient of this area, have dissolved arsenic concentrations of 1.2 mg/l and 1.7 mg/l, respectively. Dissolved arsenic in the remaining wells are all less than 1 mg/l with the lowest arsenic concentration (0.020 mg/l) in EP-79 near the western boundary of this IA. Water quality trends graphs show only low level variations in water quality over time in this area. A summary of Phase III RI groundwater quality results (metal analysis) for monitoring wells in IA-12 is in Table 2-37.

2.5.12.4 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.

The Pond Sediment Storage Area in the eastern portion of IA-12 has been identified as containing Category I materials (Figure 4-10). This material is contained in a discrete, bermed, deposition area. However, with the continued observation of this area, no definable groundwater impacts have been associated with this material. For this reason the materials in this portion of IA-12 have been re-characterized as Category II materials in order to be consistent with the criteria. The Pond Sediment Storage Area is designated Category II materials as depicted In Figure 4-10.

The Phase III RI in this area added in one boring (BH12-15) resulting in similar magnitudes of COCs as those encountered in the Phase I RI RIBH1. This represents a localized pocket of material located under approximately forty feet of stored slag. These soils may be an isolated source of metals concentrations encountered in monitor wells EP-108, EP-120, EP-121 and EP-123. However, due to their limited volume and accessibility, this area has been classified as Category II materials. Corrective actions for IA-12 will be summarized and discussed in detail in Section 4.0.

2.5.13 Sample Mill Area (IA-13)

Background, soil, groundwater and summary information for the Sample Mill Area is presented in the following sections.

2.5.13.1 Background Information

The Sample Mill Area is located southwest of the Lead Plant Area (Exhibit 1 and Figure 2-33) 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 previous RI phases utilized one existing monitor well (EP-13) and three new monitor wells (EP-101, EP-102 and EP-117) to evaluate IA-13 as well as a portion of IA-4.

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 for a portion of the area.

As a result of groundwater quality data collected from EP-13 and EP-117 during the previous phases of the RI, additional groundwater investigations were recommended. Additional soil borings were proposed for the Phase III RI for the purpose of determining the vertical and horizontal extent of Category I materials identified in the Phase II RI in this IA. Results of the Phase III RI are presented in the following sections.

2.5.13.2 Soils

During Phase II RI, the soils in this IA were characterized by forty-seven soil samples obtained from three borehole locations two of which were converted to monitor wells (BH13-1, EP-101, and EP-102) (Figure 2-33). Laboratory reports of these samples indicated arsenic, cadmium and lead concentrations ranging from bdl to 8,000 mg/kg, from bdl to 11,000 mg/kg, and from bdl to 42,000 mg/kg, respectively. All samples displaying elevated COC concentrations were obtained from boring EP-102 at shallow depth (zero to five feet bgs). Based on the Phase II RI data, an approximate volume of 7,873 cubic yards of Category I materials was estimated in the IA.

To better quantify Category I materials in the Sample Mill Area, eleven borings designated as BH13-2 through BH11-13, ranging in depth from 11 feet to 26 feet were advanced during Phase III RI. A total of eight soil samples were obtained from these borings. Laboratory reports obtained from samples collected at BH13-13 indicated maximum arsenic, cadmium, and lead concentrations of 1,100 mg/kg, 340 mg/kg, and 13,000 mg/kg, respectively. Samples obtained from the other borings displayed COCs concentrations within the TNRCC health base standards.

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 Plant operations expanded and changed over time. Presently, a layer of soil material approximately 1 foot thick overlies slag to a depth of 19 feet bgs in the southern portion of IA-13. In the northern portion of the IA there is 15 feet of slag underlying 5 feet of soil fill material. The slag was historically used to fill arroyos and built up the Front Slope area.

A summary of IA-13 soil sample results for the three main COCs (arsenic, cadmium and lead) is in Table 2-38. The boundaries of IA-13 and all soil sampling locations are in Figure 2-33.

2.5.13.3 Groundwater

There are six monitoring wells in the vicinity of IA-13: EP-13, EP-14, EP-90, EP-101, EP-102 and EP-103 (Figure 2-33). Groundwater is at depths of 57 feet to 65 feet bgs in this IA. The groundwater flow direction is generally from northeast to southwest in IA-13.

Arsenic and cadmium are the primary groundwater COCs in this IA. EP-102 is an upgradient groundwater monitoring location for this IA and shows arsenic concentrations of 0.3 mg/l entering this area from upgradient sources. The highest arsenic concentrations in groundwater within IA-13 are at well EP-13 (30 mg/l dissolved arsenic). This well is west of a spray tower, which was used to spray ore material for dust suppression and may have been a source for infiltration of water. The small backfilled arroyos beneath IA-13 may serve as a preferential flow conduit for groundwater. Monitoring well EP-118 located in IA-4, downgradient of EP-13 shows comparatively low arsenic concentrations (0.18 mg/l). EP-13 has shown progressive improvements in water quality since 1999.

Cadmium concentrations are also highest at EP-13 (0.47 mg/l dissolved cadmium). Elevated cadmium is present at EP-101 (1.5 mg/l) and EP-102 (0.13 mg/l). Lead was bdl in the dissolved phase at all four monitoring well locations. However, there were several total lead detections with comparatively high concentrations (0.39 mg/l) at EP-14.

Implementation of recent storm water control upgrades within IA-13, which include extensive re-grading and paving (capping) have eliminated or minimized the potential for standing water and additional infiltration of COCs to the groundwater. A summary of Phase III RI groundwater quality results (metal analysis) for monitoring wells in IA-13 is presented in Table 2-39.

2.5.13.4 Summary

The Sample Mill Area (IA-13) soils have been impacted by Plant 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 to groundwater, with arsenic, cadmium and lead being the primary groundwater COCs. Specific corrective actions for IA-13 will be summarized and discussed in detail in Section 4.0.

2.5.14 South Terrace Area (IA-14)

Background, soil, groundwater and summary information for the South Terrace Area is presented in the following sections.

2.5.14.1 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 Plant (Exhibit 1, Figure 2-34), and consists of a flat area that has historically been utilized for the storage of concentrates, silica fluxes, and temporary storage of Plant 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.

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 Plant operations expanded and changed over time. Presently, a layer of soil material overlies lead slag to a depth of 13 feet 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.

During Phase I and Phase II RIs, the subsurface conditions of this IA were characterized by six borings (BH14-1, BH14-2, BH14-3, EP-70, EP-71, and EP-72), three of which were completed as monitoring wells (EP-70, EP-71, and EP-72). To better classify and quantify materials in support of remediation development activities, three additional soil borings designated as BH14-4 through BH14-6, were advanced to 11 feet bgs in Phase III.

2.5.14.2 Soils

A total of ninety-seven soil samples were collected from IA-14 during the Phase I and Phase II RIs from six borehole locations (Figure 2-34). Laboratory reports obtained from the surficial soil sample collected at EP-71R displayed the highest arsenic and lead concentrations (1,300 mg/kg and 7,200 mg/kg, respectively). All other samples had COC concentrations within the TNRCC health based soil/air and ingestion standards for commercial and industrial workers.

Phase III RI activities included further investigation in a discrete area of IA-14 for the purpose of further characterization of the materials. Three soil borings (BH14-4 through BH14-6) with twenty samples were collected in the Phase III RI activities. Laboratory reports of these samples indicated a maximum arsenic and lead concentrations of 670 mg/kg and 3,800 mg/kg, respectively. Lead is the primary soil COC in IA-14. Concentrations of COCs occur primarily within the first 2 feet bgs.

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 with depth, most usually before 3 feet. Graphs of soil sample metal analysis concentration versus depth are presented in Appendix K. 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.

A summary of IA-14 soil sample results for the three main COCs (arsenic, cadmium and lead) is in Table 2-40. The boundaries of IA-14 and all soil sampling locations are in Figure 2-34.

2.5.14.3 Groundwater

Monitoring wells in this IA include EP-70, EP-71, and EP-72 (Figure 2-34). Groundwater in this IA is at a depth of approximately 60 feet bgs. The groundwater flow direction is generally from northeast to southwest.

Elevated concentrations of the COCs in groundwater occur both upgradient and downgradient of IA-14, which suggests that few source materials exist in the soils of IA-14. The underlying groundwater, which occurs in a preferential flow conduit formed by a backfilled arroyo, is impacted by COCs (primarily arsenic). Arsenic concentrations are less than 1.0 mg/l in monitoring wells in this area. Cadmium and lead are bdl. Elevated arsenic concentrations in groundwater, upgradient and downgradient of IA-14 indicate that the primary source materials are upgradient of the South Terrace Area and in the Bedding and Unloading Buildings Area (IA-8). A summary of Phase III RI groundwater quality results (metal analysis) for monitoring wells in IA-14 is presented in Table 2-41.

2.5.14.4 Summary

Recent improvements to the South Terrace Area (IA-14) included the removal of surface soil and excavation of lead and copper slag to create the excavation for the new lined storm water pond for the Plant. 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 Plant 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 of COCs in groundwater, upgradient and downgradient of IA-14, suggests that the source materials are upgradient of the South Terrace Area and in the Bedding and Unloading Buildings Area (IA-8) or some other unknown upgradient source. Although elevated concentrations of metals occur in portions of IA-14 from the surface to a relatively shallow depth between 3 feet and 5 feet bgs, the non-affected soils at greater depth to groundwater do not provide evidence of transport of metals between the surface and the groundwater. Also the underlying groundwater has not been impacted to the extent observed for other IAs having similar soil concentrations confirming that the IA-14 soils are not a direct source material impacting groundwater.

The Phase II RI Report depicted IA-14 (Figure 2-34), as being mostly classified as Category II material, with one minor area described as Category I material. The Phase III RI has characterized the former Category I materials to Category II materials because further investigation has not linked the shallow surface soils as source materials impacting the underlying groundwater in IA-14. Specific corrective actions for IA-14 will be summarized and discussed in detail in Section 4.0.

2.5.15 Former Copper Plant Area (IA-15)

Background, soil, groundwater and summary information for the Former Copper Plant Area is presented in the following sections.

2.5.15.1 Background Information

To remain consistent with the Asarco Report(s) concerning the designation of IAs, the former Copper Plant area has been designated IA-15. This IA was designated pursuant to the Closed Plant Evaluation required in the Agreed Order (TNRCC, 1996). The Former Copper Plant was an inactive area of the Plant. The Former Copper Plant is located south of the 850 feet high Stack, west of the Converter Building and north of the Former Lead Plant (Exhibit 1, Figure 2-35). The Copper Plant includes the Copper Wedge Roaster, the Copper Reverberatory Furnace, and the Copper Brick Flues. All facilities and structures at the Copper Plant, with the exception of the Copper Reverberatory Furnace, have been demolished in compliance with the SEP provisions in the Agreed Order (TNRCC, 1996).

2.5.15.2 Soils

A total of forty-two soil samples were collected from IA-15 during the Phase III RI from sixteen borehole locations (Figure 2-35). A total of fourteen soil/slag borings (BH15-1 through BH15-14) were advanced in this investigation, two of which were advanced to groundwater and completed as monitor wells (EP-130 and EP-131).

The surface soils in the area are characterized as gravelly, silty and clayey fine sands overlain by fill materials that include slag and smelter debris within the Ponds 5 and 6 Arroyo. The soils have been disturbed, reworked, altered and amended during the 100 plus years of operations at the Plant. Topographically low areas were filled in with soils, rock, slag or smelter debris, and re-graded in successive layers as Plant operations expanded and changed over time.

Initial soil investigation results indicated the majority of IA-15 was underlain by slag material or shallow soils overlaying slag material. Most of the borings encountered resistance and were completed in slag. Soil impacted with slag was not sampled. In some portions of the IA, the borings penetrated the slag to the slag/soil interface, and then advanced 5 additional feet. Soil samples were collected from this interval for analysis. A limited number of soil samples were obtained due to the resistance encountered during drilling activities.

The highest COC concentrations occur at BH15-8, at a depth of 1 to 5 feet bgs for arsenic and lead, with levels of 20,000 mg/kg and 3,700 mg/kg, respectively. Elevated metal concentrations occur in the soil cover or cap on the slag at this site. The slag ranged in thickness from 6 feet (BH15-8) to 50 feet (BH15-14). The majority of arsenic, cadmium and lead concentrations in IA-15 are below 50 mg/kg, with higher concentrations restricted to the upper three feet bgs above the slag. Concentrations dramatically decrease in the soils sampled below the slag.

A summary of IA-15 soil sample results for the three main COCs (arsenic, cadmium and lead) is in Table 2-42. The boundaries of IA-15 and all soil sampling locations are in Figure 2-35.

2.5.15.3 Groundwater

IA-15 has four monitoring wells: EP-26, EP-56, EP-130 and EP-131 (Figure 2-35). Depths to groundwater in these wells range from 57 to 66 feet bgs. The groundwater flow direction is to the southwest, following the trend of the underlying Ponds 5 and 6 Arroyo.

Arsenic and cadmium are the primary COCs in IA-15. Arsenic is highest at EP-56 (3 mg/l dissolved arsenic) and decreases downgradient to 1.2 mg/l at EP-131. The source of arsenic is believed to originate from historical seepage from the upgradient unlined process ponds in IA-9. Cadmium is elevated (0.13 mg/l) at EP-26. Total lead is found at EP-130 (0.034 mg/l), and EP-56 (0.038 mg/l), but is absent in the dissolved phase at all of the monitoring wells in this IA. A summary of Phase III RI groundwater quality results (metal analysis) for monitoring wells in IA-15 is presented in Table 2-43.

Remediation of upgradient process pond sources should eliminate the primary source of metals to groundwater within this IA. Drainage improvements and capping of Category II materials are proposed as further corrective action to minimize the potential for leaching of metals from any soils within IA-15.

2.5.15.4 Summary

The surficial soils in IA-15, located above the slag backfill, have been impacted by historical Facility processes. These soils, as result of their location above the slag backfilled Ponds 5 and 6 Arroyo, do not appear to provide source material leading to the impact on the groundwater. Therefore, the surficial soils above the slag backfill are characterized as Category II soils. Recent storm water control improvements have been implemented including the removal of some Category II and Category III materials. Source material contributing to elevated metals concentrations in the groundwater in IA-15 monitor wells has not been identified in this investigation, and appear to be attributable to other upgradient IAs and/or groundwater within the historic arroyos of the Facility. Further investigation may be required to characterize potential sources for the elevated metal found in IA-15 groundwater. Specific corrective actions will be summarized and discussed in detail in Section 4.0 for IA-15.

2.5.16 Former Lead and Sinter Plant Areas (IA-16)

Background, soil, groundwater and summary information for the Former Lead and Sinter Plant Areas is presented in the following sections.

2.5.16.1 Background Information

The Former Lead and Sinter Plants areas have been designated as IA-16. The Former Lead and Sinter Plants are located south of the Copper Plant, west of the former Pond 5, east of the Sample Mill Area and north of the Bedding Building (Exhibit 1, Figure 2-36). The Plant was originally founded as a lead smelter in 1887 and operated continuously up to its closure in 1985. The Sinter Plant, a relatively modern addition to improve the Facility process, began operations in 1979 and ceased operations in 1985 at the same time as the Lead Plant. The facilities and structures associated with the Lead and Sinter

Plants, including the Lead Baghouse and Lead Blast Furnace, have been demolished in accordance with the Agreed Order Supplemental Environmental Project (TNRCC, 1996) requirements.

2.5.16.2 Soils

A total of eighty soil samples were collected from IA-16 during the Phase III RI from forty-four borehole locations (Exhibit 1, Figure 2-36). A total of forty-five soil borings (BH16-1 through BH16-45), ranging in depth from 2 to 62 feet bgs, were advanced in this investigation, with fifteen borings placed in the Former Sinter Plant area and thirty borings located in the Former Lead Plant area.

Similar to conditions in IA-15, the surface soils in the area are characterized as gravelly, silty and clayey fine sands overlain by fill materials that include slag and smelter debris within the Ponds 5 and 6 Arroyo. The soils have been disturbed, reworked, altered and amended during the 100 plus years of operations at the Plant. Topographically low areas were filled in with soils, rock, slag or smelter debris, and re-graded in successive layers as Plant operations expanded and changed over time. Existing concrete/asphaltic paving, building foundations and floor structures are also present in this area providing a cap.

Similar to IA-15, drilling activities in this IA included puncturing rigid concrete paving structures, sampling the shallow soils overlaying slag material and then drilling through the underling slag material to the slag/soil interface and then advancing five additional feet for additional soil sampling. Soil impacted with slag was logged but not sampled.

As with IA-15, the majority of elevated metal concentrations occur in a few localize areas in IA-16, particularly in the vicinity of BH16-19 and BH16-20, occurring to depths ranging from approximately 1 foot to 6 feet bgs. The highest COC concentration was encountered in BH16-20, at a depth of 6 feet bgs with arsenic, cadmium and lead concentrations of 1,700 mg/kg, 530 mg/kg and 11,000 mg/kg, respectively.

Elevated metal concentrations occur in the soil cover or cap of the slag at this site. The slag was found to be up to 61 feet thick (BH16-45) at select points in IA-16. The majority of arsenic, cadmium and lead concentrations in IA-16 are below 100 mg/kg, with higher concentrations restricted to the upper soils above the slag. Concentrations dramatically decrease in the soils sampled below the slag.

A summary of IA-16 soil sample results for the three main COCs (arsenic, cadmium and lead) is in Table 2-44. The boundaries of IA-16 and all soil sampling locations are in Figure 2-36.

2.5.16.3 Groundwater

There is presently one monitoring well, EP-90 in IA-16 (Figure 2-36). Monitoring wells EP-13, EP-101, EP-102, and EP-103 are located south and adjacent to IA-16. Depth to groundwater is approximately 58 feet. Groundwater levels have dropped approximately 1 foot in this area over the last year and this trend appears to be related to decommissioning of the upgradient unlined ponds. Groundwater flow directions from IA-16 are to the west and southwest.

Arsenic, cadmium, and lead are the primary groundwater COCs in this area. Arsenic concentration in August 2001 at EP-90 was 0.14 mg/l, cadmium concentration was 0.01 mg/l and lead concentration was detected at 0.003 mg/l. Cadmium shows a recent increasing trend, which could be due to disturbances during demolition activities. Proposed corrective measures, including drainage improvements and capping of Category II soils should eliminate any potential sources of metals to groundwater in this area. A summary of Phase III RI groundwater quality results (metal analysis) for monitoring wells in IA-16 is presented in Table 2-45.

2.5.16.4 Summary

The surficial soils located above the slag backfill have been impacted by historical Plant processes. These soils, as result of their location above the slag backfilled Ponds 5 and 6 Arroyo, do not appear to provide source material leading to the impact on the groundwater in IA-16. Therefore, the surficial soils above the slag backfill are characterized as Category II materials. Some of the Category II area is currently capped. Impacts to soils beneath the slag materials appear to be nominal and are not the suspected source of impacts to groundwater in IA-16. Source material contributing to elevated metals concentrations in the groundwater in IA-16 monitor wells has not been identified in this investigation, and appear to be attributable to other upgradient IAs and/or groundwater within the historic arroyos of the Facility. Specific corrective actions for IA-16 will be summarized and discussed in detail in Section 4.0.

2.5.17 Former Cadmium and Zinc Plant Areas (IA-17)

Background, soil, groundwater and summary information for the Former Cadmium and Zinc Plant Areas is presented in the following sections.

2.5.17.1 Background Information

The Former Cadmium and Zinc Plants areas have been designated as IA-17. The Former Cadmium and Zinc Plants are located east of the Acid Plant Area (IA-3) (Exhibit 1, Figure 2-37). A Godfrey roaster for cadmium oxide production (Cadmium Plant) was constructed in the 1930s and a blast furnace slag fuming plant (Zinc Plant) was later constructed in 1948. Zinc production continued until the Zinc Plant was shut down in 1982. The Cadmium Plant ceased operations in 1992. The Zinc Plant and Cadmium Baghouse were demolished to foundations in 1998 and 1999, respectively, in compliance with the Agreed Order Supplemental Environmental Project (TNRCC, 1996) requirements.

2.5.17.2 Soil

A total of forty-nine soil samples were collected from IA-17 during the Phase III RI from twenty borehole locations (Figure 2-37). A total of twenty soil borings (BH17-1 through BH17-20), ranging in depth from 6 to 39 feet bgs, were advanced in this investigation, with ten borings placed in the Former Cadmium Plant Area and ten borings located in the Former Zinc Plant Area.

Similar to conditions in IA-16, the surface soils in the area are characterized as gravelly, silty and clayey fine sands overlain by fill materials that include slag and smelter debris within the Acid Plant Arroyo. The soils have been disturbed, reworked, altered and amended during the 100 plus years of operations at the Plant. Topographically low areas were filled in with soils, rock, slag or smelter debris, and re-graded in successive layers as Plant operations expanded and changed over time. Existing building foundations and concrete floor structures are also present in this area providing a cap.

Similar to IA-15 and IA-16, drilling activities in this IA included puncturing rigid concrete paving structures, sampling the shallow soils overlying slag/debris material, drilling through the underlying slag/debris material to the slag/soil interface and then advancing 5 additional feet for additional soil sampling. Soil impacted with slag was logged but not sampled.

Elevated metal concentrations occur in a few localize areas throughout IA-17, particularly in the vicinity of BH17-1, BH17-2, BH17-5 and BH17-8, occurring at depths ranging from 1 foot to 22 feet bgs (below the concrete surface). The highest COC concentration was encountered in BH17-5, at a depth of 17 feet bgs (below the concrete surface) with arsenic, cadmium and lead concentrations of 470 mg/kg, 23 mg/kg and 54 mg/kg, respectively.

Elevated metal concentrations occur in the soil cover or cap of the slag/debris at this IA. The slag/debris can range in thickness up to 33 feet bgs (BH17-12) at selected points in IA-17. The majority of arsenic, cadmium and lead concentrations in IA-17 are below 100 mg/kg, with higher concentrations restricted to the upper soils above the slag. Concentrations dramatically decrease in the soils sampled at depth. The concentrations of COCs observed in IA-17 are in general not as high as those encountered in other IAs. This may be in part, attributable to the existing concrete floor slabs in IA-17 acting as a cap.

A summary of IA-17 soil sample results for the three main COCs (arsenic, cadmium and lead) is in Table 2-46. The boundaries of IA-17 and all soil sampling locations are in Figure 2-37.

2.5.17.3 Groundwater

There are two monitoring wells in IA-17: EP-23 and EP-24 (Figure 2-37). EP-21 and EP-25 are also located within the vicinity of this IA. EP-25 is immediately downgradient in IA-1. Depth to groundwater ranges from approximately 30 to 50 feet. The groundwater flow direction in this IA is to the west near the Acid Plant Arroyo and to the southwest in the vicinity of the Parker Brothers Arroyo.

Arsenic is the primary groundwater COC in this area. Arsenic concentrations are less than 1.0 mg/l in EP-23 and EP-24, but increase in the direction of the Acid Plant to 2.8 mg/l in EP-25. Cadmium is bdl in wells in this area. Dissolved lead is also bdl, but there is total lead at EP-23 (0.02 mg/l) and EP-25 (0.007 mg/l). Proposed drainage improvements and soil capping should effectively reduce or eliminate any existing sources of metals to groundwater in this IA. A summary of Phase III RI groundwater quality results (metal analysis) for monitoring wells in IA-17 is presented in Table 2-47.

2.5.17.4 Summary

The soils located at depth beneath concrete floor structures and above the slag backfilled arroyo have been impacted by historical Facility operations. These soils, as a result of their location above the slag backfilled Acid Arroyo, do not appear to be a source of metals to groundwater in IA-17. Therefore, the soils encountered beneath the concrete floor slabs and above the slag backfill are characterized as Category II materials. The Category II materials in this area are currently capped. Impacts to soils beneath the slag materials appear to be nominal and are not considered a source of metals to groundwater in IA-17.

Source materials contributing to elevated metals concentrations in the groundwater in IA-17 monitor wells has not been identified. Specific corrective actions for IA-17 will be summarized and discussed in detail in Section 4.0.

2.5.18 Former Antimony Plant Area (IA-18)

Background, soil, groundwater and summary information for the Former Antimony Plant Area is presented in the following sections.

2.5.18.1 Background Information

The Former Antimony Plant Area has been designated IA-18. The Former Antimony Plant is located in the central part of the Plant east of IA-8 (Exhibit 1, Figure 2-38). The Antimony Plant was in operation from the late 1970s until it was decommissioned in 1986. It has since been used as the Plant Automotive Shop.

2.5.18.2 Soil

Thirty-five soil samples were collected from IA-18 during the Phase III RI from five borehole locations (BH18-1 through BH18-5) ranging in depth from 5 feet to 6 feet bgs (Figure 2-38).

The majority of the surface in IA-18 is covered with buildings and paved structures which effectively provide a cap. The soils beneath the pavement closest to the surface are characterized as gravelly, silty and clayey fine sands. The soils have been disturbed, reworked, altered and amended during the 100 plus years of operations at the Plant. Topographically, low areas were filled in with soils, rock, slag or smelter debris, and re-graded in successive layers as Plant operations expanded and changed over time.

Currently, buildings and paved structures are present in this area, and are providing a cap. The soils beneath the paved sections did not reflect the visual degree of impact characteristic of other IAs at this Facility. Slag impacted soils were not observed in the soil borings associated with IA-18.

The concentrations of COCs observed in IA-18 in general are not as elevated as those encountered in other IAs. COCs were detected in the borings associated with IA-18. Arsenic concentrations ranged from 22 mg/kg to 260 mg/kg, cadmium ranged from bdl to 26 mg/kg, and lead ranged form 24 mg/kg to 610 mg/kg. The highest COC concentration was encountered in BH18-5, at a depth of 1 foot bgs (below the asphaltic pavement) with total arsenic of 260 mg/kg and BH18-1 at a depth of 1 foot bgs (below the asphaltic pavement) with a total lead 610 mg/kg.

Overall, elevated concentrations of metals were not prevalent in soil borings in IA-18. This may be attributable to the current building and paved structures in IA-18 acting as a cap. A cumulative summary of IA-18 soil sample results for the three main COCs (Arsenic, Cadmium and Lead) is presented in Table 2-48. The boundaries of IA-18 and all soil sampling locations are presented in Figure 2-38.

2.5.18.3 Groundwater

There are four monitoring wells in IA-18 that include: EM-01, EP-68, EP-106 and EP-124 (Figure 2-38). EM-07 was an active monitoring well in this IA until closure of Ponds 5 and 6. EP-124 was installed during the Phase III RI as a replacement well for EM-07. Depth to groundwater in this area ranges from 35 feet bgs near Pond 6 to approximately 65 feet bgs on the southern side of the IA. The groundwater flow direction is primarily to the southwest. Groundwater levels on the northern portion of this area show a declining trend consistent with the decommissioning of Ponds 5 and 6.

Arsenic, cadmium and lead are COCs in this area. The highest arsenic concentrations (10 mg/l) are found at EP-24 adjacent to the former Pond 6 location. Downgradient portions of IA-8 show significantly reduced arsenic concentrations (0.05 mg/l to 0.005 mg/l arsenic). Cadmium is present at EP-106 at 0.073 mg/l. Lead was detected at EP-124 at 0.008 mg/l. The primary source of metals to groundwater in this area is believed to be the former Ponds 5 and 6. Closure and reclamation of the ponds should eliminate this source of metals to groundwater. A summary of Phase III RI groundwater quality results (metal analysis) for monitoring wells in IA-18 is presented in Table 2-49.

2.5.18.4 Summary

Results of the investigation of the former Antimony Plant area indicate that there are no adverse impacts to soil or groundwater in IA-18. Therefore, no specific corrective actions are required for this area.

2.5.19 La Calavera Area (IA-19)

Background, soil, groundwater and summary information for the La Calavera Area is presented in the following sections.

2.5.19.1 Background Information

The need to address other off-Plant areas, particularly the area surrounding the La Calavera residential community (La Calavera) located east of the Plant, was not recognized in the Agreed Order, previous work plans or reports developed by Asarco and approved by the TNRCC. This area was added to the RI during Phase III as the result of concern expressed by the EPA, and the need to collect background samples in the area around the Facility.

The area surrounding La Calavera, has been identified as IA-19 (Exhibit 1, Figure 2-39). This IA consists of undeveloped land with the exception of the historic Asarco Cemetery. It is located adjacent to the residential community and access is not limited, as there are no barriers. The La Calavera community is in a low-lying ravine, and could be potentially impacted by COCs transported in windblown dust.

IA-19 is adjacent to IA-12 (a slag storage area for Oglebay-Norton Materials, Inc.). Asarco provides access to the slag storage area to Oglebay-Norton under a lease agreement. Oglebay-Norton mines and processes slag from Asarco and sells the slag products for commercial/retail use. Dust is often generated during the operations. Slag or slag dust may affect soil concentrations in areas nearest their operations.

In June and July 2001 Hydrometrics collected soil samples on Asarco property surrounding La Calavera. Additional investigations in this area occurred as early as August of 2000 in a precursory attempt to develop baseline (background) information for areas not anticipated to be affected by Plant operations (Figures 2-39, 2-40a and 2-40b).

This sampling program was part of one of the two extensive soil sampling efforts the EPA conducted in El Paso County and New Mexico during July and August of 2001. During the first sampling effort, approximately 400 soil samples were collected. Based on the results of this sampling effort, approximately 457 additional soil samples were collected from selected locations during the second EPA sampling effort. One of the locations included the La Calavera Residential Community. Thirty-four surficial soil samples were obtained from this residential community.

The EPA provided Asarco the results obtained from these soil samples. The information provided by the EPA indicates that all samples were tested for arsenic and lead. The results indicated arsenic concentrations ranging from 33 mg/kg to 850 mg/kg. The lead concentrations ranged from 4.4 mg/kg to 64 mg/kg. A copy of these soil sample results and a map that shows sample locations is in Appendix O.

IA-19 was not part of the activities proposed in Phase II RI Report. This information has been collected, however, in support of developing project specific background concentrations for the RI. These samples are located in close proximity to the existing La Calavera Community. The investigation of soils in IA-19 included sampling surface soils and/or rock outcrops at eight locations designated as BL2, BL25 through BL30, and BL51.

2.5.19.2 Soil

A total of forty-one soil samples were collected by Hydrometrics from IA-19 during the Phase III RI (Tables 2-1 and 2-50) from eight borehole locations (Figure 2-39). One soil boring (BL2) and seven shallow soil borings (BL25 through BL30, and BL51) were advanced in this IA.

The concentrations of COCs observed in IA-19 are in general not as elevated as those encountered in other IAs. Project COCs occurred in the borings associated with IA-19. Laboratory results from the four boring and two surficial (0 to 2 inches) soil samples collected from BL2 and BL51, respectively displayed the highest COC concentrations. All other soil samples displayed COC concentrations within the TNRCC soil/air and ingestion standards for industrial use. The highest arsenic, cadmium, and lead concentrations detected were 310 mg/kg, 42 mg/kg, and 1,690 mg/kg, respectively.

A summary of soil IA-19 sample results for the three main COCs (arsenic, cadmium and lead) is in Table 2-50. The boundaries of IA-19 and all soil sampling locations are in Figure 2-39.

A cursory review of EPA soil sample results indicates that lower concentrations of arsenic and lead occur in La Calavera, indicating lesser effects from nearby Oglebay-Norton operations. Arsenic concentrations range from 15 mg/kg to 62 mg/kg, and lead concentrations range from 110 mg/kg to 850 mg/kg.

2.5.19.3 Groundwater

Groundwater samples representative of IA-19 were collected from Phase I RI monitor well EP-86 (Figure 2-39). This well is upgradient from La Calavera residences.

Most recent results from IA-19 monitor wells indicate total arsenic concentrations of 0.011 mg/l, total cadmium concentrations of bdl, and total lead concentration of bdl. No elevated metal concentrations were observed in the groundwater for IA-19. Groundwater flows from east to west across this area, and occurs at a depth of approximately 50 feet bgs. A summary of Phase III RI groundwater quality results (metal analysis) for monitoring wells in the vicinity of IA-19 is presented in Table 2-51.

2.5.19.4 Summary

IA-19 investigation results indicate there are no significant impacts to soil or groundwater compared to the TNRCC commercial/industrial health-based criteria applicable to the Facility. Residential soil samples were not collected by Asarco. However, residential samples were recently collected by the EPA, with a report forth coming.

Metals concentrations vary significantly across IA-19. It is premature to evaluate corrective action objectives in advance of the EPA review and interpretation of residential data. Accordingly, corrective actions, if needed, will be proposed later and incorporated into the broader corrective action plan.

2.5.20 Other Asarco Property, East of I-10 (IA-20)

Background, soil, groundwater and summary information for the Other Asarco Property, East of I-10 is presented in the following sections.

2.5.20.1 Background Information

IA-20 encompasses the full extent of property owned by Asarco, east and adjacent to the Plant (Exhibit 1, Figures 2-40a and 2-40b). There are no known present or historic smelter related activities in this area. Access to this area is presently not restricted by fencing. This area is considered off-Plant.

The need to address other off-Plant areas, primarily to the east of the Plant, was not recognized in the previous RIs. This IA is designated for off-Plant investigations to identify and delineate potential impacts associated with operations of the Plant, wherever they may occur. Some areas within this IA may also be considered "background" areas.

In June and July 2001 Asarco collected off-Plant/on-Facility samples east of I-10 which is located on both the south and north side of IA-11. Additional investigations of off-Plant locations occurred as early as August of 2000 in a precursory attempt to develop baseline (background) information of areas not impacted by Plant activities. These samples were collected on off-Plant Asarco properties.

2.5.20.2 Soil

During Phase II and Phase III RI, the investigations in IA-20 included the collection of thirty-four subsurface soil samples from four borehole (BL1, BL3 to BL5) and the collection of twenty-nine surficial soil and bedrock samples (BL17 to BL24, BL33 to BL50, and BL52) (Figures 2-40a and 2-40b).

Soils are silty to gravelly sands and sandy gravel, with light to moderate desert vegetation with intrusive igneous rock formations extending near or above the ground surface.

The purpose of this investigation was to determine COC background concentrations in naturally occurring media. Consistent with the requirements of the Texas Risk Reduction Rules and as indicated in the document entitled "Consistency Memorandum for the Implementation of the Existing Risk Reduction Rule VI.3 (background determinations) of the July 23, 1998, TNRCC Interoffice Memorandum", the sampling locations for the determination of background concentrations were selected because they were considered as not been impacted by Plant activities. Most of these locations are the farthest from Plant activities.

A total of thirty-three surficial soil samples (0 to 4 feet bgs) were obtained from sample locations BL3 to BL5, BL17 to BL24, BL30 to BL50, and BL52. Soil analysis results indicated arsenic, cadmium, and lead concentrations range from bdl to 235 mg/kg, from bdl to 47 mg/kg, and from 13 mg/kg to 1,180 mg/kg, respectively.

Thirty-four subsurface soil samples obtained from different depths (from 5 feet to 26 feet bgs) were obtained from BL1, BL3 to BL5. Laboratory reports of these samples indicated arsenic and lead concentrations ranging from bdl to 180 mg/kg, and from 14 mg/kg to 1,200 mg/kg, respectively. The concentrations of COCs observed in IA-20 are in general not as elevated as those encountered in other IAs.

A summary of IA-20 soil sample results for the three main COCs (arsenic, cadmium and lead) is in Table 2-52. The boundaries of IA-20 and all soil sampling locations are in Figures 2-40a and 2-40b.

2.5.20.3 Groundwater

No monitor wells were installed in the area represented by IA-20. Therefore, no groundwater analysis for IA-20 is available as part of the Phase III RI. The results of the soil investigation and future project developments may promulgate the need for groundwater monitoring. Based on information from adjacent areas, groundwater is considered to flow from east to west across this area, and occurs at depths ranging from approximately 50 to 65 feet bgs. Based on the results of the soil sampling effort, and no evidence of historic Plant operations in these areas, no groundwater impacts related to the Facility are anticipated.

2.5.20.4 Summary

IA-20 was added to the RI as part of the Phase III RI. Some areas of elevated concentrations of COC exist. Most of IA-20 areas are near what may be considered background conditions. The EPA collected surface soil samples from residential and commercial areas located north, east and south of IA-20 (further from the Plant). A cursory review of the EPA results indicates that arsenic and lead concentrations throughout much of the area are within the range of background concentrations, particularly for an urban area.

Background concentrations in urban areas are expected to be somewhat higher due to multiple anthropogenic sources of lead and arsenic in an urban environment. Concentrations of lead and arsenic in these undisturbed sample areas are considered reflective of native background concentrations for the Plant.

2.5.21 Relation of COCs in Groundwater to COCs in Soils and Plant Processes

Based on the results of the Phase I, Phase II and Phase III RIs, the primary sources of metals to groundwater on this Site are:

- Historical releases of process waters from on-Site ponds or Plant operations.
- Exposure of leachable materials such as Acid Plant sludges to storm water or other sources of infiltration.
- Infiltration of water and subsequent leaching of soils with high residual metals in areas where there has been accumulation of storm water runoff, excess application of dust suppression water, or overspray from other Plant operations. Leaching rates in these areas are sufficiently high to overcome the attenuation capacity of the soils.

The extent of metals migration in the groundwater system has been limited beneath many portions of the Plant. Metals persist in groundwater down gradient of the Plant only in those areas where the arroyos have concentrated loads along preferential flow paths or where source areas are present at the immediate Plant boundary.

2.5.22 Prediction of Future Behavior of COCs in Groundwater

The concentrations of COCs in many of the primary source areas have shown major improvements in the last three years in response to implementation of a range of corrective measures at the Plant. In the areas with the poorest water quality, the Acid Plant Area, area northwest of the Acid Bulk Storage Tanks, and other locations, arsenic concentrations have declined by greater than 50 percent in the last three years (i.e. EP-49, EP-53, EP-49 and EP-75). Water levels on portions of the Plant have also declined significantly in the last three years, particularly in the former process pond areas indicating that a very large component of Plant seepage infiltration has been eliminated.

There is typically a delay period between the time when corrective measures are implemented and when water quality improvements are actually observed. Disturbances during implementation can actually result in temporary decreases in water quality as is indicated in some areas at the Plant. Water quality improvements tend to be gradual due to both slow groundwater travel times and the effects of residual metals loads in the groundwater system.

Metals mobility in soils with a high attenuation capacity is balanced between the adsorption rates versus loading rates. As metals loads decrease, the residual metals in the groundwater system are more likely to be contained within a limited distance. Data for this Plant clearly show that more extensive transport of metals has only been observed in areas where there has been progressive loading of metals to the groundwater system over a sustained period. The high attenuation capacity of the soils for metals at this Site is attested to by the limited extent of metals in groundwater despite a long history of operations at the Plant.

Quantitative predictions of arsenic transport are very difficult to make due to the complexity of arsenic geochemistry and the difficulty of accurately characterizing historical sources and residual arsenic loads in the subsurface soils. The groundwater modeling analysis in the Phase I RI attempted to assess generalized transport relationships based on the observed distribution of arsenic in the shallow groundwater system. The conclusions from this modeling effort were that on-site soils have a high attenuation (retardation) capacity that strongly inhibits arsenic transport to downgradient areas.

The corrective action measures identified in Section 4.0 include excavation of Category I materials. As stated above, the primary source of metals to groundwater is through leaching through Category I materials from process water, storm water and the decommissioned on-Site ponds. Because of the phased approach used in implementing corrective actions at this Facility, and the substantial amount of engineering discharge controls currently in place, it is possible that Category I materials could be changed to Category II materials. This would occur if monitoring data indicates Category I materials in selected areas are not contributing to groundwater impacts.

2.5.23 Former Process Ponds and Shallow Aquifer Interaction

Three former ponds (Ponds 1, 5 and 6) are located at the Plant. Historically, the water in Pond 6 was used primarily for general supply, storm water collection, and anode cooling and fire water supply. Pond 5 was used for boiler feed backup and some storm water collection. Storm water collection was the primary function of Pond 1. Since the water in the ponds had historically exhibited elevated COC concentrations, there was a concern that water from these ponds could have impacted the groundwater of the underlying aquifer. Therefore, a comparison of the water and groundwater chemistries was undertaken.

2.5.23.1 Groundwater Chemical Comparison (Pond 1 Arroyo)

Pond 1 is constructed from a dammed arroyo located on the western property boundary and on the northern edge of the South Terrace Area. The water in the pond was from the Rio Grande and was utilized for general Plant water supply. During Phase I RI, the water quality obtained from water samples at this pond was compared to water chemistry obtained from monitoring wells installed within the vicinity of the Pond (EM-2, EM-4, EP-12, EP-13, EP-14, EP-15, EP-29 and EP-43).

Information collected from water samples was plotted on a Piper diagram for comparison purposes (Figure 2-19 of the October of 1998 Hydrometrics Phase I RI). Results obtained from this comparison indicated that the water collected from Pond 1, and groundwater collected from wells in the area, are chemically similar. The water results for Pond 1 plot just outside the monitor well data. This water chemistry difference was attributed to evaporation of pond water, which causes increased pH, salinity (i.e., increased potassium and sodium concentrations) and generally increased concentrations of common ions.

The pond geochemistry also had been affected by the addition of water that had accumulated in the area of the Bedding and Unloading Plant due to excessive dust suppression and rainfall. Pond 1, which currently is dry, was decommissioned between 1998 and 2000.

2.5.23.2 Groundwater Chemical Comparison (Ponds 5 and 6 Arroyo)

Water samples from Ponds 5 and 6, and from monitor wells EM-5, EM-6, EP-26, EP-56 and EP-77, were plotted on the same Piper diagram to compare geochemistries (Figure 2-

18 of the October 1998 Hydrometrics Phase I RI). All samples plotted similarly, suggesting a common water source. The ponds are located at the head of an arroyo drainage at the Plant. As with most arroyos on the Plant, this one has been dammed twice to construct the ponds, and was historically backfilled with Facility debris and slag.

SECTION 3.0

REVISED BASELINE RISK ASSESSMENT AND CORRECTIVE ACTION

3.0 REVISED BASELINE RISK ASSESSMENT AND CORRECTIVE ACTION OBJECTIVES

The objective of this section is to establish corrective action objectives based on an understanding of Site risks and regulatory requirements. Asarco is pursuing Closure/Remediation for this Facility with controls per 30 Texas Administrative Code (TAC) 335.561. These regulations require that the proposed corrective actions achieve the following:

- "A remedy must be permanent cleanup or, if that is not practicable, achieve the highest degree of long-term effectiveness possible.
- A remedy must be cost-effective in that it achieves the best balance between long-term effectiveness and cost for alternative remedies, which meet the cleanup objectives for a Facility.
- A remedy must achieve cleanup requirements as specified pursuant to TAC 335.563 (relating to Media Cleanup Requirements for Risk Reduction Standard Number 3)." The Media Cleanup Requirements establish a methodology and standards for evaluating site risk and determining risk-based cleanup levels.

A risk-based approach is being implemented, pursuant to TAC 335.553(b), to best meet these corrective action requirements. This section of the Report summarizes what is known regarding on-Facility risk (in accordance with TAC 335.553(b)(2)), and establishes site-specific corrective action objectives.

3.1 ON-SITE BASELINE RISK

This section summarizes what is known regarding on-Facility Baseline Risk Assessment (BLRA), and represents a revised BLRA. The information provided in this revised BLRA addresses various comments submitted by the TNRCC. Specific comment responses are included in Appendix A of this submittal. The on-Site area includes all areas actively used for smelter related activities, either presently or historically. A BLRA was completed as part of the Phase I RI Report (Hydrometrics, 1998) that addressed all on-Site areas.

Subsequently, two more phases of the RI have been implemented, culminating in this Phase III RI Report. These investigations focused on further understanding specific areas of more elevated metals concentrations in soil and groundwater, primarily in support of RD needs.

During the time interval, the TNRCC commented on the BLRA, Hydrometrics responded to the comments, the TNRCC further commented on Hydrometrics' response, and Hydrometrics provided a second response. These comments and responses are included in Appendix A. This process resulted in a common understanding of the Site risks, applicable standards and additional investigation needs. New Site investigation data and agency comments on the initial BLRA are incorporated into this assessment. Additional investigation needs are associated with the off-Plant investigation and are addressed in Section 3.3.

This revised BLRA summarizes the exposure pathways of concern and baseline risk issues (risks in the absence or any planned remedial controls). The intent is to present a framework for understanding risk issues based on knowledge gained throughout the Site investigation. A complete revision of the BLRA is not considered necessary to properly support the corrective action objectives. Data collections during the Phase II and Phase III RIs have not substantially altered fundamental risk issues controlling corrective action objectives. Quantitative evaluations of contaminant distributions and related matters are presented in Section 2.0 of this Report.

3.1.1 On-Site Exposure Assessment

This exposure assessment describes how COCs are released into the environment, how they are transported through the environment, and how they may contact an individual.

3.1.1.1 Exposure Setting

An understanding of the environmental setting and land use is necessary to properly understand chemical fate and transport, and potential exposure conditions. The relevant factors affecting exposure are as follows:

- The site has been used by several smelters and refineries since 1889.
- On-Site soils and process pond sediments are known to contain elevated metals concentrations.
- Land use proximal to the site is mixed industrial, commercial and residential.
- No appreciable terrestrial wildlife or high-quality terrestrial habitat is located within the project site.
- The Rio Grande borders the Site to the west and south. The TNRCC designated water uses are Domestic Water Supply, Non-Contact Recreation and Limited Aquatic Life. Flow is dam controlled, with higher flows released during the summer months (April to September).
- The American Canal, which also borders the Site to the west and south, is a concrete lined channel that receives flow from the Rio Grande during the summer months (April to September). This water is ultimately used for irrigation and as a supply to a domestic water supply system.
- The climate is hot and dry, with precipitation usually received as intense, short bursts.
- Northwesterly winds (along the path of the Rio Grande) predominate in the winter months (November to May), while southwesterly winds predominate in the summer months (June to October).
- Soils in the Facility area are a mix of colluvial and fluvial sediments, with areas of extensive fill by slag and other materials.
- Depth to groundwater ranges from 60 feet bgs in upgradient areas to 10 feet bgs along the Rio Grande floodplain. The shallow groundwater system beneath the

site is composed primarily of interbedded and mixed silt, sand, gravels, boulders and bedrock. Within the Rio Grande flood plain, the Rio Grande aquifer is composed primarily of fine sand and clayey sand. Groundwater flow is generally from the east-northeast toward the Rio Grande.

3.1.1.2 Exposure Pathways

From the above summary points, a conceptual model of contaminant fate and transport is provided as Figure 3-1, Baseline Exposure Pathway Flow Chart. A complete exposure pathway requires all of the following:

- **A Source of Contamination:** in this case air emissions, metal bearing materials and process fluids.
- **A Transport Mechanism for Chemical Release and Migration from the Source:** in this case storm water flow, groundwater transport and wind dispersion.
- **Contact with a Receptor and Intake:** in this case on-site workers, off-Site workers, off-Site residents and aquatic life.
- **A Mechanism for Chemical Intake into the Body:** most important for this site is inhalation and incidental soil ingestion.

Each of these exposure pathway requirements is discussed in more detail below.

Sources of Contamination

For the Facility, RIs have established that metals have been released on-Facility from various historical and contemporary smelter operations. The ores and concentrates used for smelting contain various trace metals. The act of storing, crushing, transporting, smelting and by-product treatment and disposal (e.g. stack emissions, acid generation and slag disposal or recycling) each contribute to the present condition of elevated metals in surface soils. Extensive Site regrading, excavating and numerous redevelopments have contributed to the dispersion of metals in the surface and subsurface.

Transport Mechanisms

Once released, metals may be transported by wind, storm water flow and subsurface flow mechanisms. At this Site there are the following primary transport mechanisms:

- Elevated metals concentrations in surface soils may be transported by storm water runoff to other areas of the Facility where the water accumulates. These pools of water may then percolate through soils to groundwater, carrying the metals with them.
- Release of process fluids can contribute to surface water runoff and groundwater infiltration transport mechanisms for metals. In particular, difficult to control leaks and spills of sulfuric acid solutions, generated as part of efforts to remove sulfur dioxide from stack emissions, has likely increased subsurface transport of metals in certain areas where these leaks and spills historically occurred.
- Metals in groundwater may be transported downgradient toward the Rio Grande. Factors affecting groundwater transport rates include: groundwater flow rates, the degree to which particular contaminants adsorb to soils, the soil adsorbing and absorbing qualities, and certain groundwater quality factors related to contaminant solubility. For example, at this Site there is a strong relationship between areas of known release of acid and arsenic levels in groundwater. The acidic conditions increase arsenic solubility and reduce soil sorption processes. As groundwater flow transports the acid and arsenic downgradient, the acid is consumed by the highly buffered characteristics of the native soil. As more neutral conditions are regained, arsenic mobility is reduced.
- Under dry and dusty conditions, metals adhering to soils may be dispersed into the air and transported by the wind.

Receptor Contact and Intake

The potential sources of contaminant release, history of Facility operations, and types of transport processes evident at the Site have resulted in increased metals concentrations in the surface soils, subsurface soils, and groundwater. Much smaller impacts have occurred in air and surface water. In the absence of corrective actions, on-Site workers, off-Site workers, off-Site residents and off-Site aquatic life in the Rio Grande may, depending on the actual exposure condition of a particular individual, be exposed to metals at unacceptable levels.

There are two principal mechanisms for intake of metals into the human body at this Site. Surface soils containing metals may adhere to hands, which are then ingested incidentally through inadvertent hand-to-mouth activity. Additionally, windblown dusts containing metals may be inhaled.

Although RIs conducted to date do not indicate this is happening, human and aquatic life may be exposed to contaminants that are released from groundwater to the Rio Grande. The designated uses for the Rio Grande below the American Dam are Domestic Water Supply, Non-Contact Recreation and Limited Aquatic Life. Any exposure from this pathway is expected to be minimal due to much smaller groundwater flow rates relative to surface water flow rates. No significant increase in surface water contaminant concentrations have been measured in the Rio Grande as it flows past the Site (Section 2.4).

3.1.2 Risk Characterization

This section characterizes risk at the Site by integrating the Exposure Assessment with the information known about contaminant toxicity. For this project, this is achieved simply by comparing media concentrations at various points of exposure (e.g. on-Site surface soil) with protective risk-based standards.

3.1.2.1 Comparison of Site Concentrations to Applicable Standards

The Phase I RI BLRA summarized soil, groundwater and surface water concentrations for each IA and compared them to the published TNRCC guidelines. These risk-based values for the various media (surface soil, groundwater, etc.), (updated to reflect the most recent regulatory requirements and Agency comments on the BLRA), are presented in

Table 3-1. Consistent with the TNRCC regulations [30 TAC 335.563], the bases for the risk-based regulatory standards are:

- **Soils:** The risk levels of concern, for now are based on default TNRCC assumptions regarding incidental ingestion of surface soil at a risk level of one in 1,000,000 (1×10^{-6}). Different exposure assumptions are used for residential versus commercial/industrial exposure scenarios. As our understanding of background concentrations at the Facility increases, we may incorporate different assumptions.
- **Groundwater:** MCLs established under the Safe Drinking Water Act are used as the standard. MCLs are used to regulate the nations drinking water supply. They consider health risks, treatment technology limitations and treatment costs versus health benefits. It is noted, however, that the shallow groundwater down gradient of the Facility is not used for human consumption, and is not classified as such.
- **Surface Water:** Surface water may be used for public water supply, consumption of aquatic life and limited aquatic life habitat. The human health standards were developed by the EPA assuming a certain quantity of water ingestion and ingestion of aquatic life obtained from the affected water body. The aquatic life values reflect levels deemed protective of aquatic organisms over long periods of exposure.

The results of the RI and the BLRA indicate that there are elevated concentrations of metals in soil and groundwater exceeding baseline risk-based levels of concern throughout much of the Facility. A summary of the surface soil concentrations (top three feet) for each IA is provided in Appendix N. A review of the summary tables indicates that each IA has sample results exceeding risk-based levels of concern. Similarly, a review of groundwater data (Section 2.3) indicates groundwater levels exceed MCLs in many areas underlying the Site.

TNRCC regulations and Chapter 26.121 of the TWC prohibit the imminent threat of industrial waste discharge without authorization, and prohibit the endangerment of public health and welfare [30 TAC 335.4]. Remediation resulting from an unauthorized discharge must meet the closure requirements of 30 TAC 335.8. Therefore, corrective measures addressing soil and groundwater contaminant levels, and mechanisms for transport of contaminants in soil and groundwater, are required.

3.1.2.2 Existing Controls to Minimize Exposure and Risk

Risk levels for exposed individuals are dependent upon the degree to which actual exposure compares to exposure assumptions used to develop the risk-based regulatory values. For example, subsurface soils do not present a risk for incidental ingestion unless they are excavated and brought to the surface where exposure can occur. Also, impacted groundwater does not present a risk unless it is used as a source of drinking water, or is transported off-Site at concentrations of concern to other waters used for drinking water.

Asarco has recognized that environmental conditions associated with operating a smelter require certain exposure controls. The following controls have already been implemented that minimize exposure:

- **An OSHA worker health and safety programs:** is used to ensure workers are not exposed to metals in soil and air at unacceptable levels.
- **Regulatory Compliance:** Ambient air concentrations are measured to ensure compliance with State and federal ambient air quality requirements. These standards are achieved through a combination of stack treatment and site watering to control dust levels.
- **Groundwater Use:** The shallow aquifer is not used nor planned to be used for drinking water supply. The shallow aquifer is considered brackish (unrelated to Facility operations), with TDS concentrations ranging from 3,000mg/l to 10,000 mg/l. This has prompted the TNRCC to regulate associated groundwater use. A water and monitoring well survey conducted for the Site (submitted with the

Phase I RI Report) indicates there are no groundwater supply wells within the affected area. The site borders the Rio Grande, precluding any downgradient groundwater users (the intervening highway right of way and railroad property are not potential groundwater sources).

- **Storm Water Control:** A multi-million dollar storm water management system was installed to eliminate storm water runoff from the Site and to bypass up gradient storm water run-on.

Because of these existing controls and conditions, there is no known imminent endangerment of human health or aquatic life associated with present smelter operations, despite impacts to soil and groundwater quality. The planned reconstruction of the American Canal is also a significant development that will further minimize future exposure. The IBWC has initiated plans to replace the American Canal open channel with an enclosed pipe (primarily to prevent water loss). Although no significant metal concentrations have been found in the canal to date, this reconstruction is expected to virtually eliminate the potential for impacts on this canal water by the Facility. As indicated in the various RI Reports, no significant impacts to the canal from the Facility have been observed to date, primarily because of the canal concrete liner, and the lower depth of groundwater under the canal invert in the area of concern.

3.1.2.3 Additional Controls

Despite existing protections, additional measures are necessary to ensure continued protectiveness for all potential exposure pathways, and to achieve Site closure in accordance with 30 TAC 335.8. Site closure must address soil and groundwater, as follows:

Soils

Corrective measures must ensure that contaminants in soils do not contact existing or future potential site users. This can be achieved by removal of the contaminated soils or by controlling exposure.

Groundwater

Corrective measures must control the migration of contaminants from soils to groundwater and then to the Rio Grande. Groundwater concentrations must be reduced to meet standards or deed restrictions must be implemented to prevent exposure. Additionally, contaminants in groundwater can not discharge to the Rio Grande at concentrations that degrade designated beneficial uses or exceed applicable stream standards.

The RI has identified several areas of notably higher groundwater COC concentrations, most notably for arsenic. These areas are well correlated with areas of known process fluid releases of water or sulfuric acid. These source areas of arsenic and other metals are responsible for a substantial loading of metals to the groundwater system. Eliminating the release of process fluids, further controlling storm water or removing impacted soils associated with these source areas, as appropriate to specific areas, will reduce the groundwater contamination and thereby the potential for release of arsenic and other metals to the Rio Grande. Technical explanations and support for these hydrogeological concepts are presented in Section 2.0 of this Report.

The basis for measuring concentrations of metals in groundwater, as either dissolved or total, is an important issue at this Facility. An important pathway of concern is the transport of metals in groundwater to the Rio Grande. Metals may be transported either in a dissolved form or as colloidal suspensions. The size of colloids is unknown.

Generally, TMs are used to evaluate groundwater concentrations, both for determining compliance with drinking water standards and for evaluating groundwater transport. However, in cases such as those at this Facility, where groundwater sampling generates substantial turbidity, the use of TMs may not accurately reflect actual groundwater concentrations or metal mobility.

If a future drinking water system were developed for water supply, the supply wells would be constructed to prevent undesirable levels of turbidity. Similarly, natural groundwater flow systems do not generate the type of turbidity that may be caused in some wells by sampling.

The use of TMs data alone, for monitor wells exhibiting high turbidity upon sampling, likely provides data that is biased high, particularly for less soluble metals. Background levels of metals in soil or immobile trace metals would be reflected in the turbid samples. Turbidity was prevalent in groundwater sampling at this Site.

To aid in a more complete understanding of transport characteristics (and future potential drinking water exposure) use of both dissolved and TM data is necessary. Use of TMs is required by the TNRCC regulations for demonstrating compliance.

The Corrective Action Objectives presented in Section 3.2 are intended to ensure continued and future protection of human health and the environment, and to support future potential site closure needs. Historic releases occurring before implementation of the above listed control measures are implicated as a potential source of possible off-Site contamination of surrounding areas, including possibly residential areas. This issue is addressed in Section 3.3.

3.2 ON-SITE CORRECTIVE ACTION OBJECTIVES

To be protective of risk and achieve regulatory requirements, the proposed corrective actions must remove the contaminants from the site or effectively prevent unacceptable exposure to metals. Future releases must also be controlled. The corrective action objectives are presented for each potential exposure pathway of concern (Table 3-1). Specific corrective actions for each IA are presented in Section 4.0.

3.2.1 Minimize Surface Soil Exposure

Unacceptable exposure to on-Site surface soil must continue to be prevented. Furthermore, actions necessary to achieve Site closure will be implemented. Some options for achieving these objectives may include one or more of the following:

- Excavate soils to TNRCC industrial/commercial standards in Table 3-1. This option may allow for unrestricted future site use if implemented in conjunction with appropriate remedial options for other pathways and effective prevention of future impacts.
- Deep-till surface soils to lower concentrations to below standards presented in Table 3-1.
- Implementation of institutional controls such as deed restrictions as necessary to ensure continued commercial/industrial site use. Applicable institutional controls include health and safety programs, barriers or caps that prevent exposure.
- Implementation of institutional controls such as deed restrictions as necessary to ensure continued commercial/industrial site use; excavate impacted areas to industrial/commercial standards presented in Table 3-1.
- Implementation of measures that minimize the potential for future impacts of soils to levels exceeding those in Table 3-1.

3.2.2 Minimize Windblown Dust Exposure

Wind dispersion of on-Site dust will continue to be minimized to maintain compliance with State and Federal regulations at ambient monitoring stations. Some options for achieving this may include one or more of the following:

- Excavate soils to industrial/commercial standards presented in Table 3-1.
- Use caps, buildings, or other improvements to cover contaminated soils or process operations known to generate significant impacted wind-blown dust or emissions.
- Use of water trucks and sweeper trucks to actively control windblown dust levels.

3.2.3 Prevent Groundwater Exposure and Reduce Off-Facility Metals Transport

TNRCC regulations [30 TAC 335.563(h)] require that groundwater concentrations achieve MCLs (Table 3-1) throughout a zone of impacted groundwater. Exceptions to this requirement include:

- Alternative concentration limits are approved.
- Appropriate control measures are installed and operated, or institutional or legal controls effectively prevent use of the impacted groundwater.

At this Facility appropriate controls are necessary to reduce potential metals transport to the Rio Grande in accordance with non-degradation requirements of the federal Clean Water Act and Texas Water Quality Standards [30 TAC 307]. These regulations prevent degradation of designated water quality uses and exceedance of applicable in-stream standards (Table 3-1).

Options for achieving these objectives may include one or more of the following:

- Implement institutional controls such as deed restrictions to restrict existing and future use of shallow groundwater at the Facility and implement necessary controls that reduce the rate of metals migration from groundwater to the Rio Grande.

- Eliminate process leaks and spills. Spills and leaks of acid and process water are correlated with areas of elevated arsenic and metals concentrations in groundwater. For example, elevated arsenic concentrations exist downgradient of both the Acid Plants and the Acid Storage Area.

  Also, elevated arsenic concentrations are correlated with the spray tower (located near the unloading area), which used water to control dust on conveyance systems. These acids and process waters are a primary method of concentrate transporting metals to groundwater.

Once in groundwater, the continued release of acid can greatly increase metal solubility and rate of transport. Also, the hydraulic head associated with continued process water leaks can also be a driving force in the rate of transport of metals in groundwater. These processes are explained in greater detail in Sections 2.0 and 4.0 of this Report.

Quantitative determinations of the effect of acid and process water leaks on metals transport is complicated by inherent hydrogeological uncertainties and heterogeneities. However, reducing process leaks and spills will reduce the transport of metals to groundwater and will reduce the rate of transport of metals in groundwater.

- Remove former process ponds. The ponds were large sources of process water. The hydraulic head associated with these ponds likely increased subsurface contaminate transport rates. Elevated contaminant levels accumulated in the pond sludge. The process ponds have been eliminated from service and are dry. The sediments may be excavated or otherwise isolated from further water leaching, and the ponds backfilled or re-contoured to meet future anticipated site needs.

- Excavation of source materials.

- Use caps, gradient controls and other storm water controls to minimize infiltration of water from the surface to groundwater. Accumulations of ponding storm water are also correlated with elevated metals concentrations. For example, elevated arsenic concentrations exist downgradient of the water storage area in the Ore Unloading Area (IA-8).

As for process leaks and spills, minimizing these occurrences and additional storm water improvements will further reduce the transport of metals to groundwater and are likely to reduce the rate of transport of metals in groundwater.

- Monitor groundwater changes over time. A quantitative evaluation of the effect of any particular corrective action on groundwater concentrations is inherently uncertain due to numerous hydrogeological, climatological and operational variables and uncertainties.

  A groundwater monitoring program will allow for monitoring of corrective action effectiveness and allow early detection of any pending increase in metals concentrations prior to release to the Rio Grande. Monitoring wells should be located in select areas along the Rio Grande where influx of metals to the river is thought to be highest, and in select upgradient locations with the most elevated concentrations (e.g. downgradient of the Acid Plants).

- Actively treat groundwater to achieve MCLs.

3.2.4 Improved Storm water Control

Storm water run-on and run-off will be controlled to achieve zero discharge or to comply with a storm water discharge permit. Any release of storm water from the Facility must meet the anti-degradation requirements of the Clean Water Act and Texas Water Quality Standards [30 TAC 307]. These regulations prevent degradation of designated water quality uses and exceedance of applicable in-stream standards (Table 3-1). Discharges are subject to permitting requirements of 30 TAC 305. Furthermore, storm water controls will be implemented to minimize groundwater seepage. Some options for achieving these objectives may include one or more of the following:

- Expand on the existing storm water control system to include areas around the site not previously addressed.
- Eliminate remaining areas of storm water ponding on-Site.
- Provide additional Site grading to enhance storm water runoff and collection.
- Minimize storm water run-on, or channelize storm water run-on to prevent contact with on-Facility soils.
- Cap areas to improve storm water runoff quality and reduce infiltration potential.
- Expand dust-sweeping programs to minimize the accumulation of impacted materials on paved areas.

3.3 OFF-PLANT INVESTIGATION AND RISK ASSESSMENT NEEDS

This section of the Report summarizes the history and current knowledge regarding off-Site contamination, and it establishes a course of action for addressing any excess risk or exceedance of regulatory standards.

3.3.1 History of Investigation

Previous off-Site investigations conducted by Asarco involved the Historic Smeltertown Area (IA-5). This area is presently fenced to prevent unauthorized access. A commercial office for the IBWC is located within this area. This office is located directly to the north of Smeltertown. It is particularly prone to exposure to wind blown dust from Smeltertown. The need to address other off-Facility areas, particularly residential areas north and east of the Facility, was not recognized in previous work plans or reports developed by Asarco and approved by the TNRCC. Asarco has provided notice of possible contamination issues to the IBWC, Texas Department of Transportation (TXDOT) and the railroad as required by TNRCC regulations.

Between July and August of 2001, the EPA conducted two extensive soil-sampling efforts throughout the City of El Paso, Texas, and Sunland Park, New Mexico. During the first sampling effort, over 400 surface soil samples were collected from areas largely to the east of the Facility. Based on the results of this first sampling effort, approximately 457 additional surface soil samples were collected from selected locations during the second EPA sampling effort. Two of the selected locations included the La Calavera area located north and adjacent to the Plant and areas within the University of Texas at El Paso (UTEP) Campus (see maps included in Appendix O for sampling locations). The samples were tested for lead, arsenic and possibly other metals. Asarco has been provided with the work plan and data validation reports for the first sampling effort, and the sample results of the two sampling efforts, but has not been provided with the final reports or EPA's interpretation of the data.

The sample results were provided to the Agency for Toxic Substances Disease Registry (ATSDR), which is under the U.S. Department of Health and Human Services. ATSDR evaluated the risks from exposure to the soils under present exposure conditions. In their report (ATSDR, 2001), they concluded "the lead and arsenic found in the soil do not pose a public health hazard to any of the potentially exposed populations." Regarding a daycare facility they concluded, "contaminants in the soil from the daycare do not pose a public health threat." Regarding UTEP, they concluded, "we estimate potential excess cancer risk associated with exposure to arsenic in soil from the UTEP campus to range from an insignificantly increased risk to no apparent increased risk."

The EPA soil sample results as well as maps containing sampling locations for both the La Calavera area and UTEP are included in Appendix O. A copy of the ATSDR report is also included in Appendix O.

In June and July 2001, Asarco also collected off-Plant samples on Asarco property adjacent to I-10 (IA-20). Additional samples were also collected on Asarco property adjacent to La Calavera (IA-19). Sample locations are portrayed in Figures 2-39 and 2-

40. The sample results (Table 2-50 for IA-19 and Table 2-52 for IA-20), were collected in the 0-2 inch and 2-4 inch depth, and included both bedrock and soils samples. The samples were analyzed by XRF.

3.3.2 Investigation Results

The following discussions are about off-Facility area investigation results.

Investigation Area 19 (IA-19)

IA-19 surrounds La Calavera, is located within a low-lying ravine. Metals in windblown dust or materials could potentially impact this residential area. Also (were persons to trespass onto Asarco property), residents may have access to certain adjacent areas, such as those sampled by Hydrometrics.

IA-19 soil sample results indicate arsenic concentrations in areas adjacent to the community range from 15mg/kg to 214 mg/kg, and lead concentrations range from 38 mg/kg to 1,690 mg/kg (Table 2-50). The higher concentrations predominate in areas closest to the Plant. A cursory review of EPA soil sample results indicates that lower concentrations of arsenic and lead predominate in residential areas. In the EPA's samples, arsenic concentrations range from 15 mg/kg to 62 mg/kg, and lead concentrations range from 110 mg/kg to 850 mg/kg. Sampling locations and results gathered by the EPA from this sampling event are provided in Appendix O.

La Calavera is adjacent to the slag storage area. Asarco provides access to the slag storage area to Oglebay-Norton under a lease agreement. Oglebay-Norton purchases Asarco's slag, grinds it, and then sells the ground slag to 3rd parties for use.

Considerable amounts of dust can be generated during slag grinding and transport. Slag or slag dust, which has been demonstrated to generally be inert, appears to affect soil concentrations in areas nearest these operations. The EPA sample results within the low-lying residential areas indicate lower overall metals concentrations, indicating lesser effects from Oglebay-Norton operations.

Asarco has evaluated the potential bio-availability of arsenic and lead in slag from the El Paso Site (Walker & Associates, 2001). The in-vitro bio-availability test determined the percentage of lead and arsenic that is available for uptake under human gastro-intestinal conditions. The test used a synthetic gastric solution. The methodology and results are provided in Appendix P. The results were:

- Lead 5.1 percent bio-available
- Arsenic 11.1 percent bio-available

These results indicate limited potential for uptake of lead and arsenic in ingested slag. To the extent that elevated soil-lead concentrations in the La Calavera community (or other areas) are predominantly slag influenced, these bio-availability results would support site-specific concentrations of potential concern that are higher than typical default values.

Investigation Area 20 (IA-20)

IA-20 encompasses the full extent of property owned by Asarco adjacent to the smelter Site. There are no known present or historic smelter related activities in this area. Arsenic concentrations range from not detected at 10 mg/kg to 62 mg/kg, and lead concentrations range from 22 mg/kg to 440 mg/kg (Table 2-52). Two samples contained appreciably higher concentrations: BL50 contained 187 mg/kg of arsenic and 1,160 mg/kg of lead, and BL43 contained 235 mg/kg of arsenic and 1,180 mg/kg of lead. Arsenic levels in most samples are in the 30 mg/kg to 40 mg/kg range, and lead levels in most samples are in the 50 mg/kg to 200 mg/kg range.

EPA Residential Investigation

The EPA investigation samples were collected from surface soils in residential and commercial areas located east of IA-20 (further from the Facility). It is not considered appropriate at this time to pre-empt the EPA evaluation and interpretation of the data.

A cursory review of the EPA results by Hydrometrics indicates that arsenic and lead concentrations throughout much of the area are within approximate background levels, particularly for an urban area. Higher concentrations appear to be more prevalent, but sporadic, in areas closest to the Facility (Appendix O). It is not clear what conclusions the EPA may draw with these data.

Numerous other historic and contemporary sources of lead and arsenic exist that have been known to affect residential soils. Historic use of leaded fuels in automobiles, and degradation of lead-based paints are two examples of alternate lead sources. Arsenic was used historically in insecticides and rodenticides, and is still used in chrome-copper-arsenate (CCA) treated lumber (green board). As discussed in more detail below, metals are naturally occurring in soils.

3.3.3 Off- Plant Corrective Action Objectives

This section presents an approach for incorporating the EPA off-Site investigation results and Hydrometrics' recent off-Plant investigation results into the on-Plant remediation plan in order to provide one comprehensive corrective action plan.

Investigation Area 5 (IA-5) and Investigation Area 20 (IA-20)

Asarco is intent on maintaining the property represented by IA-5 and IA-20 as open space or for possible future industrial or commercial redevelopment. IA-20 and IA-5 are presently zoned "unrestricted manufacturing." Surface soil concentrations must be below risk-based levels (RBL) that account for potential incidental ingestion of surface soil by commercial or industrial workers (Table 3-1). The TNRCC default arsenic RBL is 200 mg/kg and the lead RBL is 1,600 mg/kg.

Concentrations of metals in surface soils throughout IA-20 (north of Executive Center) are below standards, with the exception of sample BL-43. The appropriate corrective action objective is to implement the essential institutional controls necessary to ensure continued management of the property for industrial/commercial use. In the absence of such approved controls, remediation to residential exposure-based standards would be necessary to achieve closure.

The average concentration of lead in IA-5 (former Smeltertown) exceeds the standard. The corrective action objective for this area is to achieve closure requirements by reducing lead concentrations in surface soils. Some options for achieving this include:

- Excavate to below the lead industrial/commercial standard (Table 3-1).
- Cap the Site, restrict site redevelopment and provide for the continual maintenance of the cap.
- Deep-till the surface soil to reduce lead concentrations to the industrial/commercial standard (Table 3-1).

Investigation Area 19 (IA-19)

Asarco does not own portions of this IA. Presently on-Site use is residential and other private ownership. Metal concentrations vary substantially across the area. It may be appropriate to develop higher, site-specific levels of concern for areas that are predominantly impacted by slag because of the reduced bio-availability of slag (Walker and Associates, 2001). It is premature to evaluate corrective action objectives in advance of the EPA review and interpretation of the residential data. Accordingly, corrective actions will be proposed later and incorporated into the broader corrective action plan.

The average concentration of lead in IA-19 exceeds the RBL. The corrective action objective for this area is to achieve closure requirements by reducing lead concentrations in surface soils. Some options for achieving this include:

- Excavate to the lead default guidance value.
- Cap the area, restrict redevelopment and provide for the continual maintenance of the cap.
- Deep-till the surface soil to reduce lead concentrations to the guidance values.

EPA Residential Area Samples

Publicly, the ATSDR has stated (El Paso Times, 2001) that the existing levels of contamination are "not a health threat." However, the EPA has not yet announced their interpretation of results. It is premature to evaluate corrective action objectives in advance of the EPA review and interpretation of the residential data.

Accordingly, proper corrective actions, if appropriate, will be proposed after completion of EPA's site investigation efforts and incorporated into an off-Site corrective action plan. This off-Site corrective action plan would need to meet the TNRCC requirements of:

- Investigating the extent of contamination to background levels,
- Determining background levels, and
- Evaluating risk in off-Site areas.
- Developing an off-Site corrective action plan, if appropriate.

Efforts have been made to collect background soil and groundwater samples throughout the investigation. The credibility of these sites continues to come into question as the extent of the investigation has broadened over the years. Selecting background sites is further complicated by the presence of other industrial sites. Moreover, there are many sources of arsenic and lead in urban residential areas that may need to be considered.

SECTION 4.0

CORRECTIVE MEASURE STUDY

4.0 CORRECTIVE MEASURE STUDY

This Section of the Phase III RI Reports presents the proposed corrective actions for each IA. The corrective measures approach, and the rational supporting the approach, are similar to those presented in the Phase I and Phase II RI Reports. As expected, there are refinements and modifications to the previously presented corrective measures based on the new findings of the Phase III RI.

Section 4.1 is an overview of important investigation results and regulatory requirements that are pertinent to the selection of corrective measures. Section 4.2 identifies the types of corrective action alternatives selected. (Refer to the Phase I RI, Hydrometrics, 1998, for more detailed technical support). The Phase I RI Report provides an evaluation of a broader range of corrective measures alternatives, per the requirements of 30 TAC 335.553.

The preferred corrective actions meet the objectives established in the BLRA (in Phase I RI Report) with subsequent modifications in Section 3 of this Report. Asarco's response to the TNRCC comments on the BLRA is provided in Appendix A. Also, Section 4.2 of the Phase I RI, which addresses corrective measure alternatives, is reproduced in Appendix Q of this Report. Descriptions of corrective actions for each IA are presented in Section 4.3. Remedial design documents and associated cost estimates will be submitted under a separate cover.

This section organizes certain corrective actions, for example, surface water and groundwater monitoring into two general categories for the purpose of this Report. Pre-closure items refer to items to be completed before the remedial actions are finished and the project is closed by the TNRCC. Post-closure refers to activities that will take place after the project is closed (remediation is complete) per the TNRCC.

4.1 OVERVIEW

This section of the Phase III Report provides an overview of the approach and assumptions used to develop the preferred corrective action alternatives for the Site. This information is based on evaluations conducted during the Phase I and Phase II RIs, as well as supplemental evaluations provided in this document.

4.1.1 Human Health Risk Considerations

The proposed corrective actions must meet regulatory requirements and protect human health and the environment. The corrective action objectives presented in Section 3.0 were established to minimize risks at the Facility in accordance with the TNRCC Risk Reduction Standards. As presented in Section 3.0, the development of corrective measures objectives was dictated by the receptors identified during the exposure and risk assessment evaluation in the BLRA, the nature and location of the release, the Site soils, hydrogeological conditions, and regulatory requirements.

A site-specific BLRA for the Facility was conducted during the Phase I RI (Hydrometrics, 1998), and revised per comments from the TNRCC in Section 3.0 of this Phase III RI Report. The objective of the BLRA was to identify potential mechanisms for present and future exposure to COCs, and to provide preliminary, media-specific cleanup-levels where applicable that are protective of human health and the environment. Information obtained from the RI activities and from the BLRA indicate the following:

- The Facility is zoned for industrial use, with no anticipated change in the current zoning. The property is predominantly surrounded by other industrial properties.

- Metals concentrations in on-Site surface soil exceed the TNRCC commercial/industrial standards for human ingestion, inhalation, and dermal contact. Historically, this exposure pathway was managed through an OSHA mandated worker health and safety program. Corrective measures are needed to protect future Site users consistent with the requirements of the TNRCC Risk

Reduction Rules. Options may include continued worker health and safety programs, capping and/or excavation of source materials.

- Soil metals concentrations in some areas have resulted in groundwater concentrations that exceed regulatory standards. Areas of highest groundwater impact correlate well with certain Facility operations involving acids or other liquids. Improving Facility operations involving these acids and liquids, and providing improved containment in the event of spills, have minimized future potential groundwater impacts.

- In some areas, excavation of existing impacted soils is appropriate to prevent current and future groundwater impacts. In other areas, capping soils is effective to reduce the transport of metals from surface soil into groundwater. Capping will also reduce the need for watering for dust control, and reduce the amount of water that may percolate through the soil.

  Similarly, additional improvements to the Storm Water Collection and Reuse System prevent ponding of storm water, will reduce the amount of water that percolates through the soil to groundwater.

- Groundwater under portions of the Facility presently exceeds drinking water standards, and is above background levels. However, groundwater is not currently used for drinking water. In the area of concern, the groundwater is not hydrolically connected to the American Canal. During high flow conditions (August – September), occasionally, the groundwater intersects the bottom of the American Canal in an area that has not shown metal impacts in groundwater (EP-7 and SEP-4). Groundwater is hydraulically connected to the Rio Grande, but the influx is sufficiently low that no measurable change occurs in water quality in the Rio Grande as it flows past the site.

- In the absence of any imminent risk associated with groundwater impacts, or any known near-term plans to use the shallow groundwater, a corrective action plan that focuses on source control and reduction in metals influx to groundwater will achieve future compliance. Using this approach, future potential exposure will require institutional controls, such as deed restrictions and access limitations, until the Site meets applicable groundwater standards or background levels.

- COCs in air near the Facility meet the National Ambient Air Quality Standards (NAAQS) and National Emission Standards for Hazardous Air Pollutants (NESHAPS). These are concentrations established by the TNRCC under the Texas Clean Air Act and the OSHA permissible exposure limits or threshold limit values. These standards are achieved through an active treatment of stack emissions (when the Facility is operating), and through a site-wide dust suppression program. No additional corrective measures for this media are anticipated or necessary.

- Data obtained from the Rio Grande and American Canal indicate that releases from the Facility do not result in an exceedance of Texas Surface Water Quality Standards. The anti-degradation regulations must also be considered. However, no significant changes in surface water quality are observed in the Rio Grande as it flows past the Facility. Improving groundwater quality will further reduce any potential impacts to the Rio Grande.

In summary, there are no exceedences of standards for metals in air or surface water. Metals concentrations in soil and groundwater do exceed regulatory standards and baseline risk-based levels of concern (i.e. risks associated with potential exposure in the absence of any controls). Exposure to the metals in soil and groundwater is presently managed through controlled access, existing worker health and safety programs, current and designated shallow aquifer uses, and other mechanisms. However, these mechanisms are not incorporated into an approved corrective measures study. The need for additional controls to prevent future unauthorized discharge and improve present site conditions is recognized. Therefore, the risk-based corrective measures focus on the following:

- Minimizing surface soil exposure for future onsite workers.
- Minimizing wind-blown dust exposure for off-Site residents.
- Preventing groundwater exposure and reducing off-Site metals transport.
- Improving storm water controls.

4.1.2 New Investigation Area Considerations

The previous two RI phases focused on on-property areas (IA-1 through IA-14) pursuant to the Agreed Order. This Phase III RI Report includes on-Plant Closed Plant areas (IA-15 through IA-18), the off-Plant La Calavera area (IA-19) and the area east of I-10 (IA-20).

The corrective measure discussions in this section address on-Facility IAs. The residential area in IA-19 is now being evaluated by the EPA according to TNRCC human health risk evaluation procedures. No corrective actions are needed for IA-20 because COC concentrations are below relevant regulatory standards (Section 3.3). Section 4.5 of this Report includes recommended additional characterization investigations of off-Facility areas to facilitate development of the risk evaluation for that portion of the project area. Corrective action measures for off-property areas will be addressed as the appropriate data become available.

4.1.3 Site Characterization Considerations

The RI activities delineated the vertical and lateral extent of elevated metal concentrations in soil, surface water and groundwater. The investigations were also used to characterize metals distribution in soils and groundwater, including the extent and the volumes of affected media.

The studies suggest that most groundwater contamination occurs beneath discreet areas of the Facility. These areas have been related to a specific process or event, such as spills of sulfuric acid or the disposal of Acid Plant sludge. Also, groundwater flow and associated metals migration is significantly influenced by in-filled arroyos underlying the Facility.

Elevated concentrations of metals in groundwater near the Rio Grande are limited to a few monitoring wells where the river comes closest to the Facility. While it is appropriate to reduce metals concentrations in groundwater, the influx of metals from groundwater to surface water is not sufficient to affect a measurable change in surface water quality. These site-specific characteristics were used to select appropriate corrective actions.

4.1.4 Corrective Action Considerations

Detailed evaluations of corrective action alternatives for addressing impacts at the Facility were provided in the Phase I Report (Hydrometrics, 1998). The Phase II RI (Hydrometrics, 2000) included additional characterization of source areas and materials and groundwater beneath the Facility. From these data some refinement of proposed corrective actions is provided. The previous two RI Reports identified several regulatory concepts important to the development of appropriate corrective actions. These concepts are addressed below.

4.1.4.1 General Corrective Action Concepts

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 No. 3 (Section 3.0).

This Phase III RI presents supplemental corrective action information based on the results of additional investigations. Appendix Q presents the corrective action alternative analysis presented as Section 4.2 in the Phase I RI Report. The general criteria utilized in each Phase of the RIs to evaluate corrective action measures has remained the same, and includes the following key elements:

- Identify and evaluate elevated source materials based on Facility operations, and soil and groundwater characterization data.
- Recognize the influences of former arroyos beneath the Facility which influence groundwater flow.
- Consider regulatory issues such as aquifer classification.

4.2 IDENTIFICATION OF PREFERRED CORRECTIVE ACTION ALTERNATIVES

The following subsections identify and describe the preferred corrective action alternatives.

4.2.1 Engineering Controls

Engineering controls are modifications to a site or facility to reduce or eliminate the potential for exposure to a regulated substance. The following engineering controls are proposed as corrective actions for the Facility:

- **Capping:** Capping consists of covering source areas containing Category II materials with an engineered barrier to reduce the infiltration of surface water through smelter materials. This reduces potential impacts to groundwater, the potential for direct contact by workers, and the potential for wind-blown dust.

  Capping will typically consist of placing asphalt or concrete over areas containing Category II material. In areas where Facility vehicular traffic is expected, the cap will be thickened to accommodate such equipment. Other capping systems that may be considered include clean soil/vegetation, geosynthetic liners (GCL), and flexible membrane liners (FML).

- **Surface Water Runoff Control:** The Storm Water Collection and Reuse Project, which included a lined impoundment, lined sumps, pumping systems, pipelines, and storage tanks was completed in early 1999. The new storm water system effectively reduces potential off-Facility transport of materials in storm water runoff.

In conjunction with the construction of the storm water improvements, and consistent with the Agreed Order, the existing ponds in IA-9 (Ponds 1, 5, and 6) have been decommissioned. As presented in previous RI Reports, these features were considered potential sources of metals in groundwater.

- **Removal/Disposal:** Removal/disposal alternatives deemed applicable to corrective action at the Facility include excavation and on-site disposal. Excavation will be accomplished using earthmoving equipment, which may consist of backhoes, scrapers, front-end loaders, and trucks. Excavated Category I materials will be placed in the on-site disposal cell.

  On-site disposal consists of excavating Category I materials and placing them in a disposal cell constructed with a bottom liner, a leachate collection system, and a lined cover. Design will address the TNRCC general siting criteria for the selection of Industrial Solid Waste Landfill Sites (Technical Guideline No. 2) and TNRCC Criteria for Landfill Construction (Technical Guideline No. 3).

4.2.2 Institutional Controls/Deed Restrictions

Institutional controls consist of operational programs and legally binding instruments that may be used as part of a corrective action plan to control or eliminate an otherwise viable exposure pathway to ensure that exposure to remaining regulated substances is reduced to a human health and environmentally protective level.

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

- **Worker health and safety programs:** The health and safety policies and programs currently in effect at the Facility reduce the potential for exposure and health hazards. 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.

- **Municipal Restrictions on Groundwater Use:** Promulgated as aquifer use classifications.

- **Deed Restrictions:** Institutional controls typically include deed restrictions, which are legal mechanisms that prevent specific uses or activities on the property. The Facility is currently zoned for industrial use, as are most of the adjacent properties. Upon completion of closure/remediation requirements (and within 90 days after TNRCC approval), Asarco will record in the El Paso County deed records all appropriate information as required in 30 TAC 335.566 (Deed Recordation for Risk Reduction Standard No. 3).

- **Fencing and Other Access Controls:** Access to the Plant is controlled. A security system, consisting of a fence enclosing the property and controls at the Plant entrance, limits access to only appropriately trained workers and supervised visitors.

- **Dust Suppression:** Water trucks are presently used to reduce wind-blown dust concentrations. Additional paving/capping of exposed soils should allow reduced site watering without compromising ambient air quality conditions.

4.2.3 Groundwater and Surface Water Monitoring

Having completed the site investigation, it is appropriate to revise and re-focus the monitoring program. During the site investigation many monitoring points were used to understand site hydrogeological characteristics and water quality throughout the Facility. During and after implementation of the corrective measures the objectives of the monitoring program will be to gauge the performance of the corrective actions implemented, document improvements in water quality and to support future Facility closure.

Consistent with the revised surface water and groundwater needs, the following water quality monitoring program is proposed:

Pre-Project Closure

- Analyze samples for total and dissolved arsenic. While total values will be used for accessing compliance, dissolved analyses will be used to evaluate possible abberant results that may be due to excessive turbidity during sampling.

- Monitor wells adjacent the Rio Grande include: EP-80, EP-113, EP-112, EP-127, EP-111, EP-127, EP-128, EP-05, EP-06 and EP-07. These wells include the targeted "compliance wells" which must achieve MCLs prior to closure, as elaborated on in Section 4.6.

- Monitor wells within known major contaminant flow paths and arroyos: Parker Brothers Arroyo (EP-78, EP75, EP-53, EP-99, EP-85), Acid Plant Arroyo (EP-114, EP-59, EP-119, EP-62), Ponds 5 and 6 Arroyo (EP-77, EP-56, EP-116, EP-132), Pond 1 Arroyo (EP-13, EP-101, EP-118), and South Plant Area (EP-105, EM-02, EP-20). These "COC flow path" wells are expected to show reductions over time upon implementation of the corrective actions, as elaborated on in Section 4.6.

- If concentrations in "compliance wells" show a noticeable increasing trend over three or more sampling events, or if there is a sudden and substantial increase in any one "compliance well" when compared to the previous event, a contingency plan will be implemented to address potential groundwater problems.

All above mentioned compliance wells and surface water stations will be sampled quarterly. Other monitoring wells considered critical for the groundwater evaluation will also be incorporated in the sampling program. The rationale for the proposed pre-closure sampling program is discussed in Section 4.2.3.1. A complete list of monitoring wells to be sampled and their sampling frequencies is listed in Table 4-2.

<u>For Project Closure Demonstration</u> (see also Section 4.4)

- Sample all compliance wells for Total Metals (TMs) for COCs identified in the Agreed Order (arsenic, cadmium, copper, lead, selenium) to demonstrate compliance with MCLs.

- Demonstrate a consistent downward trend in total arsenic concentrations in all "COC flow path wells."

4.2.3.1 Proposed Groundwater and Surface Water Sampling Program

Since the beginning of RI activities in 1997, eighteen groundwater gauging, monitoring and water sampling events have been performed at the Site. Review of historical groundwater and surface water analytical data indicate that the presence of groundwater and surface water metal concentrations is well documented. Therefore, a new sampling frequency for monitoring wells will be implemented beginning the 3rd quarter of 2002 and ending during the 2nd quarter of 2004. During this sampling period, groundwater data will be evaluated and monitoring well sampling frequencies will be adjusted if necessary. At the end of the 2nd quarter of 2004, the groundwater and surface water data will be evaluated and a new sampling frequency will be proposed if appropriate.

The sampling frequency for surface water will remain as it is currently scheduled. The analytes evaluated during this sampling program will be those referenced in the RI Work Plan (Hydrometrics, 1996).

All existing monitoring wells will be gauged for water levels quarterly. Table 4-2 presents the proposed monitoring well sampling frequencies. The following is the rationale for the proposed new sampling frequencies:

1. Where review of historical analytical data indicate that the metal concentrations detected in specific monitoring wells are comparable (approximately the same order of magnitude) to the concentrations previously detected, the sampling frequency for those particular wells was reduced to once every six months (semiannually).

2. Where the results of two consecutive sampling events indicate metal concentrations below regulatory limits, the frequency of analysis for that particular well was reduced to once a year (annually).

3. Monitoring wells positioned either upgradient or outside the periphery of the impact boundaries that have yielded non-detectable metal concentrations for two consecutive sampling events will be sampled annually.

4. All monitoring wells situated downgradient of areas with identified groundwater impacts will be sampled quarterly.

5. All new wells will be sampled quarterly for one year before adjusting their sampling frequencies according to the criteria listed above.

6. Regardless of metal concentrations, samples should be collected from all on-Site and off-Site wells at least once a year (annually). At the end of the proposed sampling program, monitoring wells sampled annually will be evaluated to

determine whether to continue their annually sampling or to plug and abandon them.

7. The number of wells sampled and the sampling frequencies were reduced to a level sufficient for monitoring impacts and/or effectiveness of a remediation system.

Following the completion of the groundwater and surface water monitoring activities for a period of one year (3rd quarter 2002 to 2nd quarter 2003, and 3rd quarter 2003 to 2nd quarter 2004), an annual groundwater monitoring report that contains the results of all sampling and gauging events for that year will be prepared and submitted to the TNRCC. The report will summarize the monitoring events for the past year, and will provide a discussion of any significant changes that may have occurred in the subsurface conditions.

4.3 PROPOSED CORRECTIVE ACTIONS FOR EACH IA

This subsection of the Report identifies the proposed engineering controls for each IA. The proposed engineering controls for each IA are aimed at meeting all the corrective action objectives established in Section 3.3 (and reiterated in Section 4.1.4). However, the primary objective is to remove/isolate Category I and II materials, and the associated improvement of groundwater quality. For each IA, a corrective action objectives section identifies the important facility components, site use history, or other factors important to risk and regulatory compliance issues in that IA. The proposed corrective actions are then presented. This is followed by an explanation of how the corrective actions comply with the Remedy Evaluation Factors for Risk Reduction Standard No. 3 (30 TAC 335.562). Estimated remediation costs are to be submitted in a later document.

The institutional controls and groundwater monitoring controls identified in Section 4.2.2 and 4.2.3 will apply to each IA, in addition to the proposed engineering controls. The institutional controls will provide immediate, effective protection against unacceptable levels of exposure to surface soils and to groundwater. The monitoring system will monitor the effectiveness of engineering controls in reducing groundwater COC levels.

4.3.1 Converter Building/Baghouse Area (IA-1)

The following are summaries of corrective action objectives, preferred corrective action, and current status.

4.3.1.1 Corrective Action Objectives

This area contains a former sump that receives storm water run-on from other areas of the Facility, including run-on from the adjacent Acid Plant Area (IA-3). Some areas are unpaved and contain elevated metals concentrations. This area is not indicated as an important source of groundwater impacts. In fact, well EP-100 shows unexpectedly low arsenic levels.

The risk-based corrective action objective of particular relevance to this IA is to improve storm water control.

4.3.1.2 Proposed Corrective Actions

The corrective actions identified for this IA are listed below with their current status:

Proposed Corrective Action (IA-1)	**Status**
1. Implement engineering / operational controls to reduce or eliminate the releases from the Acid Plant operations.	In progress.
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. Grade area to improve surface drainage.	Completed as part of the Storm Water Collection and Reuse Project

Proposed Corrective Action (IA-1) cont'd	Status
5. Improve asphalt pavement cap over excavated areas and Category II areas.	In progress; 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 the on-site disposal cell.	Category I materials have been deposited at an off-Site hazardous waste landfill.
7. Investigate underground utilities for leakage and repair as appropriate.	Schedule to be determined.
8. Investigate reduced watering for dust control.	Upon completion of capping, reduced watering rates will be explored to the extent ambient air quality conditions are not compromised.

A conceptual illustration of corrective action measures for IA-1 is in Figure 4-1.

4.3.1.3 Remedy Evaluation Factors

Compliance with Other Laws and Regulations: Capping the remaining IA-1 area will reduce exposure to remaining metals in surface soil. Backfilling, capping and grading will minimize the potential for storm water ponding and thereby minimize the potential for transport of metals from surface soil to groundwater.

Long-term Effectiveness and Permanence: The proposed remedy has permanently eliminated the sump, a possible source of groundwater impacts. The most contaminated soils were permanently removed. The remaining metals in soils have dramatically less potential to impact groundwater. Significant downward migration of metals is not anticipated in this arid environment in the absence of storm water ponding and/or process water spills. Post-closure care will be required to maintain the caps, prevent recontamination of the capped areas, and maintain storm water collection systems.

Reduction of Toxicity, Mobility and Volume: Category I soils have been removed. The mobility of the remaining contaminants in soils will be largely reducing by implementing storm water controls and the possible reduction in use of water for dust suppression activities.

Short-term Effectiveness: The corrective measures can be implemented quickly, and many are already completed. Capping will provide immediate worker protection from surface soil exposure. Reduced metals leaching to groundwater will also occur immediately. However, changes in groundwater quality at groundwater monitoring points will be more gradual and consistent with rate of contaminant fate and transport characteristics.

Implementability: The proposed options are straightforward to implement. The degree to which site watering can be reduced is presently unknown. Identifying, isolating and repairing any underground utilities that may be releasing water has proven difficult at other similar industrial sites.

4.3.2 Boneyard/Slag Area (IA-2)

The following are summaries of corrective action objectives, preferred corrective action, and current status.

4.3.2.1 Corrective Action Objectives.

IA-2 was initially restricted to a boneyard (heavy equipment storage yard) on top of a slag pile storage area near the Slag Road and the current slag-dumping area. The boundary of the IA has been extended to include the Acid Storage Tanks, Water Cooling Towers and additional slag storage areas. Historically, the Boneyard Area was used to store drums of mixed materials, mist eliminator candles, saddles, fiberglass reinforced flues and other miscellaneous equipment.

The slag storage area was active until February 1999 when smelting operations were temporarily halted. During the multimedia inspection, the TNRCC was concerned that native soil, underlying the Boneyard, might have been impacted by the stored items. At the present, all previously stored materials in this area have been removed.

The RI has also identified areas of concern beneath the Boneyard. Elevated levels of arsenic in groundwater occur beneath IA-2, in the area of the former boneyard monitor well (EP-53). The primary source material associated with this area is thought to be sludge from the Acid Plants, which may have historically been stored behind a dam placed across a historic arroyo. This material is now located beneath areas of stored slag.

Release of acid from the adjacent acid storage area may have flowed downgradient along the historic arroyo path and into this historic sludge storage area. No evidence of impacts from the acid storage area was observed through detailed investigations in this area. This acid flow may have greatly increased the mobility of the metals in the sludge. The containment area associated with the acid tanks is in the process of being upgraded, resulting in the elimination or minimization of this Facility component as a contributor to impacts in soil and groundwater.

Fortunately, the impacts to groundwater are restricted to a relatively small area around EP-53. Once the natural soil buffers return the groundwater to more neutral conditions the mobility of arsenic would be expected to decrease.

Information obtained from the Phase I and Phase II RIs, suggested the existence of approximately 23,711 cubic yards (CY) of Category I material (acid sludge impacted soils). However, additional data obtained from the Phase III RI, indicated a substantial reduction of Category I material, from 23,711 CY to approximately 700 CY.

Particularly important risk-based corrective action objectives for this area include:

- Preventing additional acid release from the acid tanks.
- Removal of Category I materials from subsurface soils to prevent further groundwater impacts.

4.3.2.2 Proposed Corrective Action

Some remedial work has been performed in IA-2. The corrective control measures identified during the Phase I and Phase II RIs, as well as their status are listed below.

Proposed Corrective Action (IA-2)	Status
1. Debris clean up.	In progress; Debris has been cleaned up and operational changes have been implemented to restrict debris deposition in this area in the future.
2. Surface drainage improvements.	In progress; as part of the Storm Water Collection and Reuse Project.
3. Excavation of Category I materials; backfill and cap as needed.	In progress; Category I materials at the surface have been excavated. Additional material will be removed after removal of slag.
4. Disposal of Category I materials in the on-site disposal cell.	In progress; Category I materials have been deposited in an off-Site hazardous waste landfill.
5. Acid storage tank process system controls.	In progress.

A conceptual illustration of corrective action measures for IA-2 is in Figure 4-2.

4.3.2.3 Remedy Evaluation Factors

Compliance with Other Laws and Regulations: Excavating Category I materials and installing mechanisms for minimizing the potential for future release of sulfuric acid will result in improved groundwater quality. Surface drainage improvements will also improve groundwater quality by minimizing infiltration of surface water runoff.

Long-term Effectiveness and Permanence: Excavating Category I materials will permanently remove a substantial source of groundwater impacts. The remaining metals in soils have dramatically less potential to impact groundwater. Significant downward migration of metals is not anticipated in this arid environment in the absence of storm water ponding and/or process spills. Post-closure care will be required to maintain storm water drainage improvements and acid storage tank process controls.

Reduction of Toxicity, Mobility and Volume: Category I soils have been removed. The mobility of the remaining contaminants in soils will be largely reduced by implementing storm water controls and the possible reduction in use of water for dust suppression activities. Containment are upgrades should minimize acid releases which will reduce metals mobility.

Short-term Effectiveness: Reduction of the potential for metals to leach to the groundwater system will result with the removal of additional Category I materials. However, changes in downgradient groundwater quality at groundwater monitoring points will be more gradual given the COC fate and transport characteristics.

Implementability: There are no substantial impediments to implementing the proposed corrective measures.

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

The following are summaries of corrective action objectives, preferred corrective action, and current status.

4.3.3.1 Corrective Action Objectives

The Acid Plants are used to remove sulfur dioxide from gases generated during the copper smelting process and produce sulfuric acid as a by-product. The sulfuric acid is then cooled and transported via pipeline to the Bulk Acid Storage area. The release of water and acid that originated from Acid Plant process components greatly increased the subsurface mobility of arsenic and other metals. These fluids have been eliminated or greatly reduced with the implementation of operational controls that consist of upgrades and lining of sumps, and grading and paving as part of storm water control improvements.

Elevated levels of arsenic in groundwater exist beneath the Acid Plants. The elevated arsenic levels follow the potentiometric surface downgradient toward IA-5 (former Smeltertown) and then turn south, again following the potentiometric surface in IA-5. Arsenic concentrations decrease substantially prior to reaching the Rio Grande where it is likely the natural buffering capacity of the soils has neutralized the excess acid and reduced arsenic mobility.

Preventing further acid release to soils is the most important risk-based corrective action objective for this area.

4.3.3.2 Proposed Corrective Actions

Some remedial work has been performed in IA-3. Corrective control measures that were identified for this IA during the Phase I and Phase II RIs are listed below with their current status of implementation:

Proposed Corrective Action (IA-3)	**Status**
1. Engineering/operational controls to reduce or eliminate the occurrence of releases from the Acid Plants.	In progress.
2. Line and resurface the floors of Acid Plants 1 and 2, and construct perimeter sill for secondary containment.	Schedule to be determined.
3. Construct a lined secondary containment around Acid Plants.	Schedule to be determined.
4. Capping of any Category II materials.	In progress.

A conceptual illustration of corrective action measures for IA-3 is in Figure 4-3.

4.3.3.3 Remedy Evaluation Factors

Compliance with Other Laws and Regulations: Installing mechanisms to minimize the potential for future release of sulfuric acid will result in improved groundwater quality. Capping will improve storm water runoff and collection, thereby minimizing infiltration and run-off. Capping will also prevent worker exposure to surface soil.

Long-term Effectiveness and Permanence: Significant downward migration of metals is not anticipated in this arid environment in the absence of storm water ponding and/or process spills. Post-closure care will be required to maintain operational controls, spill collection systems, storm water drainage improvements and acid storage tank process controls.

Reduction of Toxicity, Mobility and Volume: The mobility of COCs in soils will likely be reduced in the absence of additional acid releases.

Short-term Effectiveness: Reduction in potential for metals leaching to groundwater will also occur upon removal of Category I materials. However, changes in groundwater quality at groundwater monitoring points will be more gradual given the rate of COC fate and transport characteristics.

Implementability: There are no substantial impediments to implementing the proposed corrective measures.

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

The following are summaries of corrective action objectives, preferred corrective action, and current status.

4.3.4.1 Corrective Action Objectives

This IA encompasses the western boundary of the Facility, where the Facility drops about 40 feet down to a railroad and roadway. This slope has been covered with slag of varying thickness (generally between a few inches to a few feet thick). Historically, this area received storm water runoff from much of the Facility. During the Phase I and Phase II RIs, downgradient areas of the following six distinct potential historical release sources were identified:

- Acid Plants
- Medford Sump
- Former Lead Plant Baghouse
- Sinter Plant Gas Cleaning and Sample Mill
- Former Pond 1 and Diesel 1 areas
- South Terrace.

The storm water accumulated in low-lying areas adjacent to the railroad tracks. Storm water controls, including a berm along the upslope edge of this IA, have been implemented to minimize further release of storm water down the Front Slope.

The area around IA-14 coincides with a historic arroyo. This arroyo was the site of the original Lead Smelter. The site was abandoned long ago, and the area backfilled, using a substantial amount of slag. The elevated metals concentrations identified in soils in this location extend down to the groundwater table. Concentrations of metals in groundwater associated with this area are likely a result of the historic Lead Smelter related Category I source materials.

The area downgradient of IA-14 also has hydrogeological significance. Groundwater influx and recharge rates to the Rio Grande alluvium are likely higher in this area. The Rio Grande moves closer to the Front Slope, greatly reducing the amount of lowland represented by the former Smeltertown area. Also, the existence of the former arroyo in this area may have resulted in more graded soils (i.e. washed out the fines), thereby increasing hydraulic conductivity.

The location of a COC source area in close proximity to the Rio Grande, in combination with increased groundwater recharge, makes this an important area for controlling groundwater quality. Presently there are no effects to water quality in the Rio Grande. However, actions are necessary to ensure groundwater quality improves and that groundwater standards are achieved in wells adjacent to the Rio Grande.

4.3.4.2 Proposed Corrective Action

During the Phase I and Phase II RIs, the following corrective control measures were identified for this IA. These are listed below with their current status:

Proposed Corrective Action (IA-4)	**Status**
1. Debris clean up.	In progress.
2. Excavation of Category I materials.	Schedule to be determined.
3. Confine Category I materials in on-site disposal cell.	Schedule to be determined.
4. Backfill excavated areas with clean soil.	Schedule to be determined.
5. Cap Category II areas.	Schedule to be determined.
6. Drainage controls for slope areas.	Schedule to be determined.
7. Construct drainage collection system in the low-lying areas.	In progress; Recently implemented storm water control improvements prevent run on from upgradient Facility components; remaining areas to be addressed.

Results from the Phase I and Phase II RIs suggested the existence of approximately 24,000 CY of Category I Material. However, based on the evaluation of recent groundwater analytical results in this IA, it was concluded that some of the material previously classified as Category I material did not meet the criteria established for Category I materials (elevated concentrations of COCs, associated groundwater impacts, visual evidence and relation to Facility processes). Therefore, the material was reclassified as Category II material.

Results of this evaluation indicated that only the area around EP-116, EP-117, BH4-4, and BH4-5 met the criteria for Category I material. The reclassification resulted in a substantial reduction of Category I material, from about 24,000 CY to approximately 4,000 CY. A conceptual illustration of corrective action measures for IA-4 is shown in Figure 4-4.

4.3.4.3 Remedy Evaluation Factors

Compliance with Other Laws and Regulations: The excavation of Category I materials (subsurface soils associated with former Lead Smelter and arroyo backfill material) will remove the bulk of the material contributing to degradation of groundwater quality in this area. Storm water controls will prevent ponding of water and minimize the downward migration, which causes metals to be transported into groundwater. Improvements in groundwater quality will occur over time. It is anticipated that MCLs in wells adjacent the Rio Grande will be achieved.

Long-term Effectiveness and Permanence: Removal of the Category I material will prevent further groundwater degradation from this source area. Significant downward migration of metals is not anticipated in this arid environment in the absence of storm water ponding and process spills. Post-closure care will be required to maintain the storm water controls.

Reduction of Toxicity, Mobility and Volume: The mobility of the COCs in soils will be largely reduced with the storm water improvements.

Short-term Effectiveness: Reduced potential for metals leaching to groundwater will also occur upon removal of Category I materials. However, changes in groundwater quality at groundwater monitoring points will be more gradual, given rate of COC fate and transport characteristics.

Implementability: There are no substantial impediments to implementing the proposed corrective measures. However, certain challenges are presented by the large amount of soil characterized as Category I materials and the relatively narrow space between the railroad property and the Front Slope Areas.

4.3.5 Historic Smeltertown Area (IA-5)

The following are summaries of corrective action objectives, preferred corrective action, and current status.

4.3.5.1 Corrective Action Objectives

Historically, this area was used for private housing for Facility employees and their families. Currently, the north-central portion of this area is used by the IBWC for field offices and by Asarco for warehousing purposes and Diesel No. 2 remediation activities. The Diesel No. 2 remediation project is located in the southern portion of the area. Most of this area is unpaved. The area is fenced to prevent unauthorized access.

Lead concentrations in the surface soil exceed industrial/commercial levels, creating a potential human health risk. Eliminating this exposure is the most important risk-based corrective action objective for this area.

4.3.5.2 Proposed Corrective Action

The following corrective action measures were identified for IA-5 during the Phase I and Phase II RIs. These are listed below with their current status:

Proposed Corrective Action (IA-5)	Status
1. Stabilize and deep till soils with elevated metal concentrations in the top 12 inches.	In progress; in conjunction with construction of the Diesel No. 2 recovery system.
2. Conduct confirmation lead sampling at 20 locations; arithmetic average to be below 1,600 mg/kg.	Schedule to be determined.

Proposed Corrective Action (IA-5) cont'd	Status
3. Incorporate materials to stabilize metals in surface soil (upper 12 inches).	Schedule to be determined.
4. Stabilize soils with native vegetation to the extent practicable to minimize wind blown dust.	Schedule to be determined.

Results obtained from the Phase I and Phase II RIs (elevated COC concentrations and other characteristics) suggested the existence of approximately 2,150 CY of Category I material. However, because of the March 15, 2001 updates to the TNRCC MSC and the re-evaluation of the Exposure and Risk Assessment previously conducted at this IA, most of the Category I Material was reclassified as Category II material. Only 300 CY of Category I Material was identified in this IA.

The revised BLRA (Section 3.0) indicated that the risks to human health under both current and probable future land use scenarios are acceptable, with the exception of surface soil lead concentrations. Therefore, the originally proposed corrective actions were modified.

A conceptual illustration of corrective action measures for IA-5 is shown in Figure 4-5.

4.3.5.3 Remedy Evaluation Factors

Compliance with Other Laws and Regulations: Deep-tilling and the addition of soil additives is expected to reduce lead concentrations to below the commercial/industrial use standard.

Long-term Effectiveness and Permanence: Post-remediation lead levels are anticipated to be lowered permanently.

Reduction of Toxicity, Mobility and Volume: Metals in soils in this area have not been shown to substantially affect groundwater quality. Deep-tilling is anticipated to have the effect of reducing the mobility and toxicity of COCs in the near surface (up to two feet deep). As an added safeguard to improve groundwater quality, soil amendments will be added during deep-tilling to further reduce potential metals mobility.

Short-term Effectiveness: Deep-tilling will quickly provide effective short-term control of COCs in the upper two feet of the area.

Implementability: There are no substantial impediments to implementing the proposed corrective measures.

4.3.6 Groundwater (IA-6)

To date, eighteen groundwater monitoring and sampling events have been conducted. These data provide an understanding of sources of COCs and associated risks, and supports regulatory compliance needs. Groundwater flow paths generally follow site topography, and are greatly influenced by former arroyo features. The arroyos may be areas of increased hydraulic conductivity and increased groundwater flow.

The groundwater flow paths are generally toward the Rio Grande. In the low-land areas of the Former Smeltertown Area (IA-5) the flow paths turn southward. The area of greatest groundwater flow into the Rio Grande is thought to occur at the south end of IA-5 where the Rio Grande flows closest to the Facility (around EP-111).

Laboratory results from the sequential groundwater sampling events indicate a general decline in metals concentrations in many areas of the site. These improvements are attributed to the numerous corrective measures implemented to date, and the recent cessation of production at the Facility. The additional corrective measures to be implemented are expected to result in further groundwater quality improvements.

There are no imminent risks resulting from the elevated COC concentrations in groundwater. Groundwater is not used as a source of drinking water. Groundwater is not causing a measurable change in metals concentrations in the Rio Grande. Corrective actions in each IA are intended to eliminate or immobilize sources of metals to groundwater, thereby improving groundwater quality throughout the site and achieving compliance at designated compliance monitoring points adjacent the Rio Grande.

As recommended in the TNRCC Consistency Document (TNRCC, 1998), upon completion of 20 groundwater monitoring and sampling events, the sampling frequencies will be modified to make the monitoring program more efficient and to focus on specific impact areas that have been remediated. The proposed monitoring program and the designated compliance monitoring points are presented in Section 4.2.3.

4.3.7 Surface Water (IA-7)

The surface water body of concern is the Rio Grande. Results from the RI indicate there is no measurable change in water quality in the Rio Grande as it flows past the Facility. Therefore, there are no corrective actions specific to the Rio Grande. Improvements in groundwater quality will likely have a small, but not measurable, effect on the water quality of the Rio Grande.

The American Canal is also a significant surface water feature. The present open-channel design is susceptible to impacts from subsurface flow, storm water and windblown dust. However, the IBWC has initiated plans to reconstruct the American Canal as a closed channel, primarily to control water loss. It is anticipated that the closed channel design will also help minimize any chance of contamination from the Plant.

A contingency is provided for monitoring surface water quality in the unlikely event that groundwater quality adjacent the Rio Grande degrades over time. The proposed monitoring program is presented in Sections 4.2.3.

4.3.8 Bedding and Unloading Building Area (IA-8)

The following are summaries of corrective action objectives, preferred corrective action, and current status.

4.3.8.1 Corrective Action Objectives

This IA consists of the Unloading and Bedding Buildings, railroad spurs and associated facilities. Historically, a variety of Facility raw materials, products and by-products were handled and/or stored in this area. During the 1994 and 1995 multimedia inspection and sampling event, the TNRCC was concerned about the quantity of potentially hazardous materials handled and stored in the area. Some areas are unpaved and contain elevated COC concentrations.

Groundwater in this area indicates little or no arsenic contamination, except for well EP-105. This well is located adjacent to a storm water collection system. The water in this concrete basin was used to supply water for dust suppression. Water from this basin is likely to be the principal source of this groundwater impact.

An important risk-based corrective action objective for this area is to control off-Plant storm run-off from the storm water collection system; thereby preventing further degradation of groundwater.

4.3.8.2 Proposed Corrective Action

Corrective action measures were identified for IA-8 during the Phase I and Phase II RIs. During the earlier phases of the investigation it was thought that the relatively modest levels of groundwater contamination in the area may be from contaminants in the soils, accordingly, previously proposed remediation plans called for extensive surface actions.

However, further investigation of surface soil concentrations in the Phase III investigation did not identify surface soil concentration that are substantially different from the rest of the site. Further inquiry led to the identification of the storm water basin as the likely dominant source of contaminants to the subsurface. This has resulted in substantial revision of proposed corrective actions when compared with previous reports. The proposed corrective actions are listed below with their current status:

Proposed Corrective Action (IA-8)	**Status**
1. Construct asphalt/FML cap for Category II areas.	Schedule to be determined.
2. Construct drainage control features (Drainage collection system). Reengineer or eliminate the storm water basin.	In progress; as part of the recently implemented storm water control improvements.
3. Implement reduced watering for dust suppression after area capping.	Schedule to be determined.

Results from the Phase I and phase II RIs suggested the existence of approximately 24,600 CY of Category I material. However, based on the results of the Phase III RI and further evaluation of recent groundwater analytical results in this IA, it was concluded that the material previously classified as Category I did not meet the criteria established for Category I materials. Therefore, the material was reclassified as Category II material.

A conceptual illustration of corrective action measures for IA-8 is in Figure 4-6.

4.3.8.3 Remedy Evaluation Factors

Compliance with Other Laws and Regulations: Eliminating recharge from the storm water basin to groundwater will result in groundwater quality improvements. Capping previously uncapped areas will reduce surface soil exposures, wind-blown dust generation, and the need for excessive site watering. These actions will in turn reduce air emissions, groundwater releases and the potential for exposure to surface soils.

Long-term Effectiveness and Permanence: Eliminating discharge to groundwater from the storm water basin will likely result in a permanent improvement to groundwater quality. In the arid environment of the Facility there is little to no precipitation and associated vertical hydrologic force that could transport metals to groundwater. Additional paving and other storm water control modifications will further reduce the potential for remaining metals in surface soils to migrate to and contaminate groundwater.

Reduction of Toxicity, Mobility and Volume: Metals mobility will be greatly reduced in the absence of downward hydrologic head.

Short-term Effectiveness: Reducing the probability of metals leaching to groundwater will occur immediately upon implementation of hydrologic controls. However, changes in groundwater quality at groundwater monitoring points will be more gradual given with rate of contaminant fate and transport characteristics.

Implementability: There are no substantial impediments to implementing the proposed corrective measures.

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

The following are summaries of corrective action objectives, preferred corrective action, and current status.

4.3.9.1 Corrective Action Objectives

Over the years, all three unlined Ponds have been used for storage of water from the Rio Grande, fresh make-up city water and process water. They were built in naturally occurring arroyos that formerly existed throughout the Facility. They were constructed long before contemporary standards for lining and containment became common practice. These ponds have been replaced with a new, lined pond located in IA-14.

Results obtained from the Phase I and Phase II RIs indicated that unlined pond sediments were a source of metals to groundwater. The hydrologic driving force associated with the water in the ponds carried COCs in the water and pond sludge into the groundwater, with groundwater flow paths following the historic arroyos within which the ponds were constructed. This is evidenced by increased arsenic concentrations in groundwater downgradient of the ponds (EP-77, EP-56, and EP-116).

Over time, a considerable volume of sludge containing metals accumulated in the pond bottoms. Approximately 26,443 CY of pond sediments are classified as Category I material. Results obtained from the Phase III RI and from the RD investigation refined the volume of Category I material to be approximately 27,100 CY as compared to the Phase II RI estimate.

Closure of the ponds and removal of Category I materials (pond sediments) to prevent future potential groundwater release is the most relevant risk-based corrective action objective for this area.

4.3.9.2 Proposed Corrective Action

The following corrective control measures were identified for the ponds in IA-9. These are listed below with their current respective status:

Proposed Corrective Action (IA-9)	Status
1. Decommission the ponds.	Completed.
2. Excavate existing pond sediments (Category I material).	Schedule to be determined.
3. Dewater sediments.	Schedule to be determined.
4. Confine Category I materials in on-site disposal cell.	Schedule to be determined.
5. Backfill depressions with clean fill.	Schedule to be determined.

A conceptual illustration of corrective action measures for IA-9 is in Figure 4-7.

In previous Reports, the ponds were considered for possible use as engineered impoundments for placement of Category I materials excavated from various IAs. Further evaluation of State landfill siting requirements as well as other design criteria has led to the conclusion that the ponds do not satisfy the designated criteria. Therefore, plans now call for backfilling the ponds with clean fill.

4.3.9.3 Remedy Evaluation Factors

Long-term Effectiveness and Permanence: The recent completion of the Storm Water Collection and Reuse System has eliminated storm water and other process fluids from entering the decommissioned unlined ponds and becoming a source of metals to groundwater. Eliminating discharge to groundwater from the unlined ponds will likely result in a permanent improvement to groundwater quality.

Reduction of Toxicity, Mobility and Volume: Removal of Category I materials (pond sediments) will dramatically reduce the volume (and mass) of contaminated soils in the area. Decommissioning the ponds has already reduced hydrolic head and therefor the mobility at underlying metals.

Short-term Effectiveness: Reduced metals leaching to groundwater will occur immediately upon implementation of the proposed actions. However, changes in groundwater quality at groundwater monitoring points will be more gradual, consistent with rate of contaminant fate and transport characteristics.

Implementability: There are no substantial impediments to implementing the proposed corrective measures.

4.3.10 Plant Entrance Area (IA-10)

The following are summaries of corrective action objectives, preferred corrective action, and current status.

4.3.10.1 Corrective Action Objectives

The Facility Entrance Area contains a storm water drain system consisting of a sump, a lift pump, and an interceptor trench that crosses the Facility entrance road. During the multimedia inspection in 1994, the TNRCC expressed concern that storm water overflow could potentially discharge into the American Canal. Therefore, the Front Entrance roadway and the storm water sump were reconstructed as part of the recent storm water control upgrades.

Additionally, the area was re-graded and a concrete pavement with curb and gutters were implemented. Results from the RI activities did not identified any Category I material in this area. This area is not considered a potential source to impact groundwater.

Maintenance of storm water controls is the most relevant risk-based corrective action objective for this IA.

4.3.10.2 Proposed Corrective Action

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 (IA-10)	Status
1. Rebuild the first 200 feet of the Facility entrance road.	Completed; improvements control surface runoff and minimize 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 4-8.

4.3.10.3 Remedy Evaluation Factors

Compliance with Other Laws and Regulations: The recent completion of the Storm Water Collection and Reuse System included rebuilding the Facility entrance road and replacing the runoff collection sump. These improvements have eliminated storm water and other runoff from potentially entering the American Canal or becoming a source of metals to groundwater.

Long-term Effectiveness and Permanence: Continued maintenance of the storm water system will be required.

Reduction of Toxicity, Mobility and Volume: The potential for release of storm water has been substantially reduced.

Short-term Effectiveness: Eliminating storm water discharge is immediately effective in preventing unauthorized discharge of storm water.

Implementability: All applicable corrective action measures for IA-10 listed above have been implemented.

4.3.11 Arroyo East of I-10 (IA-11)

The following are summaries of corrective action objectives, preferred corrective action, and current status.

4.3.11.1 Corrective Action Objectives

This area is largely unused and undeveloped land owned by Asarco. Parts of the area was formerly used for storage of Facility construction materials and demolition debris. The predominant hydrologic features in this area are two open arroyos that include; the Northern and Southern Arroyos. The Southern Arroyo was used for the storage of slag, and the Northern Arroyo was used for the storage of slag, construction materials and demolition debris. The majority of this area is undisturbed with occasional dirt roads, flood control works that include two reservoirs or drainage basins, and two dam structures.

Some areas of the IA contains metals concentrations in excess of the TNRCC cleanup standards, indicating a potential risk to human health from exposure to surface soil. Presently, the site is rarely visited by Facility workers. The area is outside of the Facility fence, and is rarely visited by anyone.

Monitoring well EP-97 indicates a relatively low level of arsenic contamination. Inquiries into historic use of the area indicates that former arsenic production material was placed in this area. The impact to groundwater is of limited extent. The area is distant from the Rio Grande, with little to no potential for future impact to water quality in the Rio Grande. Removal of the source material affecting groundwater quality is the most relevant risk-based corrective action objectives for this area.

4.3.11.2 Proposed Corrective Action

Originally, during the Phase I RI, IA-11 was included as part of IA-2. Based on the results of the Phase I RI and comments from the TNRCC, IA-11 was separated from IA-2. During phase II RI, the following eight corrective action measures were identified:

Proposed Corrective Action (IA-11)	Status
1. Clean up of debris.	Schedule to be determined.
2. Excavation of Category I materials.	Schedule to be determined.
3. Grading of excavated areas to blend with existing topography and to improve slope stability.	Schedule to be determined.
4. Disposal of Category I materials in on-site disposal cells.	Schedule to be determined.
5. Construct a protective cap (FML or GCL/drainage layer) over Category II materials.	Schedule to be determined.
6. Construct run-off drainage controls to protect remediated areas.	Schedule to be determined.

Proposed Corrective Action (IA-11) cont'd	Status
7. Stabilize disturbed areas with vegetation to prevent erosion during storm events.	Schedule to be determined.
8. Implement engineering controls (fencing) to control public access.	Schedule to be determined.

During Phase I and Phase II RI activities, a small area associated with the Southern Arroyo was considered as a potential source of metals to groundwater. Approximately 1,620 CY of Category I material was identified in this area. All material associated with the Northern Arroyo was classified as Category II material. Results of additional soil samples collected during the Phase III RI, indicated that the material identified in the Southern Arroyo of this IA did not meet the criteria to be classified as Category I material. Therefore, the material has been reclassified as Category II material. Based on concentrations of COCs, operational relations and groundwater impacts.

During the Phase III RI, the vertical and lateral extent of the materials associated with the Northern Arroyo (deposition area) was determined. Interviews with Facility personnel indicate that the former arsenic processing material (Category I) was placed in this area. This material will be excavated and disposed in the on-site disposal cells. Approximately 122,000 CY of material identified in this area will be placed in the on-site disposal cell. A conceptual illustration of corrective action measures for IA-11 is shown in Figure 4-9.

4.3.11.3 Remedy Evaluation Factors

Compliance with Other Laws and Regulations: The removal of the material with the highest metals concentrations in the area will result in groundwater quality improvements. Access controls will be necessary to prevent possible unacceptable exposure to remaining contaminated soils.

Long-term Effectiveness and Permanence: Continued maintenance of access controls and storm water controls will be required. Removal of Category I materials will be permanent.

Reduction of Toxicity, Mobility and Volume: The most contaminated material will be removed. Storm water controls will minimize erosion of remaining soils.

Short-term Effectiveness: Removal of the most contaminated materials will reduce possible exposure to humans and will minimize impacts to groundwater.

Implementability: All applicable corrective action measures for IA-10 listed above have been implemented.

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

The following are summaries of corrective action objectives, preferred corrective action, and current status.

4.3.12.1 Corrective Action Objectives

Similar to IA-11, this IA was previously included as part of IA-2. However, based on the results of the Phase I RI and comments from the TNRCC, this area was separated from IA-2 as designated as IA-12.

This area is predominantly used for slag storage. The Ephemeral Pond consists of an enclosed pond or depression in a backfilled Arroyo (Northern Arroyo from IA-11). The pond, which is dry most of the time, receives occasional local storm runoff. In the past, pond sediments were excavated from Pond 6 and stored in the southern portion of this IA, at the southwest corner of the intersection of I-10 and the Facility roadway to IA-11. Groundwater quality impacts occur downgradient of this storage area and beneath the Ephemeral Pond.

Important risk-based corrective action objectives are oriented toward improving groundwater quality, and include:

- Eliminating Category I sources of metals to groundwater.
- Improving storm water flow through the area to prevent ponding and hydrolic head on underlying metals in soils.

4.3.12.2 Proposed Corrective Action

During the Phase I and Phase II RIs, this area was identified as a potential source of groundwater impacts. Approximately, 16,000 CY of Category I material were identified from two distinctive areas that include: the Pond Sediment Storage Area and an area around boring RIBHI. Based on the result of Phase III RI however, the materials around RIBH1 that had been classified as Category I were reclassified as Category II materials. This reclassification was based on Phase III RI data, which further delineated the extent of various categories of materials. Analytical data obtained from soil borings installed in this area indicated arsenic, cadmium, and lead concentrations are within the TNRCC commercial/industrial standards.

The extent of Category I materials in the Ephemeral Pond Area was fully delineated during the Phase III RI. Results from this delineation indicate that the volume of Category I material is much less than that estimated during Phase II RI. Approximately 2,300 CY of Category I material will be removed from the Ephemeral Pond Area and placed on the on-site disposal cell.

In addition to the remediation objectives, this area is now proposed as the locations for the disposal cell for Category I material. As discussed in a later section, the TNRCC siting criteria for the selection of Industrial Solid Waste Landfill Sites (Technical Guideline No. 2) indicated that the previously selected locations in IA-9 did not meet these siting criteria. Examination of site geology and hydrology suggests that that the Ephemeral Pond Area satisfies both the TNRCC siting criteria and meets the anticipated capacity requirements. Therefore, this location has been selected for the on-site disposal cell.

The specific corrective actions to perform in this IA include:

Proposed Corrective Action (IA-12)	Status
1. Excavation of Category I materials.	Schedule to be determined.
2. Construction of disposal cell.	Schedule to be determined.
3. Dispose of Category I materials in on-site disposal cell.	Schedule to be determined.
4. Grade and construct a lined storm water impoundment.	Schedule to be determined.
5. Construct drainage improvements such as channels and culverts to complement the storm water impoundment.	Schedule to be determined.

A conceptual illustration of corrective action measures for IA-12 is shown in Figure 4-10.

4.3.12.3 Remedy Evaluation Factors

Compliance with Other Laws and Regulations: Removal of the highest metals concentrations material with metals in the area will result in groundwater quality improvements. Access controls will be necessary to prevent possible unacceptable exposure to remaining contaminated soils.

Long-term Effectiveness and Permanence: Continued maintenance of access controls, storm water controls and the disposal cell will be required. Maintain disposal cell.

Reduction of Toxicity, Mobility and Volume: The most contaminated material will be removed. Storm water controls will minimize transport of metals to groundwater.

Short-term Effectiveness: Removal of the most contaminated material will minimize impact to groundwater and lessen potential exposure to humans. The actions can be implemented upon approval. Groundwater quality improvements are anticipated to occur over time as a result of the planned source material removal activities that are a part of the proposed corrective action plan.

Implementability: There are no impediments to implementation. Upon approval of the engineering design, the TNRCC will be notified of the schedule for the construction of the disposal cell.

4.3.13 Sample Mill Area (IA-13)

The following are summaries of corrective action objectives, preferred corrective action, and current status.

4.3.13.1 Corrective Action Objectives

This IA is located southwest of the Lead Plant Area and was historically used as a leach Facility to remove chlorine from Lead Baghouse dusts prior to their addition as feed material. Some areas are unpaved and contain elevated metals concentrations. Results obtained from RI activities indicate that this area is a potential source of groundwater impact.

Relevant risk-based corrective action objectives include:

- Reduction of potential worker contact with surface soil.
- Reduction of the potential for metals to leach from surface soils to groundwater.

4.3.13.2 Proposed Corrective Action

Additional data collected during Phase III RI served to provide a more exact delineation of Category I materials. These data resulted in a reduced estimate of Category I materials to a small area near the rail unloading hoppers. Approximately 1,000 CY of Category I material will be removed from this IA and placed in the on-site disposal cell. The corrective action measures, and their status, identified for this area during the Phase II RI include:

Proposed Corrective Action (IA-13)	Status
1. Excavate Category I materials.	Schedule to be determined.
2. Backfill excavated areas with clean soil or crushed slag.	Schedule to be determined.
3. Dispose of Category I materials in on-site disposal cell.	Schedule to be determined.
4. Cap any Category II materials, if identified.	In progress; as part of storm water control improvements.
5. Cap replacement soil area with asphalt/FML.	Schedule to be determined.
6. Construct concrete slab (cap) to replace railroad ballast.	Schedule to be determined.

The potential for percolation of water into the subsurface has been reduced with recently implemented storm water control improvements. A conceptual illustration of corrective action measures for IA-13 is shown in Figure 4-11.

4.3.13.3 Remedy Evaluation Factors

Compliance with Other Laws and Regulations: Removal of the most contaminated material in the area will result in groundwater quality improvements and minimize future potential worker exposure.

Long-term Effectiveness and Permanence: The removal of Category I materials will result in permanent reductions in the volume and mass of uncontrolled contaminated material on-site. Maintenance of area caps and storm water controls will be required.

Reduction of Toxicity, Mobility and Volume: The most contaminated material will be removed. Storm water controls will minimize ponding and subsurface migration potential for remaining contaminants in soils.

Short-term Effectiveness: Removal of the most contaminated materials will improve groundwater quality and minimize worker exposure.

Implementability: There are no impediments to implementation.

4.3.14 South Terrace Area (IA-14)

The following are summaries of corrective action objectives, preferred corrective action, and current status.

4.3.14.1 Corrective Action Objectives

This area consists of a flat area that has historically been utilized for the storage of concentrates, silica fluxes, and temporary storage of Facility equipment. A lined pond has been constructed in this IA to contain storm water to in order to prevent runoff of storm water from the Site. This lined pond effectively acts like a cap, preventing infiltration of water to groundwater.

There are relatively low level groundwater impacts in this area. The source of these impacts is believed to come from the storm water storage basin locate upgradient in IA-8.

- Relative to other IAs, this is not a large contributor to exposure or risk. However, much of this area remains unpaved. Controlling exposure to surface soils and possibly reducing site watering for dust control are the most important risk-based corrective action objectives for this area.

4.3.14.2 Proposed Corrective Action

During Phase II RI activities, a small area was determined to contain elevated metals concentrations. This area was then identified as a potential source of groundwater impacts and classified as Category I material. However, based on the result of Phase III RI, these materials were reclassified as Category II materials based on COC concentrations, groundwater impacts, relation to Facility operations, etc. In addition, much of this IA is now effectively capped due to recently implemented storm water control improvements.

The corrective actions identified for this area during Phase II RI and their current status include:

Proposed Corrective Action (IA-14)	**Status**
1. Cap replacement soil area with asphalt or gravel.	Schedule to be determined.
2. Reduce site water for dust control as possible without comprising ambient air quality.	Schedule to be determined.

A conceptual illustration of corrective action measures for IA-14 is shown in Figure 4-12.

4.3.14.3 Remedy Evaluation Factors

Compliance with Other Laws and Regulations: Capping the area will minimize storm water percolation through soils and result in groundwater quality improvements. The caps will also minimize future potential worker exposure. Reduced watering for dust control may also be possible after capping to minimize mobilizing metals in the soil.

Long-term Effectiveness and Permanence: Maintenance of the cap will be required.

Reduction of Toxicity, Mobility and Volume: Capping will minimize ponding and subsurface migration potential for remaining COCs in soils.

Short-term Effectiveness: The cap will immediately reduce worker exposure to site contaminants. Groundwater quality improvements will occur in time.

Implementability: There are no impediments to implementation.

4.3.15 Copper Plant (IA-15)

The following are summaries of corrective action objectives, preferred corrective action, and current status.

4.3.15.1 Corrective Action Objectives

The Copper Plant is located south of the 850 ft Stack, west of the Converter Building and north of the former Lead Plant. The Copper Plant includes the Copper Wedge Roaster, the Copper Reverberatory Furnace, and the Copper Brick Flues. All facilities and structures at the Copper Plant, with the exception of the Copper Reverberatory Furnace, have been demolished in accordance with the SEP, contained in the Agreed Order (TNRCC, 1996).

Relative to other IAs, this area is not a major contributor to exposure or risk. Groundwater data below this area suggests that surface soil is not a source of contamination to groundwater. However, much of this area remains unpaved. Controlling exposure to surface soils and reducing site watering for dust control are the most important risk-based corrective action objectives for this area.

4.3.15.2 Proposed Corrective Action

Based on the Closed Plant evaluation data, all surface material was characterized as Category II. The following specific corrective actions are proposed:

Proposed Corrective Action (IA-15)	Status
1. Implement drainage improvements.	In progress.
2. Cap all Category II materials.	Schedule to be determined.
3. Reduce water use for dust suppression, as feasible without exceeding air quality requirements.	Schedule to be determined.

A conceptual illustration of corrective action measures for IA-15 is shown in Figure 4-13.

4.3.15.3 Remedy Evaluation Factors

Compliance with Other Laws and Regulations: Capping the area will minimize storm water percolation through soils and result in groundwater quality improvements. The caps will also minimize future potential worker exposure. Reduced watering for dust control may also be possible after capping.

Long-term Effectiveness and Permanence: Maintenance of the cap will be required.

Reduction of Toxicity, Mobility and Volume: Capping will minimize storm water ponding and subsurface migration potential for remaining contaminants in soils.

Short-term Effectiveness: The cap will immediately reduce exposure to site contaminants. Groundwater quality improvements will occur in time.

Implementability: There are no impediments to implementation.

4.3.16 Lead and Sinter Plants (IA-16)

The following are summaries of corrective action objectives, preferred corrective action, and current status.

4.3.16.1 Corrective Action Objectives

The former Lead and Sinter Plants are located south of the Copper Plant, west of the former Pond No. 5, north of the Sample Mill Area and north of the Bedding Building. The Facility was originally founded as a lead smelter in 1887 and the Lead Plant operated continuously up to its closure in 1985.

The Sinter Plant, a relatively modern addition to improve the Facility process, began operations in 1979. Sinter Plant operations ceased in 1985, at the same time as the Lead

Plant. The facilities and structures associated with the Lead and Sinter Plants, including the Lead Baghouse and Lead Blast Furnace, have been demolished down to the foundations in accordance with the Agreed Order Supplemental Environmental Project (TNRCC, 1996).

This area does contain a spray tower, which uses water to control dust levels from concentrate materials being transported over the Site by a conveyer system. Over-spray may have created a driving hydrologic force for contaminating groundwater. Operational controls to prevent this situation are warranted.

Other than the spray tower issue, this area is not a major source of exposure or risk. However, much of this area remains unpaved. Controlling run-off to surface soils and reducing site water for dust control are therefore important risk-based corrective action objectives for this area.

4.3.16.2 Proposed Corrective Action

Based on the Closed Plant evaluation data, all surface material in this area was classified as Category II. To prevent any potential percolation of surface water in this area, the following specific corrective actions are proposed:

Proposed Corrective Action (IA-16)	**Status**
1. Implement drainage improvements.	In progress.
2. Cap all Category II materials.	Schedule to be determined.
3. Reduce Spray Tower overspray onto surface soils and use secondary containment to prevent subsurface migration of metals in soil.	Schedule to be determined.

A conceptual illustration of corrective action measures for IA-16 is shown in Figure 4-14.

4.3.16.3 Remedy Evaluation Factors

Compliance with Other Laws and Regulations: Capping the area will minimize storm water percolation through soils and result in groundwater quality improvements. The caps will also minimize future potential worker exposure. Reduced watering for dust control may also be possible after capping. Spray tower controls may result in groundwater quality improvements.

Long-term Effectiveness and Permanence: Eliminating the spray tower over-spray will permanently minimize future groundwater impacts. Maintenance of the cap will be required.

Reduction of Toxicity, Mobility and Volume: Capping will minimize storm water ponding and subsurface migration potential for remaining COCs in soils. Spray tower improvements will reduce a dominant force effecting groundwater quality.

Short-term Effectiveness: The cap will immediately reduce worker exposure to site contaminants. Groundwater quality improvements will occur in time.

Implementability: There are no impediments to implementation.

4.3.17 Zinc and Cadmium Plants (IA-17)

The following are summaries of corrective action objectives, preferred corrective action, and current status.

4.3.17.1 Corrective Action Objectives

The former Cadmium and Zinc Plants were located east of the Acid Plant Area and west of the Godfrey Roaster (used for cadmium oxide production). The Cadmium Plant was constructed in the 1930s and a blast furnace slag fuming plant (Zinc Plant) was later constructed in 1948. Zinc production continued until the Zinc Plant was shut down in 1982. The Cadmium Plant ceased operations in 1992. The Zinc Plant and Cadmium

Baghouse were demolished down to foundations in 1998 and 1999, respectively, in compliance with the Agreed Order Supplemental Environmental Project (TNRCC, 1996).

This area is not a major source of exposure or risk. However, parts of this area remain unpaved. Therefore, controlling exposure to surface soils and reducing site watering for dust control is an important risk-based corrective action objectives for this area.

4.3.17.2 Proposed Corrective Action

Based on information gathered from the evaluation of this area, all surface material was classified as Category II. Although most of this area is already under impervious cover, it will be fully capped to prevent potential percolation of surface water. The following specific corrective actions are proposed:

Proposed Corrective Action (IA-17)	Status
1. Implement drainage improvements.	In progress.
2. Cap all Category II materials.	Schedule to be determined.
3. Reduce site watering, as possible.	Schedule to be determined.

A conceptual illustration of corrective action measures for IA-17 is shown in Figure 4-15.

4.3.17.3 Remedy Evaluation Factors

Compliance with Other Laws and Regulations: Capping the area will minimize storm water percolation through soils and will likely result in groundwater quality improvements. The caps will also minimize future potential worker exposure. Reduced watering for dust control may also be possible after capping, which would further reduce hydrolic head on contaminants in the soils.

Long-term Effectiveness and Permanence: Maintenance of the cap will be required.

Reduction of Toxicity, Mobility and Volume: Capping will minimize storm water ponding and subsurface migration potential for remaining COCs in soils.

Short-term Effectiveness: The cap will immediately reduce worker exposure to site contaminants. Groundwater quality improvements will occur over time.

Implementability: There are no impediments to implementation.

4.3.18 Former Antimony Plant (IA-18)

The following are summaries of corrective action objectives, preferred corrective action, and current status.

4.3.18.1 Corrective Action Objectives

The former Antimony Plant is located in the central part of the Facility, east of IA-8. The Antimony Plant was in operation from the late 1970s until it was decommissioned in 1986. It has since been stripped and the building is now in service as the Facility Automotive Shop.

Metals concentrations in soils are some of the lowest in the Facility area. There are no groundwater impacts in this area. This IA is completely covered by asphalt except for a small area near a cooling tower. Analytical data gathered from the surface and subsurface materials indicated that the risk to human health and the environment is acceptable, therefore, no corrective action is necessary.

4.3.18.2 Proposed Corrective Action

No corrective actions are proposed for this area.

4.3.19 Siting Criteria for the Design of Disposal Cells

The TNRCC General Siting Criteria for the selection of Industrial Solid Waste Landfill Sites (Technical Guideline No. 2) was reviewed to determine whether or not the original proposed disposal cell locations (IA-9) met the Siting Criteria. In general, a site for a potential disposal cell must satisfy the following TNRCC general Siting Criteria:

- A minimum separation distance of 200 feet from adjacent properties.
- At least 500 feet from public drinking water sources.
- Not in a 100-year flood plain.
- Without wetlands.
- Without subsidence areas.
- Vertically separated from the underground aquifer.

Application of the Siting and Landfill Construction Criteria results in a significant reduction in the available storage capacity of the ponds: hence, use of the ponds as disposal cells was not technically feasible. Re-examination of site geology and hydrology suggests that the Ephemeral Pond Area (IA-12), northwest of the Plant, satisfies both the TNRCC siting criteria and meet the capacity requirements.

The designs associated with the disposal cell will be developed using industry standards for landfill construction and will address TNRCC Landfill Construction Technical Guidelines (Technical Guideline No. 3). The disposal cell will be used for the disposal of Category I materials excavated from the different IAs.

4.4 SUMMARY AND INTEGRATION WITH PROJECT CLOSURE

The Site is subject to the TNRCC requirements of 30 TAC 335.8 regarding site closure. To achieve project closure at this Site it will be necessary to:

- Demonstrate achievement of applicable standards,
- Implement appropriate deed recordation, and
- Be prepared to respond on a continual basis to changing conditions affecting exposure or risk.

This section of the Report summarizes how the corrective actions are expected to achieve compliance with standards, and the anticipated approach to obtaining closure. Closure would be pursued upon achieving compliance in all media. The approach is defined for each media.

Soil: The corrective action objectives, from Section 3.2, are to minimize surface soil exposure to workers. Corrective actions relevant to involve a combination of removing the most contaminated soils and capping the site as appropriate. Furthermore, access will be restricted by maintaining a fence around the Site and controlling access through the gate. As in the past, OSHA approved health and safety program will be used to further minimize worker exposure.

The effectiveness of this program will be monitored through an evaluation of biomonitoring results integral to the Facility worker health and safety program. In support of closure, a surface water and groundwater monitoring program will be initiated.

Groundwater: The corrective action objectives from Section 3.2, are to prevent groundwater exposure and minimize off-Site contaminant transport. Corrective actions supportive of this goal generally involve a combination of process improvements, removal of Category I materials, and a variety of storm water control type improvements. Use of shallow groundwater as an aquifer for drinking water supply will be prevented through implementation of deed restrictions.

The effectiveness of these corrective measures will be tracked through use of the proposed groundwater and surface water monitoring program identified in Section 4.2.3.

Surface Water: The corrective action objectives, from Section 3.2, are to improve storm water controls. Storm water run-on and runoff will be controlled to achieve virtual zero-surface storm water discharge or to discharge in compliance with a storm water discharge permit. A variety of storm water control methods are to be utilized, including grading, capping, capture systems, pump-back systems, and channel construction.

The effectiveness of these methods will be measured against the goal of achieving a zero-surface storm water discharge or successful compliance with the terms of a storm water discharge permit.

Air: The corrective action objectives, from Section 3.2, are to minimize on-Facility and off-Facility windblown dust exposure. Corrective actions proposed to reach this goal generally involve capping areas of exposed soil. Site watering may be adjusted to use less water (to support groundwater quality improvements) without compromising ambient air quality. For on-site workers, the worker health and safety program acts to ensure there is no excess exposure.

The effectiveness of these corrective measures for off-Site areas will be evaluated using the ambient air quality data that is collected in accordance with the Facility's air quality permit. A summary of this information will be provided to document compliance with all applicable air quality requirements. On-site effectiveness will be demonstrated using compliance monitoring.

Once all of the corrective action measures objectives above are achieved, a report will be provided to the TNRCC with the necessary documentation, as described above. Additionally, a list of post-closure care requirements will be provided.

Briefly, of the major elements of these post-closure care requirements would include maintenance of various Facility-elements and programs such as monitoring, site access controls, storm water controls, site caps, and shallow groundwater use restrictions. Asarco also recognizes the ongoing need to respond on a continual basis in the event of substantial change in circumstances that could result in unacceptable threat to human health and/or the environment. Some examples of Asarco's need for review and input could include plans for site redevelopment, or re-evaluation of the new channel design for the American Canal.

4.5 PROPOSED ADDITIONAL REMEDIAL INVESTIGATION ACTIVITIES

4.5.1 Front Slope/Western Facility Boundary (IA-4) / Historic Smeltertown Area (IA-5)

An additional phase of investigation is recommended to better delineate soil and groundwater impacts in the vicinity of IA-4 and IA-5. This phase of the investigation will help to evaluate the possible existence of other unknown source materials affecting the groundwater in the area. Also, pursuant to the TNRCC Consistency Document (TNRCC, 1998), modified monitoring well sampling frequencies are recommended to make the monitoring program more efficient and cost effective.

To understand the groundwater flow and conditions in IA-5, at least eight additional borings, four of which will be converted to monitoring wells, are proposed. The wells will be installed in the vicinity of monitoring wells EP-111, EP-128, EP-127, and EP-132. Historically, these wells have showed some significant levels of arsenic in groundwater.

The data indicates that the source material affecting groundwater in this area is the Category I material existing just upgradient of the affected groundwater zone (IA-4, Front Slope). As part of the corrective actions, this material will be excavated and disposed in the on-Site disposal cell. However, to ensure that no other source material is present, the proposed addition investigation is required.

Additionally, to evaluate the subsurface conditions in the area of the IBWC, ten shallow soil borings are installed. Soil samples will be collected in five one foot interval from groundwater surface to a maximum depth of five feet.

4.5.2 The La Calavera Area (IA-19)

To properly determine if there is a potential risk for La Calavera residents to soil contaminants, a detailed surface and subsurface soil sampling program will be implemented in the area. Approximately 160 surface and subsurface soil samples will be collected for analysis from about sixty sampling locations.

At each sampling location, a surface soil sample will be collected from 0 to 1 inches bgs and will serve to characterize the surface soil. Additionally, at each location, a single, grab soil sample will be collected from 1 to 6 inches bgs. Finally, a single grab soil sample will be collected from 1-2 feet bgs.

The soil characterization will be conducted using procedures identified for the RI (RI Work Plan Hydrometrics, 1996). Samples will be submitted to Asarco's Technical Services Center (TSC) in Salt Lake City, Utah for analysis. The samples will be analyzed for the COCs identified by the TNRCC using XRF Spectrophotometry.

Based upon the analytical results, specifically whether elevated metal concentrations are detected at depth, Asarco may recommend additional sampling.

Also, in order to determined the origin, composition and availability of these COCs to the environment, at selected locations, samples will also be collected for Speciation and Bio-Availability testing.

Asarco believes that the source of any potential metal detected in the residential area is a result of the slug crushing operation that has been occurring at the Oglebay Norton Facility, located adjacent and south of the residential area.

This operation historically and currently consists of crushing the slag produced as a result of copper smelting operations at the Plant. The slag is mined by Oglebay Norton and processed into products such as railroad ballast, abrasive (sandblasting) media, and asphalt aggregate. Under natural conditions, the slag is inert, does not leach harmful substances, and poses no threat to human or animal life, or the environment. However, the very fine dust produced by the crushing operation can then become airborne an potentially pose a threat to human life.

SECTION 5.0

SUMMARY AND CONCLUSIONS

5.0 SUMMARY AND CONCLUSIONS

The following conclusions are based on the results of the Phase I, Phase II and Phase III RIs for the Facility:

General

1. Site characterization activities at the subject Facility for this Phase III RI are based on the results of the Phase I and Phase II RIs conducted pursuant to the TNRCC Agreed Order. The Phase III RI was expanded to twenty IAs from the fourteen IAs identified in the Phase II RI.

2. As with the Phase I, and Phase II RIs, in the Phase III RI, soil samples and monitor wells were installed to further delineate Category I materials and evaluate groundwater conditions.

3. As a result of the Phase III RI, some material previously classified as Category I during the Phase I and Phase II RIs, was reclassified as Category II material.

4. No appreciable terrestrial wildlife or high-quality terrestrial habitat is located within the project site.

5. Two diesel fuel spills occurred at the Facility (Diesel No. 1 and Diesel No. 2 Remedial Areas) that resulted in diesel being present in subsurface materials. Diesel No. 1 was successfully remediated under a separate Enforcement Order receiving Site Closure Status on November 15, 2000. Diesel No. 2 is being remediated as a voluntary effort.

6. Some additional soil and groundwater investigations are recommended in IA-4 and IA-5 to better define and evaluate possible remaining source areas.

7. The Closed Plants were evaluated and incorporated into the site assessment as IA-15, IA-16, IA-17, and IA-18. Findings from these evaluations are presented in the Phase III RI Report.

8. The Asarco property, bounding La Calavera, was evaluated during the Phase III RI and incorporated as IA-19.

9. The Asarco property located east of I-10 was further evaluated during the Phase III RI. This area was incorporated as IA-20.

Soils

10. Soils in the Plant area are a mix of colluvial and fluvial sediments, with areas of extensive fill consisting of slag and other materials.

11. Arsenic, cadmium, and lead are the predominant COCs in soil at the Facility. These COCs can be associated with historic smelter operations, and to some extent, occur naturally in the soils in the general area. Materials associated with potential source areas are separated into three Categories (I, II and III) based on metal concentrations, degree of potential toxicity, distribution and volume of materials, associated Facility processes, visual characteristics and impacts to groundwater.

    - Category I materials are residual byproducts from current and past smelter operations and are associated with elevated concentrations of metals in underlying groundwater.

    - Category II materials are large volumes of diluted residual by-products (most of the same materials listed as Category I) and debris from demolition of smelter facilities with residual concentrations of metals. Category II materials do not currently represent a source of metals to the underlying groundwater.

- Category III materials are copper and lead slag, as well as other basically inert materials.

Groundwater and Surface Water

12. The Rio Grande borders the Site to the west and south. The TNRCC designated water uses are Domestic Water Supply, Non-Contact Recreation and Limited Aquatic Life. Flow in the river is dam controlled, with higher flows released during the summer months (April to September).

13. The American Canal, which also borders the site to the west and south, is a concrete lined channel that receives flow from the Rio Grande during the summer months (April to September).

14. The Facility is underlain by arroyos that have been backfilled with soil, slag, and other materials. The arroyos appear to channel and control the flow of groundwater and migration of COCs beneath the Facility. The RIs and associated proposed corrective actions focus on the arroyos as having primary influence for impacts to groundwater.

15. Some elevated metal concentrations were observed during Phase I of the RI in the American Canal. These exceedences were associated with abnormally low flow conditions, and are not indicative of typical conditions. No constituents were detected above MCLs during the Phase III RI in surface water samples collected from the Rio Grande.

16. Depth to groundwater ranges from 60 feet bgs in upgradient areas to 10 feet bgs along the Rio Grande floodplain. The shallow groundwater system beneath the Site is composed primarily of interbedded and mixed silt, sand, gravel, boulders and bedrock. Within the Rio Grande flood plain, the Rio Grande aquifer is composed primarily of fine clayey sand. Groundwater flow in the vicinity of the Facility is from the east-northeast toward the Rio Grande.

17. Groundwater in the project area generally flows west toward the Rio Grande, and occurs at depths ranging from 40 to 60 feet bgs beneath the Facility, to about ten feet bgs in wells adjacent to the Rio Grande.

18. Groundwater underlying, and in the vicinity of, the Facility is not used for drinking water purposes. The nearest domestic well is approximately one-half mile north and upgradient from the Facility.

19. Elevated concentrations of arsenic, cadmium and lead were found in groundwater samples collected across the Facility.

20. A new monitoring well sampling frequency program is proposed to begin during the 3rd quarter of 2002. This program will be implemented during two years ending with the 2nd quarter of 2004.

21. During the 3rd quarter of 2003, a RI Annual Groundwater Monitoring Report will be submitted to the TNRCC.

22. Fate and transport simulations using site-specific data indicate that impacts to the Rio Grande from arsenic migration may occur if source areas/materials on the Facility are not removed or isolated in the near future.

23. Re-evaluation of soil and groundwater data gathered during RI activities suggest that the groundwater impacts in the area of EP-111, EP-127, and EP-128 are a result of the existing Category I material in IA-4, just upgradient from this impacted area. As part of the corrective actions, this material will be excavated and properly disposed in the proposed on-Site disposal cell.

Human Health Risks

24. The Human Health Risk-Based evaluation initially developed during the Phase I RI was revised during Phase III pursuant to the TNRCC comment.

The results of the Revised BLRA conclude that while elevated metals concentrations exist in soil and groundwater, no imminent health threats exist at or near the Facility. Results of the Exposure and Risk Assessments indicated the following:

- The site has been utilized by several smelters and refineries since 1889.
- On-site soils and former process pond sediments are known to contain elevated metals.
- Land use proximal to the site is primarily industrial and commercial, with some residential.

25. The exposure pathway analysis identified on-site workers, off-Site workers and off-Site residents as the only potential receptors of Facility contaminants.

26. While not legally binding as a TNRCC-approved corrective measure, the implementation of a worker health and safety program, the treatment of stack emissions, site watering for dust level control, as well as the recently constructed storm water management system, have all greatly reduced the potential for on-site and off-Site workers and off-Site residents to be exposed to site contaminants.

Corrective Action Measures

27. Corrective action objectives are as follows:

- Reduce the potential for metals exposure to Facility workers and the public.
- Minimize the potential for transport of metals to groundwater.

- Prevent increases in metal concentrations in the American Canal and Rio Grande.

28. Corrective actions will be implemented to ensure compliance with Standard No. 3 (Closure/Remediation with Controls) of the TNRCC Risk Reduction Rules. This includes:

- Institutional controls/deed restrictions (access restriction, prohibition on use of groundwater for drinking water purposes, worker health and safety programs).
- Containment (capping and surface control).
- Removal/disposal (excavation and on-site disposal).

29. Corrective actions implemented at the Facility to date have resulted in the reduction of COC concentrations in certain areas of the Facility.

30. Specific corrective action measures to remediate source areas were developed from corrective action alternatives. Corrective action alternatives were selected during the Phase I RI after an evaluation of corrective action technology and process options based on effectiveness, implementability and cost.

31. Excavation and on-site disposal alternatives apply to Category I materials and capping and surface control alternatives apply to Category II materials.

32. Corrective action alternatives and measures do not generally apply to Category III materials (slag), which will be managed in place or crushed and used as backfill for remedial construction.

33. The storm water control upgrades associated with the recently completed Storm Water Collection and Reuse System at the Facility substantially minimizes the potential for Facility storm water runoff to leave the Plant property and impact nearby surface waters, the American Canal and Rio Grande, as well as protecting groundwater.

34. Operational controls have been implemented which minimize discharges from Facility components.

35. Excavation of Category I materials has been performed in the Medford Sump (IA-1) and the Boneyard Area (IA-2).

36. Ponds 1, 5 and 6 have already been decommissioned, and will no longer provide hydrolic head for underlying metals in the soil.

37. Review of the TNRCC guidelines for the selection of Industrial Solid Waste Landfill Sites (Technical Guideline No. 2) and disposal capacity requirements, indicated that Ponds 1, 5, and 6, previously selected for use as disposal cells, will not meet the TNRCC landfill siting criteria. Therefore a new location was selected. Examination of site geology and hydrology suggests that that the Ephemeral Pond Area (IA-12), northwest of the Facility, satisfies both the TNRCC siting criteria and meet the project capacity requirements. Therefore, it was selected as the location for the on-site disposal cell.

SECTION 6.0

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6.0 REFERENCES

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TABLES

TABLE 1-1

Facility Regulatory Permit Information

Permit No.	Permit Type	Issuing Agency	Facility
20345	Air	TNRCC	Primary Copper Smelter (CONTOP Project)
4151	Air	TNRCC	Ore Unloading and Storage Facility
WQO2321	Water	TNRCC	Industrial Wastewater
TXR05A301	Water	EPA	Plant Storm Water
31235[(1)]	Solid Waste	TNRCC	Solid Waste Generator

Notes: (1) TNRCC Notice of Registration Number

TABLE 1-2

Active Solid Waste Management Units

Unit Number	Unit Description
011	Bulk Pneumatic Trailer for Resource Conservation Company (RCC) Spray Dryer Solids (Acid Plant water treatment system)
012	Drum Management Area - fenced area used to accumulate miscellaneous storage containers
013	Paint shop satellite accumulation/storage area
014	Auto shop satellite accumulation storage area
015	Acid Plant accumulation area
016	Unloading/Bedding Wastewater Treatment Plant
017	PCB Storage Building
018	Container storage area for miscellaneous refuse containers
019	Container storage area - Security Building Bunker
020	Bulk Hopper for Spray Dryer Solids
021	Container Storage Area in Laboratory
022	Container Storage Area in Health Clinic
023	21 Hazardous trash hoppers in miscellaneous areas of plant site
024	55-gallon drum used at Laboratory for satellite accumulation of organic and inorganic lab waste liquids
025	Spent Anode/Converter brick piles located on paved concrete area west of the Unloading Building and Concrete Bunkers/paved concrete south of the Unloading Building
026	Concrete Bunker north of Medford Sump
027	55 gallon drum, auto, machine, paint and old electric shops, powerhouse north and south of converters
028	Auto shop metal container < 55 gallon

TABLE 1-3

Summary of Historic Operation Actions and Reports
ASARCO El Paso Smelter Phase III Remedial Investigation

Date	Action/Report
1887	Lead plant founded.
1910's	Copper smelter added.
1930's	Godfrey roaster for cadmium added.
1948	Zinc fuming furnace added.
1972	Acid Plant 1 constructed.
1976	Antimony plant added.
1978	Acid Plant 2 constructed.
1979	Sinter plant and unloading/bedding systems added.
1985	Lead plant closed. Currently being removed.
1985, August	Asarco/TNRCC compliance agreement to investigate potential leakage of Ponds 1 and 6.
1985, September 27	Hydro-Search, Inc. Report: Regional and Local Hydrology at the El Paso Plant. Prepared to comply with compliance agreement.
1985, October 10	Hydro-Search, Inc. Report: Groundwater Monitoring Plan, Asarco, Inc., El Paso Plant. Prepared to comply with compliance agreement.
1985, November 15	Hydro-Search, Inc. Report: Liner Investigation, ASARCO, Inc. El Paso Plant. Prepared to comply with compliance agreement.
1986	Antimony plant closed. Building has been remodeled.
1990, February 7	International Boundary and Water Commission workers noticed petroleum hydrocarbons seeping into the American Canal. Hydrometrics, Raba-Kistner Consultants and Applied Earth Science enlisted to investigate spill.
1990, March 14	State of Texas provides Asarco with Notice to Proceed regarding investigations of metals down gradient of Ponds 1 and 6.
1990, March 30	Hydrometrics began investigation activities for Diesel 2 spill.
1990, May 19	Nine monitoring wells were installed down gradient of Ponds 1 and 6, and quarterly monitoring began.
1992	Design and construction of Diesel Number 1 recovery system. Cadmium plant closed. Currently being removed. Zinc furnace closed. Currently being removed.
1993	CONTOP copper process added.
1994	Design and construction of Diesel Number 2 recovery system.
1996	Began design of storm water improvements.
1996, August 29	TNRCC issues Agreed Order requiring remedial investigation.
1997-1998	Remedial Investigation field activities conducted.
1998, October	Asarco Submits Phase I Remedial Investigation Report
1999, June	TNRCC acceptance (with comments) of Phase I RI
1999, December	TNRCC approval (with comments) of Phase I RI

TABLE 1-3

Summary of Historic Operation Actions and Reports
ASARCO El Paso Smelter Phase III Remedial Investigation

1999-2000	Phase II, Remedial Investigation field activities conducted.
2000, May	Asarco submits report on Area Of Contamination (AOC) concept
2000, July	Asarco submits Phase II RI report
2000, October 13	Asarco submits Technical Memorandum for the Closed Plants evaluation
2000, December	TNRCC approves the AOC concept proposal.
2001, January 18	TNRCC authorized Asarco to proceed with the Closed Plants evaluation.
2001, February 14	TNRCC approves Phase II RI with comments
2001, March to July	Closed Plants evaluation and Phase III RI activities are performed
2001, April 27	Asarco addresses TNRCC comments on Phase II RI
2001, May 30	Asarco request TNRCC authorization for one single deliverable report documenting results from the Closed Plant Evaluation and from the Phase III RI
2001, July 10	TNRCC approves the request to submit one single report in November 16, 2001 for the Closed Plants and for the Phase III RI.

Table 1-4

General Description of Investigation Areas

Area	Description	Agreed Order Reference[1]	Status	Site Use
1	Adjacent to Converter Building Ventilation Baghouse	Findings of Fact 3(b) & 9(b),(c)	Active	Baghouse spill containment and abandoned, spent scrubber saddles noted by TNRCC.
2	Boneyard /Slag	Findings of Fact 3(d) & 9(d)	Active	Deposited slag, with equipment and debris storage on some slag areas.
3	Acid Plants 1 & 2	Findings of Fact 3(e)	Active	Sulfuric acid production.
4	Front Slope (plant boundary)	Findings of Fact 3(h)	Inactive	No particular use; historic stormwater runoff area.
5	Historic Smeltertown	Not specifically identified	Inactive	Diesel 2 recovery system.
6	Groundwater	Findings of Fact 8	Inactive	Resource not used for domestic water supply.
7	Surface Water	Not specifically identified	Inactive	Off-site downgradient water bodies include the American Canal and the Rio Grande. On-site ponding exists in slag area.
8[2]	Bedding and Unloading Buildings	From TNRCC Response to Comments	Active	Receiving, Handling and Storage Area for Incoming Feed Material.
9[2]	On-site Process Ponds	From TNRCC Response to Comments	Inactive	Three ponds formerly used for fresh water supply, process makeup water and firewater storage.
10[2]	Plant Entrance	From TNRCC Response to Comments	Active	Plant entrance and potential outfall of stormwater and spills to the American Canal.
11	Arroyos east of I-10	Findings of Fact 3(d) & 9(d)	Inactive	Storage of Facility construction materials and demolition debris.
12	Ephemeral Pond and Pond Sediment Storage Area	Not specifically identified	Active	Slag-crushing/recycling operation (Oglebay Norton Inc., formerly Parker Brothers).
13	Sample Mill	Not specifically identified	Inactive	Used as a leach facility to remove chlorine from Lead Baghouse dusts prior to their addition as feed material.
14	South Terrace	Not specifically identified	Inactive	Utilized for the storage of concentrates, silica fluxes and temporary storage of Facility equipment.
15	Copper Plant	Findings of Fact 3(h), Ordering Provisions 5, 8 & 9	Inactive	Original Copper process, Pre Con-Top technology, processed formulated blends of concentrate ores and produced copper
16	Lead and Sinter Plants	Findings of Fact 3(h), Ordering Provisions 5, 8 & 9	Inactive	Proceeded formulated blends of concentrate ores and produced Lead and Sinter.
17	Cadmium and Zinc Plants	Findings of Fact 3(h), Ordering Provisions 5, 8 & 9	Inactive	Further processing of concentrate ores and produced Cadmium and Zinc
18	Antimony Plant	Findings of Fact 3(h), Ordering Provisions 5, 8 & 9	Inactive	Further processing of concentrate ores and produced Antimony

Table 1-4

General Description of Investigation Areas

Area	Description	Agreed Order Reference[1]	Status	Site Use
19	La Calavera Community	Ordering Provisions 5, 6, &7	Active	Residential community located north and adjiacent to the Asarco property.
20	Background Information	Ordering Provisions 5 ©	Inactive	Vacant area located east of I-10, used to obtain soil samples for background purposes.

Notes:
(1) TNRCC, 1996.
(2) Includes areas added per TNRCC review of the Remedial Investigation Work Plan (TNRCC, 1997).

Ta. 2-1

Summary of Facility RI Monitor Wells, Borings, and Soil Samples
El Paso ASARCO Smelter, Remedial Investigation

IA/ Description	Phase I		Phase II		Phase III		Total	
	Wells & Borings	Samples	Wells & Borings	Samples	Wells & Borings	Samples	Wells & Borings	Samples
IA-1	3	16	3	39	0	0	6	43
IA-2	12	44	7	37	8	37	27	118
IA-3	11	41	8	59	0	0	19	100
IA-4	30	121	11	66	0	0	41	187
IA-5	24	101	3	15	5	31	32	147
IA-6	NA	NA	NA	NA	NA	NA	NA	NA
IA-7	NA	NA	NA	NA	NA	NA	NA	NA
IA-8	34	138	9	146	8	44	51	328
IA-9	2	17	7	36	45	163	54	216
IA-10	9	34	1	7	0	0	10	41
IA-11	3	16	28	158	23	67	54	241
IA-12	5	38	11	41	32	112	48	191
IA-13	0	0	3	47	12	8	15	55
IA-14	5	45	3	52	3	20	11	117
IA-15	0	0	0	0	16	42	16	42
IA-16	1	15	0	0	45	80	46	95
IA-17	0	0	0	0	20	49	20	49
IA-18	0	0	0	0	5	31	5	31
IA-19	0	0	0	0	8	42	8	42
IA-20	0	0	0	0	33	66	33	66
Subtotal	139	626	94	703	263	792		
					Total for Phases I, II & III		496	2109

Notes:
Phase I of the Remedial Investigation took place between January 1997 and June 1998.
Phase II of the Remedial Investigation took place between June 1998 and February 2000.
Phase III of the Remedial Investigation took place between March and August 2001
NA: Not applicable

Table 2-2

Reference List of Analytical Parameters (Surface and Groundwater, Soil and Sediments)
El Paso ASARCO Smelter, Remedial Investigation

ANALYTICAL PARAMETERS FOR SURFACE WATER AND GROUNDWATER		
Analytical Parameter	**Unit of Measurement**	**Abbreviation**
Biochemical Oxygen Demand	milligrams per liter (mg/l)	BOD
Fecal Coliform	colony-forming units per 100 ml	cfu/100 ml
Ammonia	milligrams per liter (mg/l)	NH_3
Total Hardness	milligrams per liter (mg/l)	Tot Hardness
Turbidity	NTUs	Turb
Temperature	degrees centigrade	Temp
Dissolved Oxygen	milligrams per liter (mg/l)	O_2 or DO
pH	units	pH
Electrical Conductivity	microsiemens	EC
Total Dissolved Solids	milligrams per liter (mg/l)	TDS
Total suspended solids	milligrams per liter (mg/l)	TSS
Calcium	milligrams per liter (mg/l)	Ca
Magnesium	milligrams per liter (mg/l)	Mg
Sodium	milligrams per liter (mg/l)	Na
Potassium	milligrams per liter (mg/l)	K
Total Alkalinity as $CaCO_3$	milligrams per liter (mg/l)	N/A
Bicarbonate	milligrams per liter (mg/l)	HCO_3
Carbonate	milligrams per liter (mg/l)	CO
Sulfate	milligrams per liter (mg/l)	SO
Chloride	milligrams per liter (mg/l)	Cl
Fluoride	milligrams per liter (mg/l)	F
Nitrate and Nitrite as Nitrogen	milligrams per liter (mg/l)	$NO_3 + NO_2$ as N
Arsenic	milligrams per liter (mg/l)	As
Barium	milligrams per liter (mg/l)	Ba
Cadmium	milligrams per liter (mg/l)	Cd
Chromium	milligrams per liter (mg/l)	Cr
Copper	milligrams per liter (mg/l)	Cu
Iron	milligrams per liter (mg/l)	Fe
Lead	milligrams per liter (mg/l)	Pb
Manganese	milligrams per liter (mg/l)	Mn
Mercury	milligrams per liter (mg/l)	Hg
Selenium	milligrams per liter (mg/l)	Se
Silver	milligrams per liter (mg/l)	Ag
Zinc	milligrams per liter (mg/l)	Zn

ANALYTICAL PARAMETERS FOR SOIL AND SEDIMENT		
Analytical Parameter	**Unit of Measurement**	**Abbreviation**
Arsenic	Milligrams per kilogram (mg/kg)	As
Cadmium	Milligrams per kilogram (mg/kg)	Cd

Table 2-2

Reference List of Analytical Parameters (Surface and Groundwater, Soil and Sediments)
El Paso ASARCO Smelter, Remedial Investigation

ANALYTICAL PARAMETERS FOR SURFACE WATER AND GROUNDWATER		
Analytical Parameter	**Unit of Measurement**	**Abbreviation**
Chromium	Milligrams per kilogram (mg/kg)	Cr
Copper	Milligrams per kilogram (mg/kg)	Cu
Iron	Milligrams per kilogram (mg/kg)	Fe
Lead	Milligrams per kilogram (mg/kg)	Pb
Selenium	Milligrams per kilogram (mg/kg)	Se
Zinc	Milligrams per kilogram (mg/kg)	Zn

Notes:
N/A: Not applicable.