Colorado Department of Public Health and Environment

Proposed Plan for an Amended Record of Decision

Asarco Globe Smelter Site

Introduction:

The state of Colorado invites the public to review and comment on a Proposed Plan to amend the 1993 Record of Decision (ROD) (Colorado Department of Health, 1993) for the Asarco Globe Plant Site (Site) in Denver, Colorado. The Site is bounded by East 51st Avenue on the south, an industrial ditch on the west, East 55th Avenue on the north, and Washington Street on the east. This Proposed Plan for an Amended ROD (the Plan) affects the Former Neutralization Pond (FNP) (Operable Unit 1 [OU1]), surface water and groundwater (OU2), and the soils and industrial ditch sediment at the former Asarco Globe Plant Site (OU4). This Plan does not modify or otherwise affect OU3 – the Community Soils and Vegetable Gardens – or the localized floodplain groundwater plume, retention ponds and detention pond sediments of OU2, all of which are located offsite and are being handled separately.

The lead regulatory agency is the Colorado Department of Public Health and the Environment (CDPHE) in consultation with the U.S. Environmental Protection Agency (EPA) in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. 9601 et. seq. and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300. This decision document explains the factual and legal basis for selecting an amended remedy for this Site. CDPHE may amend and/or finalize this proposed change to the remedy for OU1, OU2, and OU4 after reviewing and considering all information submitted during the 30-day public comment period. If the remedial action selected in a final decision is significantly different than those described in the preferred alternative, additional opportunity for public comment will be provided.

The Site is the subject of a 1993 Consent Decree between the State of Colorado and Asarco. Historically, remediation activities at the property have been guided by the Consent Decree (CD), the Scope of Work attached to the CD, and a ROD issued for the Site in February 1993. Pursuant to the 1993 CD, Asarco was responsible for remedy implementation.

Basis for ROD Amendment

The purpose of the remedial actions at OU1, OU2 and OU4 is to reduce the potential of metals contamination from entering the South Platte River and to prevent contact with metals contaminants in soil and sediments. Recent investigations and further review of existing data show that the FNP soils in OU1 are no longer a significant source of contamination to groundwater. Additional groundwater data collected recently demonstrate that the original 1993 ROD remedial action for OU2 is not restoring the terrace groundwater aquifer in the timeframe expected (30 years) and requires, according to the Third Five Year Review (dated September 25, 2009) additional evaluation. The plant is no longer operating, so portions of the OU4 remedy are no longer valid. Based on this new information, the previously selected remedies for OU1, OU2

and OU4 were reevaluated. The work outlined in this Proposed Plan will be protective of human health and the environment and provide aquifer restoration in the originally intended timeframe.

Remedial Action Objectives

Remedial Action Objectives (RAOs) provide a general description of what the cleanup will accomplish. There were no RAOs specified in the original ROD. Changed Site conditions eliminate the need for an RAO focused on the operating plant air emissions and the Community Soil, which is not being modified by this Proposed Plan. The RAOs to be applied at the Site for this Proposed Plan are:

1) Prevent direct contact with soil and wind-blown particles contaminated with lead, arsenic, cadmium and zinc.
2) Prevent surface water contact with soil contaminated with lead, arsenic, cadmium, and zinc.
3) Prevent leaching of arsenic, cadmium, and zinc from contaminated soil into the groundwater through precipitation and infiltration.
4) Prevent exposure of on-site workers to soil contaminated with lead, arsenic, cadmium, and zinc.
5) Prevent community member ingestion and biological receptor contact with sediments containing lead, arsenic, cadmium, and zinc.
6) Prevent use and/or ingestion of groundwater contaminated with arsenic, cadmium, and zinc.
7) Conduct remediation activities that will provide long-term restoration of the groundwater aquifer at the Site.

This ROD amendment is being proposed as a result of changed conditions at the Site, and because CDPHE has determined that the current remedy is not sustainable. Significant changes at the Site include Asarco's declaration of bankruptcy in 2005 along with cessation of Site operations in November 2006. Continuing water treatment obligations at the Site are currently being funded through a custodial trust (the Trust) set up as part of the Asarco bankruptcy settlement. The existing water treatment plant at the Site is nearing obsolescence and will require significant capital improvements in the near future. In addition, groundwater treatment technology for the type of contaminants found at the Site has made advances since the date of the ROD. Finally, additional data collected at the Site have changed the understanding of contaminant sources, and fate and transport, requiring significant changes to the 1993 remedy.

These changed conditions and new data have convinced CDPHE that the current remedy does not sufficiently meet the cleanup goals and Applicable or Relevant and Appropriate Requirements (ARARs) set forth in the 1993 ROD and CD. The changed Site conditions also raise significant doubts regarding the long-term effectiveness of the selected remedy for OUs 1, 2 and 4. Further, the clean up goals for the Site soils have changed, since the plant is no longer operating as a smelter. Standards for soil remediation will be set based on achieving

concentrations of arsenic, cadmium, lead and zinc that do not pose a risk to groundwater based on leachability. Soils that do not pose a risk to groundwater based on leachability, but have metals concentrations in excess of the Colorado Soil Evaluation Values (CSEVs) for commercial/industrial use will be placed in the Neutralized Soil Area and capped. The RAOs for groundwater and surface water leaving the Site will be to meet Maximum Contaminant Levels (MCL's) for arsenic, cadmium, lead and zinc.

Proposed Modifications

The proposed remedy modifications for the Site consist of the following:

- Designate the off-site localized floodplain groundwater plume as OU-5, a separate operable unit.
- Apply a patented approach to treat the onsite groundwater and soil by injection and infiltration of dilute solutions to attain the RAOs;
- Treat FNP materials with chemical or physical stabilizers as necessary to achieve RAOs and geotechnical standards for development;
- Cap treated soils and FNP materials with clean soils or development structures such as buildings, concrete or asphalt;
- Off-site disposal of any soils or FNP materials that fail to meet the Site standards; and
- Apply institutional controls on future Site uses as necessary to meet the RAOs and ARARs.

Summary

This Proposed Plan amends the 1993 ROD remedies for OU1, OU2, and OU4, and designates a new operable unit, OU5, for the off-site localized floodplain groundwater plume. The 1993 ROD will continue to apply to OU3 and the OU2 Retention Ponds, Detention pond sediments, and Localized Floodplain Groundwater Plume (described below). Remedies being modified by this proposed plan include:

OU1 – Former Neutralization Pond

1993 ROD Selected Remedy:

- Containing, capping and closing the Former Neutralization Pond (FNP) in place.

Proposed Plan Remedy Change:

- Treating, grading and containing the FNP materials
- Groundwater will be treated as part of the OU2 remedy.

OU2 – Groundwater and Surface Water

1993 ROD Selected Remedy:

- Installing a terrace drain to cut off the release of contaminated ground water from the Site to the floodplain aquifer, with treatment of the collected contaminated groundwater.
- Excavating and disposing of Industrial Drainage Ditch (IDD) and Retention Ponds sediments to remove the possibility of ingestion.

- Capping or removing Detention Pond sediments that become exposed and exceed soil action levels to remove the ingestion health threat (not part of this amendment since this amendment is only for the cleanup plan within the Site property boundaries)

Proposed Plan Remedy Change:

- Active, Site-wide in-situ groundwater treatment;
- Continued operation of the terrace drain until on-site groundwater meets treatment standards;
- Excavation and disposal of industrial ditch sediments (although this work was completed in 1995, discrete portions of the IDD have been recontaminated and must be remediated);
- Groundwater monitoring; and
- Institutional controls.

OU4 – Plant Site (soils and other sources of contamination)

1993 ROD Selected Remedy:

- Excavating, capping, controlling exposure to, or deep tilling Plant Site soils above worker or trespasser action levels to minimize the ingestion and inhalation health threats.
- Covering and vegetating the lead slag pile to minimize fugitive emissions from this area.
- Excavating and stabilizing contaminated Plant Site sediments to remove this source of groundwater contamination.
- Before use, sealing Plant floors and sumps in wet operations, with secondary containment in required Plant sumps to prevent ground water contamination.
- Installing further air pollution point source and fugitive emission controls to reduce the inhalation health threat
- Use of institutional controls, maintenance, and monitoring to supplement the remedy and to assure the protectiveness of the selected remedy into the future.

Proposed Plan Remedy Change:

- Demolition of buildings;
- Treating and containing contaminated Site soils; dust control; and
- Institutional controls for use of the property, similar to the existing ROD, creation of clean utility corridors for redevelopment, and establishment of a materials management plan.

Other elements of the 1993 ROD selected remedy either were already implemented, or are no longer necessary since the plant has ceased operation.

Site Background

Ownership and Operating History:

The former Asarco Globe Plant Site is located in north Denver and straddles the boundary between the City and County of Denver and Adams County, Colorado. The Site has been the location of various metal and refining operations since 1886 when the Holden Smelter began producing gold and silver there. In 1901, the American Smelting and Refining Company (renamed Asarco Incorporated in 1975) bought the Site, which was then known as the Globe Smelter, and converted the plant to lead smelting. Lead smelting continued until about 1919,

when the plant was converted to produce arsenic trioxide. Arsenic trioxide was principally produced from 1919 until 1926. Cadmium production commenced around 1926 and continued until 1993. Processing of indium ore began in 1944, and during the 1950's, the Globe Plant produced a variety of specialty metals including litharge (lead oxide), test lead, bismuth oxide, and occasionally thallium, indium and some small quantities of high purity metals such as antimony, copper and tellurium.

Asarco Inc. was purchased by Grupo Mexico in November 1999. It was restructured to a Limited Liability Company in 2005 and shortly thereafter, in August 2005, filed for protection under Chapter 11 of the US Bankruptcy Code. Operations had significantly declined by this time, with only small amounts of high purity metals processing taking place at the Site. The Asarco Globe Plant Site operations were shut down and processing of all metals ceased in November 2006. On December 9, 2009, the Site was transferred to the Asarco Multi-State Custodial Trust as part of the resolution of Asarco's bankruptcy proceedings.

Regulatory History:
In 1974, CDPHE's Water Quality Control Division collected water and sediment samples from the Industrial Drainage Ditch (IDD) located directly west of the Site and detected elevated concentrations of cadmium, arsenic, lead, zinc, and other metals. In 1980 and 1981, the Colorado Department of Health (predecessor agency to the CDPHE) found the Globe Plant to be out of compliance with the Colorado Solid Waste Disposal Sites and Facilities Act. Subsequent to the investigations and inspections conducted by CDPHE, the EPA listed the Asarco Globe Plant Site on the open dump inventory for 1981 under the Resource Conservation and Recovery Act (RCRA) Section 4000 criteria. Three groundwater monitoring wells were installed at the Globe Plant Site during this time.

In December 1983, CDPHE sued Asarco for damages to natural resources under CERCLA in State of Colorado v. Asarco, Inc., Civ. No. 83-C-2383, (D. Colo.). Originally, Asarco was under an Order of Consent to address the FNP and its waste. It was later determined that the State's CERCLA process would have authority over the Site. The Site was proposed for the Superfund National Priorities List (NPL) on May 10, 1993. All outstanding claims were resolved with the entry of a Federal Consent Decree between the State of Colorado and Asarco, Inc., including Natural Resource Damages (NRD) claims and prior compliance orders issued under the Colorado Hazardous Waste Management Act. The Consent Decree was signed on July 15, 1993. After talking to community members and local officials, and respecting their concerns regarding stigmatizing the community, it was determined that the Consent Decree was sufficient enforcement action and it was decided not to list the Site on the NPL.

1993 RI/FS Findings:
Characteristics of OU1, OU2 and OU4

Based on the results of the Remedial Investigation (RI), arsenic, cadmium, lead and zinc have been identified as the chemicals of concern at the Site. No evidence of significant contamination due to releases of other substances from the Site was found during the investigation. The Site was divided into several areas of concern, defined as "operable units." The operable units to be

addressed in the ROD amendment are as follows: the Former Neutralization Pond (OU1), groundwater and surface water (OU2) and the Plant Site (OU4). The Plant Site, location of the FNP, and other Site features are shown on Figure 2. The characteristics of these three OUs are described below.

i. OU1: The Former Neutralization Pond (FNP)

The FNP is located in the north central portion of the Site. The FNP was originally used for disposal of production-related wastewater streams generated at the Site. In May 1986, use of the FNP for this purpose was discontinued. Since most of the wastewater placed in the FNP drained or evaporated, what remained existed as pore water within the precipitated residues from the lime neutralization of spent electrolyte solutions. The precipitated residues, primarily gypsum and metal hydroxides, contain various metals, including zinc, cadmium and arsenic. Samples of the residues failed both the Toxic Characteristics Leaching Procedure (TCLP) and Extraction Procedure (EP) toxicity tests for cadmium and arsenic. An interim remedial action was implemented in 1986. At that time, the pond was regraded, capped with six inches of clayey soil and revegetated.

Since then, the FNP has been used for disposal of Site-related sediments and sludge from the on-site Waste Water Treatment Plant. In 1993, soils excavated from the Former Sedimentation Pond were added to the FNP. The total surface area covered was approximately 3.4 acres. The placement area was then covered with approximately 4,000 cubic yards of clean material, regraded to provide adequate drainage, and was revegetated during the 2004 season.

ii. OU2: Groundwater and Surface Water

The groundwater and surface water OU consisted of the Terrace Groundwater; Floodplain Groundwater and the Localized Floodplain Groundwater Plume; Industrial Drainage Ditch (IDD) and 51st Avenue Retention Ponds; and the Northside Sewage Treatment Plant Detention Pond, as discussed below. The Safe Drinking Water Act (SWDA) Maximum Contaminant Levels (MCLs), also known as drinking water standards, were established as the performance standards for the groundwater and surface remedies at the Site.

Terrace Groundwater

The Terrace Drain is installed near the eastern edge of the terrace portion of the Site and is approximately 2,100 feet in length. The location of the Terrace Drain is shown on Figure 2. The Terrace Groundwater is groundwater beneath the terrace portion of the Site, generally west of the Terrace Drain. Shallow groundwater on the terrace contained concentrations of cadmium, arsenic, and zinc in excess of the Federal Primary and Secondary Drinking Water Standards. Sources of the elevated metals concentrations included the disposal of un-neutralized strongly acidic zinc-rich electrolyte solutions, gels and sludges

generated during operations, leakage of cadmium-rich electrolyte solutions from wood stave storage tanks located near the leaching building, and fill material and deposits in the FNP and in the area surrounding the former sedimentation pond.

Floodplain Groundwater and the Localized Floodplain Groundwater Plume

Shallow groundwater flows southeastward from the terrace and enters the floodplain aquifer of the South Platte River, as shown on Figure 3. Upon entering the floodplain, the direction of groundwater flow bends sharply to the northeast and flows approximately 8,000 feet before entering the South Platte River. In 1993, floodplain groundwater within and beyond the Site's eastern boundary exceeded the Federal Primary and Secondary Drinking Water Standards for concentrations of cadmium, zinc, and arsenic. This included a localized area of groundwater east of the Site boundary, in the floodplain area near GW-64, where concentrations of the metals of concern were significantly higher than the concentrations throughout the majority of the floodplain plume.

Beyond the localized floodplain plume, zinc concentrations were below the performance objective of 5.0 mg/l. Concentrations of cadmium and arsenic in the floodplain aquifer were one to two orders of magnitude lower than in the terrace groundwater, but remained above performance objectives of 0.005 mg/L and 0.01 mg/L, respectively. Arsenic attenuates rapidly in the first few hundred feet of the floodplain groundwater, while cadmium persists at elevated concentrations for more than 8,000 feet to the South Platte River. Due to past drought conditions, impacts to the surface water Total Maximum Daily Load (TMDL) for cadmium have been recorded in a short section of the South Platte River. This occurs only when the Burlington ditch diverts water from the South Platte River.

Industrial Drainage Ditch (IDD) and 51st Avenue Retention Ponds

The IDD is an open ditch drainage way, which generally parallels the southwestern boundary of the Site. The location of the IDD is shown on Figure 2. It originates as an open ditch collecting runoff in an industrial area west of Interstate 25 and flows under the highway in a buried concrete pipe. It then flows as an open ditch along the west side of the Site to 51st Avenue, where it discharges to the 51st Avenue Retention Ponds. The IDD and 51st Avenue Retention Ponds were constructed to manage storm water; they are operated by the City and County of Denver. An interceptor trench was excavated on the Globe Plant Site in 1974 to prevent runoff from the vicinity of the FNP from entering the IDD. Water is extracted from the backfilled interceptor trench sump at a rate of approximately 1,000 gallons per day and treated at the existing Waste Water Treatment Plant (WWTP). The WWTP was expanded as part of the remedy to treat the Terrace Drain groundwater. Because soil berms along the perimeter of the Site prevent runoff from entering the IDD, the open interceptor trench was no longer necessary for capturing surface runoff. The interceptor trench was therefore converted to a groundwater collection system in 1996-1997

by deepening the trench, lining the downgradient side of it, placing a perforated pipe along its length, constructing a vault for the sump, and backfilling the entire trench.

Northside Sewage Treatment Plant Detention Pond

The Northside Sewage Treatment Plant (NSTP) Detention Pond is located east of the Site, along the path of surface flow from the IDD to the South Platte River. The work has been completed and the NSTP Detention Pond remedy is not being modified by this Proposed Plan.

iii. OU4: Asarco Globe Plant Site

The Plant Site OU includes buildings, point source and fugitive air emissions, surface soils, former sedimentation pond (FSP), and the spill and runoff control pond. Portions of this remedy apply to historical building operations and sources of air emissions that no longer exist.

Buildings

There are 53 manufacturing and support buildings located on the Site. These buildings were used historically for production, offices, laboratory and wastewater treatment processes when the Plant was in operation.

Point Source and Fugitive Air Emissions

The history of smelting activities at the Site is extensive as described above. This element of the remedy applies to former metals processing and production operations at the Site, which have been discontinued. Thus, this element of the remedy is unnecessary.

Surface Soils

The surface soils on the Site property have been sampled and characterized. Cadmium, arsenic, lead, and zinc concentrations are generally elevated in the upper 24 inches of Site soils because of historical smelter operations.

Sedimentation Pond

A pond approximately 50 feet in diameter was located in the northeast corner of the Site. The location of the former Sedimentation Pond is shown on Figure 2. This pond trapped sediments in surface water runoff from the northern portion of the Site. The pond was taken out of service in the early 1980s by filling it with building demolition material, regrading the area to a relatively smooth surface, and covering sediments in the pond with a thin clay cap. Total metal concentrations in sediments located below the groundwater table were elevated, with arsenic concentrations as high as 6,125 ppm. These saturated sediments were a source of arsenic contamination to shallow groundwater. In 1998, soils

were excavated from the former sedimentation pond and were transferred to the FNP. This portion of the OU4 remedy was completed.

Soil and Runoff Control Pond
The remedy requires that surface runoff be managed from active areas of the Site that could contain elevated concentrations of metals.

Summary of Risks

Human Health Risks:

The Public Health Evaluation (PHE) (Putnam,1989) was conducted as part of the Remedial Investigation/Feasibility Study (RI/FS)(TRC, 1988/1990) to characterize the current or potential threat to human health and the environment that may be posed by the contamination at the Site if no remedial actions were to occur. Risk estimates were calculated based on the concentrations of contaminants found at the Site. The methodology used in the PHE to estimate risks is also used to determine levels of contaminants that can remain on-site and still be protective of human health. Exposure scenarios were evaluated in conjunction with the contaminants identified to calculate baseline risk values. The calculated risks are estimates of the average and maximum values that could potentially occur, above the background probability of risk (i.e., risk of developing cancer if no exposure to Site-related contaminants occurred).

In the original ROD, an ecological risk assessment was not performed for aquatic life. When the remedy was selected, offsite concentrations of metals were not found in the South Platte River at levels high enough to warrant an ecological study. After remediation of the Plant Site is completed, and if the TMDL for cadmium is exceeded in section 15, we will evaluate if there is a need for an ecological study.

The four components of the risk assessment process include identification of contaminants of concern, exposure assessment, toxicity assessment, and risk characterization. These steps are discussed further below.

Contaminants of Concern:

The PHE summarizes the chemical contaminants found in various media (air, soil, sediments, surface water, ground water and garden vegetables) during the course of sampling conducted as part of the RI. Chemicals of concern (COCs) are identified based on their toxicity and the concentrations present at the Site. The COCs are then carried through the risk assessment process. Arsenic, cadmium, zinc, and lead were identified as the COCs for soil. Arsenic, Cadmium, and Zinc were identified as the COCs for surface and groundwater.
Exposure Assessment

In this step, the various ways people in the vicinity of the Site could be exposed to the selected contaminants of concern are determined. Exposure pathways examined for the Site include

inhaling ambient air, drinking the groundwater, eating vegetables grown in the soil, inhaling blowing soil, ingesting contaminated soil, ingesting IDD sediments, and dermal absorption of IDD water. Estimates of the doses of contaminants that could be taken in by humans are then calculated, based upon estimates of factors such as frequency and duration of exposure, contaminant concentration, and absorption for each pathway. Factors used for quantifying exposure are included in the PHE.

Toxicity Assessment:

A toxicity assessment involves assessing the potential for each contaminant of concern to cause adverse effects in exposed individuals. For many common toxic substances, this step has been performed and is documented in EPA's Integrated Risk Information System (IRIS) and Health Effects Assessments. Health Effects Assessments have been performed for cadmium, arsenic, lead, and zinc for use at any site where these contaminants are present. A literature search was also conducted to assess the toxicity of the contaminants of concern. More detailed information can be found in the PHE.

Risk Characterization:

In risk characterization, the concentrations of chemicals are evaluated with respect to the various ways in which people at or near a site may be exposed to those chemicals (the "exposure pathways"). Risks are computed for each exposure pathway based on the toxicity or carcinogenic potential of that contaminant, combined with the predicted level of exposure through that pathway. Carcinogenic risk is presented in the form of a probability (i.e., the increased chance of contracting cancer that is attributable to the Site).

The pathways associated with the Site that could pose risks are: ingestion of metals-contaminated soil; ingestion of contaminated groundwater; and inhalation of metals-contaminated dust.

Threat to Groundwater:
Historically, there has been a well-defined groundwater plume leaving the Site with cadmium and zinc concentrations above the state and Federal mandated maximum contaminant levels (MCLs) for these metals. Groundwater on the Site is currently being collected and treated, and will continue to be as part of this Plan. The trailing plume of groundwater (the localized floodplain groundwater) leaving the Site is expected to attenuate with time once more aggressive on-site source treatment and control is implemented. The remedy specified in the 1993 ROD allowed for the remaining floodplain contaminated groundwater …to naturally flush through time." The off-site localized floodplain groundwater plume is being designated as a separate operable unit (OU5) so that it can be evaluated and addressed at a later date, once the on-site remedy is implemented.

Within the contaminated groundwater plume, there is an increased risk of cancer and a potential for other non-cancerous adverse health effects if the groundwater were to be used as a source of drinking water. Numerous domestic well use surveys have shown that no water within the plume

is currently being used for a drinking water supply. Outside of this contaminated plume, the levels of the four chemicals are below drinking water standards.

Prior Response Actions

The response actions and remedies implemented at the Site partially addressed the groundwater contamination, reduced the flow of contamination off-site, and prevented additional release through sealing of building sumps. Specifically, Asarco completed the following actions under the 1993 ROD and CD:

- Environmental covenant restricting reuse
- Excavation of Sedimentation Pond and placement of sediments in the FNP (OU4)
- FNP surface regrading to control surface water drainage (OU1)
- FNP clay soil cover (OU1)
- Interceptor Trench groundwater collection and treatment, (on-going) (OU2)
- Terrace Drain groundwater collection and treatment (on-going) (OU2)
- IDD and retention pond sediment removal (although the Industrial Ditch sediments have since been recontaminated and are addressed in this Plan) (OU2)
- Sealing of sumps within the buildings (OU4)

1993 Cleanup Plan

In the 1993 ROD, alternatives were developed for remediation of each OU, with much of the remedy constructed around the assumption that Globe Plant operations would continue in some form indefinitely. These alternatives were evaluated and a preferred alternative was chosen. Often several of the alternatives were combined to develop a complete remedy for that OU. The complete list of alternatives evaluated for each OU can be found in the 1993 ROD.

Alternatives for Proposed ROD Amendment

In order to determine the next best step to completing the cleanup for OU1, OU2, and OU4 of the Site, three alternatives were evaluated based on nine criteria. The alternatives that were evaluated are: 1) to conduct no further remedial actions and only maintain the remedial actions currently being performed, which is the No Further Action alternative; 2) to carry out the 1993 ROD; 3) to implement the new proposed alternative. The Preferred Alternative is identified in subsequent sections of this Plan.

An estimated cost is provided for each alternative. The measure of cost used to compare the alternatives is the 30-year present worth cost. This is the amount of money that, if invested today at 7% interest rate and with the assumption of no further escalation in costs, would adequately fund the remedy over 30 years.

No Further Action Alternative

The No Further Action alternative maintains the Site in its current condition. Response actions that have already been completed would be left as-is. This alternative is presented as a starting point for comparison of the proposed alternative.

Under this alternative, there would be no remediation of the FNP soils in OU1, the terrace trench system and treatment plant would continue operation for OU2, and sediments and soil would remain at the Site (OU4). Because of the age and obsolescence of the existing wastewater treatment system, capital costs are included for system replacement within the next three years.

Capital Costs = $1,100,000
Time to Implement = 0
Annual O&M Costs = $1,020,000 30-year Present Worth Costs = $14,169,000

Implement the 1993 ROD Remedy

In order to complete the 1993 ROD Remedy the following remedy items would need to be implemented:

- FNP - OU 1
    - Cover the precipitate material with a multi-layer RCRA Subtitle C-equivalent cap
    - Install a slurry wall around the FNP
    - Install a drainage system around the FNP to drain the groundwater from the slurry wall enclosure
    - Expand the groundwater treatment system to allow for the treatment of the groundwater drained and pumped from the FNP drainage system
- Groundwater and Surface Water - OU 2
    - Re-excavation of the IDD sediment
    - Quarterly groundwater monitoring with quarterly and annual reports
    - IDD sediments may need to be removed again to meet standards
- Asarco Globe Plant Site – OU4
    - Excavation, covering, deep tilling, or exposure controls for Globe Plant Site soils above worker/trespasser action levels
    - Excavation and stabilization of sediments
    - Secondary containment in Globe Plant Site sumps
    - Spill control of Retention Pond

Capital Costs = $9,200,000
Time to Implement = 30 years (+)
Annual O&M Costs = $1,020,000
30-year Present Worth Costs = $22,269,000

Proposed Remedy Alternative

As discussed in the CDPHE Third Five Year Review (dated September 25, 2009), prior to implementing the remaining portions of the ROD new technologies will be considered. This evaluation of other remedial technologies will also take into consideration the future redevelopment of the Site. The following Proposed Remedy Alternative takes into consideration both new technologies that have been developed since the ROD (February 18, 1993) and the potential redevelopment of the Site. The treatment standards for contaminated Site soils and FNP materials are 1 mg/l for cadmium, 5 mg/l for lead, and 5 mg/l for As, as measured by the Synthetic Precipitate Leaching Procedure (SPLP) method. Lead was not found above the MCL in groundwater, and zinc is only associated with risk to aquatic life, not human health. Zinc was not found at elevated levels in the South Platte River.

OU1 – FNP

- An excess of lime was used historically to precipitate and stabilize the metals in the FNP. This excess lime has been found to be present still within the FNP. To achieve the stabilization of the FNP materials and Plant Site soils, the FNP material with excess lime will be mixed with contaminated soils, and with additional lime and other chemical amendments, and stabilized as a single unit. Contaminated soils include soils within the footprint of the buildings that are impacted above treatment standards, as well as surface soil impacted by the historic practice of conveyance of partially neutralized electrolytes to the FNP.
- Amendments will be added (via deep tilling or surface mixing) to the FNP material as necessary to create a chemically stable and compactable fill material that passes the treatment standards and is competent to withstand a hardscape cover, such as a building or pavement, without settlement.
- Treated materials will be placed in a specific on-site location and delineated as the Neutralized Soil Area (NSA). It is anticipated that the overall size of the NSA will be approximately 20 acres at completion. It will have a cover comprised of low-permeability material (buildings or paving) with a minimum of a 2-foot thick soil layer that meets the Colorado Soil Evaluation Values (CSEV's) for commercial/industrial soil metals action levels for community soils to limit stormwater infiltration. The NSA will be protected using institutional controls, including deed restrictions for excavation following redevelopment, prohibition on groundwater use until MCLs are attained, and land use restriction for industrial/commercial use.

OU2 – Groundwater and Surface Water

From January 2007 through February 2008, a pilot test was conducted to study in-situ technologies that could potentially remediate the sources of soil and groundwater contamination at the Site. Based on the pilot test data, a modified remedy is proposed that effectively addresses the primary source to groundwater, namely the former electrolytic neutralization basin and associated overflow tanks, while restoring the groundwater aquifer in-situ. While an extended periodic groundwater-monitoring period is anticipated, the decades-long operation of a pump and treat system will not be required. The alternative in-situ treatment approach will significantly reduce the duration of the groundwater remedy from the amount of time that would be required

for the remedy planned in the 1993 ROD. The following elements comprise the Proposed Alternative for OU2:

- In-situ groundwater treatment by injection and infiltration of dilute solutions to remove metals from the groundwater. This treatment technology was demonstrated by a year-long pilot study to be effective in stabilizing metals in both groundwater and in soils that were saturated during the injection process.
- Continued operation of the existing terrace drain groundwater collection system to intercept groundwater before leaving the Site. The collected water will be amended with treatment solutions and re-injected as part of the in situ treatment process.
- Excavation of IDD sediments as needed to restore the uses of each of the IDD, and treatment of the sediments on-site as part of the Neutralized Soil Area discussed above.
- Designate a new operable unit, OU5, for the off-site localized floodplain groundwater plume, the remedy for which will not be changed from the 1993 ROD at this time, but will be re-evaluated following implementation of the groundwater remedy outlined in this Plan.
- Periodic monitoring until groundwater standards are achieved and maintained for an acceptable period of time. Periodic monitoring will be established in the amended consent decree as well as the acceptable period of time. Institutional controls to prevent use of contaminated groundwater.

OU4 – Plant Soils and Sediment

The Asarco Globe Plant is no longer operating, so the focus of the Proposed Remedy Alternative for OU4 will be the demolition of buildings and remediation of the surface soil (including soil beneath the Site buildings, which was not part of the 1993 ROD remedy). Elements of the Proposed Remedy Alternative for OU4 are as follows:

- Demolition of buildings.
    - Non-hazardous, non-organic building debris (i.e., bricks and concrete) will be crushed and recycled for use as on-site fill.
    - Hazardous non-organic building debris (i.e., bricks and concrete) and FNP material will be treated using a physical and chemical stabilization method to meet treatment standards of 1 mg/l for cadmium, and 5 mg/l for arsenic, as measured by the Synthetic Precipitate Leaching Procedure (SPLP) method, and placed in the Neutralized Soil Area as discussed in OU1 above.
    - Non-hazardous and hazardous organic building materials will be disposed properly offsite. Organic building materials such as wood decompose over time, presenting a risk for settlement and other geotechnical issues if used as fill onsite.
- Dust controls during demolition and redevelopment activities will be implemented.
- Excavation, covering, in-situ treatment, deep tilling, or exposure controls will be implemented during Site activities of Plant soils to meet t the CSEVs for

commercial/industrial workers **of** 810 mg/kg cadmium, 70 mg/kg arsenic, and800 mg/kg lead.

- Soil will be treated using physical and chemical stabilization to meet treatment standards of 1 mg/l for cadmium, 5 mg/l for arsenic, 5 mg/l for lead as measured by the Synthetic Precipitate Leaching Procedure (SPLP) method, and placed in the Neutralized Soil Area. The placement of these soils and costs for this work are included in the work described for OU1, above.
- A stormwater management plan will be developed and implemented during grading and construction activities.
- Institutional controls will be placed in the form of an environmental covenant that will address maintenance of covers (buildings, roads, and limited landscaping), use of contaminated groundwater, land use restrictions and erosion controls.

Capital Costs = $10,914,000
Time to Implement = 3 years
Annual O&M Costs = $145,500
30-year Present Worth Costs = $11,652,000

Evaluation of Alternatives

In accordance with CDPHE guidelines, the above three alternatives are evaluated in this Proposed Plan for an Amended ROD based on nine criteria. This section discusses the performance of the Proposed Alternative Remedy modifications against the nine criteria, noting how it compares to the other options under consideration. The nine evaluation criteria are:

1. *Overall Protection of Human Health and the Environment*
   The No Further Action alternative is not protective of human health and the environment. It does not address the risks associated with contaminated Site soil and groundwater. Contact with the Site soil and windblown particles would not be prevented. The groundwater remedy, although in place, is not achieving the results necessary to restore the aquifer.

   The 1993 ROD, if it had been implemented fully, would not have been protective of human health and the environment. Further review of the historical and recent data shows that the conceptual Site model was incorrect and the FNP actions would not have contained the source of metals, thereby causing the 30-year objective for restoration of the Terrace Groundwater not to be achieved. Additionally, recent groundwater data have shown that the current remedy for OU2 is not restoring the aquifer as planned and that metals are still leaching from untreated source materials, primarily outside the FNP area. This is causing increased contaminant loading to the Terrace groundwater aquifer and to the treatment plant.

The Proposed Alternative is protective of human health and the environment. This alternative will treat the groundwater at the Site to restore the Terrace aquifer within 30 years, as was intended by the ROD. The Site soils and sediment will be stabilized and covered with a multi-layer cap comprised of low-permeability material (buildings or paving), with a minimum of a 2-foot thick soil layer to prevent contact with contaminants and to prevent contact through windblown particles.

2. *Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)*
The No Further Action alternative would not comply with ARARs, as it would not achieve the necessary groundwater contaminant levels to restore the aquifer to Safe Drinking Water Act MCLs. It would also not achieve the protections for windblown dust emissions and soil concentration limits. The FNP soils would not meet the requirements for RCRA Subtitle C regulations for interim status facilities including post-closure requirements that require monitoring.

   The 1993 ROD, if it had been implemented fully, would not have achieved ARARs in the anticipated timeframe. A major reason for this is that the 1993 ROD focused on containment of contaminants within the FNP, but most of the groundwater contamination at the Site is outside the FNP (previously identified as the major source of contamination to groundwater). A containment remedy around the FNP would not have significant influence on achieving ARARs in groundwater. Additionally, recent groundwater data has shown an increase in groundwater contamination, demonstrating that the implemented groundwater system for OU2 is not restoring the aquifer as planned. The 1993 ROD alternatives for surface soil and the FNP would likely have prevented exposure to soil and sediment contaminants, however additional sources of metals to the groundwater would have persisted and would not have been contained, capped or treated (surface soils around the FNP).

   The Proposed Alternative will follow the intent of the 1993 ROD and meet the 1993 ROD ARARs. The groundwater and soil treatment will restore the aquifer on-site to Safe Drinking Water Act MCLs. The remedy for the soil, sediment, and FNP material will stabilize contaminants and reduce windblown emissions as well as treat the source of metals to groundwater (surface soils around the FNP). The covering of the Site soils and sediment will prevent exposure to soil and sediment contaminants.

3. *Long-Term Effectiveness*
The No Further Action alternative would not be effective in the long-term as it would not achieve the goals of the ROD. The groundwater aquifer would not be restored, windblown emissions of contaminated dust would still be problematic, and contact with Site contaminated soils and FNP material would still present a risk to human health and the environment.

   The 1993 ROD, if it had been implemented fully, would not have been effective in the long-term. A majority of the groundwater contamination at the Site is outside the FNP and this contamination is not being addressed in the 1993 ROD remedy. Recent groundwater data has shown an increase in contaminant levels, demonstrating that the

implemented groundwater system for OU2 is not restoring the aquifer in the long-term as was anticipated in the ROD. The 1993 ROD alternatives for surface soil at the FNP would likely have been effective in the long-term and prevented exposure to soil and sediment contaminants, however more significant sources of metals to the groundwater would have persisted long-term (surface soils around the FNP).

The Proposed Alternative will provide long-term effectiveness. Remediation of the groundwater (including the contaminated groundwater outside the FNP) and soil on-site will reduce the metals contamination coming off the Site through the groundwater and windblown emissions. Previous pilot studies of the groundwater remedy demonstrated it to be effective in reducing the concentration of metals in the groundwater. The FNP, contaminated surface soil, and sediments will be stabilized and covered to prevent human or environmental contact with metals contamination. This alternative will include stabilization of the ongoing source of metals into the groundwater, namely the surface and subsurface soils outside the FNP. Also, the FNP has an Environmental Covenant which restricts the use of the Site. The use restrictions are as follows: use of the property for residential purposes, child day care or camp, and animal daycare or camp, is prohibited; except for remediation purposes, use of any groundwater is prohibited; any excavation, drilling, grading on the Site is only permitted by the CDPHE's approval

4. *Reduction in Toxicity, Mobility, or Volume Through Treatment*
The No Further Action alternative would not reduce the toxicity, mobility or volume of the contaminants. Although groundwater collection and treatment would be operating indefinitely, the contaminated Site soils would continue to be a source of metals leaching into the groundwater. Without continual upgrades to the capture system in the Terrace Drain and interception of contaminants in the bedrock beneath the Terrace Drain, some of the contaminants would continue to migrate off-site into the Floodplain aquifer and eventually the Platte River.

The 1993 ROD, if it had been implemented fully, would not have reduced the toxicity, mobility or volume of the contaminants. The 1993 ROD remedy does not significantly reduce the toxicity, mobility, or volume of the majority of the groundwater contamination at the Site through treatment. The majority of the groundwater contamination is located outside the FNP and it is not being addressed in the 1993 ROD remedy. Recent groundwater data has shown an increase in groundwater contamination, demonstrating that the implemented groundwater system for OU2 is not reducing the toxicity or volume of groundwater contamination as planned. The 1993 ROD alternatives for surface soil and the FNP may have reduced some of the toxicity and mobility of soil and sediment contaminants. The majority of contaminated groundwater and the source of metals to the groundwater, however, are both located outside the FNP, and would have persisted. Therefore, the overall toxicity, mobility, or volume of contaminants would not have been reduced with the 1993 ROD approach. This remedy also does not address the soil beneath the buildings, a potential continued source for metals contamination.

The proposed remedy will reduce the toxicity, mobility, and volume of contaminants through treatment. The remedy will treat the on-site soil and groundwater, reducing the mobility of contamination off-site and the toxicity and volume of contaminants both on-site and off-site. The Site sediments and FNP material will be stabilized to reduce the toxicity and mobility of metals. The source of the metals to the groundwater, the surface and subsurface soils around the FNP, will be addressed through treatment, as will the soils beneath the Site buildings. The covering of the Site soils and sediment will prevent mobility of soil and sediment contaminants.

5. *Short-Term Effectiveness*

The No Further Action alternative is not effective in the short term as the treatment plant operators and trespassers can be exposed to fugitive dust and contaminated soil and sediments. In addition, the groundwater contamination would persist, both beneath the Site and offsite. Operators are also exposed to the contaminated groundwater.

Implementation of either the 1993 ROD or the Proposed Alternative would results in moderate scale disturbance of contaminated soils and sediments at the Site. Disturbance of Site wastes would present a higher risk to the local community and environment when compared to the No Action alternative due to the increased construction activity.

During all construction activities at the Site, engineering controls will be implemented to prevent contamination of surface water and to minimize airborne dust.

6. *Implementability*

The No Further Action alternative is implementable as the water treatment plant is currently operating and meeting its treatment goals. However, its condition is poor and is in need of significant update and repair. Administrative implementability becomes a concern for any pump and treat remedy at the Site given that the Metro Wastewater treatment plant is above capacity for cadmium and will be required during each 5 year review of the TMDL to make improvements to the discharge quality for this downgradient cadmium-impaired segment of the South Platte River.

The 1993 ROD, if it had been implemented fully, would have been implementable using industry standard operations. Operations of the groundwater treatment plant are ongoing and utilize readily accessible materials. However, significant updates/upgrades to the current treatment plant would be required due to the increased volume of the pumped groundwater from the FNP slurry wall drainage system. The same issue of implementability due to the impairment of the South Platte River applies to the 1993 ROD remedy and becomes worse in that more water is captured if the dewatering of the FNP and the option to capture local floodplain plume water for treatment is exercised/required. Because of the greater volumes captured, pre-treated and discharged to the POTW under the 1993 ROD, more metals and more volume will go to the POTW and cause or contribute to further impairment of the cadmium-impaired river segment.

The proposed remedy is implementable at the Site. A pilot study of the groundwater remediation showed the in-situ treatment of contaminants in groundwater is viable. The deployment of the groundwater remedy in the subsurface via trenches and injection wells has been successfully implemented in sites throughout the Denver basin. The soil remediation requires standard earthmoving equipment performed as part of the redevelopment paired with analytical testing that is readily accessible.

7. *Cost*
   The present value costs are compared below:
   No further action alternative = $ 13.07 million
   1993 ROD Preferred alternative = $29.28 million
   Proposed alternative = $11.63 million

8. *Supporting Agency Acceptance*

   The US EPA concurs with this Proposed Plan for an Amended ROD and would not accept a No Further Action alternative.

9. *Community Acceptance*
   Community acceptance of the revised Proposed Plan will be evaluated after the public comment period ends and will be described in the ROD amendment for this Site.

Exhibit: Detailed Evaluation of Alternatives versus Seven Criteria

	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness	Reduction in Toxicity, Mobility, or Volume Through Treatment	Short-Term Effectiveness	Implementability	Cost
No Further Action	**Low**	**Low**	**Low**	**Low**	**Moderate**	**Moderate**	**Moderate**
1993 ROD Selected Remedy	**Moderate**	**Low to Moderate**	**Low to Moderate**	**Low to Moderate**	**Moderate**	**Moderate**	**Very High**
Proposed Remedy Alternative	**High**	**High**	**High**	**High**	**High**	**Moderate**	**Moderate**

Preferred Alternative

The preferred alternative is the Proposed Remedy Alternative because it achieves far greater treatment of the contaminants at similar costs to the No Further Action, and at less cost than the 1993 ROD alternative. The Proposed Alternative employs demonstrated technology that will restore the groundwater aquifer and complete surface soil and sediment remediation to allow for redevelopment of this Site. This alternative is expected to be more effective over the long term, provide greater protection of human health and the environment, and have a greater ability to achieve ARARs than the No Further Action or 1993 ROD alternatives.

Based on current information, CDPHE believes the Proposed Remedy Alternative meets the threshold criteria and provides the best balance of the tradeoffs with respect to the balancing and modifying criteria.

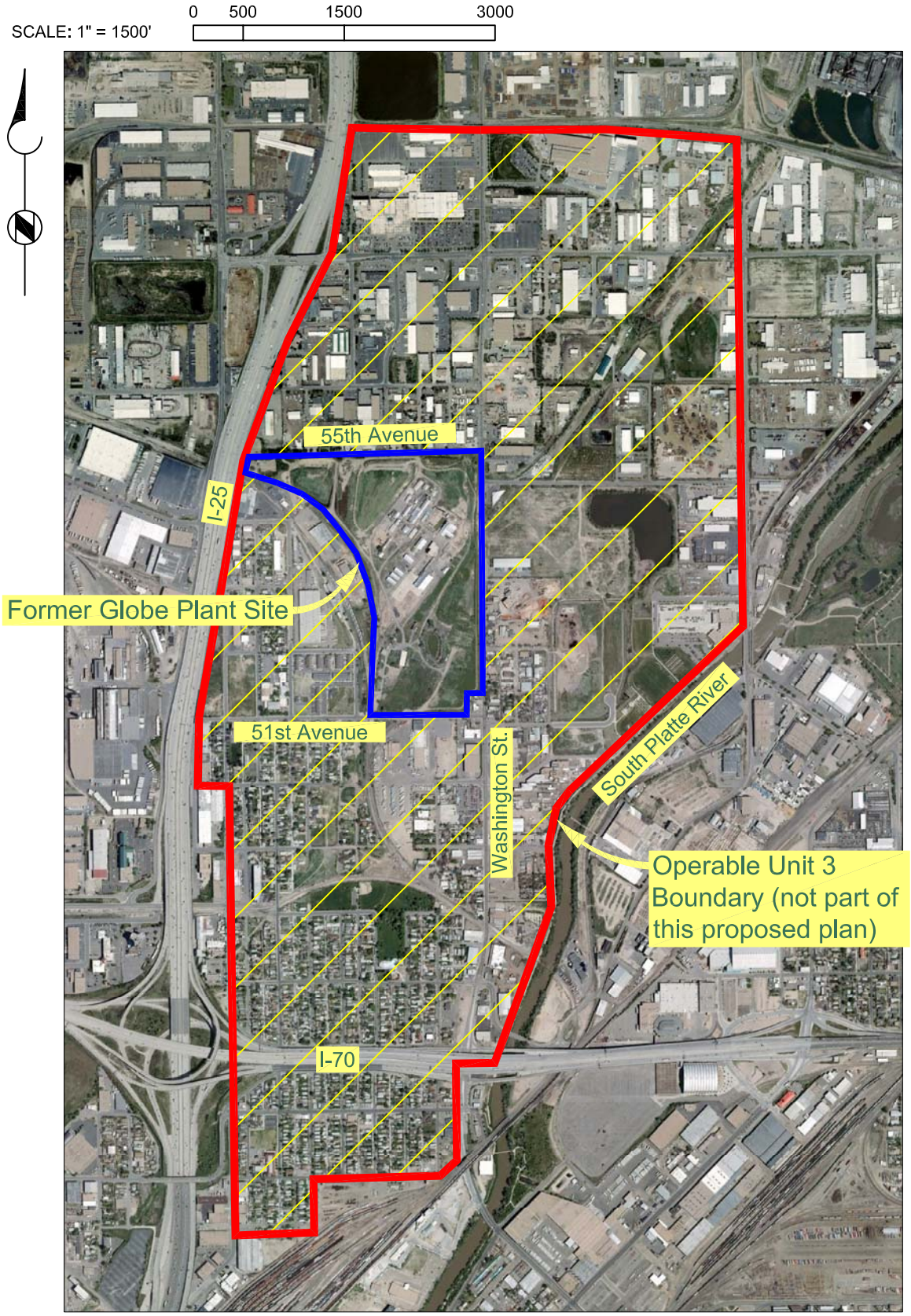

FIGURE 1 - LOCATION MAP

OPERABLE UNIT 3

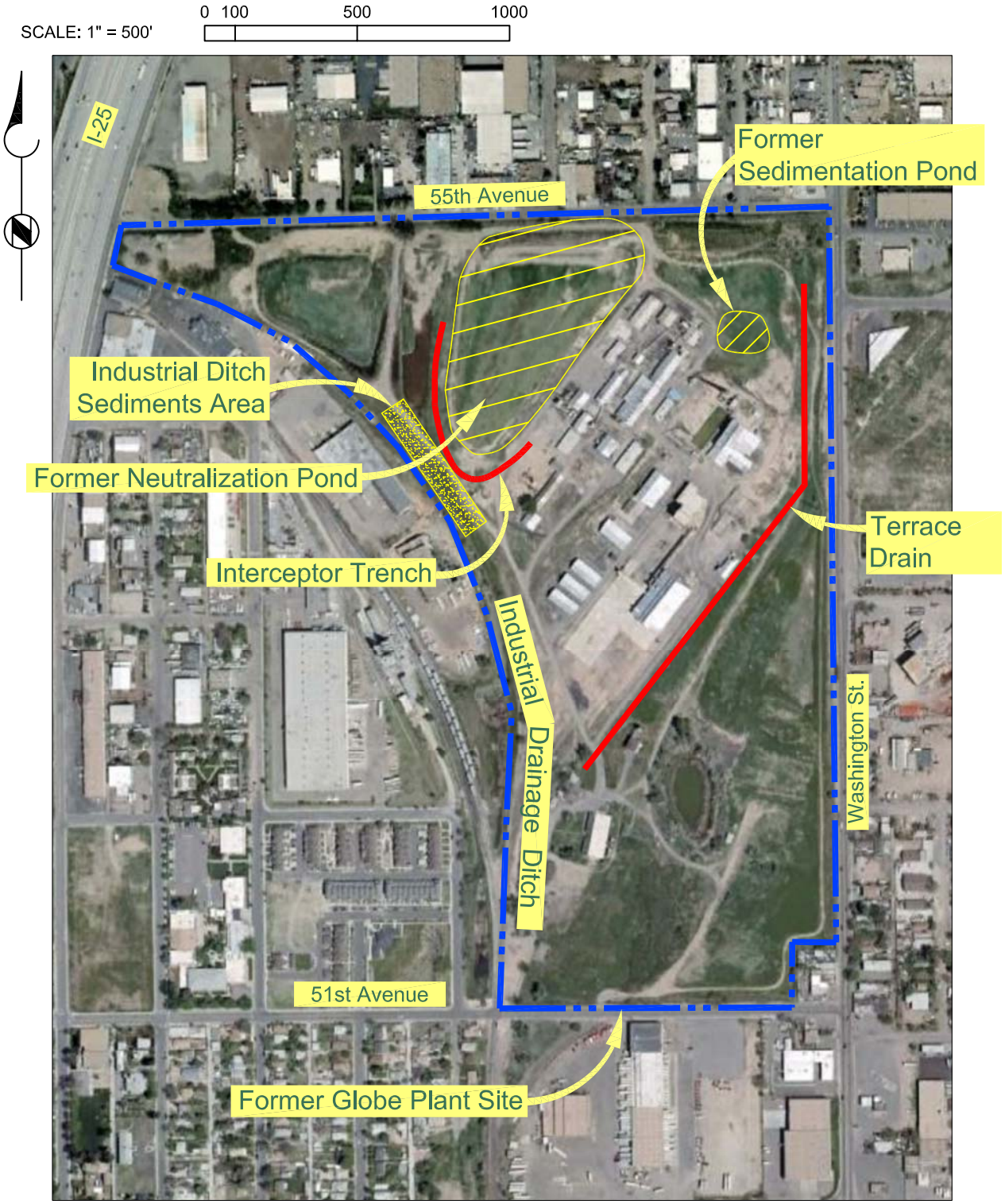

FIGURE 2 - FEATURES

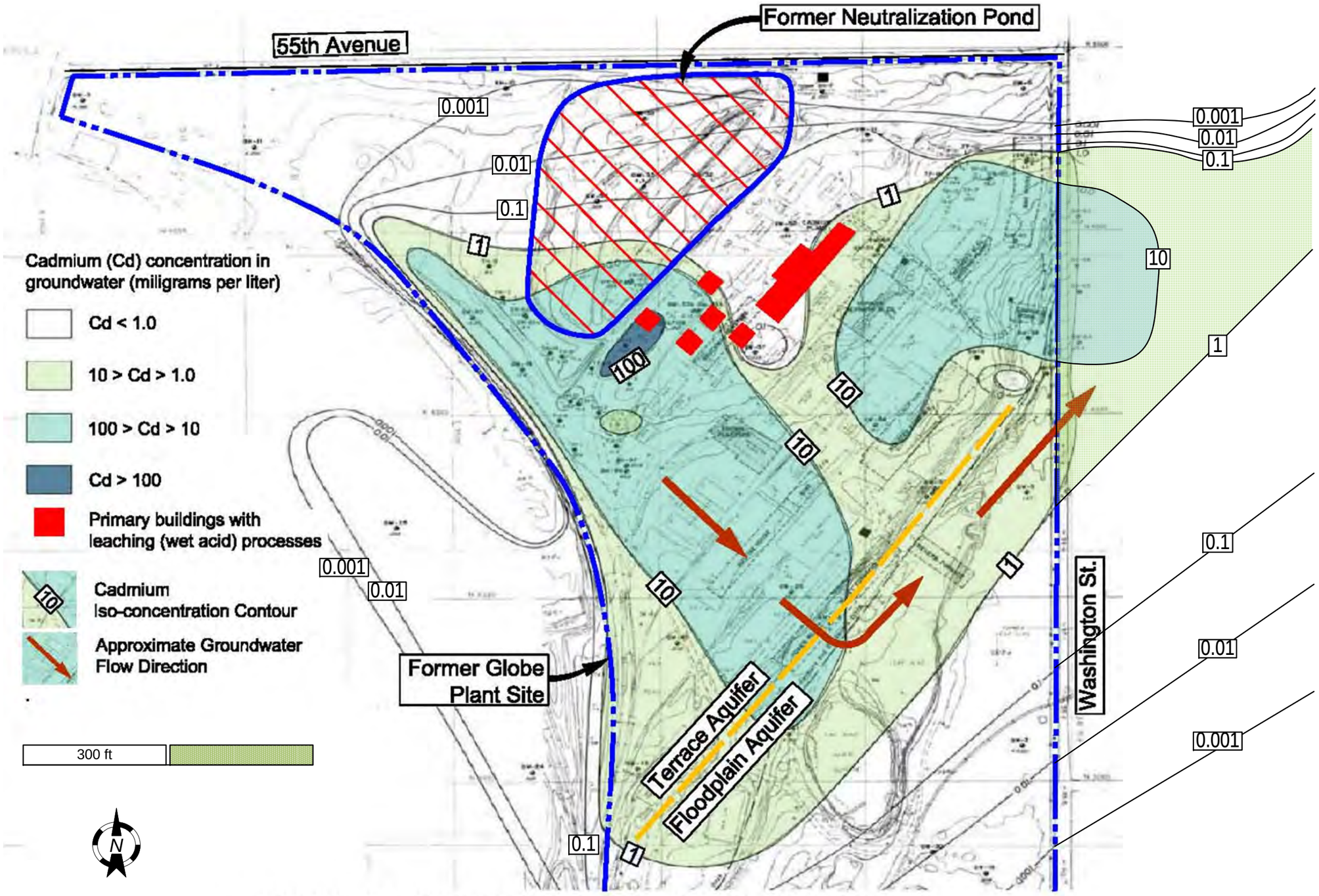

FIGURE 3 - GROUNDWATER CADMIUM PLUME MAP