Iron King Mine – Humboldt Smelter
Removal Report
Dewey-Humboldt
Yavapai County, Arizona

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List of Abbreviations and Acronyms

ADEQ	Arizona Department of Environmental Quality
bgs	Below ground surface
CAM	California Assessment Manual
E & E	Ecology and Environment, Inc.
ERRS	U.S. EPA Emergency and Rapid Response Services contractor
ERS	Emergency Response Section
ERT	U.S. EPA Environmental Response Team
FOSC	Federal On-Scene Coordinator
GPS	Global Positioning System
MS/MSD	Matrix Spike/Matrix Spike Duplicate
mg/kg	Milligrams per kilogram
mg/m^3	Milligrams per cubic meter
MDI	Material Delivery, Inc.
NAI	North American Industries
NPL	National Priorities List
RA	Removal Assessment
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
SAP	Sampling and Analysis Plan
START	Superfund Technical Assessment and Response Team
U.S. EPA	United States Environmental Protection Agency

1 Introduction

From September 13, 2011, through November 15, 2011, the United States Environmental Protection Agency (U.S. EPA), Region 9 Emergency Response Section conducted a removal of arsenic- and lead-contaminated soil at the Iron King Mine – Humboldt Smelter Superfund Site (the site), located in Dewey-Humboldt, Arizona. U.S EPA Federal On-Scene Coordinator (FOSC) Craig Benson tasked the Ecology and Environment, Inc. (E & E) Superfund Technical Assessment and Response Team (START) to provide technical assistance to support the removal. The removal was conducted after a U.S. EPA/START assessment determined that 13 properties within the site should be subject to a time-critical removal action (TCRA). The assessment activities were documented in the START document, *Iron King Mine – Humboldt Smelter Assessment Report, Dewey-Humboldt, Yavapai County, Arizona* (September 2011) (Technical Direction Document No. T02-09-10-09-0004). The TCRA described in this report is an interim U.S. EPA removal activity while U.S. EPA works toward identifying a long-term remedial action for the site.

The TCRA consisted of the removal of surface and near-surface contaminated soil from 11 private residential properties and from one municipal property. At one additional residential property, a small tailings pile (STP) of approximately 21,500 cubic yards was removed and placed on the main tailings pile at the Iron King Mine. As an additional remedial action under the TCRA, ash material on the Humboldt Smelter property was sprayed with a fixative agent to minimize dispersal of the ash by wind and rain.

This report describes the activities conducted to perform the TCRA.

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2 Site Description

2.1 Site Location

The Iron King Mine – Humboldt Smelter site is located in Dewey-Humboldt, Yavapai County, Arizona (Appendix A, Figure 1). The approximate geographical coordinates of the Dewey-Humboldt town hall are latitude 34.503043° north; longitude 112.243559° west. The town of Dewey-Humboldt was incorporated on December 20, 2004, from the existing unincorporated towns of Dewey and Humboldt, located adjacent to one another in the Agua Fria River Valley, 11 miles east of Prescott, Arizona. Dewey-Humboldt is located between the mine and the smelter (Appendix A, Figure 2). The population of the town was 3,613 in 2005 according to a census estimate. Three waterways (Chaparral Gulch, Galena Gulch, and Agua Fria River) transect the site.

2.2 Iron King Mine

The Iron King Mine property is approximately 153 acres in size. It is located west of Highway 69, bordered by the Chaparral Gulch and residences to the north; Highway 69 to the east; Galena Gulch to the south; and undeveloped land to the west. The Iron King Mine was a periodically-active gold, silver, copper, lead, and zinc mine from 1906 until 1969. The present owner of the 85-acre portion of the Iron King Mine area of interest referred to as the Iron King Mine Proper Area is North American Industries (NAI), which produces Hydromax fertilizers and soil supplements. Previous ownership included Ironite Products Company, which marketed Ironite fertilizer produced from mine tailings from 1989 to 2006. The principal feature of the Iron King Mine Proper Area is a large (more than 50 acres) tailings pile that contains high concentrations of arsenic and lead. The tailings are subject to off-site migration mainly via air particulate migration and surface water transport.

2.3 Humboldt Smelter

The Humboldt Smelter property is located less than one mile east of the Iron King Mine property, on the east side of Highway 69. The approximately 189-acre smelter property is bounded by residences to the north and west; the Agua Fria River to the east; and Chaparral Gulch to the south. The majority of the Humboldt Smelter is owned by Greenfields Enterprises, LLC, which purchased the property in 2003. No businesses are currently operating on the property. The Humboldt Smelter area of interest includes tailings and slag deposit areas and numerous ash

piles. The ash pile material has been subject to off-site migration mainly via air particulate migration and surface water transport.

2.4 Small Tailings Pile

The STP was comprised of approximately 21,500 cubic yards of mine tailings containing high concentrations of arsenic and lead and detectable concentrations of cyanide. It was located immediately to the north of the Iron King Mine Proper Area on a 40-acre private parcel designated as OFS-002[1]. Although located on private residential property, the STP was associated with historical mining activities at the Iron King Mine. Anecdotal information from NAI President S. Schuchardt suggests that the STP resulted from a short-lived gold and silver extraction processing attempt that was conducted in or around the 1960s. Mining of the same ore also resulted in the main tailings pile on NAI property (primarily for zinc recovery), but a cyanide extraction process was used in an Iron King Mine operations area, and the slurry was either hydraulically conveyed or piped to a tailings pond at the STP location.

The Chaparral Gulch bordered the STP to the northeast-to-southeast. Surface water readily flowed in, around, and through the area into the Upper Chaparral Gulch. Hay Bale Ravine bordered the STP to the south and flowed northeast into Chaparral Gulch (Appendix A, Figure 3). There were no storm water controls mitigating surface water migration from this area. In addition, much of this area was devoid of vegetation, and STP soils were subject to migration. The STP was considered source material because it is a source of contamination to other media such as surface water and air.

The STP was removed as part of the activities described in this report. The STP material was placed on the main tailings pile at Iron King Mine.

[1] Previous site studies at the Iron King Mine – Humboldt Smelter used the term “OFS”, which stands for “off-site soil”, to describe in-town soil sample properties. To avoid confusion when comparing new data to old data for particular properties, the convention of using “OFS” is continued although the properties are no longer considered “off site.”

3 Previous Investigations

At least 185 residential and commercial properties located in the town of Dewey-Humboldt have been sampled to date in an effort to evaluate metals (primarily arsenic and lead) contamination in shallow soils (surface to up to 18-inch-depth profile). Sample locations have been selected from parcels that were suspected of being impacted by historical mining and smelting operations. In general, for those parcels found to exhibit arsenic and lead above background concentrations, the near surface soils (i.e., 0 – 2 inches below ground surface [bgs]) of these parcels are impacted to a higher degree than the deeper surface soils (i.e., 10 – 18 inches bgs). Parcels with elevated arsenic and lead have been found to be located in closer proximity to the Iron King Mine and Humboldt Smelter. Parcels farther away from these source areas are less likely to have been impacted from particulate migration or surface water transport. A map showing all in-town parcels that were either sampled or were visually assessed and determined to not require sampling is provided in Appendix A, Figure 4.

3.1 Arizona Department of Environmental Quality, 2002

In April 2002, the Arizona Department of Environmental Quality (ADEQ) sampled sediment near residential parcels throughout the Chaparral Gulch as part of a Preliminary Assessment/Site Inspection. The investigation revealed arsenic concentrations of up to 509 milligrams per kilogram (mg/kg) and lead concentrations of up to 513 mg/kg. The current U.S. EPA Regional Screening Levels for arsenic and lead in residential soil are 0.39 and 400 mg/kg, respectively. As discussed in Section 4, the current site-specific background concentrations for arsenic and lead in the Dewey-Humboldt area, determined by EA Engineering, Science and Technology, Inc. (EA) on behalf of the U.S. EPA Remedial Program, have been determined to be 38 and 23 mg/kg, respectively (EA, 2011).

3.2 U.S. EPA/START 2005

In 2005, ADEQ requested that the U.S. EPA assess surface soils at residential properties in the vicinity of the Chaparral Gulch and Iron King Mine. In response to the request, the U.S. EPA and START conducted a site assessment of 17 properties along the Chaparral Gulch (E & E, 2005). Soil samples were collected to determine arsenic and lead concentrations on these properties. Ten samples were collected from each property, which included nine surface samples (0-6 inches bgs) and one subsurface sample (18 inches bgs). Analytical results from

the sampling event identified lead and arsenic concentrations in surface soil samples at four of the properties that were sufficiently high to warrant a removal action. The removal action was conducted by Brown and Caldwell in late 2006 (EA, 2010).

3.3 EA Engineering, Science and Technology, Inc., 2008-2010

In 2008, the Iron King Mine – Humboldt Smelter site was listed on the National Priorities List (NPL), and a Remedial Investigation (RI) was conducted by EA for the U.S. EPA's Remedial Program. From 2008 to 2010, as part of the RI, EA collected soil samples at 168 parcels within the town. The parcels sampled were selected from areas suspected of being impacted by historical mining and smelting operations (based on wind patterns) and where homeowner sampling access agreements could be obtained. The objective of the RI sampling was to identify levels of metals contamination in soil resulting from the site, and specifically to evaluate impacts on the community of Dewey-Humboldt. Nine discrete samples from the 0 to 2-inch depth interval and one discrete sample from the 10 to 12-inch depth interval were collected at each parcel. The deeper-depth interval was selected at random from beneath one of the nine surface sample locations. The nine surface sample locations were selected on a parcel-by-parcel basis (judgmentally) with an attempt to be spatially representative while taking into account site features (e.g., driveways and landscaping) and roof drainage patterns. The RI samples were analyzed for 23 "target analyte list" metals, including arsenic and lead.

Also as part of the RI, EA collected background soil samples from several different soil types and areas about the site. Background Soil Type 1 was identified as the predominant soil type for the study area, and a background concentration of 48 mg/kg for arsenic and 44 mg/kg for lead was established (EA, 2010). A subsequent addendum to the EA RI report revised the average background concentrations of arsenic and lead in Soil Type 1 to 38 and 23 mg/kg, respectively (EA, 2011).

3.4 U.S. EPA Removal Assessment

In the fall of 2010, the U.S. EPA Remedial Program requested that the U.S. EPA Emergency Response Section provide support to conduct a Removal Assessment (RA) at the site. The RA included site inspections and additional sampling in order to determine what properties should be subject to a TCRA. The RA determined that 13 properties should be subject to the TCRA. The properties are listed in Appendix A, Table 1. The RA was documented in the START report, *Iron King Mine – Humboldt Smelter Assessment Report, Dewey-Humboldt, Yavapai County, Arizona* (September 2011) (TDD No. T02-09-10-09-0004).

4 U.S. EPA and START Removal Activities

Removal activities were conducted from September 13, 2011, through November 15, 2011. Appendix A, Figure 4 presents a map of all properties previously investigated at the site and indicates the properties where removals were conducted. Four types of removal activities were conducted at the site:

- Removal of arsenic- and lead-contaminated soil at 11 residential properties and at one municipal property. This activity also included confirmation soil sampling, site restoration to pre-removal conditions using clean borrow material, and hydroseeding of removed, stockpiled soil.
- Periodic sampling of borrow material prior to use, to ensure that the material was not contaminated with arsenic or lead at concentrations greater than the site-specific action levels.
- Application of Gorilla-Snot® fixative agent to the surface of ash piles at the Humboldt Smelter to reduce ash dispersion by wind or rain.
- Removal of the STP and restoration of the surface water drainage pathway that was blocked by the pile. This activity also included confirmation soil sampling to document post-removal conditions, and hydroseeding of removed, stockpiled tailings.

During the previous U.S. EPA assessment activities at the site, it became evident to the U.S. EPA and START that the most-contaminated properties identified for the TCRA were, in all but one case, grouped around Sweet Pea Lane and that the grouping was not consistent with arsenic and lead contamination being caused by wind distribution or surface water deposition from Iron King Mine or Humboldt Smelter. As removal work progressed, all properties subject to the TCRA along the Sweet Pea Lane corridor were found to still contain concentrations of arsenic and/or lead at a two-foot depth that exceeded the site-specific action levels for these analytes. Historical aerial photographs showed that the area of Sweet Pea Lane was the location of a former railroad spur leading into the Humboldt Smelter. Local citizens visiting the U.S. EPA command post at the site during the removal confirmed the railroad's previous existence and, in one case, described how the railroad bed had been bulldozed flat in order to make an area for houses to be built upon, on the northeast side of Sweet Pea Lane. Corroboration of the bulldozing was found in the form of heavy iron girder pieces and railroad ties that

were uncovered and removed during U.S. EPA removal activities at some of the properties.

Site-specific action levels for all removal work conducted at the site were determined by the U.S. EPA to be:

- 38 mg/kg for arsenic
- 23 mg/kg for lead.

These action levels are based on average concentrations of arsenic and lead in soil in the vicinity of the site, determined through an interim U.S. EPA background study (EA, 2011). Additional background information is being collected by the U.S. EPA and the average background concentrations for arsenic and lead are likely to be revised over time.

4.1 General Information Regarding Removal Activities

During the period September 13, 2011, through November 7, 2011, 12 residential and municipal properties were excavated; confirmation sampling was conducted; and the removed soil was replaced with clean fill material. In certain cases, fences or small structures that had been removed to facilitate soil removal were replaced, and some properties were re-sodded or hydroseeded.

During the period October 27, 2011, through November 15, 2011, the STP was removed and the removal area was re-shaped to restore the original drainage pathway into Chaparral Gulch.

All removal work was conducted in accordance with the *Iron King Mine – Humboldt Smelter Removal Work Plan* (Work Plan) (September 2011). The Work Plan was prepared by the U.S. EPA's Emergency and Rapid Response Services (ERRS) contractor, with some support from the START. Confirmation sampling was conducted in accordance with Appendix D of the Work Plan, the START-prepared *Sampling and Analysis Plan, Iron King Mine – Humboldt Smelter Removal, Yavapai County, Arizona* (SAP) (September 2011) (Appendix B). The SAP includes a consolidated health and safety plan functional for the START, ERRS, and U.S. EPA as an appendix.

There were no deviations from the Work Plan or SAP, with the following two exceptions:

- Nine borrow material samples were analyzed for a different analytical suite than specified in the Work Plan (see Sections 4.1.3 and 4.1.6).
- One sample from the STP was analyzed for additional analytical parameters at U.S. EPA request (see Sections 4.1.3 and 4.3.4).

4.1.1 Property Assessment Form and Access Agreements

Prior to the removal activities, the U.S. EPA obtained signed access agreements from all property owners subject to the TCRA. In addition, FOSC Benson, a

representative of the START, and a representative of the U.S. EPA's ERRS contractor met with each property owner and discussed the planned removal activities; the methods for dealing with underground utilities; the method for dealing with outdoor pets; and other issues. Information was solicited from the property owners regarding their knowledge of septic tank and leach field locations and other underground utility locations. A "Pre-Removal and Post-Restoration Property Assessment Form" was filled out for each property, which the property owner signed twice: once before the removal was conducted, and once after the removal was completed and found acceptable by the property owner. Copies of the Pre-Removal and Post-Restoration Property Assessment Forms for each property are maintained in the project file. For the STP, because the STP is at a distance from the owner's home, no property assessment form was prepared. However, an access agreement was obtained.

4.1.2 Sampling Design

Removals at each property were conducted as described in the Work Plan. Excavators, backhoes, bobcats, and skid steers were used to remove contaminated soil into dump trucks, and hand-shoveling was employed to remove soil near foundations, fences, trees, and subsurface utilities. The U.S. EPA *Superfund Lead-Contaminated Residential Sites Handbook* (OSWER Directive 9285.7-50) (August, 2003) (Lead Handbook) was referenced during development of the sampling design and was used as a guideline where possible.

Following guidelines in the Lead Handbook, the START collected removal confirmation composite samples after a one-foot lift of contaminated soil had been removed, with one five-point composite sample collected from each front, back, and side yard of a residential property. In all cases, the five points of the composite sample were well-distributed in order to best-represent the area being sampled, and all samples were obtained from a depth of 0-2 inches. This procedure was also used for individual hot spot removals.

If composite samples from any area exceeded the site-specific action levels for arsenic and/or lead, another one-foot lift was removed in that area and another composite sample was then collected at the two-foot depth. In cases where contaminated soil was still found at the two-foot depth, plastic snow fence material was placed at that depth prior to placing backfill material in the excavation. The intention for the placement of the snow fence was to provide a visual barrier between clean backfill material and the still-contaminated soil beneath it. In some cases, by U.S. EPA decision, some properties were excavated directly to a two-foot depth, and other properties were pot-holed to one- and two-foot depths to determine the depth to be excavated. At properties where excavations were conducted initially to a one-foot depth, these properties were put on a stand-by status and protected with temporary fencing pending receipt and review of the confirmation sample analytical results.

4.1.3 Sample Analysis and Data Validation

All samples were submitted to TestAmerica Laboratories, Inc. (TestAmerica) in Phoenix, Arizona, for analysis. All samples were analyzed for total arsenic and total lead by U.S. EPA Method 6010B. All but nine borrow area samples were analyzed for eight Resource Conservation and Recovery Act (RCRA) metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). Nine borrow samples were only analyzed for total arsenic and lead. As discussed in Section 4.3.4, one sample collected from the STP was analyzed for 17 California Assessment Manual metals (CAM-17 metals) and for total cyanide.

A START chemist performed a Tier 2 validation of all sample data in accordance with *Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan and Data Validation Procedures* (1990), *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (2004), and *U.S. EPA Region IX Superfund Data Evaluation/ Validation Guidance R9QA/006* (2001). Blind duplicate samples were submitted with the samples at a frequency of approximately 10 percent, and additional sample volumes were provided for matrix spike/matrix spike duplicate (MS/MSD) sample analysis at a frequency of approximately 5 percent. The duplicate and MS/MSD results were evaluated as part of the data validation process. The data were found to be acceptable as definitive category data, and the data were determined to be usable to meet project use objectives. The data validation reports are archived in the project file. Validated laboratory data sheets are presented in Appendix C.

4.1.4 Air Monitoring and Sampling

A weather station with logging capability was operated during all removal operations. The weather station measured and logged wind direction, speed, temperature, and other weather factors on a per-minute basis, and the resulting data are archived in the START project file. Continuous air monitoring and air sampling was conducted by the START for every day that removal operations involving the movement of soil or tailings occurred. Three to four air stations (depending on the activities being conducted and the extent of the disturbed area) were placed about the perimeter of the removal activities. Each air station included one dust monitor equipped with data logging capability and alarm, and one air sampler comprised of an air pump and attached mixed cellulose ester cartridge. Air monitors were set to alarm at 2.5 milligrams per cubic meter (mg/m^3), the action level specified in the Work Plan assuming a protection factor of 2.

Air monitoring instruments were zeroed at the beginning of each day, and air sampling pump flow rates were logged at the beginning and end of each day. Air monitoring results were logged on a per-minute basis and the results downloaded and archived at the end of each day. No air monitoring result maximum per-minute average exceeded the action level of 2.5 mg/m^3. Instances of brief spikes that did not exceed the action level were often found to coincide with activity unrelated to the removal activities, such as trash truck operations and dust devils.

Air samples for six days of air sampling (a total of 19 samples) collected during the beginning, the middle, and the end of removal operations were submitted to TestAmerica for analysis. None of the air samples analyzed were found to contain detectable concentrations of arsenic. One of the 19 samples analyzed was found to contain lead at a concentration of 0.000447 mg/m^3. The current Occupational Safety and Health Administration permissible exposure limit is 0.05 mg/m^3 (as a time-weighted average). Air samples that were not analyzed have been archived by the START. Appendix A, Table 2 presents the air monitoring and air sampling results for the TCRA.

4.1.5 Transport and Hydroseeding of Removed Soil

4.1.5.1 Residential Area Soil

Prior to the start of removal activities, S. Schuchardt of NAI agreed, at FOSC Benson's request, to accept the contaminated soil for placement on the top of the Iron King Mine main tailings pile. The soil, together with hydroseeding, will act as a dust suppression cover on the surface of the main tailings pile. All excavated soil from the eastern side of Highway 69 (that is, from all removal sites except the STP) was therefore transported to the main tailings pile. A total of 6,339 cubic yards of contaminated soil was removed from the residential properties and the municipal property. When the transfer of soil was completed, the transferred soil was hydroseeded to control wind and rain dispersion of the soil. Appendix A, Figure 5 shows the footprint of the contaminated soil placed upon the main tailings pile. The footprint covers 100,350 square feet (2.3 acres) to a depth of from one to approximately four feet bgs.

The hydroseed mixture used is known as "Prescott Blend," and is comprised of:

28% Blue Gramma
16% Sheep Fescue
11% Western Wheat Grass
11% Arizona Fescue
4% Curly Mesquite
12% Side Oats Gramma
18% Other

The University of Arizona is reportedly conducting a phytostabilization study with a small portion of the hydroseeded contaminated soil. This work is being conducted with U.S. EPA approval, but it is not part of the TCRA and the U.S. EPA has no involvement in the study, its processes, or conclusions.

4.1.5.2 STP Tailings Material

Tailings material from the STP was transported to a temporary pad on the southeast side of the Iron King Mine main tailings pile. This activity is described in Section 4.3. A total of 21,500 cubic yards of contaminated soil were removed from the STP. After transport, the STP tailings material was not hydroseeded, but a fixative agent, Gorilla-Snot®, was applied to its surface.

4.1.6 Determination of Borrow Sources and Borrow Source Sampling

The START collected 35 soil samples from nine different borrow soil suppliers in order to determine which available soil met the site-specific action level requirements for arsenic and lead. Four suppliers were chosen, based on analytical results; cost of the material; availability; and ease of delivery:

Material Delivery, Inc. (MDI)
10233 W. Northern Avenue
Glendale, AZ 85355

MDI
2815 East Rose Garden Lane
Phoenix, AZ 85050

MDI
8524 North Morning Glory Road
Paradise Valley, AZ 85253

C&R Arrowhead
1405 Road 6 North
Chino Valley, AZ 86323

A memorandum prepared by the START during the removal describing the borrow material sampling and import quantities is provided in Appendix D. Appendix A, Table 3 presents the borrow soil sampling results. Nine of the samples were only analyzed for the parameters total arsenic and total lead. Twenty-six borrow samples were analyzed for RCRA 8 metals.

4.1.7 Photographic Documentation

For each of the 13 properties subjected to the TCRA, pre-removal and post-restoration photographs were taken and are maintained in the project file. Photographic documentation of typical removal activities is presented in Appendix E.

4.1.8 Information Packets

Upon completion of removal activities, the U.S. EPA provided information packets to each of the property owners involved in the TCRA. Each packet contained a CD-ROM and hard copies of some or all of the following types of information:

- Personalized cover letter from FOSC Benson
- Sample locations figure and table presenting all property-specific data for the parameters arsenic and lead
- Signed copies of the Property Assessment Form and Access Agreement
- Plot plans and schematics (if any)

4.2 Removal of Contaminated Soil at Residential Properties and Municipal Property

The following sections describe the removal activities that were conducted at the 11 residential properties and the municipal property located on the east side of Highway 69. Table 4 presents all confirmation sample results for the removal activities.

4.2.1 OFS-103

One hot spot was identified on this property during previous U.S. EPA sampling events. As a result, an area of 35 feet by 35 feet was excavated and removed around the hot spot, to a depth of two feet bgs. The area to be excavated was determined by FOSC Benson and was extended well beyond the original area of the hot spot. FOSC Benson determined that the excavation should be conducted directly to the two-foot depth (by-passing the one-foot depth) and immediately backfilled with clean fill material after confirmation sampling and placement of snow fence, in order to minimize inconvenience to the property owner.

A map showing the area of the removal at OFS-103 is provided in Appendix A, Figure 6. One five-point composite sample was collected at the two-foot bgs depth prior to installation of snow fence and backfilling with clean fill material. The results are presented in Appendix A, Table 4. Both arsenic and lead were found to still exceed their site-specific action levels at the two-foot depth.

The property owner of OFS-103 is also the owner of adjacent properties OFS-142 and OFS-143. These two other properties were not subject to the TCRA. The U.S. EPA obtained permission from the property owner, for a small fee, to use OFS-142 as a staging area for mechanical equipment and incoming borrow material. Parts of the fence around OFS-142 were removed and, at the completion of the removal activities, replaced. The disrupted areas of OFS-103 and OFS-142 were restored to pre-removal conditions and then hydroseeded.

4.2.2 OFS-111

OFS-111 was initially excavated to a one-foot bgs depth and confirmation sampled by the START. All of the one-foot bgs samples were found to contain arsenic and lead at levels greater than the site-specific action levels. The property was therefore excavated to a two-foot depth; confirmation sampled; and a snow fence barrier was placed prior to backfilling the excavation with clean fill material. An area on the southeast corner of the property where a shed had to be temporarily removed was excavated directly to two feet bgs, sampled, snow fenced; and subsequently backfilled with clean fill material before replacement of the shed.

The confirmation sample analytical results are presented in Appendix A, Table 4. All one-foot and two-foot bgs samples exceeded the site-specific action levels for arsenic and lead. Appendix A, Figure 7 shows the area of the removal.

4.2.3 OFS-118

Before the TCRA, OFS-118 had fairly new landscaping that included plants, a decorative brick wall, decorative gravel, and a paver-block back patio. ERRS contracted a local landscaper to document pre-removal property conditions and to restore the property to pre-removal conditions after the removal of contaminated soil had been completed and backfill had been placed. The property owner subsequently had additional work done by the landscaper that the U.S. EPA was not involved with.

OFS-118 was excavated directly to a two-foot depth; confirmation sampled; snow fence was placed; and the excavated area was backfilled with clean fill material.

Appendix A, Figure 8 shows the area of the removal. All confirmation samples exceeded the site-specific action levels at the two-foot depth. The analytical results are presented in Appendix A, Table 4.

4.2.4 OFS-132

OFS-132 was initially pot-holed and sampled at one foot bgs. Pot-holing required the use of a shovel to reach the one-foot depth at 5 locations in each quadrant of the property. The sample results indicated that all four samples exceeded one or both of the site-specific action levels for arsenic and lead. All quadrants of the property were therefore excavated to two feet bgs; the excavation floor was sampled; snow fence was placed; and the excavated area was backfilled with clean fill material. All two-foot-depth confirmation samples met or exceeded the site-specific action levels for arsenic and/or lead. The analytical results are presented in Appendix A, Table 4. Appendix A, Figure 9 shows the area of the removal.

4.2.5 OFS-133 and OFS-119

A 10-foot-wide strip of soil on the northwestern border of OFS-119 was included in the removal conducted at the OFS-133 property. The southeastern confirmation sampling quadrant of OFS-133 included the strip of soil from OFS-119.

OFS-133 was excavated directly to a two-foot depth; sampled; snow fence was placed; and the excavated area was backfilled with clean fill material. Prior to excavation on the southeast border of OFS-133, a fence was removed with the property owner's approval. After backfilling with clean soil was completed, a new fence was installed at U.S. EPA expense.

Appendix A, Figure 10 shows the area of the removal. All confirmation samples exceeded the site-specific action levels at the two-foot depth. The analytical results are presented in Appendix A, Table 4.

4.2.6 OFS-148

OFS-148 was excavated to a one-foot depth and confirmation sampled. All the samples exceeded the site-specific levels for arsenic and/or lead. Excavation was

continued to a two-foot depth; the excavation was confirmation sampled; snow fence was placed; and the excavated area was backfilled with clean fill material. Landscaping gravel and a rock drainage channel at the front of the house were restored to pre-removal conditions.

Appendix A, Figure 11 shows the area of the removal. All confirmation samples exceeded the site-specific action levels at the two-foot depth. The analytical results are presented in Appendix A, Table 4

4.2.7 OFS-208 and OFS-244

A hot spot was removed along the property line between OFS-208 and OFS-244. This hot spot was the only area identified as requiring a removal under the TCRA that was not associated with the Sweet Pea Lane corridor. The approximate dimensions for the removal area were 12 by 15 feet. To minimize the time of disruption for the property owners, the removal was conducted directly to a two-foot depth; the excavation was confirmation sampled; snow fence was placed; and the excavation was backfilled with clean fill material. The confirmation sample at the two-foot depth did not exceed the site-specific action levels for either arsenic or lead. Appendix A, Table 4 presents the confirmation sample results. Appendix A, Figure 12 shows the approximate location of the removal.

4.2.8 OFS-260

OFS-260 is a municipal corridor under the jurisdiction of the town of Dewey-Humboldt. A portion of this property is composed of a berm or hillside leading up to the parcels on the northeast side of Sweet Pea Lane, with the remainder of the OFS-260 property being a dirt road and an overgrown vehicle access-way leading to the Humboldt Smelter property.

This property is split into two areas by a fence located near the northern corner of the OFS-301 property. The portion of OFS-260 that is located to the north-northwest of OFS-301 was determined through assessment sampling to require a removal of contaminated soil. This long and narrow property that contains no dwellings was divided into two approximately-equal rectangular areas for the purpose of confirmation sampling. The northern area was pot-holed to one foot bgs at five locations and sampled, with the five aliquots composited into one sample for analysis. That confirmation sample exceeded both site-specific action levels, and therefore soil was removed to a two-foot depth. Two confirmation samples were collected at the two-foot depth. Because removal was not complete to the two-foot depth at the time of sampling, the three northern-most portions of composite sample 003 were collected via potholing. Once soil was removed to two feet bgs, snow fence was placed, and the excavated area was backfilled with clean fill material. The analytical results for the confirmation samples are presented in Appendix A, Table 4. All results exceeded the site-specific action levels for arsenic and lead. To prevent soil erosion on the hillside, the hillside was hydroseeded. Appendix A, Figure 13 shows the area of the removal.

4.2.9 OFS-301

Hot spots were removed from inside the back yard fence of this property, and from an area immediately outside of the fence to the northeast. The northwest wall of the wood fence was temporarily removed to facilitate contaminated soil removal. To minimize the time of disruption for the homeowner, the removal was conducted directly to a two-foot depth; the excavation was confirmation sampled; snow fence was placed; and the excavation was backfilled with clean fill material. As the area within the fence had originally been covered with grass, new sod was installed and the fence was restored to its original condition. The confirmation sample analytical results are presented in Appendix A, Table 4. Both samples exceeded the site-specific action levels at the two-foot depth. Appendix A, Figure 14 shows the area of the removal.

4.2.10 OFS-306

This property is located directly to the northeast of the OFS-260 property. The southern portion of OFS-306, a roughly-triangular area, was subject to the TCRA. The southern portion was divided in two areas for the purpose of confirmation sampling. One-foot-depth confirmation samples, collected by pot-holing, exceeded the site-specific action level for lead. Only one of the one-foot-depth confirmation samples did not exceed the action level for arsenic. The removal was therefore conducted to a two-foot depth; confirmation samples were collected; snow fence was placed; and the removal area was backfilled with clean fill material. The two-foot-depth confirmation samples also exceeded the site-specific action levels for lead. At one of the confirmation sample areas, arsenic did not exceed the site-specific action level of 38 mg/kg.

The confirmation sample analytical results are presented in Appendix A, Table 4. Appendix A, Figure 15 shows the area of the removal.

4.3 Small Tailings Pile Removal

The STP originally had a footprint of approximately 36,000 square feet and a height of from approximately 6 to 15 feet as measured from the southeastern toe of the pile. STP removal and site restoration activities were conducted during the period October 27, 2011, through November 15, 2011. A total of approximately 21,500 cubic yards of tailings material were removed and placed on a temporary pad lined with geosynthetic material located on the “lower bench” of the Iron King Mine main tailings pile, which is located to the southeast of the main pile. The STP material stored on the pad is expected to be used, with additional import material from future remediation activities, to help buttress the main tailings pile.

Appendix A, Figure 16 presents the former location of the STP, along with the location of the temporary road constructed to transfer out the STP tailings material. Appendix A, Table 4 presents STP sample analytical results for confirmation samples collected from the floor of the removal excavation, as well as from other material sampled from the pile.

4.3.1 STP Removal Process

To accomplish the removal, a 1,250-foot long temporary road was constructed by bulldozer to provide a means for trucking tailings material up to the storage pad. STP excavation and load-out was conducted using an excavator and two 70-ton dump trucks. Tailings removed were generally reddish in color (with the exception of a gray material described below) and were easily discernable from the native soils beneath the pile. As removal work progressed, the START recorded the progress using a global positioning system (GPS) on a daily basis to document STP footprint extent (Appendix A, Figure 17). Upon completion of the removal, the tailings on the pad were compacted with an excavator and the surface was given a heavy application of Gorilla-Snot®.

4.3.2 STP Confirmation Sampling

Confirmation samples were collected by the START following guidelines described in the SAP. Confirmation samples were collected from the "floor" of the STP in native material as it was uncovered. Although the SAP specified that one composite sample would be collected for every 4,000 square feet of area, a total of 12 confirmation samples (not including quality control samples) were collected from the STP floor, for an average frequency of one per 3,000 square feet. The five points of each composite sample were well-distributed in order to best-represent the area being sampled. All samples were obtained from a depth of 0-2 inches. Appendix A, Figure 17 shows the locations from which the confirmation samples were collected. A GPS instrument was used to document the boundaries of each composite confirmation sample location.

Five of the STP confirmation samples indicated concentrations of arsenic and lead that were below the site-specific action levels. The STP was only removed to the depth of the original grade, and no additional removal was conducted at confirmation sample locations that were found to exceed the action level for one or both analytes.

4.3.3 Additional STP Characterization Sampling

Four samples were collected by the START to additionally characterize the material of the STP. One sample of a gray sludge material is described in Section 4.3.4, below. Three other samples were collected from the southern berm of the STP, and from excavation sidewalls. All four samples exceeded the site-specific action levels for arsenic and lead. The results for the additional characterization samples are included in Appendix A, Table 4.

4.3.4 STP Gray Sludge Material

A gray sludge material was encountered in a bowl formation within the northern quarter of the tailings pile. The material was moist and elastic, and totaled approximately 1,400 cubic yards. When removed from the STP, this material was kept in a separate location from other tailings material, in an area immediately south of the temporary pad. A START-collected sample of the material contained concentrations of arsenic and lead at 5,000 and 5,100 mg/kg, respectively. The sample was also analyzed for CAM-17 metals and total cyanide, at U.S. EPA

request. The analytical results are presented in Appendix A, Table 5. Other than high concentrations of arsenic and lead, the most significant results were mercury at 17 mg/kg, cadmium at 120 mg/kg, zinc at 48,000 mg/kg, and cyanide at 1.9 mg/kg.

4.3.5 Hydrogeologic Restoration of STP Area

The U.S. EPA's Environmental Response Team (ERT) was responsible for restoring grades and drainage patterns upon completion of the removal of the STP. A 50-year return period storm for the local area was used for the design. The design included:

- Completion of surface grading within the area of the former STP.
- Installation of polypropylene filter fabric and coarse riprap over a 65-foot wide, 3-foot high vertical "spill point" leading from Iron King Mine property and a steep, adjoining downstream area.
- Completion of a 400-foot diversion channel constructed with filter fabric and riprap for conveying stormwater from the spillway into Chaparral Gulch. The channel is approximately three feet deep, 21 feet wide at the top, and three feet wide at the bottom.
- Installation of approximately 675 feet of straw wattle on the steep slopes to protect against future erosion.

Appendix A, Figure 16 shows the location of the completed diversion channel. Appendix F presents ERT's Site Restoration and Design Implementation report, prepared by ERT's contractor, Lockheed Martin.

4.4 Application of Fixative to Humboldt Smelter Ash Piles

Approximately 12 acres of ash piles on the Humboldt Smelter property were sprayed with a fixative called Gorilla-Snot®. The application of the fixative was conducted in order to reduce dispersion of the ash by wind and rain. The application was conducted by ERRS over a period of three non-consecutive days. Appendix A, Figure 18 presents a map showing the ash pile areas treated with fixative.

5 Summary

Over the period September 13, 2011, through November 15, 2011, the U.S. EPA conducted a TCRA at the Iron King Mine – Humboldt Smelter NPL site located in Dewey-Humboldt, Arizona.

At 11 residential properties and at one municipal property, soil contaminated with arsenic and lead was removed to a depth of two feet below ground surface. A total of 6,339 cubic yards of contaminated soil were removed from the 12 properties. The contaminated soil was moved to the top of the Iron King Mine main tailings pile and was subsequently hydroseeded. START confirmation sampling documented concentrations of arsenic and lead at the two-foot depth at each property. In all removal locations except OFS-208/244, arsenic and/or lead concentrations found at the two-foot depth exceeded the site-specific action levels, and snow fence was placed in the excavation to provide a visual barrier between clean backfill material and the still-contaminated soil beneath it. Removed contaminated soil was replaced with soil documented to be below the site-specific action levels for arsenic and lead. Upon completion of backfill with clean material, each property was restored to pre-removal conditions.

At the STP, 21,500 cubic yards of contaminated soil were moved to a temporary, lined pad located on the southeast side of the Iron King Mine main tailings pile. START confirmation sampling documented concentrations of arsenic and lead at the excavation floor. Five of the 12 STP confirmation samples collected from the excavation floor indicated concentrations of arsenic and lead that were below the site-specific action levels. The STP was only removed to the depth of the original grade, and no additional removal was conducted at confirmation sample locations that were found to exceed the action level for one or both analytes. The area of the former tailings pile was re-contoured and a drainage pathway into Chaparral Gulch was restored.

Approximately 12 acres of loose ash material on the Humboldt Smelter property was sprayed with a fixative in order to reduce the amount of ash dispersed through wind and rain.

The TCRA was conducted as an interim U.S. EPA removal activity while the U.S. EPA works toward identifying a long-term remedial action for the site.

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6 References

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A Figures and Tables

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Figure 1 Site Location Map

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Figure 2 Site Map

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Figure 3 Former Small Tailings Pile

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Figure 4 In-Town Parcel Assessment and Removal

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Figure 5 Footprint of Removed Soil Placed on Iron King Mine Main Tailings Pile

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Figure 6 OFS-103 Removal Area

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Figure 7 OFS-111 Removal Areas

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Figure 8 OFS-118 Removal Areas

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Figure 9 OFS-132 Removal Areas

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Figure 10 OFS-133 and OFS-119 Removal Areas

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Figure 11 OFS-148 Removal Areas

Figure 12 OFS-208 and 244 Removal Area

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Figure 13 OFS-260 Removal Areas

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Figure 14 OFS-301 Removal Areas

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Figure 15 OFS-306 Removal Areas

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Figure 16 New Diversion Channel and Location of Temporary Road

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Figure 17 STP Excavation Progress and Excavation Floor Confirmation Sampling Locations

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Figure 18 Application of Fixative to Humboldt Smelter Ash

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Table 1 Properties Subject to U.S. EPA Time-Critical Removal Action

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Table 2 Air Monitoring and Sampling Results

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Table 3 Borrow Area Sample Results

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Table 4 Analytical Results for Confirmation Samples

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Table 5 STP Gray Sludge Material CAM-17 Metals and Total Cyanide Results

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B Sampling and Analysis Plan

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C Laboratory Data Sheets

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D START Borrow Material Memorandum

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E Photo Documentation

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ERT Site Restoration and Design Implementation Report

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