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Formation Environmental Project No.: 010-003 Task 3

Mr. David Mercer
3082 32nd Street By-Pass Road, Suite D
Silver City, NM 88061

Subject: Final Ecological Risk Assessment for the Lampbright Investigation Unit, Chino Mine Investigation Area

Dear Mr. Mercer:

Enclosed you will find one hard copy and four CDs containing the Final Ecological Risk Assessment for the Lampbright Investigation Unit at the Chino Mine Site. The document has been revised to accommodate comments from NMED and Chino Mines through April, 2018.

Please do not hesitate to contact me at (724)387-1067 if you have any questions. Thank you.

Sincerely,
FORMATION ENVIRONMENTAL, LLC

J.M. Allen

Joe Allen
Senior Risk Assessor/Project Manager

cc: Joe Fox; NMED - 1 HC, 1 CD
Petra Sanchez; USEPA – 2 CDs
Alicia Voss; Freeport – 1 HC, 1 CD
Pam Pinson; Chino 1 HC**, 2** CDs
Matt Barkley; Arcadis – 1 CD

FINAL

Ecological Risk Assessment for the Lampbright Investigation Unit Chino Mine Investigation Area, Grant County, New Mexico

May 2018

Prepared for:

New Mexico Environment Department

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LIST OF ACRONYMS

95% UCL	95th Upper Confidence Limit
AF	Availability Factor
AOC	Administrative Order on Consent
BAF	Bioaccumulation Factor
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BRI	Background Remedial Investigation
BW	Body Weight
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CLF	Chiricahua Leopard Frog
CMC	Chino Mines Company
COPCs	Chemicals of Potential Concern
CSM	Conceptual Site Model
DEL	*de minimus* Effects Level
DW	Dry Weight
EcoSSLs	Ecological Soil Screening Levels
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
ERI	Ecological Remedial Investigation
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
H/WCIU	Hanover and Whitewater Creeks Investigation Unit
IUs	Investigation Units
kg/kg	kilogram per kilogram
km	kilometer
LIU	Lampbright Investigation Unit
LOAEL	Lowest-Observed-Adverse-Effects Level
LOEC	Lowest-Observed-Effect Concentration
LSO	Lampbright Stockpile Operations
µm	microns

LIST OF ACRONYMS (Continued)

mg/kg	milligram per kilogram
mi	mile
NCSS	Number Cruncher Statistical Systems
NMED	New Mexico Environment Department
NOAEL	No-Observed-Adverse-Effects Level
NOEC	No-Observed-Effect Concentrations
pre-FS RAC	pre-Feasibility Study Remedial Action Criteria
PLS	Pregnant Leach Solution
pCu^{2+}	Negative Logarithm of the Cupric Ion Concentration
PEC	Probable Effects Concentration
PEL	Probable Effects Level
pH	Negative Logarithm of the Hydrogen Ion Concentration
RAC	Remedial Action Criteria
RBC	Risk-Based Concentration
RI/FS	Remedial Investigation/Feasibility Study
SESAT	Southwest Endangered Species Act Team
SPLP	Synthetic Precipitation Leaching Procedure
S/TSIU	Smelter and Tailing Soils Investigation Unit
SSL	Soil Screening Level
TEC	Threshold Effect Concentration
TM	Technical Memorandum
TRV	Toxicity Reference Value
UCL	Upper Confidence Limit
UCL95	Upper 95th percentile Confidence Limit
ug/L	Microgram per Liter
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
WER	Water-Effect Ratio

1.0 INTRODUCTION AND PURPOSE

This document presents the results of the Ecological Risk Assessment (ERA) for the Lampbright Investigation Unit (LIU) at the Chino Mine Investigation Area (the Site), Grant County, New Mexico (the site). The Chino Mine operational areas, located approximately 12 miles southeast of Silver City, include open pit copper mining facilities, rock stockpiles, leach stockpiles, mineral processing facilities, and tailings impoundments (Figure 1.0-1). Freeport McMoRan Chino Mines Company (CMC) controls approximately 116,000 acres around the mining and mineral processing facilities.

In December 1994, CMC and the New Mexico Environment Department (NMED) entered into an Administrative Order on Consent (AOC) to conduct environmental investigations at the Chino Mine Investigation Area which includes the areas outside of the Chino Mine operational areas that have or may have been impacted by historical mine operations. The AOC required that a Remedial Investigation/Feasibility Study (RI/FS), including human health risk assessments (HHRAs) and ecological risk assessments (ERAs), be completed for each of the following Investigation Units (IUs):

- Lampbright Draw;
- Hanover Creek Channel;
- Whitewater Creek Channel;
- Smelter;
- Hurley Soils; and
- Tailings Impacted Soils.

For practical and logistical reasons, the Hanover Creek Channel and Whitewater Creek Channel IUs (H/WCIU) and the Smelter IU and Tailings Impacted Soils IUs (S/TSIU) have been combined for performing the RI/FS investigations.

CMC and NMED agreed to conduct a baseline ERA (BERA) for all the IUs based on suggestions that an ERA could be more effectively conducted on a Sitewide basis. An Ecological IU was designated for this purpose and added to the AOC in December 1995 (NMED 1995). The Ecological IU encompasses areas of the other IUs that may contain ecological resources that may be affected by contaminant release (NMED 1995).

The Sitewide BERA, completed in December 2005 (NewFields 2005), was conducted in accordance with United States Environmental Protection Agency (USEPA) guidance for ERAs at Superfund (i.e. Comprehensive Environmental Response, Compensation and Liability Act of 1980 [CERCLA]) sites (USEPA 1992, 1997). While the Chino Mine Site is not a Superfund site, the intent of the AOC is to produce CERCLA-like investigations and remedies. General guidance on conducting ERAs (USEPA 1998) was used in planning and development of the risk characterization approach of the BERA and in the terminology used in the Sitewide BERA Report..

Because the RI had not been completed when the BERA was designed and conducted, the nature and extent of contamination in the IUs had not been fully characterized. Therefore, the BERA design focused on identifying chemicals of potential concern (COPCs) for ecological receptors, characterizing stressor-response relationships for key COPCs, and developing risk-based tools for further evaluating ecological risk in individual IUs as more complete nature and extent characterization information became available from the RI. As described in Section 1 of the Sitewide BERA Report (NewFields 2005), and detailed in Technical Memorandum No. 1 (TM-1) (Schafer 1999), the Chino ERA study design was based on assessing risk along a gradient of contamination, indicated by soil copper concentrations and pH. The tools provided in the Sitewide BERA were intended to facilitate implementation of the ERAs for each IU as additional RI data became available. The IU-specific ERA for the LIU focuses on the risk characterization in terms of Sitewide contribution to risk, to help focus risk management decisions.

The LIU is assumed in this assessment to include the areas northeast of the S/TSIU and near the active mining operations and the drainages associated with the Lampbright Stockpiles, as shown on Figure 1.0-1 and defined in the LIU RI Report (ARCADIS 2012). The LIU does not include those areas that are part of the Hurley Soils IU, S/TSIU, H/WCIU or the operational areas of the Site.

1.1 Summary of Problem Formulation

A full problem formulation discussion is presented in the Sitewide BERA Report (NewFields 2005) and TM-1 (Schafer 1999). A detailed discussion of the Site setting and LIU investigation history is provided in the LIU RI Report (ARCADIS 2012).

As with the other IUs at the Site, the potential chemical stressors in the LIU consist primarily of metals. The Sitewide BERA identified potentially complete exposure pathways that were used to evaluate the risk of direct effects on ecosystem components from chemical stressors associated with the Site. The potentially complete exposure pathways used to guide the assessment in the Sitewide BERA and the LIU ERA are shown in a conceptual site model (CSM) provided in Figure 1.1-1.

The Sitewide BERA also noted that indirect effects of components of the ecosystem that are not directly affected by exposure to chemical stressors can result from habitat effects to ecosystem components that may have been directly affected by exposure (e.g., a loss of nesting sites or prey base may have an effect on raptor populations even if the exposure to raptors is not predicted to be at a level of concern). The potential for indirect effects is also discussed for the LIU in this assessment.

1.1.1 Site Description

The physiography and geology of the LIU are described in detail in the LIU RI (ARCADIS 2012) and are not repeated here.

In general, habitat within the LIU is made up of primarily upland forest types such as ponderosa pine – oak forest alliance, alligator juniper – oak forest alliance, mountain mahogany - shrubland alliance, and alligator juniper – oak/grama woodland alliance. Fluvial forest and shrubland alliance is prevalent in the narrow riparian corridors of the drainages (Figure 1.1-2).

As discussed in the LIU RI, there are several primary and secondary sources and release mechanisms within the LIU. The primary potential source of COPCs within the LIU is the Lampbright Stockpile Operations (LSO). Primary sources within the LSO include low-grade ore, waste rock, historical mine water, leachate from the copper leaching operation known as pregnant leach solution (PLS), and raffinate (recycled PLS following removal of copper) associated with historical operations and releases.

Primary release mechanisms may include both historical and operational releases. Releases include fugitive dust from ore and waste rock at the LSO. Raffinate sprayed or dripped onto the stockpiles may also have been a localized historical release. Otherreleases may include seepage of meteoric water, raffinate spray, and/or PLS releases to groundwater, stormwater, or overland flow.

Upland soils upon which fugitive dust and raffinate spray may have been deposited are described in the LIU RI as potential secondary sources. COPCs deposited on upland soils could be transported into the LIU tributaries and/or absorbed by biotic media within the LIU. In addition, COPCs in groundwater could be transported to surface water via seeps and springs or be adsorbed onto sediments within the LIU tributaries.

Secondary release mechanisms include potential infiltration to groundwater of PLS via historical overland flow within the collection system. PLS and raffinate have also been discharged from the LSO and main Lampbright Stockpile on several occasions into the LIU tributaries. These releases are discussed in detail in the LIU RI Section 3.2.

Both primary and secondary release mechanisms within the LIU have potentially affected several media:

- Upland Soil;
- Surface Water;
- Sediment;
- Biotic Media; and

- Groundwater.

As discussed in the BERA, potential ecological receptors for the LIU are birds, mammals, aquatic receptors, and the vegetation community.

The CSM for the LIU is provided in Figure 1.1-1. The CSM was created as part of the BERA process and has been modified slightly to accurately reflect the conditions within the LIU as discussed in the LIU RI.

1.1.2 Assessment Endpoints

Assessment endpoints are explicit expressions of the ecological resource to be protected (USEPA 1992, 1997, 1998). The BERA process identified a set of assessment endpoints based on ecological relevance, potentially complete exposure pathways, and taxonomic groups that may be sensitive to chemical stressors and are potentially exposed as well as site management goals (Schafer and Associates 1999).

Risk questions are described by USEPA (1997) as the questions the ERA will attempt to answer regarding whether or not assessment endpoints could be adversely affected by exposure to COPCs. They form the basis for identifying the specific analyses to be conducted and the data needed to perform the analysis. In some cases, risk questions may be stated as risk hypotheses (USEPA 1998) that form the basis for identifying the data collection and analysis to be performed.

The endpoints and risk questions used to guide the development of the Sitewide BERA are presented in Table 1.1-1. The assessment endpoints can be broken down into three main categories with subcategories as follows:

Terrestrial Vegetation as Wildlife Habitat

- Upland community
- Community of non-perennial drainages

Terrestrial Wildlife

- Herbivorous, insectivorous and omnivorous birds
- Raptors
- Herbivorous, granivorous and omnivorous small mammals
- Ruminants
- Mammalian predators

Aquatic Receptors

- Amphibians

- Aquatic community

1.1.3 Sitewide BERA Conclusions

As noted above, the Sitewide BERA study design was based on assessing risk along a gradient of contamination, indicated by soil copper concentrations and pH described in the Background RI (BRI) (CMC 1995). The Sitewide BERA assessed potential risks to each of the assessment endpoints at the CMC site. Some potential risks were identified for several receptors evaluated.

The conclusions reached in the Sitewide BERA regarding potential risks are summarized below:

1) No significant risks within the LIU were identified for any receptor; however, data within the LIU were limited.

2) In other areas of the Site, metal concentrations have apparently increased, and soil pH has decreased as a result of mining operations in some areas of the Site; metal concentrations are most elevated in surface soils;

2a) Due to depressed pH, the bioavailable fraction of metals has increased, and metal exposure has also apparently increased;

2b) A wide range of exposure conditions exist at the Site, corresponding to both elevated metal concentrations and depressed pH; and

2c) A wide range of exposure conditions exist in a demonstrable gradient with distance from the smelter and tailing impoundments within the S/TSIU.

<u>Vegetation</u>

Overall trends identified from results of the Sitewide BERA analysis indicated that:

1) Phytotoxicity testing using standard test species (alfalfa and perennial ryegrass) and Site soils collected along the gradient showed significant toxicity in soils collected from the most heavily contaminated locations. Toxicity increased with metal concentration and inversely with pH. In the area potentially affected by the Smelter, sites most distant from the smelter showed low or no toxicity; and

2) Differences in upland vegetation community structure and composition varied along the gradient; locations closest to the sources and containing the highest concentrations tended to have lower richness and cover than areas farther from the sources.

Terrestrial Wildlife

The conclusions drawn indicate that potentially significant risks to wildlife receptors appear to be relatively restricted to the most contaminated areas of the Site, immediately east of the smelter and northernmost tailings impoundments (within the S/TSIU) and at some locations along the Hanover and Whitewater Creek corridor (some of which is within the S/TSIU). Risks to small ground-feeding birds appeared to be of potentially greatest concern based on risk from copper intake from ingested soils and food, as well as cumulative risk from intake of other COPCs. Risk to small mammals was of second-greatest concern, but was substantially less than that estimated for ground-feeding birds based on the magnitude of hazard quotients. Individuals of larger and more mobile receptors, such as ruminants, mammalian predators, and raptors appeared to be at relatively low risk. Overall, the Sitewide BERA indicates that local populations inhabiting the AOC or within sub-areas of the AOC could be affected. No effects to regional populations of wildlife were predicted.

No significant risks to wildlife were predicted based on the limited data available in the LIU.

Aquatic Life

At the time of completion of the BERA, few surface water and sediment data were available for use assessment. The report generally concluded that potential risks from cadmium, copper, lead, and zinc in surface water and sediment were predicted along the Whitewater Creek corridor, which is in the Hanover Whitewater Creek IU, and in Bolton Draw, which is in the S/TSIU. However, it was noted that the habitat in these areas is limited by low flows and frequent absence of water. Therefore, the aquatic communities in these areas are limited and typical of non-perennial aquatic habitats in the desert southwest.

Stock tanks in the S/TSIU represent isolated potential breeding areas for amphibians and invertebrates. Potentially significant risks were noted for multiple stock tanks within the S/TSIU, mostly the farthest upstream tanks where sediment from the most-affected sections of the S/TSIU are trapped. The Sitewide BERA concluded that copper concentrations exceeded water quality criteria and amphibian Toxicity Reference Values (TRVs) in these ponds and may limit production during times when water is present. Physical disturbance, in the form of cattle usage, is extensive in these areas and could also limit amphibian breeding.

As with the other receptor groups, no significant risks were identified in the LIU, but only very limited data were available for the BERA. The additional data collected during the LIU RI process are further evaluated in this assessment.

1.1.4 COPCs Evaluated in the BERA

The Sitewide BERA identified a list of COPCs that were assessed for each of the three main assessment endpoints. The COPCs evaluated in the Sitewide BERA are listed below and constitute the list of COPCs that are further evaluated in the LIU ERA:

Vegetation

- Copper
- Hydrogen ion activity (pH)

Terrestrial Wildlife

- Cadmium
- Chromium
- Copper
- Lead
- Molybdenum
- Selenium
- Zinc

Aquatic Receptors

- Cadmium
- Copper
- Lead
- Zinc

These chemicals were identified as COPCs in the Sitewide BERA via the screening-level risk assessment process that conservatively compared upper-bound concentrations to risk-based toxicity values and were carried forward into the detailed risk analysis presented in the BERA Report (NewFields 2005).

1.1.5 Data Available for Use in the LIU ERA

Data were collected from the LIU under several investigations completed prior to the LIU RI and are discussed in detail in the RI Report Section 2.8 (ARCADIS 2012).

Specifically for the LIU RI, 27 surface soil samples (0 to 1 inch below ground surface [bgs]) and 27 shallow soil samples (0 to 6 inches bgs) were collected. The shallow soil samples were specifically collected for ERA purposes while the surface soil samples were collected for use in the HHRA. Samples were collected from 21 locations downwind of the Lampbright Stockpile and 6 locations from upwind 'reference' areas. The surface soil samples were sieved through a 250 micron (µm) mesh to isolate only very fine soil particles. The shallow soil samples were sieved to include the less than 2000 µm size fraction, which was consistent with methodologies used in the Sitewide BERA.

The surface soil data collected for the LIU RI from the smaller size fraction are of use for the HHRA but are of limited use for the ERA. The smaller size fraction sampled for the HHRA soil samples represents the soils that would most likely adhere to human skin. While dermal exposure to wildlife receptors may be a pathway of exposure, it is generally considered to be of lower concern than ingestion pathways evaluated quantitatively in the Sitewide BERA. Soil samples from the larger size fraction are more likely to represent the soils that wildlife receptors may be exposed to when grazing, browsing, or burrowing.

For shallow soils, data were collected under several investigations as discussed in the LIU RI. The data available for use in the BERA were limited to samples collected as part of the Ecological Remedial Investigation (ERI) and the BRI. Since the sample collection techniques used for the ERI and BRI were different than those used for the LIU RI, and the number of samples from the ERI and BRI are limited, combining the two datasets is of little value to the assessment in quantitative analyses. As a result, the quantitative upland risk evaluations in this assessment were conducted using the 2010 LIU RI data only. The locations of the shallow surface soil samples used in the ERA are shown in Figure 1.1-3 and all data are shown in Appendix A, Table A-1.

A limited number of surface water (n = 4) and sediment samples (n = 4) were collected within Tributary 2 and Tributary 2A specifically for the LIU RI Report. In addition, a number of samples of both media were also available for use in the LIU ERA and are presented in the LIU RI Report as indicative of current conditions. These samples were collected as part of the following investigations:

- Surface Water
    - ERI Report (ARCADIS JSA 2001)
    - Sitewide Abatement Program (Golder 2009)
    - Post Corrective Action Monitoring Report (Golder 2010)

- Sediment
    - Background Report (CMC 1995)
    - ERI Report (ARCADIS JSA 2001)
    - Sitewide Abatement Program (Golder 2009)
    - Post Corrective Action Monitoring Report (Golder 2010)

Sample locations for both surface water and sediment are shown in Figure 1.1-4 and all data are provided in Appendix A, Tables A-2 (Sediment) and A-3 (Surface Water).

1.1.6 COPCs Evaluated in the LIU ERA

Section 4.3.3 of the LIU RI Report (ARCADIS 2012) provided comparisons of LIU shallow soils to reference area soils to determine if LIU soils are elevated in relation to the reference soils using 'ecological decision criteria' which were derived primarily from USEPA ecological soil screening levels (EcoSSLs; USEPA 2005). For chemicals with concentrations exceeding decision criteria, shallow soil data were then compared to Site-specific background concentrations derived from mineralized soils. Ten metals were identified as being statistically elevated above reference concentrations and/or greater than the ecological decision criteria presented in the LIU RI Report:

- Aluminum;
- Barium;
- Boron;
- Chromium;
- Copper;
- Lead;
- Nickel;
- Selenium;
- Vanadium; and
- Zinc.

Several of the COPCs listed for shallow soils in the LIU RI Report were not identified as Sitewide COPCs in the BERA (Section 1.1.4), including aluminum, barium, boron, and vanadium. Data for each of these chemicals were screened in the LIU RI Report using the EcoSSL benchmarks, with the exception of boron for which no EcoSSL was available.

In order to determine if these COPCs should be carried forward into the LIU ERA, 95th upper confidence limit of the mean concentrations (95% UCL) in shallow soil samples collected for the LIU ERA were compared to the 95th percentile concentrations for upland soils assessed in the BERA (BERA Appendix E; Table 1). This comparison is provided in Table 1.1-2 and the LIU data are provided in Appendix A.

Potential risks from aluminum, barium, and boron were screened in the BERA and the chemicals were subsequently not selected as sitewide COPCs at higher concentrations (aluminum and boron) than were detected in the LIU. In contrast, the LIU 95% UCL concentration of barium (266.4 milligram per kilogram [mg/kg]) was higher than the BERA 95th percentile (181 mg/kg).

However, the EcoSSLs for soil invertebrates (330 mg/kg) and mammalian wildlife (2,000 mg/kg) were both greater than the 95% UCL for LIU shallow soils indicating *de minim*us risk. As a result, aluminum, barium, and boron do not require additional assessment in this ERA.

Vanadium was not analyzed in the BERA soils, so risks to vanadium were not evaluated in the BERA. The 95% UCL vanadium concentration in LIU shallow soils (44 mg/kg) was less than the mammalian EcoSSL (280 mg/kg) but greater than the avian EcoSSL (7.8 mg/kg). However, all shallow soil samples collected for the LIU RI, including reference samples, exceeded the avian EcoSSL indicating that the avian EcoSSL for vanadium may not be applicable for soils in the LIU. While avian risks cannot be conclusively ruled out, the minor increase in downgradient (95% UCL = 44 mg/kg) versus reference area (95% UCL = 32.8 mg/kg) vanadium concentrations in shallow soils is not expected to result in a significant increase in risk to avian receptors, and therefore, vanadium was not assessed further in this ERA.

1.2 Organization of the LIU ERA Report

This report is organized by groups of assessment endpoints and relies heavily on detailed problem formulation presentations provided in the Sitewide BERA and TM-1, while focusing on the results of the LIU RI data and the assessment of ecological risk based on the current database which has been expanded since the completion of the BERA. Risk analysis is grouped by assessment endpoint as follows:

- Section 2: Risk Analysis for Vegetation in the LIU
- Section 3: Risk Analysis for Wildlife in the LIU
- Section 4: Risk Analysis for Amphibians and Aquatic Receptors in the LIU
- Section 5: General Risk Assessment Uncertainties

Section 6: Conclusions and Recommendations

2.0 RISK ANALYSIS FOR VEGETATION IN THE LIU

This section presents the LIU risk analysis for the terrestrial vegetation assessment endpoint. As discussed in the Sitewide BERA and in the RI Report, the primary contaminant sources in the LIU for upland areas are windblown materials from the stockpiles (Figure 1.1-1).

The primary exposure pathway for terrestrial plants to COPCs in LIU soils is through absorption or direct contact of roots with contaminated soils. The mobility and bioavailability of COPCs in soils are important considerations to the risk assessment. The geochemical nature of metals and inorganics following deposition onto soils and sediments greatly affects their mobility, speciation, and bioavailability. Important geochemical reactions occur in soils that strongly affect the speciation of metals and the ease with which they are assimilated by plants. Most important is the pH of the immediate environment, and secondarily is the concentration of dissolved ligands. At acidic pH, most metals occur in solution as the free metal ion (e.g., Cu^{2+} or Pb^{2+}). As pH increases, the free metal ion bonds with dissolved ligands to form charged and uncharged dissolved complexes of varying stability and bioavailability (e.g., $CuSO_4$, $CuHCO^{3+}$, $CuCO_3$, Cu-organic). Stable complexes exhibit substantially lower bioavailability, and hence lower toxicity, than weak complexes or the free metal ion. Depending on the pH, the proportion of metal complexes may comprise a significant portion of the total metal load in a system. Consequently, the total content of metals in soil and water is less important than the abundance of the speciation and bioavailable fraction present. As discussed in the Sitewide BERA, while potential risks from multiple COPCs were assessed, the vegetation risk analysis is focused on soil copper COPC concentration and pH as they were determined in that assessment to be the best measures for predicting potential effects on vegetation.

2.1 Assessment Endpoint and Objective

The quality of vegetation as wildlife habitat in uplands and along non-perennial drainages is the primary assessment endpoint for the LIU. Vegetation is critical as a food source and as physical habitat for wildlife. Loss of vegetative cover can result in erosion of surface soils, which can inhibit revegetation. Various plant species have been shown to be sensitive to metals, including copper and acidic pH in soils by exhibiting toxic responses when exposed. Metal toxicity to vegetation can alter the plant community composition and structure, which can result in decreased wildlife habitat and range quality. The assessment objective in the Sitewide BERA was to determine the extent to which changes in metal concentrations and pH due to mine and mineral processing activities could adversely affect vegetation at the Site.

2.2 Predicted Cupric Ion Activity

Measures of bioavailable copper, especially cupric ion activity, appears to be the best predictor of potential phytotoxicity at the Site based on the conclusions of the Sitewide BERA. Cupric ion activity is expressed as pCu^{2+}, which is the negative logarithm of cupric ion activity. Similar to pH, the lower the pCu^{2+} value, the higher the activity. The predicted pCu^{2+} in each of the LIU shallow soil samples was calculated using the 2-variable (pH and total copper) model for the upland study and reference area locations. This model was selected in the BERA because it was the best predictor of pCu^{2+} in soils using only total copper concentration (mg/Kg) and pH as model inputs (R^2 = 0.97).

$$pCu^{2+} = 7.34 + (0.93\ x\ pH) - (1.15\ x\ \ln[Cu_{total}])$$

Results of the predicted pCu^{2+} values are presented in Table 2.2-1.

The pCu^{2+} measure was used to assess risk to the vegetation community because it was shown in the Sitewide BERA to have the highest degree of correlation with biological variables and was the best predictor of responses for the mostly upland areas of the Site. The predicted pCu^{2+} results can, therefore, be used as a predictive tool for identifying potential toxicological responses within the upland areas of the LIU.

Two pCu^{2+} benchmarks were presented in the Sitewide BERA as indicative of a range of potential effects to terrestrial vegetation. The *de minimis* effect level (DEL) and probable effect level (PEL) represent Site-specific estimates of potential toxic effects to the vegetation community. The DEL represents a range of pCu^{2+} levels above which ecologically meaningful effects are not expected. The range of the DEL (pCu^{2+} > 6 - 7) represents pCu^{2+} above which differences in species richness and variables related to canopy cover were not generally observed between the on-Site and reference locations. The DEL incorporates a weight-of-evidence for both laboratory and field measurements. The range reflects the conclusion that the potential for ecologically significant effects is low for pCu^{2+} values greater than 7.

At cupric ion activities higher than the PEL (pCu^{2+} < 5), emergence, survival and rhizobial root nodule counts in laboratory test species were significantly reduced, as compared to reference areas. Similarly, species richness and canopy cover were also consistently lower at sampling locations with pCu^{2+} values less than 5. As a result, the BERA concluded that significant effects to components of the vegetation community could be expected in areas where the pCu^{2+} was less than the PEL.

Soils with pCu^{2+} values between 5 and 7 are also not expected to have ecologically significant effects, but confidence is lower and the potential for effects increases as pCu^{2+} approaches the PEL level of 5. While the DEL and PEL were determined in the BERA as a sitewide measure, IU-specific data will be considered for each IU as appropriate.

As indicated in Table 2.2-1 and shown in Figure 2.2-1, one LIU RI soil sample had a pCu^{2+} value calculated to be less than the PEL ($pCu^{2+} < 5$), while 2 of the 6 mineralized reference area soils had calculated pCu^{2+} values less than 5. The pCu^{2+} was calculated to be less than 7 (the DEL) in 6 of 21 remaining LIU RI shallow soil samples (<2,000 um) and in 2 of 6 of the remaining LIU mineralized reference area soil samples.

The single, non-reference, shallow soil sample with a pCu^{2+} less than 5 (L-08) was located immediately to the west of the main and south Lampbright stockpiles. All four of the reference soil samples collected to the north of the main Lampbright Stockpile had pCu^{2+} values less than the DEL and 2 were also less than the PEL. The LIU RI indicates that these samples were all collected from the Beartooth Quartzite Formation. While the Beartooth Quartzite formation is not always mineralized, the formation in the LIU reference area is likely a part of the ore body and is known to contain naturally elevated copper concentrations in that area. Based on the information provided in the LIU RI, the area of the reference area to the north of the Lampbright Stockpile, may contain elevated copper and somewhat lower pH than found in soils at that Site.

Because the lowest pCu^{2+} values were observed in the reference samples, it is impossible to distinguish Site-related pCu^{2+} and natural levels of pCu^{2+} using available Site data. Since no community vegetation data are available from the reference and Site-related areas with pCu^{2+} less than the DEL and PEL, no definitive comparisons of habitat quality can be provided for the two areas. It is, however, unlikely that pCu^{2+} values less than the DEL and PEL observed in LIU shallow soils outside of the reference areas will have widespread habitat quality impacts that would significantly decrease their value as wildlife habitat.

2.3 Community Metric and Laboratory Phytotoxicity Testing

Plant community data were collected as part of the Sitewide BERA at two locations within, one each Tributary 1 and Tributary 2 drainages (ERA-30 and ERA-34; Table 2.3-1). Soils from ERA-30 were included in the laboratory toxicity studies (Table 2.3-2). No additional data for either of these two measures were collected as part of the LIU RI. Results from these locations were included in development of the sitewide risk assessments tools described above. The results were not intended to be fully representative of the LIU, but results are summarized below.

In plant community sampling, species richness was relatively high at both locations (43 and 30 species at ERA-30 and ERA-34, respectively), as was canopy cover (85% and 71%; Table 2.3-1), indicating that likely functional communities were present in both drainages.

In phytotoxicity tests, no significant differences in seeding emergence or survival were observed for either rye grass or alfalfa when compared to reference area soils or to negative control soils.

Significantly reduced root and shoot weight, as well as shoot length, were observed relative to reference area soils for rye grass, but not alfalfa, but these endpoints where more highly variable in toxicity testing, and are likely less reliable indicators of toxicity.

2.4 Terrestrial Vegetation Conclusions

Estimated pCu2+ levels were less than the PEL at five of 27 shallow soil sampling locations in LIU. Four of those locations were within the reference dataset indicating the presence of naturally occurring mineralized soils that may contain bioavailable copper at levels that may affect plant growth and community structure versus what was observed in the non-mineralized reference areas used in the Sitewide BERA. However, no community or toxicity data from mineralized reference soils were available.

Overall, the limited community data from the LIU results in some uncertainty regarding risks to the vegetation function in the LIU. The two locations within LIU from which community data were available indicated that the vegetation communities in those drainages were diverse relative to drainages in the S/TSIU and H/WCIU.

The overall conclusion for vegetation in the LIU is that communities have not been adversely affected by chemical contaminants to the extent that wildlife habitat function has been significantly degraded.

3.0 RISK ANALYSIS FOR TERRESTRIAL WILDLIFE IN THE LIU

This section provides additional risk analysis for terrestrial wildlife to supplement the analyses conducted as part of the Sitewide BERA (NewFields 2005) with the data collected in the LIU RI.

The site-wide BERA concluded that risk potentials were primarily elevated for the small ground-feeding bird receptor in the areas closest to the smelter and tailings impoundments and were not elevated within the LIU. Risks to regional populations of wildlife were not predicted for any receptor and localized populations of large and mobile receptors (e.g., ruminants and mammalian/avian predators) were predicted to be low.

3.1 Exposure Point Concentrations

Seven COPCs for the terrestrial wildlife assessment endpoint were identified in the Sitewide BERA. The same seven COPCs were subsequently evaluated in the LIU ERA. The COPCs are:

- Cadmium;
- Chromium;
- Copper;
- Lead;
- Molybdenum;
- Selenium; and
- Zinc.

For comparison of soils concentrations to benchmarks, statistical values to representative of exposure point concentrations (EPCs) for the COPCs were calculated using two software packages. The 95th percentile EPC, as used in the Sitewide BERA, was calculated using Number Cruncher Statistical Systems (NCSS 2011), while a 95% UCL on the mean was calculated using ProUCL (EPA 2011). Summary statistics were calculated using only data from the LIU RI shallow soils (0 to 6 inches bgs, <2000 µm) downwind of the LSO and in the reference area samples for the seven COPCs are presented in Table 3.1-1.

3.2 Comparison to Copper Soil Screening Levels

The Sitewide BERA provided soil screening levels (SSLs) for copper in order to provide a quick screening tool to identify potential risks to the small ground-feeding bird receptor and recommended that additional samples from the IU-specific RIs be compared to these values when the samples were available. No copper SSLs were developed in the Sitewide BERA for other receptors because the small ground-feeding bird was shown to be the most sensitive receptor to copper and SSLs calculated for this receptor would be protective of all other receptors.

A series of SSLs were calculated for the No Observed Adverse Effect Level (NOAEL) and Lowest Observed Adverse Effects Level (LOAEL)-based TRVs based on Hazard Quotients (HQs; HQ = Exposure/TRV) from 1 to 100, and soil bioavailability. Using an HQ of 1, the range of SSLs calculated in the Sitewide BERA was from 192 mg/kg to 586 mg/kg based on whether a NOAEL or LOAEL TRV was used and the range of potential copper bioavailability estimates for soil. Copper bioavailability from food was assumed to be 100% in all cases. Copper that has been taken up into food tissues is expected to be considerably more bioavailable than copper from soils. Because Site-specific data indicating that copper in food items is not highly bioavailable is not available, no adjustment to the copper relative (bio) availability factor (AF) from food was made.

In the Sitewide BERA, the small ground-feeding bird was assumed to have a diet made up of 100% seeds and the median bioaccumulation factor (BAF) calculated from ERI data was used to estimate the seed concentration from the co-located soil concentration of copper (seed concentration = soil concentration X BAF). BAFs were calculated as the ratio of copper in food items versus co-located soil samples. The use of the median BAF represented a significant source of uncertainty in the Sitewide BERA risk characterization. Typically, accumulation of metals in food items occurs at a greater rate at lower soil concentrations than at higher concentrations. Subsequent to the completion of the Sitewide BERA, an alternative risk-based concentration (RBC) was calculated for the S/TSIU (Formation 2010) based on data provided by CMC regarding both the exposure model for the small ground-feeding bird and on the uptake of copper into terrestrial invertebrates and seeds and the relative bioavailability of copper from soils to the small ground-feeding bird receptor.

The final recalculated RBC (1,114 mg/kg) corresponded to a 100% invertebrate diet for the small ground-feeding bird using the LOAEL TRV (42 mg/kg BW/day) and assuming 10% relative bioavailability from soils. In addition, NMED provided Chino with a pre-Feasibility Study Remedial Action Criterion (pre-FS RAC) for the S/TSIU for copper equal to 1,600 mg/kg which represents the same calculations but reduced soil bioavailability (NMED 2011). The S/TSIU pre-FS RAC is included here as an additional metric for the toxicity assessment.

As indicated on Figure 3.2-1, none of the shallow soil samples collected within the LIU exceeded the recalculated RBC (1,114 mg/Kg) or Pre-FS RAC (1,600 mg/Kg), indicating a low risk of adverse effects to populations of small ground-feeding birds from exposure to copper in the LIU.

3.3 Additional COPCs

No significant risks to any wildlife receptors from any COPCs other than copper were predicted in the Sitewide BERA. For that reason, no additional SSLs were calculated in the Sitewide BERA. Table 3.1-1 presents the 95th percentile concentrations of each of the seven COPCs (non-reference soils only) discussed in the detailed risk analysis of the Sitewide BERA, as well as the 95th percentile concentrations from the LIU samples.

The 95th percentile concentrations of cadmium, molybdenum, and selenium were all lower than the 95th percentile concentrations evaluated as part of the Sitewide BERA. This indicates that the risk characterization in the Sitewide BERA is a conservative (i.e., more protective) representation of risks for the LIU. Because no significant Sitewide risks were predicted in the Sitewide BERA for any of those COPCs, the LIU sampling results indicate that no significant risk is predicted for cadmium, molybdenum, or selenium from shallow soils in the LIU.

The 95th percentile chromium, lead, and zinc concentrations in LIU shallow soils were all greater than the 95th percentiles calculated in the Sitewide BERA. Because metals cannot be screened out based on this simple comparison, additional exposure calculations are provided in Table 3.3-1 for the small ground-feeding bird and small mammal receptors. The estimated exposure was calculated for each COPC at the 95th UCL concentration in both the downgradient and reference areas and the estimated exposures were compared to the NOAEL and LOAEL TRVs. Both the small ground-feeding bird and small mammal models were used because they were shown to be the two most sensitive receptors in the Sitewide BERA.

The calculations provided in Table 3.3.1 are based on the same exposure parameters utilized in the Sitewide BERA, with the exception of the small ground-feeding bird which was assumed to ingest 70% invertebrate tissue and 30% seeds, as discussed for the copper RBC calculations in Section 3.2. Exposure and risk calculation details are provided in Appendix B.

Because no tissue (i.e., invertebrate, plant foliage, or seed) data were available at most of the LIU sampling locations, COPC concentrations in prey and forage tissue were estimated from soil concentrations. Tissue concentrations were estimated using two approaches. First, the median BAF presented in the Sitewide BERA was used as a conservative method for estimating invertebrate and seed concentrations. As discussed previously, this estimation is a source of uncertainty because bioaccumulation can vary depending on soil concentrations. Typically, bioaccumulation factors are inversely proportional to soil concentrations, however, the data collected under the ERI were not strongly correlated enough to meet the guidelines for the use of regression-based bioaccumulation models as outlined in TM-1. As a result, TM-1 indicated that the median BAFs were used. Second, the average BAFs from ERA-30 and ERA-34, the only locations for which biota tissue is available, were used. BAF calculations for these two sites are provided in Appendix B. The BAFs, and consequently the overall exposure estimates, were not substantially different between the estimation methods. However, both are presented because the second approach represents a direct measure of BAFs for the lower LIU, and the first method is based on soil and biota concentration relationships Sitewide.

HQs greater than 1.0 were calculated for chromium and zinc exposure to the small ground-feeding bird using the NOAEL TRV, but not the LOAEL TRV in the downgradient area. Zinc had an HQ greater than 1.0 for both the NOAEL and LOAEL TRV in the reference area and chromium had an HQ greater than 1.0 for the NOAEL TRV only in the downgradient area.

For the small mammal receptor, HQs for zinc greater than 1.0 for both the NOAEL and LOAEL TRVs were calculated in the reference area. Downgradient area HQs calculated for the small mammal receptor were all less than 1.0.

There were no appreciable differences in the HQs calculated using either set of BAF estimation methods cited above.

3.4 Terrestrial Wildlife Conclusions

Risks to terrestrial wildlife from exposure to COPCs released from LIU sources appear to be low. Exposure calculations indicate that exposure rates for the most sensitive wildlife receptors within the LIU are lower than the LOAEL TRVs in all cases. Only NOAEL HQs greater than 1.0 were calculated in the downgradient area, while LOAEL HQs greater than 1.0 were calculated for both the small ground-feeding bird and small mammal receptors for zinc in the reference area samples.

Based on these results, risks to the terrestrial wildlife endpoint are expected to be low for Site-related COPCs.

4.0 RISK ANALYSIS FOR AQUATIC RECEPTORS IN THE LIU

The Sitewide BERA indicated potentially unacceptable risks to aquatic receptors in surface water pools along the Hanover and Whitewater Creek corridors. The COPCs of greatest concern were cadmium, copper, lead, and zinc. The pools in the H/WCIU were predicted to have some potentially significant risks to aquatic receptors since they represent isolated potential breeding areas for amphibians and aquatic invertebrates.

Within LIU, the BERA identified upper Lampbright Draw as representing the most important aquatic resource at the Site because persistent aquatic habitat is present. Risks to receptors in upper Lampbright Draw were, however, predicted to be generally low based on a lack of exceedance of water quality benchmarks, with the exception of copper concentrations in several areas that were marginally higher than the chronic water quality criterion. The BERA concluded that the water quality exceedances in LIU likely represent little or no risk to aquatic receptors if they are adapted to elevated metal concentrations associated with the mineralized formation (Beartooth Quartzite) at the upper end of the drainages.

The conclusions for LIU were based on only a few samples that were available at the time. Considerable sampling of surface water and sediment within LIU has been conducted since the completion of the Sitewide BERA both for the LIU RI and for other purposes. The currently available and applicable surface water and sediment data discussed in the LIU RI are further considered in this document to complete the BERA for the aquatic receptor endpoint. Data are provided in Appendix A, Table A-2 (sediment) and Table A-3 (surface water) and sampling locations are presented on Figures 4.1-1 and 4.2-1. Tables 4.1-1 and 4.1-2 present water quality criteria and Tables 4.1-3 and 4.1-4 present the comparisons of COPC concentrations in surface water to these criteria.

4.1 Surface Water

Lampbright Draw in the LIU is generally a non-perennial stream system which includes two tributaries (Tributary 1 and Tributary 2). Other tributaries to Lampbright Draw include Rustler Canyon and Martin Canyon, located approximately 5 and 10 miles south (downgradient) of the Lampbright Stockpile. Lampbright Draw flows to the southwest where both Lampbright Draw and Whitewater Creek converge with San Vicente Creek.

The aquatic components of the ecosystem at the Site are limited to ephemeral and intermittent streams. Ephemeral stream segments are above the regional water table and typically only flow in direct response to runoff events from rainfall or snowmelt. Flow in intermittent stream segments is more extended at certain times of the year, such as when they receive seasonal flow from localized groundwater flows and runoff events. At different times of year, both of these conditions exist in various parts of Lampbright Draw and the tributaries. Temporary pools along these reaches can persist for several weeks or longer. As indicated in the LIU RI (ARCADIS 2012), seeps and springs where shallow alluvial water expresses to stream segments are present in both Tributaries 1 and 2. A total of 15 seeps and springs were mapped by Golder (2007) within Tributaries 1 and 2.

Several persistent pools were observed along Lampbright Draw, including the upper reaches near the Lampbright Stockpile and lower reaches below Rustler Canyon at the extreme eastern edge of the site. Drainages in Rustler Canyon and Martin Canyon tend to have persistent flow in some reaches that ultimately drain to Lampbright Draw. These drainages are shown in Figure 4.1-2.

Fish have been observed in upper Lampbright Draw, including longfin dace (Jennings 1998), indicating permanent habitat suitable for supporting fish populations. However, Lampbright Draw, downstream of Martin Canyon, is dry for much of the year and does not support permanent flows or fish populations. Unidentified centrarchid (sunfish) species were observed by the ERA field team in stock tanks along Lampbright Draw (ERA 43 and ERA 44) in 1999.

Amphibians potentially present are mostly limited to species that require water only for breeding and are either terrestrial as adults or can burrow into the mud as breeding pools begin to dry. Species potentially present in the project vicinity include the red-spotted toad, Great Plains toad, southwestern toad, Woodhouse's toad, Couch's spadefoot toad, New Mexico spadefoot toad, and plains spadefoot toad (Williamson et al. 1994). The tiger salamander and canyon treefrog are also potentially present. Chiricahua leopard frogs (CLF) (*Lithobates chiricahuensis;* a U.S Fish and Wildlife Service Threatened species), bullfrogs, and canyon treefrogs (adults and/or tadpoles) were identified in a survey of Lucky Bill (drains to Whitewater Creek), Martin, and Rustler canyons and Lampbright Draw conducted by Western New Mexico University (Jennings 1998). Based on subsequent surveys, the US Fish and Wildlife Service (USFWS 2007) concluded that populations in West Lampbright, Main Rustler, West Rustler, and Martin canyons were likely extinct due to chytridiomycosis by 2008. CLF were observed in Ash Spring through July, 2009 but were not observed 2010. The locations of the known historical CLF populations are shown in Figure 4.1-2 but the current status of CLF populations within Lambright draw drainages is unknown.

The entire LIU RI surface water dataset is provided in Appendix A, Table A-3. Tables 4.1-3 and 4.1-4 present surface water data for cadmium, copper, lead, and zinc which were identified in the Sitewide BERA as the COPCs of highest concern. COPC concentrations in LIU surface water samples are compared to acute and chronic New Mexico Water Quality Criteria (NMWQC) (20.6.4 NMAC) and to amphibian TRVs, including the CLF toxicity benchmarks (Little and Calfee 2008)(Tables 4.1-1 and 4.1-2). It should be noted that the CLF benchmarks are based on toxicity tests using water at a lower hardness (approx. 100 mg/L) than present in LIU tributaries (typically >400 mg/L). The toxicity of copper to aquatic organisms generally decreases with increasing organic carbon concentration and water hardness, and increases with other factors such as increasingly acidic pH. The relative importance of hardness is reflected by the use of hardness-dependent NMWQC for several metals, including copper. To account for the potential effects of hardness on the CLF-based water quality benchmarks, the NOECs and LOECs for cadmium, copper, and zinc were adjusted using the slope factors described for the NMWQC (20.6.4 NMAC).

Chino has recently completed studies for the S/TSIU that are meant to support potential development of Site-specific water quality copper criteria for surface water (ARCADIS 2013). The studies are based on use of the Water-Effect Ratio (WER) method to adjust state criteria for the apparent effects of Site-specific water on standard laboratory toxicity tests for the copepod *Daphnia magna*. The studies are consistent with USEPA guidance and were conducted with approval of the NMED Surface Water Quality Bureau. The study shows significant effects of several water quality parameters, particularly alkalinity, dissolved organic carbon, and total dissolved solids which may ameliorate some of the toxic effects of copper to *D. magna.* If the WER identified for S/TSIU surface water were applied to the LIU results, risk-based criteria (NMWQC and possibly the CLF NOEC/LOEC) could increase, which would reduce risk estimates for aquatic biota.

Additionally, CMC has indicated several other uncertainties related to the CLF toxicity endpoints provided by Little and Calfee (2008) including concerns related to the study design (number of replicates and concentrations tested) that have been taken into consideration in the conclusions for the potential effects to the CLF.

For regulatory purposes, the chronic and acute NMWQCs apply to surface waters classified as perennial or intermittent with a designated, existing or attainable use of “aquatic life” (i.e., permanent aquatic habitat). In cases with ephemeral water bodies where the designated use is defined as “limited aquatic life” only the acute NMWQCs are applicable. However, as noted in the LIU RI, no formal hydrologic classification using NMED’s Hydrology Protocol has been conducted in the LIU drainages. The acute and chronic NMWQCs are used in this risk assessment as relative toxicity-based benchmark values. The comparisons are not intended to reflect regulatory compliance with New Mexico Water Quality Control Commission regulations.

4.1.1 Tributary 1

A total of 69 samples were collected from 9 locations within Tributary 1 over a one-year period 2007–2008 under the Sitewide Abatement Program. Sampling locations are shown in Figure 4.1-1. Comparisons to NMWQC and amphibian TRVs are provided in Table 4.1-3. No sample-specific hardness values were available for these samples so the estimated hardness (400 mg/L) from the Tributary 1 sample collected in the ERI was used to calculate the chronic and acute NMWQC shown in Table 4.1-3.

Cadmium and lead were not detected in any sample.

Copper was detected in 33 samples and the lowest CLF No Observed Effect Concentration (NOEC) adjusted for hardness was exceeded in 11 samples. Copper was also detected at concentrations greater than the lowest CLF Lowest Observed Effect Concentrations (LOEC) adjusted for hardness at 2 sampling locations (LB7S and LBT1-BF1). The geometric mean of the leopard frog NOEC endpoints as well as the chronic NMWQC was also exceeded in the September 2008 sample collected at location LBT1-BF1. All previous samples collected at that location were either non-detect or detected at concentrations less than the NMWQC.

Sample location LB-7S is at the edge of the boundary of Discharge Permit 376 (DP-376). Since the sample locations is outside of the AOC boundary, risk management decisions should be addressed under DP-376 and the Chino Mine Sitewide Abatement Plan.

Only one sample at LBT-BF1 was collected in 2008, with no additional sampling in subsequent years. Since 2008, however, source control has been implemented in the Dam 8 area resulting in reduced loads and decreased surface water concentrations at LBT1-BF1. Currently LBT1-BF1 cannot be located and may no longer be present. Data from monitoring wells in the vicinity of the former sampling location may be useful in making risk management decisions as part of the FS process.

Zinc was detected in 5 of 69 samples. Zinc concentrations were lower than all of the benchmarks.

The Tributary 1 drainage has been characterized as ephemeral, with baseflow described as temporally and spatially discontinuous, and when present, occurring as seeps and stagnant pools with little or no flow (Golder 2009). The conditions present within the drainage should be taken into consideration as part of the risk management process for the LIU.

4.1.2 Tributary 2

2010 Rainfall Pool Samples

Four rainfall pools within Tributary 2 and Tributary 2A were sampled in September 2010. All data from these samples are provided in Appendix A; Table A-3 and the locations are shown in Figure 4.1-1. Comparisons of the sampling results to the NMWQC and amphibian TRVs are provided in Table 4.1-4.

Neither the acute nor the chronic NMWQC were exceeded in any sample for cadmium, copper, lead, or zinc. The lowest hardness adjusted CLF NOEC for copper was exceeded in three of the four samples, while the lowest LOEC was not exceeded any sample. The geometric mean of the CLF NOECs was similarly not exceeded in any of the samples. As shown in Table 4.1-2, the lowest NOEC and LOEC are based on effects on body weight of test organisms. The LOECs for mortality, body length, and development were not exceeded in any sample.

Sitewide BERA Sample

One surface water sample from the ERI was available from Tributary 2 (ERA-36) as shown in Figure 4.1-1. The copper concentration exceeded only the lowest hardness adjusted NOEC for the CLF. Cadmium, lead, and zinc were not detected in the sample (Table 4.1-4).

Tributary 2 Post-Corrective Action Monitoring Samples

Surface water monitoring was conducted periodically at 11 locations from 2008 to 2010 within Tributary 2 following corrective actions related to a spill of PLS in that tributary (Golder 2010). The sampling locations are shown in Figure 4.1-1 and the data are compared to NMWQC and amphibian TRVs in Table 4.1-4. The (calculated) hardness of water was greater than 400 mg/L in all samples, so 400 mg/L was used as a default measure of hardness in the standards calculations.

Cadmium was detected in only 2 of 10 post-corrective action monitoring samples, both collected in 2008. The chronic NMWQC was exceeded in both samples in which cadmium was detected (LBT-11 and LBT-12). Cadmium was not sampled at either location after 2008.

Copper was detected in 11 of 18 samples and exceeded the hardness adjusted CLF NOEC in 4 samples and the hardness adjusted LOEC in 1 sample. Copper concentrations did not exceed the hardness adjusted geometric mean NOEC for CLF endpoints in any sample nor did copper concentrations exceed the chronic or acute NMWQC in any sample.

Lead was detected in 1 sample (Location LBT-11) at a concentration that exceeded the chronic NMWQC. The lead detection at LBT-11 occurred in 2008, but lead was not analyzed at LBT-11 in 2009 or 2010.

Zinc was detected in 8 of 18 samples. The hardness adjusted CLF NOEC and the geometric mean NOAEC was exceeded in 3 samples from one location (LBT-11). Samples collected at location LBT-11 also exceeded both the chronic and acute NMWQC in 2009 and 2010, and the chronic NMWQC in 2008. The elevated zinc concentrations appear to be isolated because NMWQC for zinc were not exceeded in samples collected from upstream (LBT-16) or downstream (LBT-10) of LBT-11. Tributary 2 is partially located in a mineralized area, and given the isolated nature of the exceedances, it is possible that a relatively small area of naturally occurring zinc may be influencing the data observed at LBT-11. If additional risk management decisions are required within Tributary 2, the possible effect of mineralized background in the area of LBT-11 should be considered.

4.2 Sediment

Table 4.2-1 and Figure 4.2-1 presents sediment data for the COPCs selected in the Sitewide BERA: cadmium, chromium, copper, lead, and zinc. The concentrations in each sample are compared to the sediment TRVs also identified in the Sitewide BERA. Cadmium, chromium, copper, lead and zinc were selected for further analysis in the S/TSIU based on results of the Sitewide BERA that indicated they were the primary aquatic COPCs of concern at the Chino Mine Site. All COPC data identified in the LIU RI Report as being representative of current conditions were included in this assessment.

Two types of sediment TRVs were evaluated. The threshold effect concentration (TEC) represents the concentration below which no significant toxicological effects are expected, similar to the NOAEL TRV used for the wildlife endpoints. The probable effects concentration (PEC) represents a concentration above which significant effects are predicted. The PEC is generally analogous to the LOAEL TRV used for the wildlife endpoint.

Exceedances of the sediment benchmarks are shown in Table 4.2-1. Exceedance of the TEC was noted for chromium (7 of 37 samples), copper (51 of 53 samples), lead (1 of 37 samples), nickel (6 of 37 samples) and zinc (16 of 45 samples). The PEC was exceeded by copper (6 samples) and nickel (1 sample). The occasional exceedance of the TEC in the LIU tributaries is not expected to be indicative of a source of risk for the aquatic community endpoint, especially in non-perennial reaches. As a result, risks from cadmium, chromium, lead and zinc in sediment are expected to be low.

Similarly, the single exceedance of the nickel PEC at location T2S6 in Tributary 2 is not expected to be indicative of wide-spread risk to the aquatic community. This conclusion is further supported by a study conducted for the Tri-States Mining District in Missouri, Oklahoma, and Kansas (MacDonald et al. 2009). In that study, toxicity from sediments derived from mineralized soils was extensively tested for cadmium, lead, and zinc. Toxicity thresholds representative of 10% reductions in amphipod survival (T_{10}) were greater than the consensus-based PECs for cadmium, lead, and zinc published by MacDonald et al. (2000) and based on a more global sample set. However, the data from the mineralized areas suggest copper benchmarks that are lower than the global consensus-based PECs[1]. The direct application of these thresholds from the MacDonald et al. (2009) study to LIU sediments is somewhat uncertain, however, the reduced toxicity from the sediments derived from mineralized soils does suggest a similar reduction may be expected in LIU sediments.

[1]The T_{10} for mussel survival and biomass (37.1 mg/kg and 27.1 mg/kg) developed in the MacDonald et al. (2009) study for copper for mineralized sediments less (< 2 mm) were similar to the consensus TEC for copper (31.6 mg/kg) and the T_{20} (representative of a 20% reduction in survival and biomass) were much lower (46.4 mg/kg for survival and 38.1 mg/kg for biomass) than the consensus PEC (149 mg/kg).

For copper, within Tributary 1, 22 total samples were available and 20 contained copper at concentrations exceeding the TEC while 3 also exceeded the PEC. In Tributary 2, copper concentration in each of the 24 samples exceeded the TEC while one exceeded the PEC. Finally, each of the 7 samples collected from Tributary 2A also contained copper at concentrations exceeding the TEC while 2 samples also exceeded the PEC.

Potential risks from copper in sediments are elevated in many areas of the Site, especially in the areas outside of the LIU closest to the smelter and tailings impoundments. Copper concentrations found in the LIU sediments are considerably lower than those identified in S/TSIU or H/WCIUs. However, these concentrations are also greater than those indicated as background concentrations in the LIU RI report (i.e., those locations downstream of the confluence of Tributaries 1 and 2), which ranged from 12.4 to 44.5 mg/kg.

As a result, the potential for risk to the aquatic community endpoint from exposure to copper concentrations in LIU sediment is somewhat uncertain. It is unknown to what extent sediment-dwelling invertebrates inhabit the LIU drainage due to the ephemeral nature of the system. It is clear, however, should persistent habitat be present the risk of adverse effects is elevated within Tributaries 1 and 2, especially in the areas where copper concentrations exceeded the PEC. Risks in these areas are also elevated above the background copper concentrations reported in the LIU RI report.

Figure 4.2-2 shows the ERA sediment sampling locations in relation to the regulatory boundaries associated with the active operations within the LIU. The boundary of DP-376 is shown and the sediment samples within that boundary are outside of the area covered by the AOC. Sediment samples 2214 and 2215 may not be directly applicable to risk management decisions covered under the AOC, but should be considered as part of DP-376. Because copper concentrations were greater than the PEC in both locations, should persistent aquatic habitat develop in those areas, risks to aquatic receptors should be further considered.

Direct measurements of sediment toxicity were not conducted, nor were quantitative or qualitative characterization of aquatic communities in permanent or temporary water bodies available for this assessment. Similar to the conclusions reached for the H/WCIU, sediment toxicity tests with appropriate test species could be conducted to reduce uncertainty, but it is unclear whether results would alter risk management decisions and no specific recommendations for testing is provided in this ERA. Should additional data be required to adequately address the uncertainty in these conclusions, specific test recommendations will be provided.

4.3 Sediment SPLP Analysis

Table 4.2-2 and Figure 4.2-1 present data from 2 sediment samples collected from Tributary 1 at LBIU. Sediment samples were analyzed for concentrations of solid phase and leachable COPCs using the synthetic precipitation leaching procedure (SPLP).

While not a direct measure of potential surface water risk, the SPLP data can be informative in predicting whether or not COPCs would leach into surface water when present at potentially toxic concentrations. When compared to the surface water quality benchmarks presented in Table 4.1-3 and 4.1-4, none of the SPLP data exceeded the lowest water quality benchmark for cadmium, copper, lead, or zinc (assuming 400 mg/L hardness). These results suggest that sediment in Tributary 1 is not expected to be a significant source of COPC leaching to surface water.

4.4 Aquatic Life Conclusions

The results of the LIU aquatic risk analysis are generally consistent with those noted in the Sitewide BERA with some exceptions. The CLF TRVs were not available at the time of completion of the Sitewide BERA. Since copper concentrations in surface water exceeded the hardness-adjusted NOEC at most locations in both Tributary 1 and Tributary 2 and the LOEC at several locations (primarily in Tributary 1) where copper is detected, the potential for risk to the CLF cannot be entirely dismissed within either Tributary 1 or 2.

In 2007, the USFWS included Lampbright Draw and its tributaries within Recovery Unit 8 as part of their final species recovery plan for the CLF. The recovery unit also included Martin and Rustler canyons within the S/TSIU and H/WCIU and indicates that populations of the frog were present at numerous locations within Lampbright Draw and its tributaries until the late 1990s and possibly later (USFWS 2007). The recovery plan also indicates that small populations within the S/TSIU and perhaps the H/WIU were possibly present in 2007, but that the populations in LIU are likely to be extinct due to chytridiomycosis, caused by infection from a pathogenic fungus. The final critical habitat designation was published in the March 20, 2012 Federal Register (USFWS 2012), indicating the presence of one critical habitat unit within the Chino Mines Investigation Unit (in the S/TSIU) at Ash and Bolton Springs where the frog is expected to be currently found. To the east of the LIU, a critical habitat was also established along the Mimbres River, outside of the Chino Mines Investigation Unit. No critical habitat was defined within the LIU, presumably because of the extinction caused by chytridiomycosis in the late 1990s.

In the habitat designation, USFWS provided guidance on the likelihood of dispersal by the CLF:

"Chiricahua leopard frogs are reasonably likely to disperse 1.0 mile (mi) (1.6 kilometers (km)) overland, 3.0 mi (4.8 km) along ephemeral or intermittent drainages (water existing only briefly), and 5.0 mi (8.0 km) along perennial water courses (water present at all times of the year), or some combination thereof not to exceed 5.0 mi (8.0 km)." (USFWS 2007).

The Southwest Endangered Species Act Team (SESAT) developed a document for aiding in the assessment of effects to the CLF (SESAT 2008). In that document, SESAT notes that accurately identifying whether habitat for the CLF occurs within the project area where the CLF is likely to occur is a critical step in potentially identifying whether effects to the frog are possible. This includes the use of the dispersal potential discussed by USFWS (2007) and a good identification of habitats within that potential dispersal area is needed to make a determination of the potential presence or absence of the frog. The habitats to be considered are further defined as 'suitable' or 'marginal'. Further determinations of whether the habitat is occupied, likely to be occupied, or unoccupied should also be considered.

An unoccupied habitat is defined as: "Sites that support all of the constituent elements necessary for Chiricahua leopard frogs, but where surveys have determined the species is not currently present. The lack of individuals or populations in the habitat is assumed to be the result of reduced numbers or distribution of the species such that some habitat areas are unused. It is expected that these areas would be used if species numbers or distribution were greater.

Site occupancy can also change due to immigration and colonization, which may occur anytime during the warmer months (and is most likely to occur during the summer monsoons). If extant populations occur within reasonable dispersal distance of a site under assessment supporting suitable habitat, colonization is likely to occur and surveys more than once a year as part of project planning or effects analysis may be warranted to assess presence/absence."

Based on this guidance and the unknown presence/absence of suitable or marginal unoccupied habitats within the LIU but known former populations within LIU drainages, dispersal of the CLF into the LIU from areas where the frog was historically observed is unlikely but cannot be entirely dismissed in either Tributary 1 or Tributary 2 or in Lampbright Draw. Therefore, the risk analysis presented in this document is relevant if the state or federal agencies that are tasked with the protection of the CLF as a threatened species agree that the CLF is a key management endpoint for the Site.

Exceedance of the NMWQC chronic and acute criteria are limited within the LIU drainages. The most notable exception is zinc at location LBT-11 in Tributary 2 where the acute criterion is exceeded in all available samples. No known anthropogenic source of zinc is present at that location, zinc has not been detected in alluvial groundwater within the LIU (ARCADIS 2012). It is possible that LBT-11 is located within a mineralized area, however, risk cannot be conclusively considered to be low within Tributary 2 based on the currently available data from location LBT-11 due to the consistently elevated zinc concentrations found there. Risks from zinc in Tributary 1 are low.

Risks to aquatic life from sediment exposure appear to be lower than those predicted for the other IUs at the Site; however, copper concentrations in sediment exceeded the PEC at 6 locations (3 locations within Tributary 1, 3 locations within Tributary 2A and 1 location in Tributary 2). The quality of aquatic habitat or the permanence of the water at the locations where the PECs were exceeded has not been formally characterized making the prediction of risk at these locations uncertain. Given the small number of PEC exceedances observed, widespread risks to the aquatic community from exposure to COPCs in sediment is expected to be low within the LIU drainages. If the PEC exceedances correspond with areas of persistent benthic habitat, risk in those areas may be higher than predicted elsewhere. The presence or absence of aquatic habitat and/or habitat for the Chiricahua leopard frog or other amphibians is a source of uncertainty for the LIU ERA; however, SPLP data indicate that sediment leaching to surface water is not expected to be a significant source of COPCs.

5.0 GENERAL RISK ASSESSMENT UNCERTAINTIES

Uncertainty is an inherent part of risk assessment. The Sitewide BERA presented a comprehensive evaluation of the uncertainties specific to the Sitewide BERA. The sources of uncertainty discussed in the Sitewide BERA included:

- Sampling uncertainty and data gaps (i.e., uncertainty about spatial distribution of contamination as a consequence of limitations in sampling a site).
- Uncertainty in the selection of COPCs.
- Uncertainty in the natural (seasonal and/or annual) variability in the species, populations, communities, and ecosystems in question, as well as uncertainty regarding individual sensitivity to COPCs.
- Uncertainty in risk characterization using laboratory-based toxicity values and the HQ approach.
- Uncertainty in models and parameters used to estimate risk potentials.
- Uncertainty in assessing background COPC concentrations that may relate to calculated risk potentials.

A thorough discussion of these uncertainties is provided in the Sitewide BERA and all apply to the risk assessment for the LIU.

In general, the Sitewide BERA presented a conservative determination of COPCs and a less conservative risk characterization that provided ranges of potential risks for use in making risk management decisions. Sitewide COPCs were selected based on a conservative screening approach that minimized the potential for Type I error, or the potential for not selecting chemicals that are potential risk drivers as COPCs. This approach allows similar limitations of Type I error within the LIU since the COPCs from the Sitewide BERA were carried into this risk assessment.

Risk-based conclusions were reached in the Sitewide BERA based on potential ranges of risk to the assessment endpoints. Similarly, this risk assessment used the conclusions reached in the Sitewide BERA to assess potential risks within the LIU. Conditions in the LIU were reviewed in terms of the conditions that were discussed as potential risk drivers in the Sitewide BERA. This approach assumes similar uncertainties in the LIU assessment as those that were identified and discussed in the Sitewide BERA.

Of particular importance within the LIU, very limited data regarding aquatic habitat quality and aquatic community presence and structure is available. While there are clearly concentrations of

COPCs in surface water and sediment within the LIU that could have deleterious effects to the aquatic community, the current presence or health of the community is not known. In addition, the status of the CLF within the LIU is a major source of uncertainty since surface water concentrations of copper exceed both the NOEC and LOEC TRVs at several locations within the LIU drainages. These uncertainties should be considered by risk managers when determining a risk-based course of action for the LIU.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Risks to the terrestrial vegetation community and terrestrial wildlife assessment endpoints due to exposure to Site-related COPCs are generally low within the LIU. Predicted pCu^{2+} was lower than the PEL and/or the DEL at several locations within the LIU. However, four of the locations with pCu^{2+} lower than the PEL were within the LIU soils considered representative of an area of mineralized background for the IU located north of the Lampbright Stockpile. Vegetation community data are limited; however, those data that are available indicate that the vegetation community appears to be healthy and diverse. Similarly, for the terrestrial wildlife assessment endpoint, all calculated HQs outside of reference areas are less than LOAEL TRVs and risk to the terrestrial wildlife populations inhabiting the LIU are predicted to be low.

Aquatic habitat in the LIU is limited, primarily due to lack of persistent water sources. Risk to the aquatic community endpoint within the LIU drainages overall appears to be low; however, there are several uncertainties regarding the presence and quality of aquatic habitat that should be addressed in risk management decisions. In addition, no direct measurements of sediment or surface water toxicity were available for this assessment. Should more accurate assessment of toxicity be required to make risk management decisions at the Site, such testing should be considered as part of the Feasibility Study process.

Finally, exceedances of the CLF TRVs were noted for copper at several locations and zinc at one location (LBT-11), but it is unclear whether habitat at those locations is suitable as breeding and rearing pools for the leopard frogs. Updated surveys of CLFs and habitat at the Site would be helpful in determining whether elevated levels of copper and other COPCs represent unacceptable risks.

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TABLES

Table 1.1-1
Summary of Assessment Endpoints as Defined in the Baseline Ecological Risk Assessment
Lampbright Investigation Unit

Management Goal:

Prevent or remediate adverse direct or indirect effects on ecological communities or populations of ecological receptors from toxic exposure to chemicals in mine waste

Assessment Endpoint	Risk Hypotheses or Question	Measures
	Exposure Assessment	
1. **Vegetation Community of Upland Sites**	1. COC concentrations in soils or vegetation do not exceed reference	Distribution of metals in soils and vegetation from site and reference areas
	2. COC concentrations in site soils do not exceed screening level TRVs	Metal concentrations in soils, TRVs for vegetation
	3. Nutrient levels are sufficient to support normal vegetation growth	K, P, NO_2+NO_3 TOC, pH in soils of site and background
	4. What proportion of landscape unit with [metals] in soils exceeding TRV or site-specific risk-based criterion?	Distribution of elevated metal concentrations in soils or sediments
	Effects Assessment	
	5. Existing vegetation community at site is not degraded with respect to reference	Vegetation community structure in site and background areas; results of range quality assessment; sites located along gradient of conditions if possible
	6. Are COC concentrations or altered physical conditions in soils inhibiting recruitment?	Vegetation community and phytotoxicity test results for germination, root elongation, seedling growth from gradient of soil conditions
	7. Dose-response relationship exists between toxicity and soil contamination	Vegetation community and phytotoxicity test results for germination, root elongation, seedling growth from gradient of soil conditions
	8. What proportion of landscape unit(s) with adverse effects?	Spatial distribution of areas exhibiting adverse effects; elevated concentrations
	9. Are habitats in landscape unit fractionated by physical disturbance or chemical contamination?	Mapped distribution of vegetation types, wildlife species that may be restricted to habitat types against metal concentrations
	Exposure Assessment	
2 **Vegetation Community of Ephemeral Drainages**	1. COC concentrations in soils/sediments or vegetation exceed reference	Distribution of metals in soils and vegetation from site and reference areas
	2. COC concentrations in site soils exceed screening level TRVs	Metal concentrations in soils, TRVs for vegetation
	3. Dose-response relationship exists between residues and soil contamination	Metal concentrations in soils and plant tissues from co-located sites along gradient of conditions
	4. Nutrient levels are sufficient to support normal vegetation growth	K, P, NO_2+NO_3 TOC, pH in soils of site and background
	5. What proportion of landscape unit has [metals] in soils exceeding TRV or site-specific risk-based criterion?	Distribution of elevated metal concentrations in soils or sediments
	Effects Assessment	
	6. Existing vegetation community at site is not degraded with respect to reference area	Qualitative comparison of species present to unaffected or less affected sites (reference condition may not be available)
	7. COC concentrations are not accumulating in plant tissues	Metal concentrations in soils and plant tissues from gradient of conditions
	8. Are COC concentrations or altered physical conditions in soils inhibiting recruitment?	Phytotoxicity test results for germination, root elongation, seedling growth from gradient of soil conditions
	9. Dose-response relationship exists between toxicity and soil contamination	Phytotoxicity test results for germination, root elongation, seedling growth from gradient of soil conditions
	10. What proportion of landscape unit(s) with adverse effects?	Distribution of areas exhibiting adverse effects; elevated concentrations
	11. Habitats in landscape unit fractionated by physical disturbance or chemical contamination?	Mapped distribution of vegetation types, wildlife species that may be restricted to habitat types against metal concentrations

Table 1.1-1
Summary of Assessment Endpoints as Defined in the Baseline Ecological Risk Assessment
Lampbright Investigation Unit

Management Goal:

Prevent or remediate adverse direct or indirect effects on ecological communities or populations of ecological receptors from toxic exposure to chemicals in mine waste

Assessment Endpoint	Risk Hypotheses or Question	Measures
	Exposure Assessment	
3 **Herbivorous, Insectivorous, and Omnivorous Birds**	1. COC exposure do not exceed TRVs (estimate by habitat type [i.e., upland, ephemeral drainage] and location on site)	COC concentrations in soils, seeds, foliage, invertebrates; TRVs for small and large granivorous, omnivorous, and insectivorous birds; Intake calculations
	2. COC in exposure media do not exceed reference levels	COC concentrations in soils, seeds, foliage from site units and reference area
	3. What soil concentrations are associated with exposures that exceed TRVs?	Correlation between COC concentrations in soils and either (a) concentrations in forage or prey or (b) bioaccumulation factors
	Effects Assessment	
	4. Habitat quality is not degraded in potentially affected areas	Habitat quality (vegetation community structure) in site vs. reference
	5. What portion of landscape unit with [metals] in soils and vegetation exceed risk-based criterion?	Spatial distribution of elevated metal concentrations in sediments, soils, and vegetation in landscape unit(s)
	Exposure Assessment	
4 **Raptors**	1. COC exposure do not exceed TRVs (estimate by habitat type [i.e., upland, ephemeral drainage] and location on site)	COC concentrations in soils, invertebrates, small mammals TRVs for raptors; Intake calculations
	2. COC in exposure media do not exceed reference levels	COC concentrations in soils, prey
	3. What soil concentrations are associated with exposures that exceed TRVs?	Correlation between COC concentrations in soils and either (a) concentrations in forage or prey or (b) bioaccumulation factors
	Effects Assessment	
	4. Habitat quality is not degraded in potentially affected areas	Habitat quality (vegetation community structure) in site vs. reference
	5. What portion of landscape unit with [metals] in soils and vegetation exceed risk-based criterion?	Spatial distribution of elevated metal concentrations in sediments, soils, and vegetation in landscape unit(s)
	Exposure Assessment	
5 **Herbivorous, Granivorous, and Omnivorous Small Mammals**	1. COC exposure do not exceed TRVs (estimate by habitat type [i.e., upland, ephemeral drainage] and location on site)	COC concentrations in soils, seeds, foliage, invertebrates; TRVs for small and large granivorous, omnivorous, and insectivorous birds; Intake calculations
	2. COC in exposure media do not exceed reference levels	COC concentrations in soils, seeds, foliage from site units and reference area
	3. What soil concentrations are associated with exposures that exceed TRVs?	Correlation between COC concentrations in soils and either (a) concentrations in forage or prey or (b) bioaccumulation factors
	Effects Assessment	
	4 Histopathology is associated with elevated concentrations in tissues	COC concentrations in liver, kidney; Histopathological assessment of tissues
	5 Habitat quality is not degraded on site	Habitat quality (vegetation community structure) in site vs. reference
	6 What portion of landscape unit with [metals] in soils and vegetation exceed risk-based criterion?	Spatial distribution of elevated metal concentrations in sediments, soils, and vegetation in landscape unit(s)

Table 1.1-1
Summary of Assessment Endpoints as Defined in the Baseline Ecological Risk Assessment
Lampbright Investigation Unit

Management Goal:

Prevent or remediate adverse direct or indirect effects on ecological communities or populations of ecological receptors from toxic exposure to chemicals in mine waste

Assessment Endpoint	Risk Hypotheses or Question	Measures
		Exposure Assessment
6 **Ruminant Wildlife**	1. COC exposure do not exceed TRVs (estimate by habitat type [i.e., upland, ephemeral drainage] and location on site)	COC concentrations in soils, foliage of palatable species; TRVs for ruminants; Intake calculations
	2. COC in exposure media do not exceed reference levels	COC concentrations in soils, seeds, foliage from site units and reference area
	3. What soil concentrations are associated with exposures that exceed TRVs?	Correlation between COC concentrations in soils and either (a) concentrations in forage or (b) bioaccumulation factors for uptake soil-forage
		Effects Assessment
	4. Habitat quality is not degraded on site	Habitat quality (vegetation community structure) in site vs. reference
	5. What portion of landscape unit with [metals] in soils and vegetation exceed risk-based criterion?	Spatial distribution of elevated metal concentrations in sediments, soils, and vegetation in landscape unit(s)
		Exposure Assessment
7 **Mammalian Predators**	1. COC exposure do not exceed TRVs (estimate by habitat type [i.e., upland, ephemeral drainage] and location on site)	COC concentrations in soils, small mammals; TRVs for mammals; Intake calculations
	2. COC in exposure media do not exceed reference levels	COC concentrations in soils, seeds, foliage from site units and reference area
	3. What soil concentrations are associated with exposures that exceed TRVs?	Correlation between COC concentrations in soils and either (a) concentrations in forage (b) bioaccumulation factors for uptake soil-forage
		Effects Assessment
	4. Habitat quality is not degraded on site	Habitat quality (vegetation community structure) in site vs. reference
	5. What portion of landscape unit with [metals] in soils and vegetation exceed risk-based criterion?	Spatial distribution of elevated metal concentrations in sediments, soils, and vegetation in landscape unit(s)
		Exposure Assessment
8 **Aquatic Community and Amphibians**	1. Metal concentrations in water do not exceed toxicity thresholds for amphibians or aquatic life	Data on water quality from temporary and permanent aquatic habitat
	2. COC in exposure media do not exceed reference levels	Data on water quality from temporary and permanent aquatic habitat in reference area
		Effects Assessment
	3. Determine whether aquatic animals and amphibians occur in aquatic habitats to the extent expected	Presence/absence of breeding aquatic invertebrates, fish, or amphibians in aquatic habitats; site and reference (if available)
	4. Sediment are not toxic to aquatic stages of amphibians and the aquatic community	Data on metal content of sediment in temporary and aquatic habitats; sediment toxicity testing if necessary

Table 1.1-2
Non-BERA COPC Screening
Lampbright Investigation Unit

	LIU Shallow Soils 95% UCL (mg/kg)	BERA 95th Percentile (mg/kg)
Aluminum	19,191	21,600
Barium	266.4	181
Boron	5.1	6
Vanadium	44.2	NA

Note: LIU reference soils were not used in the calculation

BERA = Baseline Ecological Risk Assessment

COPC = Chemicals of potential concern

LIU = Lampbright Investigation Unit

mg/kg = milligrams per kilogram

Table 2.2-1
Predicted pCu^{2+} in Shallow Soil Samples
Lampbright Investigation Unit

LIU Shallow Soil Sample ID	Total Copper Concentration (mg/kg)	pH	pCu^{2+}
L-01	253	6.22	6.8
L-02	108	7.31	8.8
L-03	167	5.53	6.6
L-04	75.1	6.6	8.5
L-05	152	5.91	7.1
L-06	118	4.62	6.2
L-07	246	5.49	6.1
L-08	319	4.17	4.6
L-09	25.8	7.6	10.7
L-10	65.9	7.46	9.5
L-11	95.2	6.19	7.9
L-12	102	5.03	6.7
L-13	85.4	6.16	8.0
L-14	106	5.28	6.9
L-15	133	5.73	7.0
L-16	61.4	6.03	8.2
L-17	114	6.03	7.5
L-18	80.9	6	7.9
L-19	76	7.58	9.4
L-20	63.3	7.23	9.3
L-21	100	5.86	7.5
R-1	322	5.16	5.5
R-2	506	5.06	4.9
R-3	514	5.13	4.9
R-4	308	4.69	5.1
R-5	57.3	5.25	7.6
R-6	35.2	5.64	8.5

$$pCu^{2+} = 7.34 + (0.93\, x\, pH) - (1.15\, x \ln[Cu_{total}])$$

Red	Indicates predicted pCu^{2+} less than the probable effects level (PEL) of 5.
Orange	Indicates predicted pCu^{2+} greater than the PEL of 5 and less than the *de minimus* effects level (DEL) of 6.
Yellow	Indicates predicted pCu^{2+} within the range of upper and lower bound DELs (greater than 6 and less than 7).

LIU = Lampbright Investigation Unit

mg/kg = milligrams per kilogram

Table 2.3-1
Results of Community Composition Data from the Sitewide BERA
Lampbright Investigation Unit

Location	SiteType	Vegetation Alliance[1]	Basal Cover Summary[2]				Canopy Summary	Diversity		
			Percent Rock Cover	Percent Bare Ground	Percent Litter Cover	Percent Live Vegetation	Percent Canopy Cover[3]	Total Richness	Woody Richness	Percent Alien[4]
ERA-01	Upland Study	Mine Fac (Mesq/Grama)	51	14 U	33 U	2	27 N	6 N	3	0
ERA-02	Upland Study	Mesq/Grama	25	35 U	40 U	0	32 N	4 N	2	0
ERA-03	Upland Study	Mesq/Grama	26	25 U	49 Y	0	50 N	15 U	4	0
ERA-04	Upland Study	Mesq/Grama	14	49 Y	37 U	0	37 N	15 U	4	0
ERA-05	Upland Study	Mesq/Grama	11	51 U	38 U	0	41 N	17 U	3	0
ERA-06	Upland Study	Mesq/Grama	17	52 U	30 U	1	34 N	6 N	1	0
ERA-07	Upland Study	Mesq/Grama	9	86 N	5 N	0	27 N	13 U	2	7.4
ERA-08	Upland Study	Mesq/Grama	3	58 U	39 U	0	51 N	20 U	5	2.0
ERA-09	Upland Study	Mesq/Grama	35	48 Y	17 N	0	37 N	11 U	4	0
ERA-10	Upland Study	Mesq/Grama	17	40 Y	43 Y	0	65 N	15 U	3	0
ERA-11	Upland Study	Mesq/Grama	5	68 U	26 N	1	78 Y	27 Y	3	0
ERA-12	Upland Study	Mesq/Grama	4	75 N	19 N	2	57 N	42 Y	2	0
ERA-13	Upland Study	Mtn Mahog	17	50 Y	33 U	0	49 N	22 U	3	0
ERA-14	Upland Study	Mixed Grama	3	50 Y	47 Y	0	92 U	27 Y	1	0
ERA-15	Upland Study	Mixed Grama	3	68 U	29 U	0	60 U	29 Y	1	0
ERA-16	Upland Reference	Mixed Grama (est)	4	46	50	0	90	38	3	0
ERA-17	Upland Reference	Mixed Grama (est)	8	37	55	0	81	28	3	0
ERA-18	Upland Reference	Mixed Grama (est)	21	31	48	0	68	42	3	0
ERA-19	Upland Reference	Mixed Grama (est)	2	50	48	0	87	31	1	4.6
ERA-20	Upland Reference	Mixed Grama (est)	8	51	41	0	85	30	2	0
ERA-21	Upland Reference	Mixed Grama (est)	15	42	43	0	77	27	1	0
ERA-22	Ephemeral Drainage	Fluv For	15	50	35	0	52	26	4	12
ERA-23	Ephemeral Drainage	Fluv For	2	50	47	1	52	31	10	0
ERA-24	Ephemeral Drainage	Fluv For	1	60	38	1	63	29	6	0
ERA-25	Ephemeral Drainage	Fluv For	1	77	21	1	70	52	4	5.7
ERA-26	Ephemeral Drainage	Fluv For	8	47	45	0	29	4	2	0
ERA-27	Ephemeral Drainage	Fluv For	15	54	31	0	45	25	4	0
ERA-28	Ephemeral Drainage	Fluv For	0	43	56	1	85	26	2	1.2
ERA-29	Ephemeral Drainage	Fluv For	6	27	60	7	77	28	2	60
ERA-30	Ephemeral Drainage	Fluv For	1	45	52	2	85	43	4	11
ERA-31	Ephemeral Drainage	Fluv For	18	60	21	1	50	44	4	2
ERA-32	Ephemeral Drainage	Mine Fac	16	60	24	0	51	27	4	5.9
ERA-33	Ephemeral Drainage	Fluv For	6	11	15	NA	57	41	8	5.3
ERA-34	Ephemeral Drainage	Fluv For	9	48	41	2	71	30	1	1.4

[1] Alliance According to *Comprehensive Vegetation Survey of The Chino Mine, Grant County, New Mexico (DBS&A 2000)*

Fluv For = Fluvial Forest and Shrubland
Mesq/Grama = Mesquite/Mixed Grama Shrubland
Mixed Grama = Mixed-Grama Herbaceous
Mine Fac = Mine Facilities/Urban
Mtn Mahog = Mountain Mahogany Shrubland

[2] Basal Cover refers to condition at ground surface.
[3] Canopy cover refers to vegetaion cover at 1 meter or less in height.
[4] Alien refers to non-native species (woody and herbaceous).
Equivalence/Interval Test Results: U = uncertain; N = not in normal reference range; Y = in normal reference range

Shaded rows represent LIU locations

Table 2.3-2
Results of Statistical Comparisons from Phytotoxicity Tests from the Sitewide BERA
Lampbright Investigation Unit

Phase I Perennial Ryegrass Statistical Compariaons

	Emergence		Survival		Mean Shoot Length		Mean Wet Shoot Weight		Mean Dry Shoot Weight		Mean Root Length		Mean Wet RootWeight		Mean Dry Root Weight	
	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont
ERA-1	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
ERA-5	Sig	NS	Sig	NS	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
ERA-10	NS	NS	Sig	NS	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
ERA-12	Sig	NS	NS	NS	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
ERA-14	Sig	NS	Sig	NS	NS	Sig	Sig	Sig	Sig	Sig	NS	NS	NS	Sig	Sig	Sig
ERA-16		NS		Sig		Sig		Sig		Sig		NS		Sig		Sig
ERA-22	NS	NS	NS	NS	Sig	Sig	Sig	Sig	NS	Sig	Sig	Sig	Sig	Sig	Sig	Sig
ERA-24	NS	NS	NS	NS	NS	Sig	Sig	Sig	Sig	Sig	Sig	Sig	NS	Sig	NS	Sig
ERA-26	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
ERA-29	NS	NS	NS	NS	Sig	Sig	Sig	Sig	NS	Sig	Sig	Sig	NS	Sig	Sig	Sig
ERA-30	NS	NS	NS	NS	Sig	Sig	NS	Sig	Sig	Sig	NS	NS	Sig	Sig	Sig	Sig
ERA-31	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	NS	Sig	Sig	Sig	Sig	Sig	Sig	Sig
Neg Contol	NS	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	NS	Sig	Sig	Sig	Sig	Sig
Pos. 160	Sig	NS	Sig	NS	Sig	NS	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	NS	Sig
Pos. 320	NS	NS	NS	NS	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	NS	Sig	Sig	Sig
Pos. 640	NS	NS	NS	NS	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig

Phase I - Alfalfa Statistical Comparisons

	Emergence		Survival		Mean Rhizobium Nodules		Mean Shoot Length		Mean Wet Shoot Weight		Mean Dry Shoot Weight		Mean Root Length		Mean Wet Root Weight		Mean Dry Root Weight	
	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont
ERA-1	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
ERA-5	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
ERA-10	NS	Sig	NS	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	NS	Sig	Sig	Sig	Sig
ERA-12	NS	Sig	Sig	Sig	NS	Sig	Sig	Sig	NS	Sig	NS	Sig	Sig	Sig	Sig	Sig	NS	Sig
ERA-14	NS	NS	NS	NS	NS	Sig	Sig	Sig	NS	Sig	NS	Sig	Sig	Sig	NS	NS	NS	Sig
ERA-16		Sig		NS		Sig		Sig		Sig		Sig		Sig				
ERA-22	NS	NS	NS	NS	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	NS	Sig	Sig	Sig	Sig	Sig
ERA-24	NS	Sig	NS	NS	NS	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	NS	NS	Sig	Sig
ERA-26	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
ERA-29	Sig	NS	NS	NS	Sig	Sig	NS	Sig	NS	Sig	NS	Sig	NS	Sig	NS	NS	NS	Sig
ERA-30	NS	NS	NS	NS	NS	Sig	NS	Sig	NS	Sig	NS	Sig	NS	Sig	NS	NS	NS	Sig
ERA-31	Sig	Sig	Sig	Sig	NS	Sig	NS	Sig	NS	Sig	NS	Sig	Sig	NS	Sig	Sig	Sig	Sig
Neg Contol	Sig	Sig	NS	Sig	Sig	NS	Sig	NS	Sig	NS	Sig	NS	Sig	NS	Sig	Sig	Sig	NS
Pos. 160	NS	NS	NS	NS	NS	Sig	NS	Sig	Sig	Sig	Sig	NS	Sig	NS	NS	Sig	Sig	NS
Pos. 320	NS	NS	NS	NS	NS	Sig	NS	Sig	NS	Sig	NS	Sig	Sig	Sig	NS	NS	Sig	Sig
Pos. 640	Sig	NS	NS	NS	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	NS	NS	NS	NS	Sig

Phase 2 - Alfalfa Statistical Analysis

	Emergence		Survival		Mean Rhizobium Nodules		Mean Shoot Length		Mean Wet Shoot Weight		Mean Dry Shoot Weight		Mean Root Length		Mean Wet Root Weight		Mean Dry Root Weight	
	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont	Ref Soil	Neg Cont
ERA-8	NS	NS	NS	NS	NS	Sig	Sig	NS	Sig	Sig	Sig	Sig	Sig	NS	Sig	Sig	Sig	Sig
ERA-11	NS	NS	NS	NS	Sig	Sig	Sig	NS	Sig	NS	Sig	NS	Sig	Sig	Sig	Sig	Sig	Sig
ERA-21		Sig		Sig		Sig		Sig		Sig		Sig		Sig				
ERA-27	Sig	NS	Sig	NS	NS	Sig	Sig	NS	Sig	Sig	Sig	Sig	NS	Sig	NS	NS	Sig	Sig
ERA-28	Sig	NS	Sig	NS	NS	Sig	Sig	Sig	Sig	Sig	NS	NS	Sig	Sig	NS	NS	NS	Sig
ERA-31	NS	Sig	NS	Sig	Sig	NS	NS	Sig	NS	Sig	NS	NS	Sig	NS	Sig	Sig	Sig	Sig
Neg Contol	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	NS	Sig	NS	Sig
Pos. 160	NS	NS	Sig	NS	Sig	NS	Sig	NS	Sig	NS	Sig	NS	Sig	NS	NS	Sig	NS	NS
Pos. 320	Sig	NS	Sig	NS	Sig	NS	Sig	NS	NS	NS	Sig	NS	Sig	NS	NS	NS	NS	Sig
Pos. 640	NS	Sig	Sig	Sig	Sig	NS	Sig	NS	NS	NS	Sig	NS	Sig	NS	Sig	Sig	NS	Sig

Sig - Significant difference from control ($p < 0.05$) using a t-test.
NS - No significant difference from control ($p > 0.05$) using a t-test.
ERA-16 (Phase I) and ERA-21 (Phase 2) are control samples. No statistical analysis was completed.

Shaded rows represent LIU locations

Table 3.1-1
Exposure Point Concentrations for Wildlife Receptors
Lampbright Investigation Unit

COPC	95th Percentile		75th Percentile		Median		95th Upper Confidence Limit		95th Percentile Upland Soils Site-wide BERA (NewFields 2005)
	Downwind	Reference Area	Downwind	Reference Area	Downwind	Reference Area	Downwind	Reference Area	
Cadmium	1.63	0.99	0.855	0.8	0.66	0.62	0.815	0.82	3.22
Chromium	61.4	18.4	25.1	17.4	17.3	14.9	27	17.5	16.8
Copper	312.4	514	142.5	508	102	315	150.7	461.9	2310
Lead	105.2	35.1	38	33.4	19.8	28.7	58.3	33.4	40.9
Molybdenum	8.7	15.1	3.6	14.3	2.3	9.4	3.8	13.4	43
Selenium	0.871	1.2	0.48	1.0	0.3	0.79	0.41	1.0	2
Zinc	124.3	878	97.9	293	85.4	92.1	91.9	794.4	91.5

All units are presented in milligrams per kilogram dry weight (mg/kg DW).

Table 3.3-1
Hazard Quotient Calculations
Small Ground-Feeding Bird and Small Mammal Receptors
Lampbright Investigation Unit

Analyte	Statistic	Ingestion Rate Food (WW kg/kg BW/day)	Ingestion Rate Food (DW kg/kg BW/day)	Diet Composition			BERA Median Bioaccumulation Factor			Estimated Tissue Concentration (mg/kg)			Food Exposure (mg/kg/day)				Percent of Diet as Soil	Ingestion Rate Soil (DW kg/kg BW/day)	Soil Concentration (mg/kg)	Bioavailability Factor	Soil Exposure (mg/kg/day)	Total Dose (mg/kg BW/day)	Toxicity Reference Value (mg/kg BW/day)		Hazard Quotient (HQ)	
				Foliage	Seed	Invert	Foliage	Seed	Invert	Foliage	Seed	Invert	Foliage	Seed	Invert	Total							NOAEL	LOAEL	NOAEL	LOAEL
Sitewide Median Bioaccumulation Factors (BAFs)																										
Small Ground-Feeding Bird																										
Chromium	95th UCL; Downgradient	0.918	0.287	0	0.3	0.7	0.137	0.133	0.029	3.70E+00	3.59E+00	7.83E-01	0.00E+00	3.09E-01	5.03E-01	8.12E-01	10	0.0287	27.0	1.00	7.75E-01	1.59E+00	1.3	13	1.2	0.12
	95th UCL; Reference Area	0.918	0.287	0	0.3	0.7	0.137	0.133	0.029	2.40E+00	2.33E+00	5.08E-01	0.00E+00	2.00E-01	3.26E-01	5.27E-01	10	0.0287	17.5	1.00	5.02E-01	1.03E+00	1.3	13	0.8	0.08
Lead	95th UCL; Downgradient	0.918	0.287	0	0.3	0.7	0.0659	0.108	0.012	3.84E+00	6.30E+00	7.00E-01	0.00E+00	5.42E-01	4.50E-01	9.92E-01	10	0.0287	58.3	0.25	4.18E-01	1.41E+00	4	9	0.4	0.2
	95th UCL; Reference Area	0.918	0.287	0	0.3	0.7	0.0659	0.108	0.012	2.20E+00	3.61E+00	4.01E-01	0.00E+00	3.11E-01	2.58E-01	5.68E-01	10	0.0287	33.4	0.25	2.40E-01	8.08E-01	4	9	0.2	0.1
Zinc	95th UCL; Downgradient	0.918	0.287	0	0.3	0.7	0.72	0.759	1.23	6.62E+01	6.98E+01	1.13E+02	0.00E+00	6.01E+00	7.26E+01	7.86E+01	10	0.0287	91.9	1.00	2.64E+00	8.13E+01	10	210	8.1	0.4
	95th UCL; Reference Area	0.918	0.287	0	0.3	0.7	0.72	0.759	1.23	5.72E+02	6.03E+02	9.77E+02	0.00E+00	5.19E+01	6.28E+02	6.80E+02	10	0.0287	794.4	1.00	2.28E+01	7.03E+02	10	210	70.3	3.3
Small Mammal																										
Chromium	95th UCL; Downgradient	0.665	0.212	0.11	0.43	0.46	0.137	0.133	0.029	3.70E+00	3.59E+00	7.83E-01	2.71E-01	3.27E-01	2.40E-01	8.37E-01	10	0.0212	27.0	1.00	5.72E-01	1.41E+00	1.8	18	0.8	0.08
	95th UCL; Reference Area	0.665	0.212	0.11	0.43	0.46	0.137	0.133	0.029	2.40E+00	2.33E+00	5.08E-01	1.75E-01	2.12E-01	1.55E-01	5.43E-01	10	0.0212	17.5	1.00	3.71E-01	9.14E-01	1.8	18	0.5	0.05
Lead	95th UCL; Downgradient	0.665	0.212	0.11	0.43	0.46	0.0659	0.108	0.012	3.84E+00	6.30E+00	7.00E-01	2.81E-01	5.74E-01	2.14E-01	1.07E+00	10	0.0212	58.3	0.25	3.09E-01	1.38E+00	80	800	0.02	0.002
	95th UCL; Reference Area	0.665	0.212	0.11	0.43	0.46	0.0659	0.108	0.012	2.20E+00	3.61E+00	4.01E-01	1.61E-01	3.29E-01	1.23E-01	6.12E-01	10	0.0212	33.4	0.25	1.77E-01	7.89E-01	80	800	0.01	0.001
Zinc	95th UCL; Downgradient	0.665	0.212	0.11	0.43	0.46	0.72	0.759	1.23	6.62E+01	6.98E+01	1.13E+02	4.84E+00	6.36E+00	3.46E+01	4.58E+01	10	0.0212	91.9	1.00	1.95E+00	4.77E+01	120	240	0.4	0.2
	95th UCL; Reference Area	0.665	0.212	0.11	0.43	0.46	0.72	0.759	1.23	5.72E+02	6.03E+02	9.77E+02	4.18E+01	5.50E+01	2.99E+02	3.96E+02	10	0.0212	794.4	1.00	1.68E+01	4.13E+02	120	240	3.4	1.7
Average BAF from ERA-30 and ERA-34																										
Small Ground-Feeding Bird																										
Chromium	95th UCL; Downgradient	0.918	0.287	0	0.3	0.7	0.19	0.1	0.04	5.13E+00	2.70E+00	1.08E+00	0.00E+00	2.32E-01	6.94E-01	9.26E-01	10	0.0287	27.0	1.00	7.75E-01	1.70E+00	1.3	13	1.3	0.13
	95th UCL; Reference Area	0.918	0.287	0	0.3	0.7	0.19	0.1	0.04	3.33E+00	1.75E+00	7.00E-01	0.00E+00	1.51E-01	4.50E-01	6.00E-01	10	0.0287	17.5	1.00	5.02E-01	1.10E+00	1.3	13	0.8	0.08
Lead	95th UCL; Downgradient	0.918	0.287	0	0.3	0.7	0.05	0.12	0.003	2.92E+00	7.00E+00	1.75E-01	0.00E+00	6.02E-01	1.12E-01	7.15E-01	10	0.0287	58.3	0.25	4.18E-01	1.13E+00	4	9	0.3	0.1
	95th UCL; Reference Area	0.918	0.287	0	0.3	0.7	0.05	0.12	0.003	1.67E+00	4.01E+00	1.00E-01	0.00E+00	3.45E-01	6.44E-02	4.09E-01	10	0.0287	33.4	0.25	2.40E-01	6.49E-01	4	9	0.2	0.1
Zinc	95th UCL; Downgradient	0.918	0.287	0	0.3	0.7	0.67	0.51	0.67	6.16E+01	4.69E+01	6.16E+01	0.00E+00	4.04E+00	3.96E+01	4.36E+01	10	0.0287	91.9	1.00	2.64E+00	4.62E+01	10	210	4.6	0.2
	95th UCL; Reference Area	0.918	0.287	0	0.3	0.7	0.67	0.51	0.67	5.32E+02	4.05E+02	5.32E+02	0.00E+00	3.49E+01	3.42E+02	3.77E+02	10	0.0287	794.4	1.00	2.28E+01	4.00E+02	10	210	40.0	1.9
Small Mammal																										
Chromium	95th UCL; Downgradient	0.665	0.212	0.11	0.43	0.46	0.19	0.1	0.04	5.13E+00	2.70E+00	1.08E+00	3.75E-01	2.46E-01	3.30E-01	9.52E-01	10	0.0212	27.0	1.00	5.72E-01	1.52E+00	1.8	18	0.8	0.08
	95th UCL; Reference Area	0.665	0.212	0.11	0.43	0.46	0.19	0.1	0.04	3.33E+00	1.75E+00	7.00E-01	2.43E-01	1.60E-01	2.14E-01	6.17E-01	10	0.0212	17.5	1.00	3.71E-01	9.88E-01	1.8	18	0.5	0.05
Lead	95th UCL; Downgradient	0.665	0.212	0.11	0.43	0.46	0.05	0.12	0.003	2.92E+00	7.00E+00	1.75E-01	2.13E-01	6.38E-01	5.35E-02	9.04E-01	10	0.0212	58.3	0.25	3.09E-01	1.21E+00	80	800	0.02	0.002
	95th UCL; Reference Area	0.665	0.212	0.11	0.43	0.46	0.05	0.12	0.003	1.67E+00	4.01E+00	1.00E-01	1.22E-01	3.65E-01	3.07E-02	5.18E-01	10	0.0212	33.4	0.25	1.77E-01	6.95E-01	80	800	0.01	0.001
Zinc	95th UCL; Downgradient	0.665	0.212	0.11	0.43	0.46	0.67	0.51	0.67	6.16E+01	4.69E+01	6.16E+01	4.50E+00	4.27E+00	1.88E+01	2.76E+01	10	0.0212	91.9	1.00	1.95E+00	2.96E+01	120	240	0.2	0.1
	95th UCL; Reference Area	0.665	0.212	0.11	0.43	0.46	0.67	0.51	0.67	5.32E+02	4.05E+02	5.32E+02	3.89E+01	3.69E+01	1.63E+02	2.39E+02	10	0.0212	794.4	1.00	1.68E+01	2.56E+02	120	240	2.1	1.1

Notes: *Italicized*: Concentrations found in foliage were used as seed tissue concentrations.
Invertebrate and foliage exposure calculated using fresh weight ingestion rate because invertebrate tissue data were reported in fresh weight in the BERA.
Seed and soil exposure calculated using dry weight ingestion rate since data were reported in dry weight in the BERA.
HQ greater than 1.0
95th UCL = 95th Upper Confidence Limit
BW = body weight
DW = dry weight
kg/kg = kilograms/kilogram
LOAEL = Lowest-Observed Adverse Effects Level
mg/kg = milligrams/kilogram
NA = Not analyzed
NOAEL = No-Observed-Adverse-Effects Level
WW = wet weight

Table 4.1-1
Acute and Chronic Calculations for Hardness-Dependent
New Mexico Water Quality Criteria Calculations
Lampbright Investigation Unit

COPCs	m	b	Conversion Factor (CF)
Acute			
Cadmium	0.8968	-3.5699	1.136672-[(ln hardness)(0.041838)]
Copper	0.9422	-1.7	0.96
Lead	1.273	-1.46	1.46203-[(ln hardness)(0.145712)]
Zinc	0.9094	0.9095	0.978
Chronic			
Cadmium	0.7647	-4.218	1.101672-[(ln hardness)(0.041838)]
Copper	0.8545	-1.702	0.96
Lead	1.273	-4.705	1.46203-[(ln hardness)(0.145712)]
Zinc	0.9094	0.6235	0.986

Criteria (ug/L) = exp(m[ln(hardness)]+b)(CF)
20.6.4 NMAC; 12/20/12

Table 4.1-2
Chiricauhua Leopard Frog Toxicity Reference Values
Lampbright Investigation Unit

COPC	Mortality		Body Length		Body Weight		Developmental (Gosner Stage)		Geometric Mean of All Endpoints	
	NOEC	LOEC	NOEC	LOEC	NOEC	LOEC	NOEC	LOEC	NOEC	LOEC
Cadmium	351	N/A	19	110	19	110	19	110	39	110
Copper	47	165	7	47	3	7	7	47	9.12	40.0
Zinc	165	N/A	63	N/A	63	N/A	63	N/A	80.1	N/A

LOEC = Lowest-Observed-Effect Concentration
NOEC = No-Observed-Effect Concentration
units = ug/L dissolved
N/A = Not Available

Table 4.1-3

**Surface Water COPC Concentrations
Compared to NMWQC;
Tributary 1**

Lampbright Investigation Unit

		LB7S	LB7S	LB7S	LB7S	LB7S	LB7S	LB7S	376-05-04	376-05-04	376-05-04	376-05-04	376-05-04	376-05-04	376-05-04	376-05-05	376-05-05	376-05-05
		Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial
		10/4/2007	11/27/2007	1/9/2008	4/2/2008	6/18/2008	8/20/2008	9/16/2008	10/4/2007	1/9/2008	2/20/2008	4/2/2008	6/18/2008	8/20/2008	9/16/2008	10/6/2007	11/27/2007	1/9/2008
COPC	**Units**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**
Cadmium Concentration in Sample	ug/L	0.2 U	0.2 U	0.2 U	2 U	2 U	2 U	2 U	0.2 U	0.2 U	2 U	2 U	2 U	2 U	2 U	0.2 U	0.2 U	0.2 U
Acute NMWQC [2]	ug/L	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38
Chronic NMWQC [2]	ug/L	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22
Leopard Frog NOEC [1a]	ug/L	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7
Leopard Frog LOEC [1b]	ug/L	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311
Leopard Frog GM NOEC [1c]	ug/L	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
Leopard Frog GM LOEC [1d]	ug/L	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311
Copper Concentration in Sample	ug/L	2.1	11.6	3.9	10 U	10 U	10 U	27	2.1	5.7	10 U	10 U	10 U	10 U	10 U	3.6	1.5	3.3
Acute NMWQC [2]	ug/L	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6
Chronic NMWQC [2]	ug/L	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Leopard Frog NOEC [1a]	ug/L	9.6	***9.6***	9.6	9.6	9.6	9.6	***9.6***	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
Leopard Frog LOEC [1b]	ug/L	22.3	22.3	22.3	22.3	22.3	22.3	***22.3***	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3
Leopard Frog GM NOEC [1c]	ug/L	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1
Leopard Frog GM LOEC [1d]	ug/L	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0
Lead Concentration in Sample	ug/L	3 U	3 U	3 U	7.5 U	7.5 U	7.5 U	7.5 U	3 U	3 U	7.5 U	7.5 U	7.5 U	7.5 U	7.5 U	3 U	3 U	3 U
Acute NMWQC [2]	ug/L	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281
Chronic NMWQC [2]	ug/L	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94
Leopard Frog NOEC [1a]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog LOEC [1b]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog GM NOEC [1c]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog GM LOEC [1d]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Amphibian TRV [1]	ug/L	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000
Zinc Concentration in Sample	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10.1	10 U	10 U	10 U
Acute NMWQC [2]	ug/L	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564
Chronic NMWQC [2]	ug/L	428	428	428	428	428	428	428	428	428	428	428	428	428	428	428	428	428
Leopard Frog NOEC [1a]	ug/L	217	217	217	217	217	217	217	217	217	217	217	217	217	217	217	217	217
Leopard Frog LOEC [1b]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog GM NOEC [1c]	ug/L	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275
Leopard Frog GM LOEC [1d]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hardness	mg/L	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400

[1] No-Effect Concentration based on data presented in Harfenist et al. 1989 or derived in TM-1 (Schafer and Associates 1999).
[1a] Highest no-effect concentration observed in Little and Calfee 2008.
[1b] Lowest effect concentration observed in Little and Calfee 2008.
[1c] Geometric mean of NOEC concentrations for all endpoints observed Little and Calfee 2008.
[1d] Geometric mean of LOEC concentrations for all endpoints observed in Little and Calfee 2008.
[2] Calculated with equation 1 (acute) or 2 (chronic) of 20.6.4.900(I) NMAC; As Amended thorugh July 17, 2005.
Highlight - Detectected concentration is greater than one or more criteria
Bold/Italics - Exceeded criterion
N/A - Not Available
No hardness data provided for 2007/2008 sitewide abatement program data. Hardness was estimated based on the results of the single sample collected from Trib 1 in 1995.
U - not detected in the sample.

Table 4.1-3

Surface Water COPC Concentrations Compared to NMWQC; Tributary 1

Lampbright Investigation Unit

		376-05-05	376-05-05	376-05-05	376-05-05	376-05-05	376-05-05	LBT1-BF1	LBT1-BF1	LBT1-BF1	LBT1-BF1	LBT1-BF1	LBT1-BF1	LBT1-BF1	2408	2408	2408	2408	2408
		Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial	Shallow Alluvial
		2/20/2008	4/2/2008	5/13/2008	6/18/2008	8/20/2008	9/16/2008	10/4/2007	11/27/2007	1/9/2008	2/20/2008	4/1/2008	8/20/2008	9/16/2008	10/5/2007	11/27/2007	1/9/2008	2/20/2008	4/1/2008
COPC	**Units**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**
Cadmium Concentration in Sample	ug/L	2 U	2 U	2 U	2 U	2 U	2 U	0.2 U	0.2 U	0.2 U	2 U	2 U	2 U	2 U	0.2 U	0.2 U	0.2 U	2 U	2 U
Acute NMWQC [2]	ug/L	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38
Chronic NMWQC [2]	ug/L	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22
Leopard Frog NOEC [1a]	ug/L	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7
Leopard Frog LOEC [1b]	ug/L	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311
Leopard Frog GM NOEC [1c]	ug/L	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
Leopard Frog GM LOEC [1d]	ug/L	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311
Copper Concentration in Sample	ug/L	10 U	15	10 U	10 U	10 U	10 U	2.3	2.7	2.7	10 U	10 U	10 U	36	2.4	3.3	3.2	11	10
Acute NMWQC [2]	ug/L	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6
Chronic NMWQC [2]	ug/L	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	***29.3***	29.3	29.3	29.3	29.3	29.3
Leopard Frog NOEC [1a]	ug/L	9.6	***9.6***	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	***9.6***	9.6	9.6	9.6	***9.6***	***9.6***
Leopard Frog LOEC [1b]	ug/L	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	***22.3***	22.3	22.3	22.3	22.3	22.3
Leopard Frog GM NOEC [1c]	ug/L	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	***29.1***	29.1	29.1	29.1	29.1	29.1
Leopard Frog GM LOEC [1d]	ug/L	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0
Lead Concentration in Sample	ug/L	7.5 U	7.5 U	7.5 U	7.5 U	7.5 U	7.5 U	3 U	3 U	3 U	7.5 U	7.5 U	7.5 U	7.5 U	3 U	3 U	3 U	7.5 U	7.5 U
Acute NMWQC [2]	ug/L	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281
Chronic NMWQC [2]	ug/L	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94
Leopard Frog NOEC [1a]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog LOEC [1b]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog GM NOEC [1c]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog GM LOEC [1d]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Amphibian TRV [1]	ug/L	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000
Zinc Concentration in Sample	ug/L	10 U	98	10 U	10 U	10.6	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	17	11
Acute NMWQC [2]	ug/L	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564
Chronic NMWQC [2]	ug/L	428	428	428	428	428	428	428	428	428	428	428	428	428	428	428	428	428	428
Leopard Frog NOEC [1a]	ug/L	217	217	217	217	217	217	217	217	217	217	217	217	217	217	217	217	217	217
Leopard Frog LOEC [1b]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog GM NOEC [1c]	ug/L	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275
Leopard Frog GM LOEC [1d]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hardness	mg/L	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400

[1] No-Effect Concentration based on data presented in Harfenist et al. 1989 or derived in TM-1 (Schafer and Associates 1999).
[1a] Highest no-effect concentration observed in Little and Calfee 2008.
[1b] Lowest effect concentration observed in Little and Calfee 2008.
[1c] Geometric mean of NOEC concentrations for all endpoints observed Little and Calfee 2008.
[1d] Geometric mean of LOEC concentrations for all endpoints observed in Little and Calfee 2008.
[2] Calculated with equation 1 (acute) or 2 (chronic) of 20.6.4.900(I) NMAC; As Amended thorugh July 17, 2005.
Highlight - Detectected concentration is greater than one or more criteria
Bold/Italics - Exceeded criterion
N/A - Not Available
No hardness data provided for 2007/2008 sitewide abatement program data. Hardness was estimated based on the results of the single sample collected from Trib 1 in 1995.
U - not detected in the sample.

Table 4.1-3

Surface Water COPC Concentrations
Compared to NMWQC;
Tributary 1

Lampbright Investigation Unit

		2408	2408	2409	2409	2409	2409	2409	2409	2409	376-96-04	376-96-04	376-96-04	376-96-04	376-96-04	376-96-04	376-96-04	376-96-04	376-96-04
		Shallow Alluvial	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**
		8/20/2008	**9/16/2008**	**10/5/2007**	**11/27/2007**	**1/9/2008**	**2/20/2008**	**4/1/2008**	**8/25/2008**	**9/17/2008**	**10/5/2007**	**11/27/2007**	**1/10/2008**	**2/19/2008**	**4/2/2008**	**5/13/2008**	**6/18/2008**	**8/20/2008**	**9/17/2008**
COPC	**Units**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**
Cadmium Concentration in Sample	ug/L	2 U	2 U	0.2 U	0.2 U	0.2 U	2 U	2 U	2 U	2 U	0.2 U	0.2 U	0.2 U	2 U	2 U	2 U	2 U	2 U	2 U
Acute NMWQC [2]	ug/L	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38
Chronic NMWQC [2]	ug/L	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22
Leopard Frog NOEC [1a]	ug/L	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7
Leopard Frog LOEC [1b]	ug/L	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311
Leopard Frog GM NOEC [1c]	ug/L	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
Leopard Frog GM LOEC [1d]	ug/L	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311
Copper Concentration in Sample	ug/L	10 U	10 U	4.9	15	5.8	10	10 U	10 U	14	1.8	1.4	1.6	10 U	10 U	10 U	10 U	10 U	10 U
Acute NMWQC [2]	ug/L	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6
Chronic NMWQC [2]	ug/L	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Leopard Frog NOEC [1a]	ug/L	9.6	9.6	9.6	***9.6***	9.6	***9.6***	9.6	9.6	***9.6***	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
Leopard Frog LOEC [1b]	ug/L	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3
Leopard Frog GM NOEC [1c]	ug/L	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1
Leopard Frog GM LOEC [1d]	ug/L	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0
Lead Concentration in Sample	ug/L	7.5 U	7.5 U	3 U	3 U	3 U	7.5 U	7.5 U	7.5 U	7.5 U	3 U	3 U	3 U	7.5 U	7.5 U	7.5 U	7.5 U	7.5 U	7.5 U
Acute NMWQC [2]	ug/L	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281
Chronic NMWQC [2]	ug/L	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94
Leopard Frog NOEC [1a]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog LOEC [1b]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog GM NOEC [1c]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog GM LOEC [1d]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Amphibian TRV [1]	ug/L	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000
Zinc Concentration in Sample	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acute NMWQC [2]	ug/L	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564
Chronic NMWQC [2]	ug/L	428	428	428	428	428	428	428	428	428	428	428	428	428	428	428	428	428	428
Leopard Frog NOEC [1a]	ug/L	217	217	217	217	217	217	217	217	217	217	217	217	217	217	217	217	217	217
Leopard Frog LOEC [1b]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog GM NOEC [1c]	ug/L	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275
Leopard Frog GM LOEC [1d]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hardness	mg/L	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400

[1] No-Effect Concentration based on data presented in Harfenist et al. 1989 or derived in TM-1 (Schafer and Associates 1999).
[1a] Highest no-effect concentration observed in Little and Calfee 2008.
[1b] Lowest effect concentration observed in Little and Calfee 2008.
[1c] Geometric mean of NOEC concentrations for all endpoints observed Little and Calfee 2008.
[1d] Geometric mean of LOEC concentrations for all endpoints observed in Little and Calfee 2008.
[2] Calculated with equation 1 (acute) or 2 (chronic) of 20.6.4.900(I) NMAC; As Amended thorugh July 17, 2005.
Highlight - Detectected concentration is greater than one or more criteria
Bold/Italics - Exceeded criterion
N/A - Not Available
No hardness data provided for 2007/2008 sitewide abatement program data. Hardness was estimated based on the results of the single sample collected from Trib 1 in 1995.
U - not detected in the sample.

Table 4.1-3

Surface Water COPC Concentrations
Compared to NMWQC;
Tributary 1

Lampbright Investigation Unit

		2410	**2410**	**2410**	**2410**	**2410**	**2410**	**2410**	**2410**	**LB6**	**LB6**	**LB6**	**LB6**	**LB6**	**LB6**	**LB6**	**LB6**	**ERA-34**
		Shallow Alluvial	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**9/9/1995**
		10/5/2007	**11/29/2007**	**1/10/2008**	**2/19/2008**	**4/1/2008**	**5/13/2008**	**8/26/2008**	**9/23/2008**	**10/5/2007**	**1/9/2008**	**2/19/2008**	**4/1/2008**	**5/13/2008**	**6/18/2008**	**8/27/2008**	**9/22/2008**	**Surface Water**
COPC	**Units**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**	**Tributary 1**
Cadmium Concentration in Sample	ug/L	0.2 U	0.2 U	0.2 U	2 U	2 U	2 U	2 U	2 U	0.2 U	0.2 U	2 U	2 U	2 U	2 U	2 U	2 U	3 U
Acute NMWQC [2]	ug/L	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38
Chronic NMWQC [2]	ug/L	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22
Leopard Frog NOEC [1a]	ug/L	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7
Leopard Frog LOEC [1b]	ug/L	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311
Leopard Frog GM NOEC [1c]	ug/L	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
Leopard Frog GM LOEC [1d]	ug/L	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311
Copper Concentration in Sample	ug/L	1.8	4.6	1.6	10 U	10 U	10 U	10 U	13	2.5	3.3	10 U	10 U	10 U	10 U	10 U	10 U	17
Acute NMWQC [2]	ug/L	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6
Chronic NMWQC [2]	ug/L	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Leopard Frog NOEC [1a]	ug/L	9.6	9.6	9.6	9.6	9.6	9.6	9.6	***9.6***	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	***9.6***
Leopard Frog LOEC [1b]	ug/L	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3
Leopard Frog GM NOEC [1c]	ug/L	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1
Leopard Frog GM LOEC [1d]	ug/L	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0
Lead Concentration in Sample	ug/L	3 U	3 U	3 U	7.5 U	7.5 U	7.5 U	7.5 U	7.5 U	3 U	3 U	7.5 U	7.5 U	7.5 U	7.5 U	7.5 U	7.5 U	40 U
Acute NMWQC [2]	ug/L	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281
Chronic NMWQC [2]	ug/L	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94	10.94
Leopard Frog NOEC [1a]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog LOEC [1b]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog GM NOEC [1c]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog GM LOEC [1d]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Amphibian TRV [1]	ug/L	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000
Zinc Concentration in Sample	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acute NMWQC [2]	ug/L	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564	564
Chronic NMWQC [2]	ug/L	428	428	428	428	428	428	428	428	428	428	428	428	428	428	428	428	428
Leopard Frog NOEC [1a]	ug/L	217	217	217	217	217	217	217	217	217	217	217	217	217	217	217	217	217
Leopard Frog LOEC [1b]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog GM NOEC [1c]	ug/L	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275
Leopard Frog GM LOEC [1d]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hardness	mg/L	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400

[1] No-Effect Concentration based on data presented in Harfenist et al. 1989 or derived in TM-1 (Schafer and Associates 1999).
[1a] Highest no-effect concentration observed in Little and Calfee 2008.
[1b] Lowest effect concentration observed in Little and Calfee 2008.
[1c] Geometric mean of NOEC concentrations for all endpoints observed Little and Calfee 2008.
[1d] Geometric mean of LOEC concentrations for all endpoints observed in Little and Calfee 2008.
[2] Calculated with equation 1 (acute) or 2 (chronic) of 20.6.4.900(I) NMAC; As Amended thorugh July 17, 2005.
Highlight - Detectected concentration is greater than one or more criteria
Bold/Italics - Exceeded criterion
N/A - Not Available
No hardness data provided for 2007/2008 sitewide abatement program data. Hardness was estimated based on the results of the single sample collected from Trib 1 in 1995.
U - not detected in the sample.

Table 4.1-4
Surface Water COPC Concentrations Compared to NMWQC; Tributary 2
Lampbright Investigation Unit

		2010 RI Samples				Post-Corrective Action Monitoring											Post-Corrective Action Monitoring							ERI Data
		Trib2A-SW	**38+20-SW**	**130+00-SW**	**65+40-SW**	**LBT-07**	**LBT-08**	**LBT-09**	**LBT-10**			**LBT-11**			**LBT-12**	**LBT-13**	**LBT-14**	**LBT-15**	**LBT-16**			**LBT-17**		**ERA-36**
		9/23/2010	**9/23/2010**	**9/23/2010**	**9/23/2010**	**7/22/2008**	**7/22/2008**	**7/22/2008**	**7/21/2008**	**9/17/2009**	**9/23/2010**	**7/22/2008**	**9/17/2009**	**9/21/2010**	**7/23/2008**	**7/23/2008**	**7/21/2008**	**7/22/2008**	**7/23/2008**	**9/21/2009**	**9/24/2010**	**9/21/2009**	**9/21/2010**	**9/9/1995**
		Rainfall Pool	**Rainfall Pool**	**Rainfall Pool**	**Rainfall Pool**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Shallow Alluvial**	**Surface Water**
COPC	**Units**	**Tributary 2a**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**	**Tributary 2**
Cadmium Concentration in Sample	ug/L	0.038 J	0.036 U	0.036 U	0.036 U	2 U	2 U	2 U	2 U	---	---	2.8	---	---	4.2	2 U	2 U	2 U	2 U	--	--	--	--	3 U
Acute NMWQC [2]	ug/L	4.91	2.36	3.38	3.50	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38
Chronic NMWQC [2]	ug/L	1.13	0.61	0.83	0.85	1.22	1.22	1.22	1.22	1.22	1.22	***1.22***	1.22	1.22	***1.22***	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22
Leopard Frog NOEC [1a]	ug/L	49	26	35	36	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7
Leopard Frog LOEC [1b]	ug/L	286	148	205	211	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311
Leopard Frog GM NOEC [1c]	ug/L	102	53	73	76	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
Leopard Frog GM LOEC [1d]	ug/L	286	148	205	211	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311
Copper Concentration in Sample	ug/L	5.2	8.9	9.4	9.1	12	11	10 U	10 U	6.9	9.4	26	10.7	2.7	10 U	10 U	10 U	10 U	10 U	3.6	4.5	4.5	2.9	17
Acute NMWQC [2]	ug/L	44.76	19.92	29.67	30.75	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6
Chronic NMWQC [2]	ug/L	26.70	12.81	18.38	18.99	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Leopard Frog NOEC [1a]	ug/L	8.72	**4.18**	***6.0***	***6.21***	***9.6***	***9.6***	9.6	9.6	9.6	9.6	***9.6***	***9.6***	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	***9.6***
Leopard Frog LOEC [1b]	ug/L	20.40	9.77	14.0	14.5	22.3	22.3	22.3	22.3	22.3	22.3	***22.3***	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3
Leopard Frog GM NOEC [1c]	ug/L	9.12	12.7	18.3	18.9	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1
Leopard Frog GM LOEC [1d]	ug/L	40	55.8	80	83	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0	128.0
Lead Concentration in Sample	ug/L	0.019 U	0.019 U	0.019 U	0.053 J	7.5 U	7.5 U	7.5 U	7.5 U	---	---	24	---	---	7.5 U	7.5 U	7.5 U	7.5 U	7.5 U	--	--	--	--	40 U
Acute NMWQC [2]	ug/L	251.27	101.56	159.30	165.82	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281	281
Chronic NMWQC [2]	ug/L	9.79	3.96	6.21	6.46	10.9	10.9	10.9	10.9	10.9	10.9	***10.9***	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
Leopard Frog NOEC [1a]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog LOEC [1b]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog GM NOEC [1c]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog GM LOEC [1d]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Amphibian TRV [1]	ug/L	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000
Zinc Concentration in Sample	ug/L	2.5 J	0.99 J	4.2 J	1.6 J	70	50	20	10 U	10 U	10 U	510	610	1090	200	20	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acute NMWQC [2]	ug/L	511.60	234.15	343.96	356.07	564	564	564	564	564	564	564	***564***	***564***	564	564	564	564	564	564	564	564	564	564
Chronic NMWQC [2]	ug/L	387.49	177.35	260.52	269.69	428	428	428	428	428	428	***428***	***428***	***428***	428	428	428	428	428	428	428	428	428	428
Leopard Frog NOEC [1a]	ug/L	196	89.8	132	137	217	217	217	217	217	217	***217***	***217***	***217***	217	217	217	217	217	217	217	217	217	217
Leopard Frog LOEC [1b]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Leopard Frog GM NOEC [1c]	ug/L	250.0	114	168.0	174.0	275	275	275	275	275	275	***275***	***275***	***275***	275	275	275	275	275	275	275	275	275	275
Leopard Frog GM LOEC [1d]	ug/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hardness	mg/L	359	152	232	241	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400

[1] No-Effect Concentration based on data presented in Harfenist et al. 1989 or derived in TM-1 (Schafer and Associates 1999).
[1a] Highest no-effect concentration observed in Little and Calfee 2008.
[1b] Lowest effect concentration observed in Little and Calfee 2008.
[1c] Geometric mean of NOEC concentrations for all endpoints observed Little and Calfee 2008.
[1d] Geometric mean of LOEC concentrations for all endpoints observed in Little and Calfee 2008.
[2] Calculated with equation 1b or 2a of 20.6.4.900(I) NMAC; As Amended thorugh July 17, 2005.
Highlight - Detectected concentration is greater than one or more criteria
Bold/Italics - Exceeded criterion
Hardness estimated in LIU RI used for RI samples. Hardness was calculated for post corrective action monitoring samples using Ca and Mg data.
COPC - Chemical of potential concern
N/A - Not Available
U - Not detected in the sample; J - Estimated

Table 4.2-1
Comparison of Sediment Data to TEC and PEC Sediment Benchmarks
Lampbright Investigation Unit

Sample Location	Type	Tributary	Sample Date	Program	Cadmium (0.99 / 4.98)	Chromium (43.4 / 111)	Copper (31.6 / 149)	Lead (35.8 / 128)	Nickel (22.7 / 48.6)	Zinc (121 /459)
2214	Site	1	1995	Background Report	0.2 U	12.5	721	22.6	12.7	208
2215	Site	1	1995	Background Report	---	---	260	---	---	---
2216	Site	1	1995	Background Report	0.2 U	8.57	138	14.5	8.1	72.5
2218	Site	1	1995	Background Report	---	---	37.8	---	---	---
2219	Site	1	1995	Background Report	---	---	58.4	---	---	---
2220	Site	1	1995	Background Report	0.2 U	4.91	32.9	14.6	2.1 U	45.6
2221	Site	1	1995	Background Report	0.2 U	4.17	30	12.6	2.2	50
2222	Site	1	1995	Background Report	---	---	30.2	---	---	---
2223	Site	1	1995	Background Report	---	---	52.1	---	---	---
2224	Site	1	1995	Background Report	0.2 U	6.77	46.2	10.1	3.3	59.6
ERA-34-1	Site	1	9/9/1999	ERA Report	0.52	6.1 J	59.7	23.3 J	7.6	71.4
ERA-34-2	Site	1	9/9/1999	ERA Report	0.57	5.9 J	57.4	30.2 J	5	64.3
ERA-34-3	Site	1	9/9/1999	ERA Report	0.5	5.1 U	54.1	30.6 J	3.8	58.8
2408	Site	1	5/5/2009	Sitewide Abatement	---	61	50	19	10 U	78
2409	Site	1	5/5/2009	Sitewide Abatement	---	86	68	18	10 U	78
2410	Site	1	5/6/2009	Sitewide Abatement	---	79	72	22	10 U	120
376-05-04	Site	1	5/5/2009	Sitewide Abatement	---	86	296	25	10	137
376-05-05	Site	1	5/6/2009	Sitewide Abatement	---	41	99	27	10 U	102
376-96-04	Site	1	5/6/2009	Sitewide Abatement	---	59	76	24	10 U	108
LBT1-BF1	Site	1	5/5/2009	Sitewide Abatement	---	55	147	37	10 U	103
1-1	Site	1	12/09/10	S/TSIU AOC	0.27 B	12.5	51.5	10.7	10.2	58
1-2	Site	1	12/09/10	S/TSIU AOC	0.35	9	44	11	8.3	81
2201	Site	2A	1995	Background Report	---	---	129 J	---	---	---
2202	Site	2A	1995	Background Report	0.21 U	8.32	183 J	21.2	13.7	118
2203	Site	2A	1995	Background Report	---	---	46.9 J	---	---	---
2206	Site	2A	1995	Background Report	0.2 U	4.96	164 J	21.7	8.35	89.8
2207	Site	2A	1995	Background Report	---	---	75.2 J	---	---	---
2211	Site	2A	1995	Background Report	0.28	7.01	125	18.6	11.8	112
TRIB 2A	Site	2A	9/23/2010	LIU AOC	0.17 J	9.1	38.4	17	9.1	84

Table 4.2-1
Comparison of Sediment Data to TEC and PEC Sediment Benchmarks
Lampbright Investigation Unit

Sample Location	Type	Tributary	Sample Date	Program	Cadmium (0.99 / 4.98)	Chromium (43.4 / 111)	Copper (31.6 / 149)	Lead (35.8 / 128)	Nickel (22.7 / 48.6)	Zinc (121 /459)
130+00	Site	2	9/23/2010	LIU AOC	0.36	10.4	77.9	19.1	9.7	124
156+50	Dup	2	9/23/2010	LIU AOC	0.35	9.8	89.3	19.4	9.4	109
38+20	Site	2	9/23/2010	LIU AOC	0.49	16.1	71.5	23.4	13.2	136
65+40	Site	2	9/23/2010	LIU AOC	0.52	21.6	92.3	28.8	16.3	162
T2S1	Site	2	7/21/2008	Corrective Action	0.32	6.5	94.1	8.1	21.4	80
	Site	2	9/16/2009	Corrective Action	---	---	52.1	---	---	88.9
	Site	2	9/21/2010	Corrective Action	---	---	63.5 J	---	---	92.9
T2S10	Site	2	7/22/2008	Corrective Action	0.52	9.3	199	11.2	45.3	177
	Site	2	9/17/2009	Corrective Action	---	---	107	---	---	171
	Site	2	9/21/2010	Corrective Action	---	---	84.8 J	---	---	210
T2S11	Site	2	7/22/2008	Corrective Action	0.46	15.5	94	11.8	19.4	151
T2S12	Site	2	7/22/2008	Corrective Action	0.41	13	126	10.4	38.6	138
T2S2	Site	2	7/21/2008	Corrective Action	0.29	5.2	99	7.6	15.6	88.8
T2S3	Site	2	7/21/2008	Corrective Action	0.43	7	103	9	34.1	111
	Site	2	9/17/2009	Corrective Action	---	---	70.4	---	---	112
	Site	2	9/21/2010	Corrective Action	---	---	90.2 J	---	---	107
T2S4	Site	2	7/22/2008	Corrective Action	0.54	7.8	91.9	12.3	44.7	168
T2S5	Site	2	7/22/2008	Corrective Action	0.35	7.3	123	8.9	26.7	121
T2S6	Site	2	7/22/2008	Corrective Action	0.59	12.6	140	11.5	51	168
T2S7	Site	2	7/23/2008	Corrective Action	0.36	7.9	56.1	10.3	20.6	110
	Site	2	9/21/2009	Corrective Action	---	---	50.5	---	---	138
	Site	2	9/21/2010	Corrective Action	---	---	37.4 J	---	---	126
T2S8	Site	2	7/23/2008	Corrective Action	0.36	7.7	71.7	8.2	17.6	95.6
T2S9	Site	2	7/23/2008	Corrective Action	0.65	9.2	143	11.4	13.7	150

Notes:

TEC / PEC are presented in parentheses for each COPC.

All results in mg/kg = milligram per kilogram

U = Below detection limit

J = Concentration estimated between RL and MDL

--- = no data for this constituent at this location.

Yellow shading indicates exceedance of the TEC.

Red shading indicates exceedance of the PEC.

PEC - Probable Effects Concentration

TEC - Threshold Effects Concentration

Table 4.2-2
LIU Synthetic Precipitation Leaching Procedure Data
Lampbright Investigation Unit

Sample ID (inches bgs)	Sample Date	Metal Analysis							
		Cadmium		Copper (1312)		Lead (1312)		Zinc (1312)	
		ug/L		ug/L		ug/L		ug/L	
Lowest Water Quality Benchmark		**1.22**		**9.6**		**10.9**		**217**	
LAMPBRIGHT TRIB-1-1(0-0.5)	12/9/2010	<0.5	U	3.4		0.4	B	8	
LAMPBRIGHT TRIB-1-1(1-1.5)	12/9/2010	<0.5	U	3.8		1.4		6	
LAMPBRIGHT TRIB-1-1(2-2.5)	12/9/2010	<0.5	U	4		1.3		1.1	
LAMPBRIGHT TRIB-1-2(0-0.5)	12/9/2010	<0.5	U	4.9		0.3	B	3	B
LAMPBRIGHT TRIB-1-2(1.5-2)	12/9/2010	<0.5	U	6.1		0.2	B	3	B

Notes:

SPLP - Synthetic Precipitation Leaching Procedure

ug/L = microgram per liter

% = percent

U = Validation qualifier indicating result was qualified or reported as non-detect

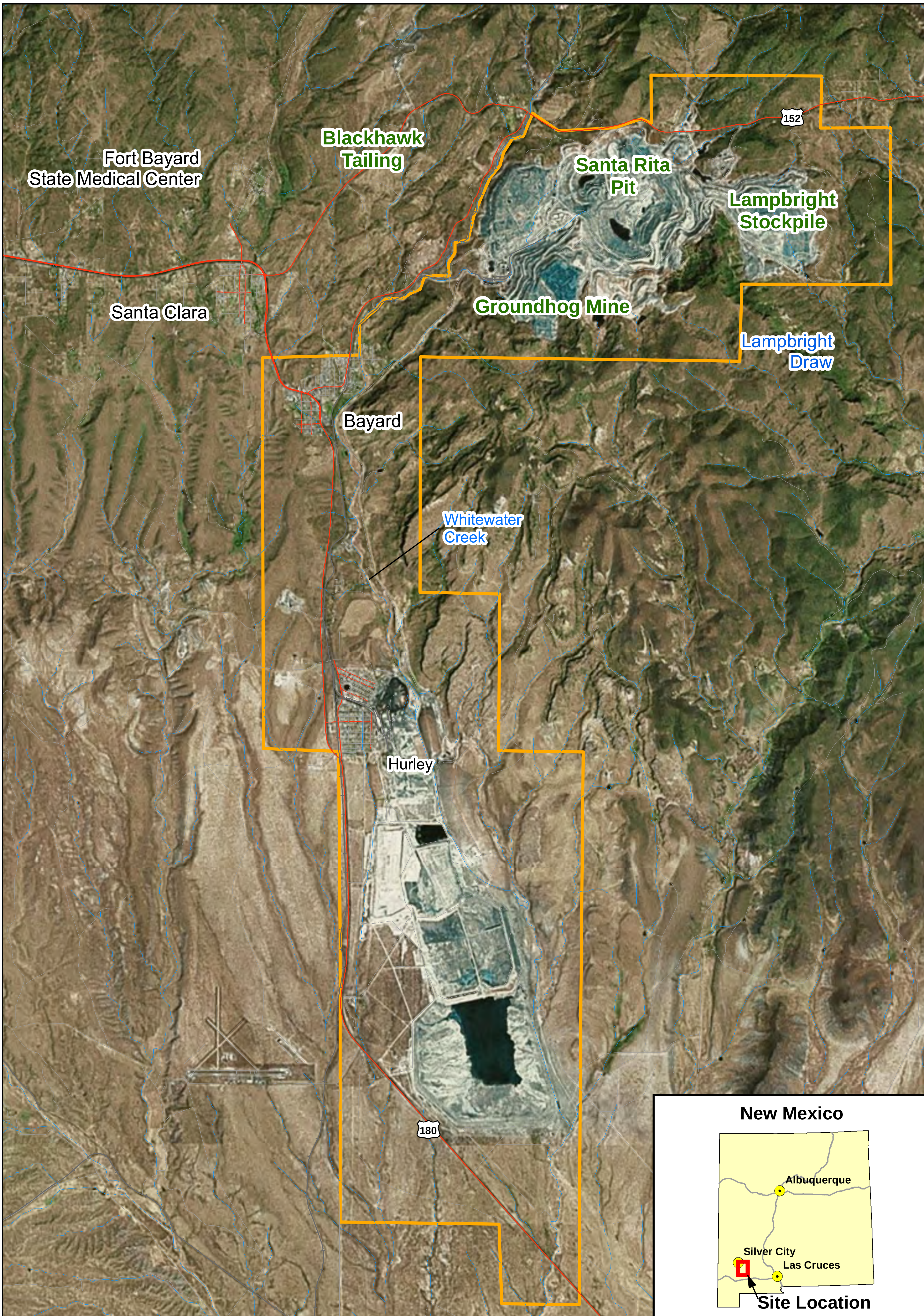
B = Laboratory identifier for estimated value.

umhos/cm = micromhos/cm

< = Analyte not detected above MDL and displayed as <PQL

Aluminum (1312) = number in parentheses beside the parameter name is the EPA specified lab extration method. (1312) is the method for SPLP leachability.

FIGURES



Legend

- Railroad
- Drainage
- Major Roads
- AOC Boundary
- Road

Note: Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

0 4,000 8,000
Feet

N

Chino Mines AOC
Lampbright IU Ecological Risk Assessment

Figure 1.0-1

CHINO MINES
LAMPBRIGHT INVESTIGATION UNIT AREA

DATE: Feb 20, 2018
BY: FSR FOR: JMA

FORMATION ENVIRONMENTAL

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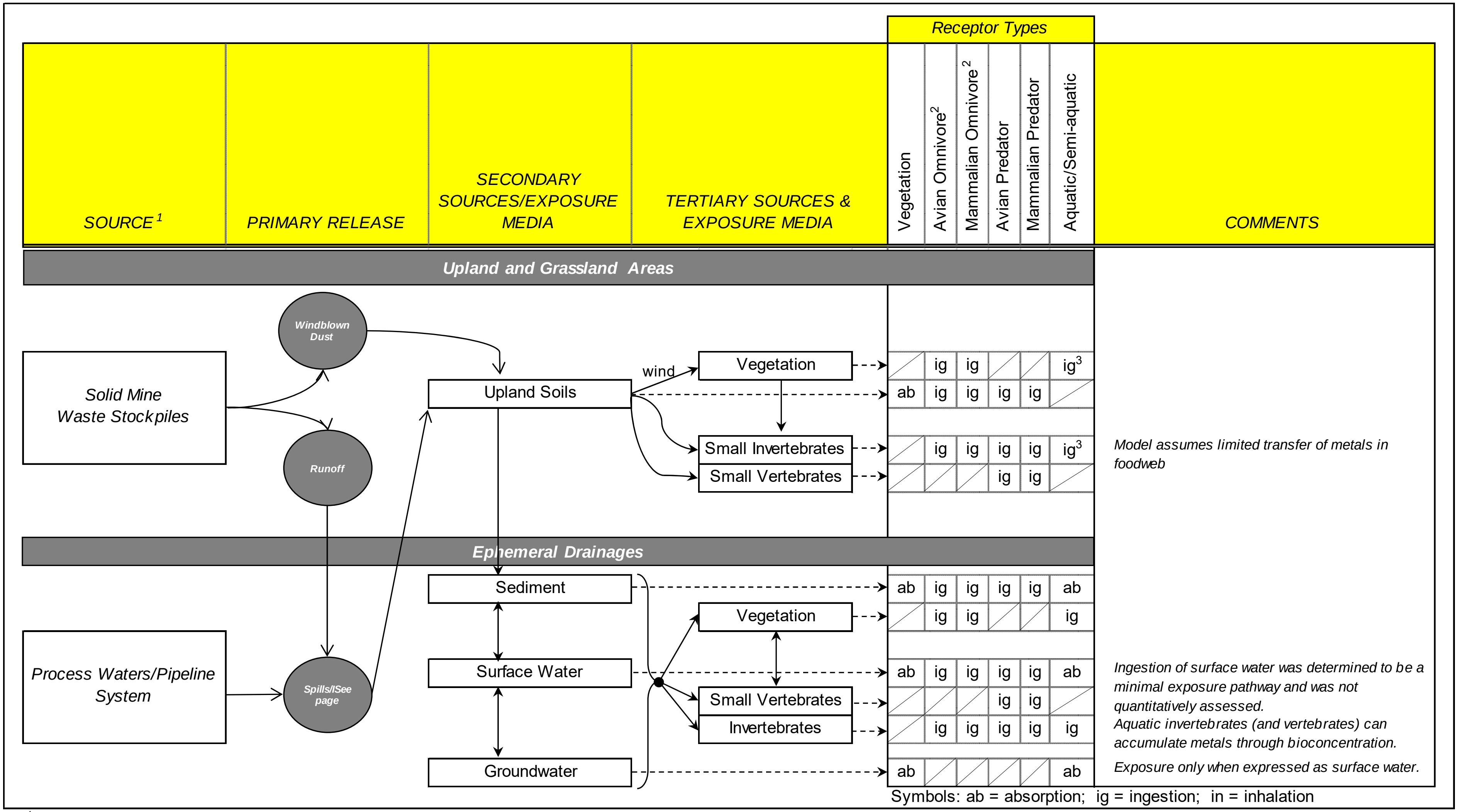


[1] Includes current and historical sources as identified in AOC Background Report and RI Proposals.

[2] Includes herbivores and assumes most omnivores do not ingest vertebrate prey.

[3] Amphibians may be exposed to upland sources; however, the pathway was not quantitativley assessed.

Figure 1.1-1 Conceptual Site Model for Exposure of Ecological Receptors in the LIU; Chino Mines ERA

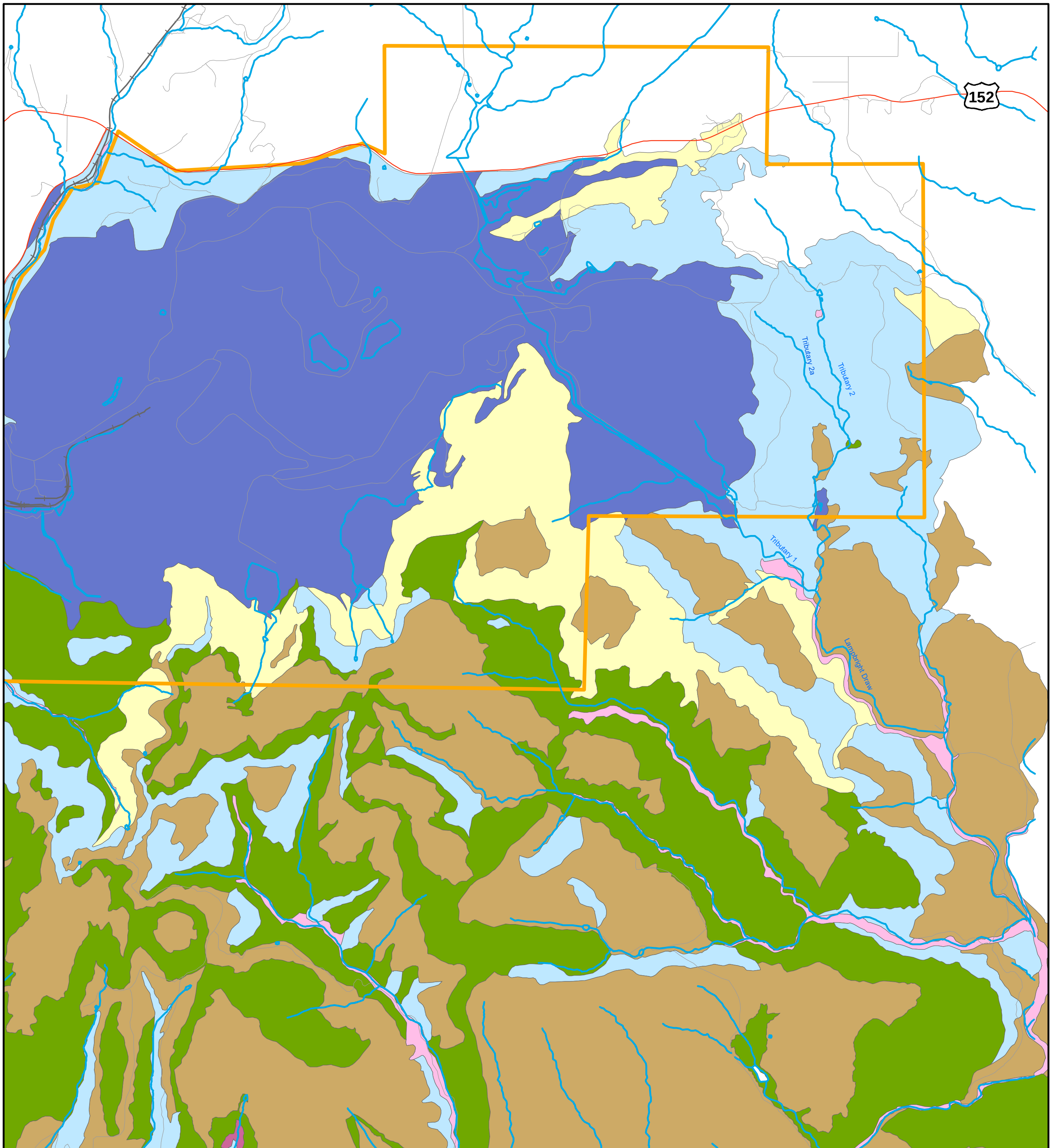
Chino Mines AOC
Lampbright IU Ecological Risk Assessment

PRJ: 010-003

Date: Feb 20, 2018

FOR: JMA

FORMATION ENVIRONMENTAL



Legend

Stream or River		Mine Facilities/Urban	
Road		Pondrosa Pine-Oak Forest Alliance	
Railroad		Alligator Juniper-Oak Woodland Alliance	
Highways		Mountain Mahogany Shrubland Alliance	
AOC Boundary		Mixed-Grama Herbacious Alliance	
Fluvial Forest and Shrubland Alliance		Alligator Juniper-Oak/Grama Woodland Alliance	
Mesquite/Mixed Grama Shrubland Alliance			

N

0 2,000 4,000

Feet

Chino Mines AOC
Lampbright IU Ecological Risk Assessment

Figure 1.1-2

LAMPBRIGHT INVESTIGATION UNIT VEGETATION TYPES

DATE: Feb 20, 2018

BY: FSR FOR: JMA

FORMATION ENVIRONMENTAL

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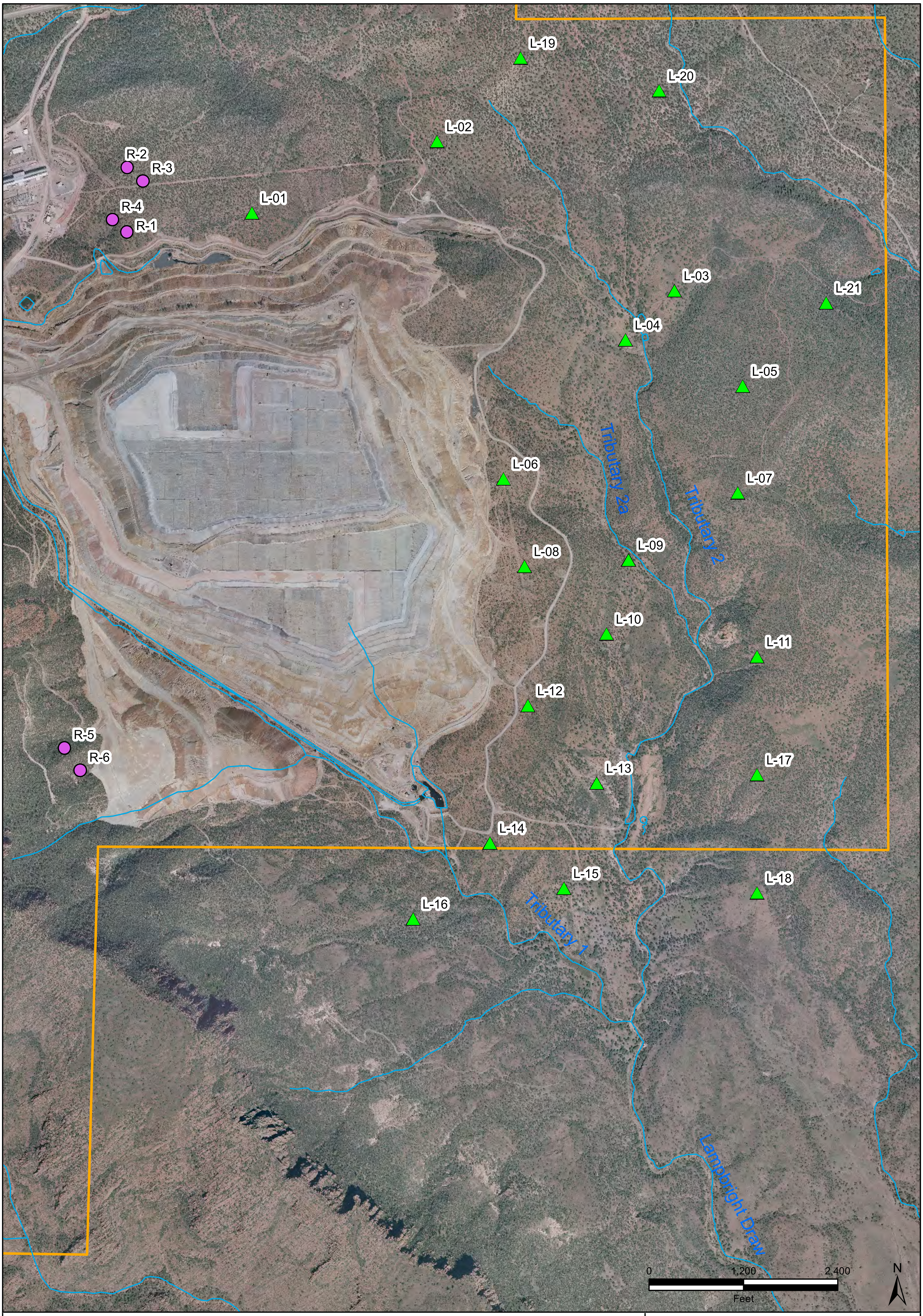

Legend

- Soil Reference Locations
- Soil Site Locations
- Drainage
- Road
- AOC Boundary

Chino Mines AOC
Lampbright IU Ecological Risk Assessment

Figure 1.1-3

LAMPBRIGHT RI SOIL SAMPLE LOCATIONS

DATE: Feb 20, 2018	
BY: FSR	FOR: JMA

FORMATION ENVIRONMENTAL

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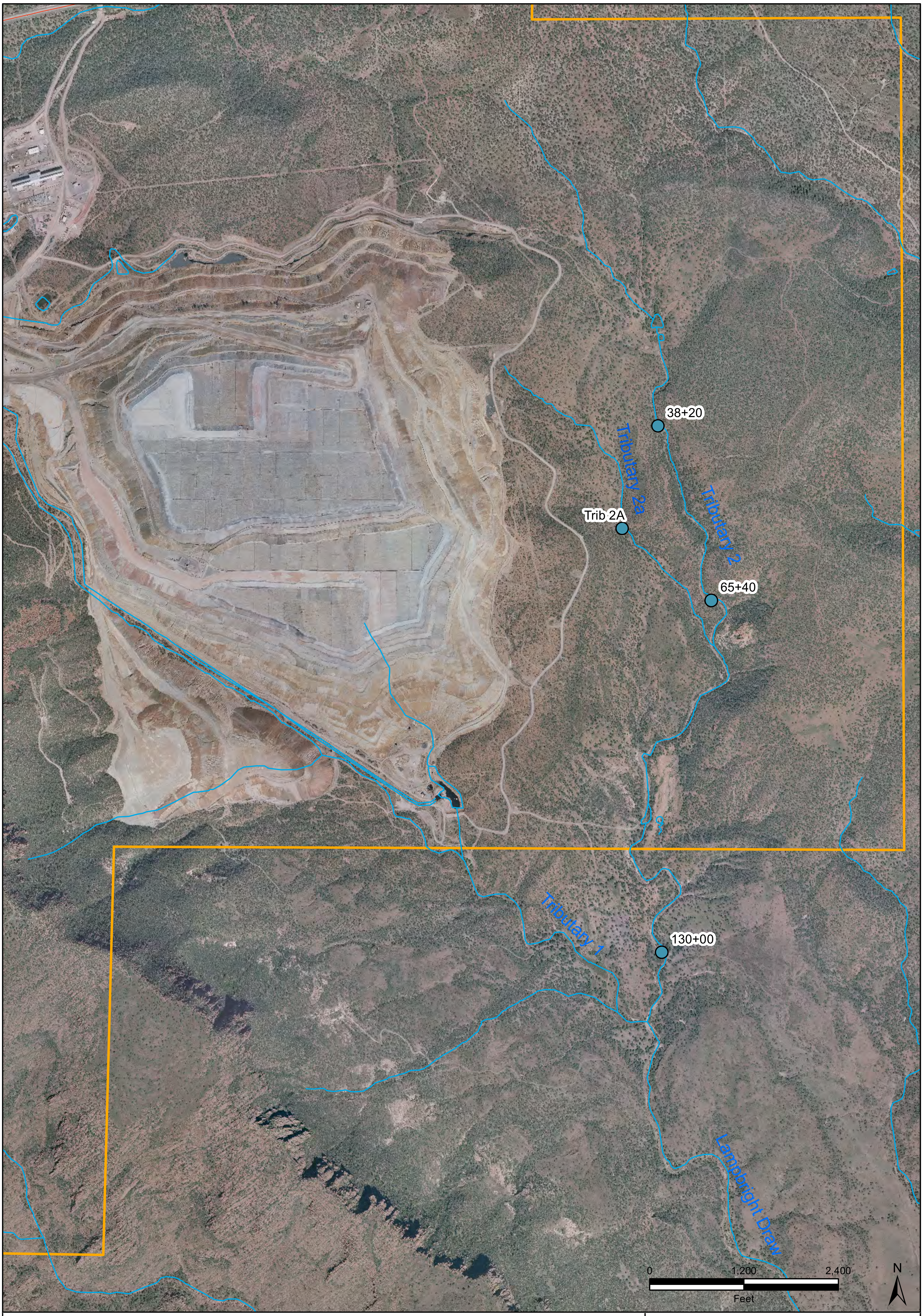

Legend

- Sample Location
- Railroad
- Drainage
- AOC Boundary
- Road

Chino Mines AOC
Lampbright IU Ecological Risk Assessment

Figure 1.1-4

LAMPBRIGHT RI SEDIMENT AND SURFACE WATER SAMPLE LOCATIONS

DATE: Feb 20, 2018	FORMATION ENVIRONMENTAL
BY: FSR	FOR: JMA

S:\GIS\arcprj\2010054\pf\LBIU\Fig114_SED_Locs.mxd

Legend

- pCu^{2+}< PEL
- pCu^{2+} >PEL < DEL
- pCu^{2+} within the DEL Range
- pCu^{2+}> DEL

Drainage

Road

AOC Boundary

Chino Mines AOC
Lampbright IU Ecological Risk Assessment

Figure 2.2-1

ESTIMATED pCu^{2+} IN LIU RI SHALLOW SOIL SAMPLE LOCATIONS COMPARED TO POTENTIALLY PHYTOTOXIC LEVELS

DATE: Feb 20, 2018	FORMATION ENVIRONMENTAL
BY: FSR	FOR: JMA

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Legend

- Cu < AVIAN RBC (1,114 mg/kg)
- Cu > RBC;< S/TSIU preFS RAC
- Cu > S/TSIU preFS RAC (1,600 mg/kg)
- Drainage
- Road
- AOC Boundary

Chino Mines AOC
Lampbright IU Ecological Risk Assessment

Figure 3.2-1

TOTAL COPPER IN LIU RI SHALLOW SOIL SAMPLES COMPARED TO AVIAN RBC'S

DATE: Feb 20, 2018

BY: FSR | FOR: JMA

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2\010054\plt\LBIU\Fig321_TotalCu.mxd

Legend

Investigation

- ERI
- LIU RI
- SITEWIDE ABATEMENT
- Drainage
- Road
- AOC Boundary

Note: Sample Locations with a * are approximate
The following points from the Sitewide Abatement
Report are not posted: LBT-07, LBT-08, LBT-09
LBT-12, LBT-13, LBT-14, LBT-15, LBT-17

Chino Mines AOC
Lampbright IU Ecological Risk Assessment

Figure 4.1-1

SURFACE WATER SAMPLING LOCATIONS EVALUATED IN THE ERA

DATE: Feb 20, 2018
BY: FSR
FOR: JMA

FORMATION ENVIRONMENTAL

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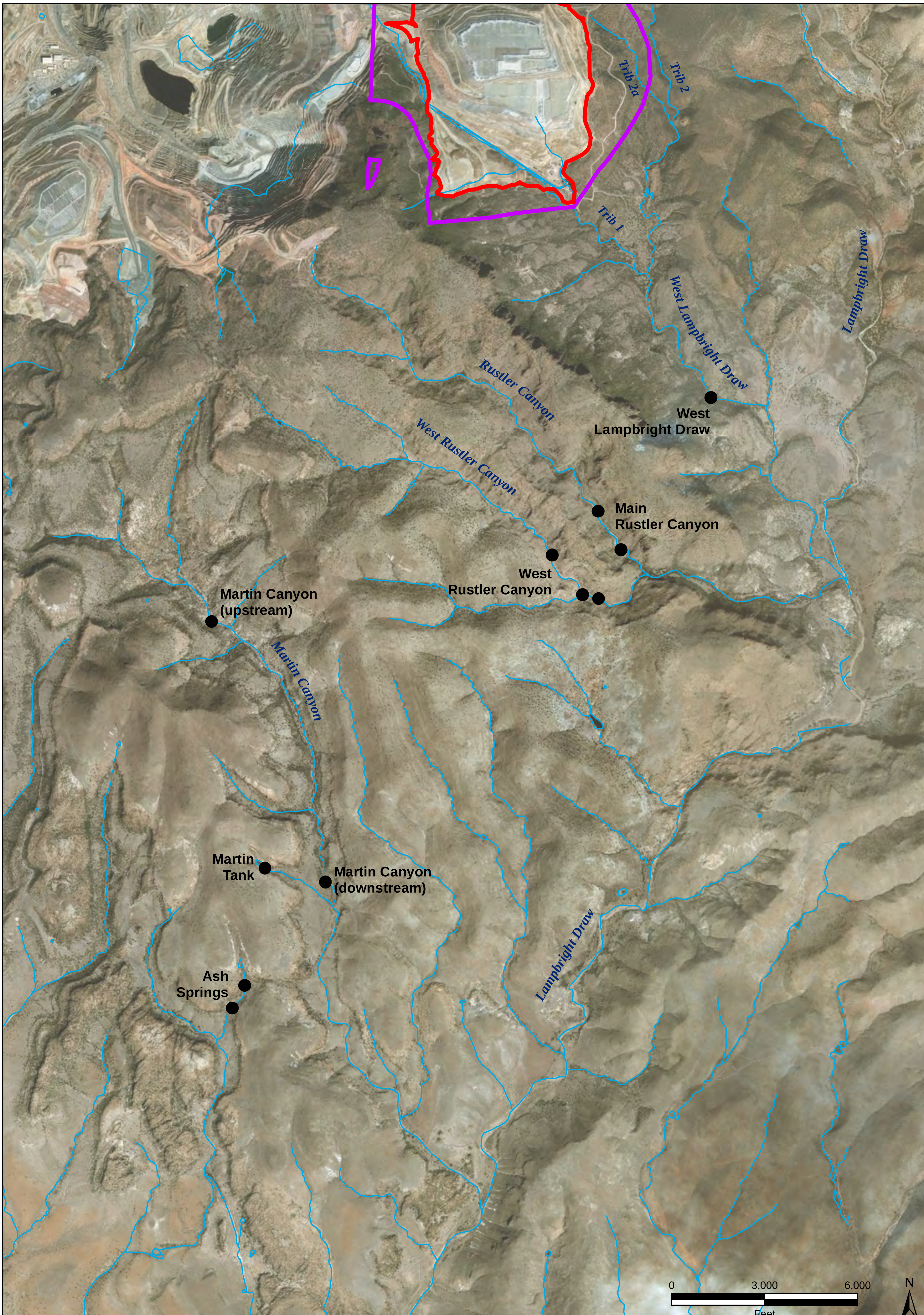


Legend

- Historical Chiricahua Leopard Frog Surveyed Populations
- Drainage
- Road
- DP-376 Boundary
- MMD Design Limit Boundary; MMD Design

Source: Chino Property Composite Map of Annual NMGF Chiricahua Leopard Frog Surveys (1997-2010)

CHINO MINES AOC
LAMPBRIGHT IU ECOLOGICAL RISK ASSESSMENT

FIGURE 4.1-2

HISTORIC CHIRICAHUA LEOPARD FROG POPULATIONS IN THE LAMPBRIGHT DRAINAGE

DATE: FEB 19, 2018

BY: CRL

FOR: JMA

FORMATION
ENVIRONMENTAL

S:\GIS\arcprj\2010054\plt\LBIU\Fig412_HistChiriLeopFrog.mxd

Legend

Investigation

- BRI
- ERI
- LIU RI
- CORRECTIVE ACTION
- SITEWIDE ABATEMENT

Drainage

Road

AOC Boundary

Chino Mines AOC
Lampbright IU Ecological Risk Assessment

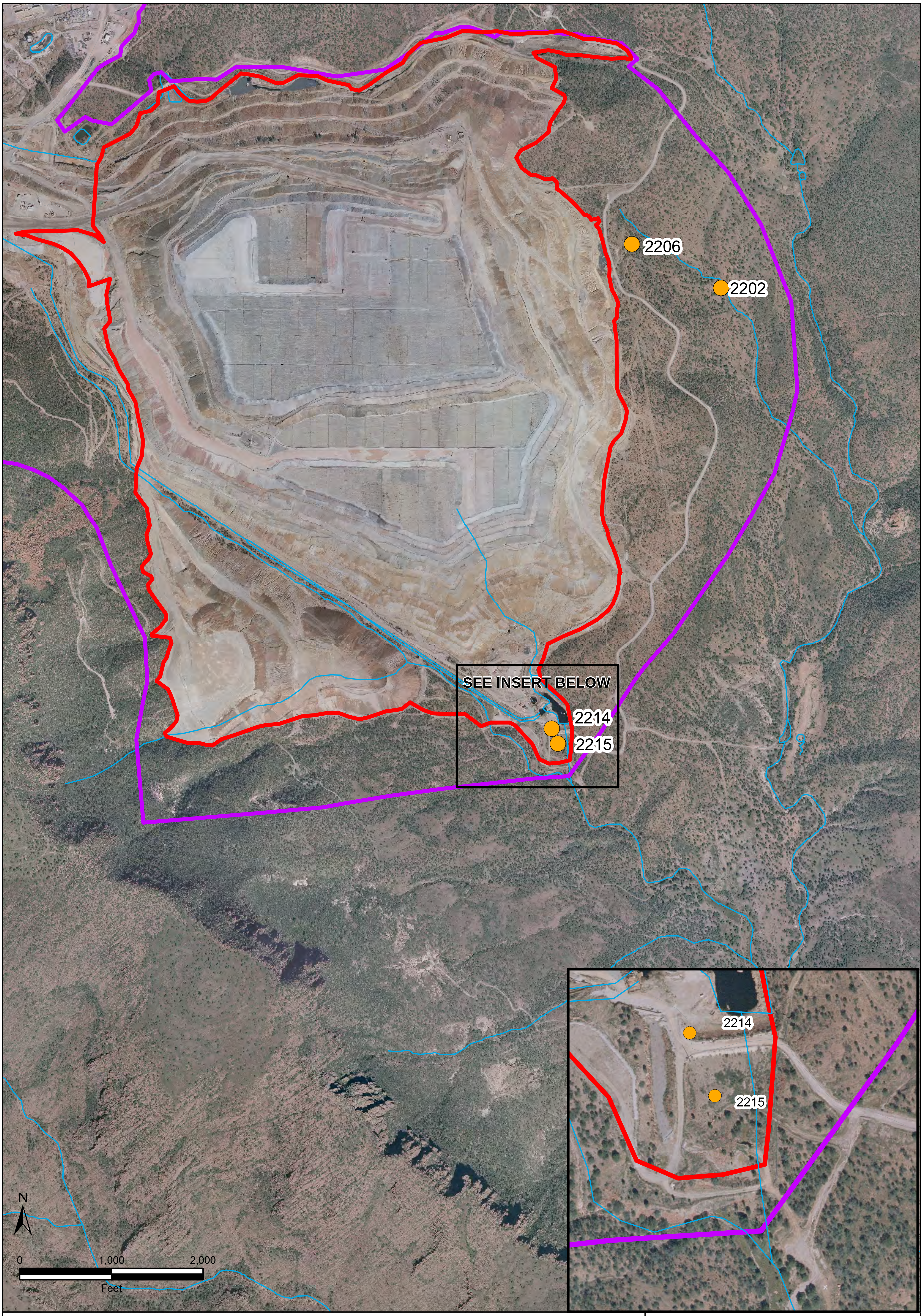
Figure 4.2-1

SEDIMENT SAMPLING LOCATIONS EVALUATED IN THE ERA

DATE: Feb 20, 2018	
BY: FSR	FOR: JMA

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2\010054\plt\LBIU\Fig421_SED_SAMP_LOCS_Eval_ERA.mxd



Legend

- Sediment Sample Location (CMC 1995)
- DP-376 Boundary
- MMD Design Limit Boundary; MMD Design
- Drainage
- Road

Chino Mines AOC
Lampbright IU Ecological Risk Assessment

Figure 4.2-2

ERA SEDIMENT SAMPLES IN RELATION TO REGULATORY BOUNDARIES

DATE: Feb 20, 2018	
BY: EEB	FOR: JMA

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2\010054\plt\LBIU\Fig422_Bound_SED_rev.mxd

APPENDIX A

Appendix A-1
Shallow Soil Data Collected during the Remedial Investigation
Lampbright Investigation Unit

Sample Location	Type	Date	Aluminum	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium
L-01	Site	2010	8320	3.4	76.2	0.43 J	4.3	0.59	2850	15	10.2	253	22600	38.8	1460
L-02	Site	2010	21300	7.1	90.7	1.1	6.8	0.57	59700	46.1	8.6	108	25200	13.3	5000
L-03	Site	2010	23800	3.7	234	0.99	1.9	0.72	4110	28.7	10.8	167	26000	25.5	2890
L-04	Site	2010	19500	6.9	183	1.5	1.6	0.54	3570	17.5	6.7	75.1	25300	19.8	1820
L-05	Site	2010	10900	9.4	80.2	0.84	4.6	0.76	2350	28.4	9	152	25100	107	1310
L-06	Site	2010	13800	1.3	112	0.87	0.86	0.32	1730	5.9	10.1	118	18200	15.1	1850
L-07	Site	2010	12100	5.7	120	0.75	4.7	0.9	2620	17.3	10.7	246	16500	37.1	1610
L-08	Site	2010	15100	2.1	111	0.57	0.81 U	0.59	2280	18.6	13	319	22600	29.8	5630
L-09	Site	2010	16800	3.2	216	0.92	3.4	0.28 J	23000	11.9	8.6	25.8	25500	16.9	2590
L-10	Site	2010	12200	3.5	110	0.87	2.9	0.33 J	44800	7.7	9.6	65.9	27400	15	1720
L-11	Site	2010	10700	6.3	94.5	0.78	4.7	0.71	2030	21.7	8.2	95.2	23900	88.5	1160
L-12	Site	2010	14800	1.7	99.3	0.63	0.81 U	0.42 J	3460	15.3	9.4	102	21600	13.6	4950
L-13	Site	2010	23500	1.4	375	0.65	0.81 U	0.9	8790	18.9	9	85.4	23300	21.3	8940
L-14	Site	2010	14600	1.1	65.1	0.54	0.81 U	0.68	5330	16.7	11.1	106	20600	35.9	5650
L-15	Site	2010	16400	1.8	136	0.67	0.81 U	0.6	4310	11.4	8.4	133	19800	18.9	4290
L-16	Site	2010	12000	1.2	99	0.75	1.4	0.53	2360	11.9	6.5	61.4	15400	13.1	2370
L-17	Site	2010	13100	7	110	0.74	4	0.66	2670	20.2	9.8	114	17600	47.8	1260
L-18	Site	2010	28900	1.3	566	1	4.2	1.7	6480	4.4	8.7	80.9	19700	14.4	5020
L-19	Site	2010	25800	8.4	125	1.3	12.5	0.92	88200	46.7	8.4	76	27500	17.2	4680
L-20	Site	2010	29600	35.9	127	1.3	10.9	1	45600	63	7.5	63.3	23200	14.4	4990
L-21	Site	2010	9440	4	127	1	4.1	0.81	2300	12	8.8	100	16500	80.4	1130
R-1	Reference	2010	14800	8.5	131	1.4	3.5	0.99	2050	17	21.3	322	32100	28	5300
R-2	Reference	2010	10100	4.7	120	0.53	3.3	0.74	2480	15.5	11.5	506	18600	35.1	1640
R-3	Reference	2010	9910	5.6	93	0.62 J	3.6	0.71	2240	18.4	12.1	514	21500	32.8	1480
R-4	Reference	2010	7260	5.4	61.8	0.45 J	3.2	0.53	1300	14.2	10.7	308	21200	29.4	1390
R-5	Reference	2010	9920	0.81	78.7	0.68	1.4	0.33	2220	4.3	3.8	57.3	10200	11.2	2340
R-6	Reference	2010	11300	0.72	77.7	0.74	1.9	0.45	2530	4.8	4.1	35.2	9330	10.5	2440

Notes:

All samples were collected 0-1 inch bgs

All results in mg/kg = milligram per kilogram

U = below detection limit

J = concentration was estimated between the RL and MDL

RL = Reporting Limit

MDL = Method Detection Limit

Appendix A-1
Shallow Soil Data Collected during the Remedial Investigation
Lampbright Investigation Unit

Sample Location	Type	Date	Manganese	Molybdenum	Nickel	Potassium	Selenium	Sodium	Sulfate	Vanadium	Zinc	pH
L-01	Site	2010	684	6.9	9	1230	0.9	29.1	140	27	85.4	6.22
L-02	Site	2010	432	2.2	33.8	2130	0.47	57.7	24.4	47.8	89.5	7.31
L-03	Site	2010	517	4.9	18.1	2160	0.33 J	112	93.8	61.1	91.1	5.53
L-04	Site	2010	323	2.2	14.8	2180	0.6 J	45.6	61.1	34.4	107	6.6
L-05	Site	2010	759	4.3	8.8	1340	0.44 U	36.7	40.7	64.6	76.1	5.91
L-06	Site	2010	431	2.3	8.1	4110	0.38	47.8	291	14.7	71.6	4.62
L-07	Site	2010	760	5.5	9.3	1490	0.58 U	35.8	84.4	36.9	96.1	5.49
L-08	Site	2010	673	8.9	10.9	1570	0.3 UJ	61.9	1180	39.9	125	4.17
L-09	Site	2010	371	0.89	13.1	3420	0.61 J	60	35.9	29.9	65.2	7.6
L-10	Site	2010	331	1.7	13.8	2680	0.56 J	69.3	161	23.4	63.4	7.46
L-11	Site	2010	837	2.3	9.3	1170	0.42	22.1	15.9	52.3	118	6.19
L-12	Site	2010	542	2.4	8.4	1220 J	0.1 UJ	78.2	285	41	79	5.03
L-13	Site	2010	738	2.2	11.5	1690	0.1 UJ	154	36.5	37.2	90.2	6.16
L-14	Site	2010	570	1.7	10.9	1250	0.2 UJ	56.9	74.6	42.9	62.3	5.28
L-15	Site	2010	552	2.6	7.8	1790	0.49	56.2	69.3	33.5	89.1	5.73
L-16	Site	2010	476	1.4	6.8	1650	0.3	106	13.9	36	33	6.03
L-17	Site	2010	709	2.7 J	9.2	1450	0.6 U	23.9	30.2	41	56	6.03
L-18	Site	2010	548	0.92 J	4.5	2440	0.3 U	136	48.8	37.2	61.7	6
L-19	Site	2010	340	0.98 J	35.4	2740	0.3 UJ	92.6	21.1	43.4	69.6	7.58
L-20	Site	2010	637	1.3 J	39.8	3000	0.3 UJ	53.1	17.2	59.2	99.7	7.23
L-21	Site	2010	841	2.9 J	9.3	1020	0.3 U	27.9	35.4	29.4	118	5.86
R-1	Reference	2010	1650	9.6	18.4	1550	0.95	33.4	200	28.8	878	5.16
R-2	Reference	2010	868	15.1	8.7	1370	1.2	40.1	65.3	28.4	97.4	5.06
R-3	Reference	2010	875	14	8.9	1490	0.85	40.9	56.3	38.9	94.2	5.13
R-4	Reference	2010	535	9.2	7.5	1070	0.73	33.2	138	25.8	89.9	4.69
R-5	Reference	2010	247	1.5	3.4	1420	0.15	91.5	40.2	19.6	24.1	5.25
R-6	Reference	2010	249	0.8	3.3	1680	0.53	92.6	30.9	18	23.6	5.64

Notes:

All samples were collected 0-1 inch bgs

All results in mg/kg = milligram per kilogram

U = below detection limit

J = concentration was estimated between the RL and MDL

RL = Reporting Limit

MDL = Method Detection Limit

Appendix A-2A
Surface Sediment Samples Collected for the Remedial Investigation
Lampbright Investigation Unit

Location	TRIB 2A	38+20	65+40	130+00	130+00
Field Sample ID	TRIB 2A	38+20	65+40	130+00	156+50
Sample Date	9/23/2010	9/23/2010	9/23/2010	9/23/2010	9/23/2010
Type	Site	Site	Site	Site	Dup
Trib	2A	2	2	2	2
Aluminum	9570	14100	18500	10700	10600
Arsenic	3.2	5.7	6.6	3.3	3.1
Barium	141 J	190 J	239 J	112 J	103 J
Beryllium	0.66	0.87	1.1	0.62	0.61
Boron	0.81 J	2.1	2.3	0.81	0.81 U
Cadmium	0.17 J	0.49 J	0.52 J	0.36 J	0.35 J
Calcium	4520	13100	16100	7250	8490
Chromium	9.1	16.1	21.6	10.4	9.8
Cobalt	11.7	9.2	10.7	8.3	7.8
Copper	38.4	71.5	92.3	77.9	89.3
Iron	19200	19700	23100	22800	20300
Lead	17 J	23.4 J	28.8 J	19.1 J	19.4 J
Magnesium	3460	3110	3960	4560	4650
Manganese	545	623	716	529	479
Molybdenum	4.2	1.8	2.4	4.9	1.9
Nickel	9.1	13.2	16.3	9.7	9.4
pH	7.72	7.91	7.66	8.34	8.38
Potassium	1790 J	2160 J	2550 J	1520 J	1430 J
Selenium	0.5 U	0.59 U	0.5 U	0.5 U	0.5 U
Sodium	54.2	70.3	81.2	61.4	62.1
Sulfate, SO4	53.3	270	695 D	74.3	52.4
Vanadium	23.4	25.3	31	31.3	27.3
Zinc	84	136	162	124	109

Notes:

All results in mg/kg = milligram per kilogram, except for pH, presented in standard units.

U = Below detection limit

J = Concentration estimated between RL and MDL

RL = Reporting Limit

MDL = Method Detection Limit

Appendix A-2B
Sediment Data Collected for the Remedial Investigation Report
Lampbright Investigation Unit

Field Sample ID (inches bgs)	Sample Date	Type	Trib	Metals Analysis																			
				Aluminum, total	Arsenic, total	Barium, total	Cadmium, total	Calcium, total	Chromium, total	Cobalt, total	Copper, total	Iron, total	Lead, total	Magnesium, total	Manganese, total	Molybdenum, total	Nickel, total	Potassium, total	Selenium, total	Silica, total	Sodium, total	Vanadium, total	Zinc, total
LAMPBRIGHT TRIB-1-1(0-0.5)	12/09/10	Site	1	14600	2.6	101	0.27 B	9900	12.5	8.39	51.5	19900	10.7	7000	531	0.6 B	10.2	1100	0.14	6200	<800 U	37.9	58
LAMPBRIGHT TRIB-1-1(1-1.5)	12/09/10	Site	1	12200	2.9	112	0.33	3800	6	6.63	27.4	18000	17.1	4100	546	0.5 B	5.6	2300	0.14	5700	<800 U	31.3	86
LAMPBRIGHT TRIB-1-1(2-2.5)	12/09/10	Site	1	12700	3.1	142	0.41	4100	6.5	7.51	44.1	18800	22.4	4600	666	0.5 B	6.5	2100	0.15	4600	<800 U	29.8	94
LAMPBRIGHT TRIB-1-2(0-0.5)	12/09/10	Site	1	14700	2.7	106	0.35	7700	9	8.87	44	21000	11	6200	584	0.5 B	8.3	1700	0.11	6200	<800 U	34.9	81
LAMPBRIGHT TRIB-1-2(1.5-2)	12/09/10	Site	1	15500	2.7	164	0.39	10000	8.8	11.6	129	25400	15.6	6500	852	0.4 B	9.6	1900	0.15	4400	<800 U	24	141

Notes:

mg/kg = milligram per kilogram

U = Validation qualifier indicating result was qualified or reported as non-detect.

B = Laboratory identifier for estimated value.

Appendix A-2C
Sediment Data, Tributary 2
Lampbright Investigation Unit

Location	Sample Date	Type	Trib	Al	Ag	As	Se	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	V	Zn	Laboratory Paste pH	SO4
T2S7	4/28/2008	Site	2	8,100	<0.50	4.89	0.312	<4.0	194	0.945	20,500	0.51	24.9	7.22	234	24,100	<0.033	1,810	2,520	1,420	1.04	66.3	17.9	17.2	14.8	185	7.31	855
T2S8	4/28/2008	Site	2	10,300	<0.50	18.5	0.426	<4.0	121	1.03	25,500	0.69	21.1	12.6	359	22,300	<0.033	1,540	3,310	846	1.89	88.1	19.4	26	23.3	260	7.43	1,320
T2S9	4/28/2008	Site	2	10,700	<0.50	4.14	0.301	<4.0	124	0.889	10,200	0.6	14.6	11.2	168	23,200	<0.033	1,670	3,420	656	1.75	68.8	15.6	32	23.8	260	7.3	594
T2S10	4/23/2008	Site	2	8,860	<0.50	5.43	0.442	<4.0	115	0.871	10,800	1.51	15.1	11	207	20,300	0.06	1,330	3,120	566	1.91	124	15.9	62.5	23	400	7.29	929
T2S11	4/23/2008	Site	2	11,600	<0.50	5.99	0.339	<4.0	149	1.2	18,700	0.83	14.5	24.8	201	29,200	<0.033	1,420	3,410	754	1.52	100	21.7	24.2	40.7	295	7.43	810
T2S12	4/23/2008	Site	2	8,910	<0.50	10.9	0.342	<4.0	142	0.876	11,100	0.82	12.9	14.8	166	23,500	<0.033	1,120	2,900	629	1.31	167	18.5	31.1	29.7	291	7.59	733
T2S6	4/23/2008	Site	2	9,550	<0.50	6.13	0.319	<4.0	134	0.959	8,720	0.67	11.7	17	189	26,200	<0.033	1,300	2,890	610	1.86	68	17.2	76.6	37.7	281	7.23	656
T2S5	4/23/2008	Site	2	9,230	<0.50	5.07	0.265	<4.0	121	0.878	7,960	0.32	10.4	12.4	207	22,500	0.045	1,560	2,680	564	2.22	61.4	13.3	59.5	27.1	181	6.9	629
T2S4	4/23/2008	Site	2	8,140	<0.50	3.96	0.213	<4.0	102	0.663	17,100	<0.20	8.78	9.09	98.2	21,300	<0.033	1,620	3,110	497	2.63	59.3	11.7	27.2	22.9	105	7.37	376
T2S3	4/23/2008	Site	2	13,300	<0.50	4.6	0.361	<4.0	159	0.834	14,100	0.43	8.18	20.7	97.2	18,600	<0.033	2,000	3,690	917	2.64	93.8	16	27.2	27.1	110	7.25	373
T2S2	4/23/2008	Site	2	12,000	<0.50	1.64	<0.200	<4.0	547	0.536	9,420	0.24	11.4	7.99	118	15,900	<0.033	1,090	5,420	1,270	3.45	196	9.04	12.8	23.6	98.1	6.99	458
T2S1	4/23/2008	Site	2	8,460	<0.50	2.39	<0.200	<4.0	69.5	0.599	4,500	<0.20	8.86	8.6	125	20,700	<0.033	1,150	4,240	509	2.48	62.5	10.5	20.4	23.4	118	7.6	69
T2S7	7/23/2008	Site	2	6,270	<0.50	5.38	0.34	<4.0	136	0.669	10,500	0.36	9.12	7.9	56.1	17,400	<0.033	1,100	2,250	770	1.2	<50	10.3	20.6	14.2	110	7.31	313
T2S8	7/23/2008	Site	2	5,380	<0.50	3.35	<0.200	<4.0	73.6	0.519	8,870	0.36	7.67	7.7	71.7	11,700	<0.033	971	1,590	456	1.57	<50	8.2	17.6	12.1	95.6	7.25	492
T2S9	7/23/2008	Site	2	8,070	<0.50	3.21	0.231	<4.0	98.9	0.797	18,000	0.65	9.27	9.2	143	19,000	<0.033	1,220	2,360	460	1.73	65.6	11.4	13.7	18.3	150	7.13	3,140
T2S10	7/22/2008	Site	2	6,670	<0.50	3.86	0.299	<4.0	68	0.765	6,560	0.52	8.53	9.3	199	16,200	<0.033	922	1,680	337	1.46	<50	11.2	45.3	18.5	177	7.15	977
T2S11	7/22/2008	Site	2	7,690	<0.50	3.05	<0.200	<4.0	89	0.926	6,750	0.46	7.78	15.5	94	16,300	<0.033	1,110	1,830	405	1.39	<50	11.8	19.4	21.8	151	7.38	247
T2S12	7/22/2008	Site	2	5,240	<0.50	3.56	0.333	<4.0	62.4	0.8	6,760	0.41	7.66	13	126	19,300	<0.033	764	1,880	405	1.22	<50	10.4	38.6	22.4	138	7.34	416
T2S6	7/22/2008	Site	2	6,860	<0.50	4.54	<0.200	<4.0	101	0.743	6,260	0.59	9.25	12.6	140	18,100	<0.033	980	1,770	476	2	<50	11.5	51	25.5	168	7.1	397
T2S5	7/22/2008	Site	2	5,820	<0.50	5.8	0.284	<4.0	54.8	0.76	9,410	0.35	7.01	7.3	123	17,500	<0.033	832	2,660	425	1.42	<50	8.9	26.7	20.8	121	7.35	125
T2S4	7/22/2008	Site	2	7,870	<0.50	3.8	0.22	<4.0	121	0.882	4,710	0.54	8.13	7.8	91.9	22,700	<0.033	851	1,920	411	1.85	<50	12.3	44.7	24	168	7.18	461
T2S3	7/21/2008	Site	2	5,960	<0.50	3.15	<0.200	<4.0	54.4	0.608	5,780	0.43	8.26	7	103	16,800	<0.033	805	2,790	430	1.39	<50	9	34.1	17.9	111	7.41	83
T2S2	7/21/2008	Site	2	7,470	<0.50	2.1	<0.200	<4.0	213	0.478	6,470	0.29	8.61	5.2	99	12,300	<0.033	763	4,080	547	1.39	80.6	7.6	15.6	16.1	88.8	7.24	385
T2S1	7/21/2008	Site	2	5,650	<0.50	2.12	<0.200	<4.0	65.5	0.477	5,430	0.32	7.46	6.5	94.1	14,600	<0.033	795	2,870	457	1.95	<50	8.1	21.4	18.6	80	6.98	370
T2S7	5/5/2009	Site	2	---	---	---	---	---	---	---	33,200	---	---	---	72.6	16,600	---	1,440	2,700	910	---	50.1	---	---	---	108	7.74	581
T2S10	5/5/2009	Site	2	---	---	---	---	---	---	---	7,120	---	---	---	126	17,800	---	1,370	2,260	561	---	105	---	---	---	202	7.34	1,070
T2S3	5/5/2009	Site	2	---	---	---	---	---	---	---	14,300	---	---	---	76.1	19,100	---	1,010	2,850	529	---	60.4	---	---	---	128	7.72	368
T2S1	5/6/2009	Site	2	---	---	---	---	---	---	---	6,930	---	---	---	79	19,500	---	1,210	3,960	588	---	58.1	---	---	---	116	8.04	133
T2S7	9/21/2009	Site	2	---	---	---	---	---	---	---	13,600	---	---	---	50.5	14,600	---	1,030	2,690	1,120	---	<50	---	---	---	138	7.54	90.1
T2S10	9/17/2009	Site	2	---	---	---	---	---	---	---	9,110	---	---	---	107	13,300	---	1,060	1,900	520	---	<50	---	---	---	171	7.19	328
T2S3	9/17/2009	Site	2	---	---	---	---	---	---	---	6,000	---	---	---	70.4	17,000	---	851	2,680	510	---	<50	---	---	---	112	7.63	75.3
T2S1	9/16/2009	Site	2	---	---	---	---	---	---	---	4,550	---	---	---	52.1	14,600	---	877	3,100	412	---	<50	---	---	---	88.9	7.95	37
T2S7	9/21/2010	Site	2	---	---	---	---	---	---	---	8,260	---	---	---	37.4[J]	18,900	---	1,930	2,450	603	---	<50	---	---	---	126	7.55	177
T2S10	9/21/2010	Site	2	---	---	---	---	---	---	---	6,010	---	---	---	84.8[J]	12,500	---	1,390	1,920	525	---	<50	---	---	---	210	6.76	413
T2S3	9/21/2010	Site	2	---	---	---	---	---	---	---	6,370	---	---	---	90.2[J]	15,500	---	1,270	2,890	361	---	<50	---	---	---	107	7.53	136
T2S1	9/21/2010	Site	2	---	---	---	---	---	---	---	11,300	---	---	---	63.5[J]	17,000	---	1,170	5,370	656	---	50.1	---	---	---	92.9	8.01	25.4

Notes:

Data collected for DP-376 - Correct Action Monitoring program

all results in mg/kg = milligrams per kilogram except for pH shown in standard units

--- = not analyzed

< = not detected. Detection limit shown.

Appendix A-2D
Sediment Data, Tributary 1
Lampbright Investigation Unit

Location	Field Sample ID	SampDate	Type	Trib	As	Cr	Co	Cu	Pb	Mo	Ni	St	V	Zn
2408	2408	5/5/2009	Site	1	<20	61	10	50	19	<10	<10	493	78	78
2409	2409	5/5/2009	Site	1	<20	86	11	68	18	<10	<10	498	81	78
2410	2410	5/6/2009	Site	1	<20	79	14	72	22	<10	<10	352	73	120
376-05-04	376-05-04	5/5/2009	Site	1	<20	86	18	296	25	<10	10	266	76	137
376-05-05	376-05-05	5/6/2009	Site	1	<20	41	10	99	27	<10	<10	464	74	102
LBT1-BF1	376-05-0X	5/5/2009	Dup	1	<20	64	13	64	24	<10	<10	437	81	103
376-96-04	376-96-04	5/6/2009	Site	1	<20	59	14	76	24	<10	<10	399	85	108
LBT1-BF1	LBT1-BF1	5/5/2009	Site	1	<20	55	13	147	37	<10	<10	447	83	103

Notes:

Data from Site Wide Abatement program

all results in mg/kg = milligrams per kilogram

< = not detected. Detection limit shown.

Appendix A-2E
Sediment Data Presented in the Ecological Remedial Investigation Report
Lampbright Investigation Unit

Location	Field ID	Sample Date	Type	Trib	Depth (in bgs)	Analyte	Result	Lab Qual
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Aluminum	7860	
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Aluminum	8970	
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Aluminum	7800	
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Antimony		R
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Antimony		R
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Antimony		R
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Arsenic	2.1	
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Arsenic	1.7	
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Arsenic	0.6	U
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Barium	104	
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Barium	135	
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Barium	167	
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Boron	1	U
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Boron	1.7	
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Boron	1	U
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Cadmium	0.52	
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Cadmium	0.57	
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Cadmium	0.5	
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Calcium	2970	
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Calcium	2080	
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Calcium	2960	
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Chromium	6.1	J
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Chromium	5.9	J
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Chromium	5.1	U
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Cobalt	7.9	
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Cobalt	7.4	
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Copper	59.7	
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Copper	57.4	
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Copper	54.1	
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Iron	10600	
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Iron	13200	
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Iron	11300	
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Lead	23.3	J
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Lead	30.2	J
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Lead	30.6	J
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Manganese	464	J
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Manganese	564	J
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Manganese	498	
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Mercury	0.02	UJ
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Mercury	0.04	J
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Mercury	0.02	UJ
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Molybdenum	1.4	
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Molybdenum	1.2	
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Nickel	7.6	
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Nickel	5	
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Nickel	3.8	
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Organic Matter	1.22	
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	pH	5.4	
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	pH	6.3	
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	pH	6.9	
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Phosphorus	0.053	
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Selenium	0.27	
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Selenium	0.1	U
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Selenium	0.23	
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Thallium	0.13	
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Thallium	0.1	
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Thallium	0.08	
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Vanadium	16.3	J
ERA-34	ERA34-1	9/9/1999	Site	1	0-6	Zinc	71.4	
ERA-34	ERA34-2	9/9/1999	Site	1	0-6	Zinc	64.3	
ERA-34	ERA34-3	9/9/1999	Site	1	0-6	Zinc	58.8	
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Aluminum	5530	
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Antimony		R
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Arsenic	1.4	
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Barium	116	
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Boron	1	

Appendix A-2E
Sediment Data Presented in the Ecological Remedial Investigation Report
Lampbright Investigation Unit

Location	Field ID	Sample Date	Type	Trib	Depth (in bgs)	Analyte	Result	Lab Qual
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Cadmium	0.3	
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Calcium	2230	
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Chromium	3.9	J
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Cobalt	5.6	
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Copper	52.6	
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Iron	9160	
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Lead	30.9	J
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Manganese	653	J
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Mercury	0.02	UJ
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Molybdenum	1.6	
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Nickel	3.1	
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	pH	7	
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Selenium	0.1	U
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Thallium	0.08	
ERA-34	ERA34-3	9/9/1999	Site	1	8-14	Zinc	50.2	

Notes:
All results in mg/kg
U = Validation qualifier indicating result was qualified or reported as non-detect.
UJ = Validation qualifier indicating that result was reported as non-detect and that the associated reporting limit is considered to be an estimated quantity.
J = Validation qualifier indicating that the associated value is considered to be an estimated quantity.
R = Rejected the result due to a quality control issue.

Appendix A-2F
Sediment Data Presented in the Background Report
Lampbright Investigation Unit

Location	**2201**	**2202**	**2203**	**2206**	**2207**	**2207**	**2211**	**2214**	**2215**	**2216**	**2216**	**2218**	**2219**	**2220**	**2221**	**2222**	**2223**	**2224**
Field ID	**2201**	**2202**	**2203**	**2206**	**2207 [a]**	**2208 [a]**	**2211**	**2214**	**2215**	**2216 [a]**	**2217 [a]**	**2218**	**2219**	**2220**	**2221**	**2222**	**2223**	**2224**
Sample Date	1995	1995	1995	1995	1995	1995	1995	1995	1995	1995	1995	1995	1995	1995	1995	1995	1995	1995
Type	Site	Site	Site	Site	Site	Dup	Site	Site	Site	Site	Dup	Site	Site	Site	Site	Site	Site	Site
Trib	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1
Aluminum	NA	12,000 J	NA	9,440 J	NA	12,000 J	7,900	19,500	NA	14100	16900	NA	NA	5,750	5,110	NA	NA	8,190
Arsenic	NA	4.72	NA	4.6	NA	6.09	4.27 J	2.51 J	NA	2.41 J	1.12 J	NA	NA	1.41 J	1.54 J	NA	NA	1.05 J
Barium	NA	137 J	NA	88.5 J	NA	91.3 J	82.8	184	NA	143	143	NA	NA	111	52.6	NA	NA	81.1
Beryllium	NA	0.79	NA	0.59	NA	0.47	0.62	0.87	NA	0.86	0.9	NA	NA	0.4	0.3	NA	NA	0.33
Boron	NA	2.11 J	NA	1.2 UJ	NA	1.3 UJ	1.6	2.1	NA	1.2	2.6	NA	NA	1.2	1.2 U	NA	NA	1.4
Cadmium	NA	0.21 U	NA	0.2 U	NA	1.77	0.28	0.2 U	NA	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	NA	NA	0.2 U
Calcium	NA	7,630	NA	3,040	NA	5,350	4,150	7,320	NA	3330	3840	NA	NA	7,990	2,990	NA	NA	3,160
Chromium	NA	8.32	NA	4.96	NA	6.03	7.01	12.5	NA	8.57	9.23	NA	NA	4.91	4.17	NA	NA	6.77
Cobalt	11.2	11.7	13.6	12.9	8.9	6.75	11	22.4	13.5	9.85	10.1	6.24	6.96	5.33	6.13	8.1	7.24	7.03
Copper	129 J	183 J	46.9 J	164 J	75.2 J	133 J	125	721	260	138	143	37.8	58.4	32.9	30	30.2	52.1	46.2
Iron	NA	21,600 J	NA	14,500 J	NA	18,500 J	19,900	23,400	NA	15400	15500	NA	NA	9,660	10,500	NA	NA	12,300
Lead	NA	21.2	NA	21.7	NA	171	18.6	22.6	NA	14.5	9.7	NA	NA	14.6	12.6	NA	NA	10.1
Magnesium	NA	2,930 J	NA	1,590 J	NA	4,420 J	2,600	8,900	NA	3800	4200	NA	NA	2,260	2,780	NA	NA	2,850
Manganese	NA	440 J	NA	348 J	NA	560 J	514	1,050	NA	426	444	NA	NA	507	484	NA	NA	449
Mercury	NA	0.1 U	NA	0.1 U	NA	0.1	0.1 U	0.1 U	NA	0.1 U	0.1 U	NA	NA	0.1 U	0.1 U	NA	NA	0.1 U
Molybdenum	NA	1.19	NA	5.74	NA	0.64 U	2.41	10.4	NA	1.92	0.6 U	NA	NA	0.6 U	0.6 U	NA	NA	0.6 U
Nickel	NA	13.7	NA	8.35	NA	11.1	11.8	12.7	NA	8.1	5.4	NA	NA	2.1 U	2.2	NA	NA	3.3
Potassium	NA	2,230 J	NA	2,400 J	NA	2,140 J	1,560	1,590	NA	1610	1750	NA	NA	730	778	NA	NA	1,090
Selenium	NA	0.2	NA	0.2	NA	1.7	0.2	0.5	NA	0.3	0.3	NA	NA	0.1	0.1 U	NA	NA	0.1 U
Silver	NA	0.21 U	NA	0.2 U	NA	0.21	0.29	0.2 U	NA	0.2 U	0.26	NA	NA	0.28	0.2 U	NA	NA	0.31
Sodium	NA	145 J	NA	32.2 J	NA	497 J	77 J	701 J	NA	103 J	117 J	NA	NA	75 U	107 J	NA	NA	115 J
Vanadium	NA	17.9 J	NA	9.22 J	NA	14.7 J	17	25.1	NA	20.1	20.2	NA	NA	16.5	17.3	NA	NA	22.6
Zinc	NA	118	NA	89.8	NA	427	112	208	NA	72.5	76.8	NA	NA	45.6	50	NA	NA	59.6
Sulfate	375	2,300	765	327	298	17,300	246	40,300	2,550	519	815	175	60.6	14.3	104	31.4	101	30.9
pH	8.05 J	7.98 J	7.91 J	7.32	7.73	7.4	7.83 J	4.13 J	4.98 J	6.05 J	6.07 J	7.04 J	7.85 J	7.55 J	8.12 J	7.7 J	8.03 J	8.04 J

Notes:

all results in mg/kg except pH, shown in standard units.

U = Validation qualifier indicating result was qualified or reported as non-detect.

UJ = Validation qualifier indicating that result was reported as non-detect and that the associated reporting limit is considered to be an estimated quantity.

J = Validation qualifier indicating that the associated value is considered to be an estimated quantity.

NA = Not Analyzed

Sediment sample removed during Corrective Action

[a] Sample 2208 is a field duplicate of 2207

[b] Sample 2217 is a field duplicate of 2217

Appendix A-3
Surface Water Data Used in the Ecological Risk Assessment
Lampbright Investigation Unit

Tributary	Event	Location ID	Sample Type	Sample Date	Aluminum	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Selenium	Zinc
2A	AOC Sampling - Rainfall Pool Collection	Trib 2A-SW	Rainfall Pool	9/23/2010	0.017 U	0.00043 U	3.80E-05 J	0.0023	0.0052	1.90E-05 U	0.003	0.0006 J	0.0025 J
2	AOC Sampling - Rainfall Pool Collection	38+20-SW	Rainfall Pool	9/23/2010	0.017 U	0.00043 U	3.60E-05 U	0.0005 J	0.0074	0.00012 J	0.002	0.0004 J	0.001 J
		130+00-SW	Rainfall Pool	9/23/2010	0.017 U	0.00043 U	3.60E-05 U	0.0007 J	0.0089	1.90E-05 U	0.002	0.0006 J	0.0042 J
		65+40-SW	Rainfall Pool	9/23/2010	0.0189 J	0.00043 U	3.60E-05 U	0.0005 J	0.0091	5.30E-05 J	0.003	0.0006 J	0.0016 J
	Post-Corrective Action Monitoring	LBT-07	Shallow Alluvial Water	7/22/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.012	0.0075 U	0.01 U	0.003 U	0.07
		LBT-08		7/22/2008	0.102	0.025 U	0.002 U	0.006 U	0.011	0.0075 U	0.01 U	0.003 U	0.05
		LBT-09		7/22/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.02
		LBT-10		7/21/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.01 U
				9/17/2009	---	---	---	---	0.0069	---	---	---	0.01 U
				9/23/2010	---	---	---	---	0.0094	---	---	---	0.01 U
		LBT-11		7/22/2008	0.08 U	0.025 U	0.0028	0.006 U	0.026	0.024	0.011	0.003 U	0.51
				9/17/2009	---	---	---	---	0.0107	---	---	---	0.61
				9/21/2010	---	---	---	---	0.0027	---	---	---	1.09
		LBT-12		7/23/2008	0.08 U	0.025 U	0.0042	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.2
		LBT-13		7/23/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.02
		LBT-14		7/21/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.01 U
		LBT-15		7/22/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.01 U
		LBT-16		7/23/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.01 U
				9/21/2009	---	---	---	---	0.0036	---	---	---	0.01 U
				9/24/2010	---	---	---	---	0.0045	---	---	---	0.01 U
		LBT-17		9/21/2009	---	---	---	---	0.0045	---	---	---	0.01 U
				9/21/2010	---	---	---	---	0.0029	---	---	---	0.01 U
1	ERA Report	ERA-36	Surface water	9/9/1995	0.03 U	0.121 U	0.003 U	0.01 U	0.017	0.04 U	0.01 U	0.04 U	0.01 U
	Sitewide Abatement Program	LB7S	Shallow Alluvial Water	10/4/2007	0.08 U	0.025 U	0.0002 U	0.006 U	0.0021	0.003 U	0.01 U	0.003 U	0.01 U
				11/27/2007	0.08 U	0.025 U	0.0002 U	0.006 U	0.0116	0.003 U	0.01 U	0.003 U	0.01 U
				1/9/2008	0.08 U	0.025 U	0.0002 U	0.006 U	0.0039	0.003 U	0.01 U	0.003 U	0.01 U
				4/2/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.01 U
				6/18/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.01 U
				8/20/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.01 U
				9/16/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.027	0.0075 U	0.01 U	0.003 U	0.01 U
		376-05-04		10/4/2007	0.08 U	0.025 U	0.0002 U	0.006 U	0.0021	0.003 U	0.01 U	0.003 U	0.01 U
				1/9/2008	0.08 U	0.025 U	0.0002 U	0.006 U	0.0057	0.003 U	0.01 U	0.003 U	0.01 U
				2/20/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.01 U
				4/2/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.01 U
				6/18/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.01 U
				8/20/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.01 U
				9/16/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.0101
		376-05-05		10/6/2007	0.08 U	0.025 U	0.0002 U	0.006 U	0.0036	0.003 U	0.01 U	0.003 U	0.01 U
				11/27/2007	0.08 U	0.025 U	0.0002 U	0.006 U	0.0015	0.003 U	0.01 U	0.003 U	0.01 U
				1/9/2008	0.08 U	0.025 U	0.0002 U	0.006 U	0.0033	0.003 U	0.01 U	0.003 U	0.01 U
				2/20/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.01 U
				4/2/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.015	0.0075 U	0.01 U	0.003 U	0.098
				5/13/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.01 U
				6/18/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.01 U
				8/20/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.0106
				9/16/2008	0.08 U	0.025 U	0.002 U	0.006 U	0.01 U	0.0075 U	0.01 U	0.003 U	0.01 U

Appendix A-3
Surface Water Data Used in the Ecological Risk Assessment
Lampbright Investigation Unit

Tributary	Event	Location ID	Sample Type	Sample Date	Aluminum		Arsenic		Cadmium		Chromium		Copper		Lead		Nickel		Selenium		Zinc	
1	Sitewide Abatement Program	LBT1-BF1	Surface expression of shallow alluvial water	10/4/2007	0.08	U	0.025	U	0.0002	U	0.006	U	0.0023		0.003	U	0.01	U	0.003	U	0.01	U
				11/27/2007	0.08	U	0.025	U	0.0002	U	0.006	U	0.0027		0.003	U	0.01	U	0.003	U	0.01	U
				1/9/2008	0.08	U	0.025	U	0.0002	U	0.006	U	0.0027		0.003	U	0.01	U	0.003	U	0.01	U
				2/20/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				4/1/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				8/20/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				9/16/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.036		0.0075	U	0.01	U	0.003	U	0.01	U
		2408	Surface expression of shallow alluvial water	10/5/2007	0.08	U	0.025	U	0.0002	U	0.006	U	0.0024		0.003	U	0.01	U	0.003	U	0.01	U
				11/27/2007	0.08	U	0.025	U	0.0002	U	0.006	U	0.0033		0.003	U	0.01	U	0.003	U	0.01	U
				1/9/2008	0.08	U	0.025	U	0.0002	U	0.006	U	0.0032		0.003	U	0.01	U	0.003	U	0.01	U
				2/20/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.011		0.0075	U	0.01	U	0.003	U	0.017	
				4/1/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01		0.0075	U	0.01	U	0.003	U	0.011	
				8/20/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				9/16/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
		2409	Surface expression of shallow alluvial water	10/5/2007	0.08	U	0.025	U	0.0002	U	0.006	U	0.0049		0.003	U	0.01	U	0.003	U	0.01	U
				11/27/2007	0.08	U	0.025	U	0.0002	U	0.006	U	0.015		0.003	U	0.01	U	0.003	U	0.01	U
				1/9/2008	0.08	U	0.025	U	0.0002	U	0.006	U	0.0058		0.003	U	0.01	U	0.003	U	0.01	U
				2/20/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01		0.0075	U	0.01	U	0.003	U	0.01	U
				4/1/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				8/25/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				9/17/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.014		0.0075	U	0.01	U	0.003	U	0.01	U
		376-96-04	Shallow Alluvial Water	10/5/2007	0.08	U	0.025	U	0.0002	U	0.006	U	0.0018		0.003	U	0.01	U	0.003	U	0.01	U
				11/27/2007	0.08	U	0.025	U	0.0002	U	0.006	U	0.0014		0.003	U	0.01	U	0.003	U	0.01	U
				1/10/2008	0.08	U	0.025	U	0.0002	U	0.006	U	0.0016		0.003	U	0.01	U	0.003	U	0.01	U
				2/19/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				4/2/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				5/13/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				6/18/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				8/20/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				9/17/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
1	Sitewide Abatement Program	2410	Shallow Alluvial Water	10/5/2007	0.08	U	0.025	U	0.0002	U	0.006	U	0.0018		0.003	U	0.01	U	0.003	U	0.01	U
				11/29/2007	0.113		0.025	U	0.0002	U	0.006	U	0.0046		0.003	U	0.01	U	0.003	U	0.01	U
				1/10/2008	0.08	U	0.025	U	0.0002	U	0.006	U	0.0016		0.003	U	0.01	U	0.003	U	0.01	U
				2/19/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				4/1/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				5/13/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				8/26/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				9/23/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.013		0.0075	U	0.01	U	0.003	U	0.01	U
		LB6	Shallow Alluvial Water	10/5/2007	0.08	U	0.025	U	0.0002	U	0.006	U	0.0025		0.003	U	0.01	U	0.003	U	0.01	U
				1/9/2008	0.08	U	0.025	U	0.0002	U	0.006	U	0.0033		0.003	U	0.01	U	0.003	U	0.01	U
				2/19/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				4/1/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				5/13/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				6/18/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				8/27/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U
				9/22/2008	0.08	U	0.025	U	0.002	U	0.006	U	0.01	U	0.0075	U	0.01	U	0.003	U	0.01	U

APPENDIX B

Table B-1
Exposure Parameters Used in LIU Risk Calculations

Small Ground Feeding Bird	**IR_f (fresh weight)**	0.918	mg/kg BW/day	Calculated from Nagy (2001) equation for passerine birds (BW = 12 g.). FMI (g/day) = $2.438(\text{Body Weight}_{\text{grams}})^{0.607}$
	IR_f (dry weight)	0.287	mg/kg BW/day	Calculated from Nagy (2001) equation for passerine birds (BW = 12 g). DMI (g/day) = $0.630(\text{Body Weight}_{\text{grams}})^{0.683}$
	Diet Composition	30% Seed 70% Invertebrate	--	Proportions based on a generic diet.
	Percent Diet as Soil	10%	--	
Small Mammal	**IR_f (fresh weight)**	0.665	mg/kg BW/day	Intake value for deer mouse (*Peromyscus maniculatus*) calculated in Nagy (2001).
	IR_f (dry weight)	0.212	mg/kg BW/day	Intake value for deer mouse (*Peromyscus maniculatus*) calculated in Nagy (2001).
	Diet Composition	11% Foliage 43% Seed 46% Invertebrate	--	Proportions based on Flake et al. (1973) as reported in EPA (1993)
	Percent Diet as Soil	10%	--	

Table B-2
Toxicity Reference Values Used in LIU Risk Calculations.

Chemical	Small Ground-feeding Bird		
	TRV_{NOAEL} (mg/kg day)	TRV_{LOAEL} (mg/kg day)	Reference
Chromium	1.3	13	CEPA 1994
Lead	4	9	Edens & Garlich 1983
Zinc	10	210	Gasaway & Bus 1972
	Small Mammal		
Chromium	1.8	18	NAS 1974
Lead	80	800	Stowe & Goyer 1971
Zinc	120	240	Schlicker & Cox 1968

Table B-3
Calculation of Average Bioaccumulation Factors at ERA-30 and ERA-34
Lampbright Draw Investigation Unit ERA

Location	Analyte	Measured Concentrations (mg/kg)				Bioaccumulation Factors		
		Soil	Invertebrate	Seed	Foliage	Invertebrate	Seed	Foliage
ERA 30	Chromium, total	8.2	0.26	1.06	0.957	0.031	0.129	0.117
	Lead, total	38.8	0.025	6.7	1.14	0.001	0.174	0.029
	Zinc, total	91.0	65.2	42.1	93.5	0.717	0.463	1.028
ERA 34	Chromium, total	4.9	0.25	0.3	1.29	0.052	0.062	0.266
	Lead, total	28.0	0.14	2.0	1.9	0.005	0.073	0.068
	Zinc, total	64.8	40.3	35.5	20.5	0.622	0.548	0.316
				Average	Chromium, total	0.04	0.10	0.19
					Lead, total	0.003	0.12	0.05
					Zinc, total	0.67	0.51	0.67

Appendix B-4

Wildlife Exposure and Risk Calculation Details

The hazard quotients (HQs) presented in Section 3 were calculated as follows:

$$HQ = \frac{Intake_{total}}{TRV}$$

where:

HQ	=	Hazard Quotient
Intake	=	Calculated total intake of the COPC
TRV	=	Receptor specific TRV

Intake was estimated for wildlife receptors based on intake of metals in food and surface water, and from the incidental ingestion of surface soil/tailings and/or sediment while foraging. The intake equations presented below are based on equations presented in USEPA (1993).

The total daily intake as a result of exposure via these pathways for terrestrial receptors is the sum of the intakes from the different pathways, with the total average daily intake ($Intake_{total}$) of a specific COPC is calculated as:

$$\boxed{Intake_{total} = Intake_{food} + Intake_{water} + Intake_{soil}}$$

where:

$Intake_{food}$ = average daily intake from ingestion of prey items (vegetation and animal tissues).

$Intake_{soil}$ = average daily intake from incidental ingestion of surface soil.

$Intake_{water}$ = average daily intake from the ingestion of water.

The diet of mammals and birds may include both plant and animal (invertebrate and/or vertebrate) prey. The following equation was used to calculate the amount of individual COPCs that a wildlife receptor could obtain from the ingestion of animal tissue and plant tissue:

$$\text{Intake}_{\text{food}} = AUF * \sum_{i=1}^{m} (IR_f * P_i) * C_{ij} * AF_{ij}$$

where:

- $\text{Intake}_{\text{food}}$ = amount of specific COPC ingested per day via the ingestion of prey tissues (mg/kg bw-d);
- m = total number of ingested prey types;
- IR_f = ingestion rate of food (kg/kg bw-d);
- P_i = fraction of food as prey type i;
- C_{ij} = $COPC_j$ in prey $type_i$ (mg/kg);
- AF_{ij} = bioavailability factor of $COPC_j$ in prey $type_i$ (AF_{ij} = 1); and
- AUF = Area Use Factor or fraction of food/soil/water derived from the site (AUF = 1.0).

NOTE: Food ingestion rate varies between prey types. Ingestion rates of seeds were calculated using the dry weight food ingestion rate. Ingestion of all other prey types used the fresh weight ingestion rate.

In addition to the ingestion of COPCs accumulated in food items, wildlife receptors may also be exposed to COPCs through the inadvertent ingestion of surface soil and/or sediment while foraging. The following equation was used to calculate the amount of a COPC that a wildlife receptor could obtain from the ingestion of soil or sediment.

$$\text{Intake}_{\text{soil}} = AUF * (IR_f * P_s * C_{js} * AF_{js})$$

where:

- $\text{Intake}_{\text{soil}}$ = amount of specific COPC ingested per day via the incidental ingestion in soil/sediment (mg/kg bw-d);
- IR_f = total dry weight ingestion rate of food (kg/kg bw-d);
- P_s = proportion of total food ingestion as soil or sediment;
- C_{js} = dry weight concentration of $COPC_j$ in soil or sediment (mg/kg);
- AF_{js} = bioavailability factor of $COPC_j$ in soil or sediment. Assumed to be 1.0 for chromium and zinc and 0.25 for lead; and
- AUF = Area Use Factor or fraction of soil derived from the site (AUF = 1.0).

Water intake was assumed to be negligible for these receptors and was not included in the exposure calculations.

Daily rates for intake of forage, prey, and incidental ingestion of soils are presented in Table C-1. TRVs are provided in Table C-2.

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