



Final Draft
PRELIMINARY ASSESSMENT/SITE INSPECTION REPORT
IRENE MINE

Grand Mesa, Uncompahgre and Gunnison National Forests, Colorado

November 2020

Contract 1282MK20P0014| Order No. 1



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TABLE OF CONTENTS

1.	INTRODUCTION	1
2.	SITE BACKGROUND.....	3
2.1	Site Location	3
2.2	Mining Claim Evaluation.....	3
2.2.1	Mineral Resource Data System Evaluation	3
2.2.2	Current Mining Claims Evaluation.....	4
2.3	Environmental Setting.....	5
2.3.1	Climatology.....	5
2.3.2	Topography and Hydrology.....	5
2.3.3	Geology and Mineralogy	6
2.4	Sensitive Species Assessment.....	7
2.5	Known or Suspected Contaminant Sources.....	8
2.6	Records Review	8
2.6.1	USFS and Colorado Geological Survey AML Inventory	8
2.6.2	CDPHE Water Quality Assessment Map.....	8
2.6.3	Superfund Enterprise Management System (SEMS) (Formerly CERCLIS)	10
2.6.4	Colorado Division of Water Resources – Well Survey	10
2.7	Previous Investigations.....	11
3.	SITE INSPECTION	16
3.1	Site Inspection and Sampling.....	16
3.1.1	Irene Adit Water and Sediment Sampling.....	16
3.1.2	Irene Adit Water Quality Measurements.....	17
3.1.3	Irene Soil Sampling	17
3.1.4	Waste Pile Volume Estimates	18
3.2	Sample Analyses, Sample Handling, QA/QC, and Documentation.....	18
3.2.1	Analytical Methods	18
3.2.2	Sample Handling, Quality Control, Decontamination	19
4.	DECISION PARAMETERS	20
4.1	Human Health Screening Levels	20
4.2	Ecological Risk-Based Screening Levels	21
5.	ANALYTICAL RESULTS	23
5.1	Surface Soil Results.....	23
5.1.1	Waste Pile Surface Soil Comparison to Human Health Screening Levels	23
5.1.2	Comparison to Ecological Screening Levels.....	23
5.1.3	Comparison to Background.....	24
5.1.4	Leaching potential	24
5.2	Sediment Results.....	25
5.2.1	Comparison to Ecological Screening Levels.....	25
5.3	Surface Water.....	25
5.3.1	Dissolved Metals Comparison to Human Health Standards.....	25
5.3.2	Total Metals Comparison to Human Health Standards.....	26
5.3.3	Surface Water Results in Comparison to Ecological Screening Values	26



5.3.4	Red Mountain Creek Idarado Compliance Point	27
5.4	COPC/COPEC Screening Results.....	27
5.5	Quality Assurance/Quality Control	28
6.	MIGRATION/EXPOSURE PATHWAYS AND TARGETS	29
6.1	Human Health and Ecological Compounds of Potential Concern	29
6.2	Soil Pathway	30
6.3	Sediment Pathway.....	30
6.4	Surface-Water Pathway.....	31
6.5	Groundwater Pathway	31
6.6	Air Pathway	32
7.	CONCLUSIONS AND RECOMMENDATIONS.....	33
7.1	Waste Pile Surface Soil	33
7.2	Sediment	33
7.3	Surface Water.....	34
7.4	Groundwater	34
7.5	Air	35
8.	REFERENCES	36

TABLES

Table 3-1.	Sampling Summary.....	1
Table 4-1.	Human Health Risk-Based Screening Levels	2
Table 4-2.	Ecological Risk-Based Screening Levels for Soil and Sediments.....	3
Table 4-3.	Colorado Hardness Function Coefficients for Aquatic Life Table Value Standards (TVS) ¹ , Acute and Chronic ³	4
Table 5-1.	Waste Pile Surface Soil Results Compared to Human Health Screening Levels	5
Table 5-2.	Waste Pile Surface Soil Results Compared to Ecological Screening Values.....	7
Table 5-3.	Background Surface Soil Results	10
Table 5-4.	Waste Pile Surface Soil Results Compared to Background Surface Soil Results.....	11
Table 5-5.	Waste Pile Surface Soil Synthetic Precipitation Leaching Procedure (SPLP) Results Compared to USEPA MCLs	13
Table 5-6.	Sediment Results Compared to Ecological Screening Values.....	14
Table 5-7.	Adit Water Sample Results Compared to Human Health Screening Levels (Dissolved Metals).....	15
Table 5-8.	Adit Water Samples Compared to Human Health Screening Levels (Total Metals)....	17
Table 5-9.	Adit Water Sample Results Compared to Ecological Screening Levels.....	19
Table 5-10.	Idarado Compliance Point Surface Water Sample Results Compared to Human Health Screening Levels (Dissolved Metals)	21
Table 5-11.	Idarado Compliance Point Surface Water Sample Results Compared to Human Health Screening Levels (Total Metals)	23
Table 5-12.	Idarado Compliance Point Surface Water Sample Results Compared to Ecological Screening Levels.....	25

FIGURES

Figure 2-1.	Regional Location Map.....	1
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Figure 2-3. Site Location Map.....	3
Figure 2-4. MRDS Location.....	4
Figure 2-5. Snotel Precipitation Data, Station #538 - Idarado	5
Figure 2-6. Ironton Geologic Map, Irene Mine	6
Figure 2-7. National Wetlands and Surface Water Inventory Map.....	7
Figure 2-8. Site Feature Map.....	8
Figure 2-9. USFS and Colorado Geological Survey AML Inventory.....	9
Figure 2-10. CDPHE Integrated Water Quality Map	10
Figure 2-11. CDWR Well Survey	11
Figure 3-1. Sampling Locations.....	12



APPENDICES

Appendix A	USEPA PA/SI Checklist
Appendix B	PA Supporting Information (Database Search Results, Stream Classifications, Maps)
Appendix C	USEPA Sampling Results, Irene Mine, September 2019
Appendix D	Volume Estimate Worksheets, Irene Mine
Appendix E	Laboratory Analytical Results
Appendix F	Data Validation and Verification
Appendix G	Photo-Documentation, Irene Mine



ACRONYMS

AI	Applied Intellect, LLC
AMD	Acid mine drainage
AML	Abandoned mine land
AMSL	above mean sea level
B&M	Birds and Mammals
BCC	Birds of Conservation Concern
BCR	Bird Conservation Region
Bgs	Below ground surface
BKG	Background
BLM	United States Bureau of Land Management
BT	Total Extraction of Sediments
CaCO ₃	Calcium carbonate
CAS	Chemical Abstract Service
CCC	Criterion continuous concentration
CDPHE	Colorado Department of Public Health and Environment
CDWR	Colorado Division of Water Resources
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CFS	Cubic feet per second
CGS	Colorado Geological Survey
CMC	Criterion Maximum concentration
COPC	Contaminant of Potential Concern
COPEC	Contaminant of Potential Ecological Concern
COR	Contracting Officer's Representative
CPG	Certified Professional Geologist
CY	Cubic yard
DA	Draining Adit
Eco-SSL	Ecological Soil Screening Level
ECOS	Environmental Conservation Online System
EqP	Equilibrium partitioning
ESV	Ecological Screening Value
F	Fahrenheit
FR	Forest Road
GPS	Global Positioning System
HSP	Health and Safety Plan
HRS	Hazard Ranking System
LANL	Los Alamos National Laboratory
LOAEC	Lowest Observed Adverse Effect Concentration
LR2000	BLM Legacy Rehost 2000 database
MCL	Maximum contaminant limit
MDL	Method detection limit
MRTS	Meridian, Township, Range and Section



MS	matrix spike
MSD	matrix spike duplicate
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
µg/L	micrograms per liter
µS/cm	microSiemens per centimeter
MOPC	Medium of potential concern
MRDS	Mineral Resources Data System
MS/MSD	matrix spike and matrix spike duplicates
mV	millivolts
NF	National Forest
NOAEL	No Adverse Effect Level
NPS	National Park Service
NRCS	Natural Resources Conservation Center
NTU	Nephelometric turbidity units
ORNL	Oak Ridge National Laboratories
ORP	Oxidation reduction potential
PEC	Probable Effect Concentration
P&I	Plants and Invertebrates
PA/SI	Preliminary Assessment/Site Inspection
PE	Professional Engineer
PEL	Probable Effect Level
PLSS	Public Land Survey System
PPE	Probable Point of Entry
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
R4	USFS Region 4
REC	Receiving stream
RG	Registered Geologist
RSL	USEPA Regional Screening Levels
SAA	Superfund Alternative Approach
SAP	Sampling and Analysis Plan
SD	Sediment
SDWA	Safe Drinking Water Act
SEMS	Superfund Enterprise Management System
SI	Site Inspection
SL	Risk-based or technology-based screening level
SLERA	Screening Ecological Risk Assessment
SOW	Statement of Work
SPLP	Synthetic Precipitation Leaching Procedure
SW	Surface Water
TAL	Target Analyte List Metals
TEC	Threshold Effect Concentration



TEL	Threshold Effect Level
TMDL	Total Maximum Daily Load
TOC	Total organic carbon
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USFS	United States Forest Service
USGS	United States Geological Survey
WP	Waste Pile
WQCC	Water Quality Control Criteria



1. INTRODUCTION

This report presents the results of a Preliminary Assessment/Site Inspection (PA/SI) for the Irene Mine located in the Uncompahgre National Forest (NF) in Ouray County, Colorado.

The United States Department of Agriculture (USDA), Forest Service (USFS), Grand Mesa Uncompahgre and Gunnison National Forests (GMUG) contracted Applied Intellect, LLC (AI) to perform Comprehensive Environmental Response Compensation and Liability Act (CERCLA) PA/SIs at five abandoned mine land (AML) sites located in Ouray County, Colorado.

This work is based on the USFS GMUG Statement of Work (SOW) provided May 21, 2020, which include reconnaissance of the sites for environmental sampling and assessment of site features. These features included waste rock or tailings, background surface soil, background surface water and sediment, and potentially impacted surface water and sediment, and estimation of waste volumes, followed by development of the PA/SI reports. Planning documents for the PA/SI were developed by AI, approved by GMUG, and include the Work Plan, Sampling and Analysis Plan (SAP), and the project Health and Safety Plan (HSP) (AI 2020).

According to the USFS SOW, the PA/SIs are required to achieve the following objectives:

- Perform Field Sampling according to approved SAP and HSP. In addition to sampling, estimate the volumetric quantities of tailings/waste rock piles and to determine the nature and extent of contamination at each site.
- Assess PA/SI level risk evaluation by providing data tables, comparing analytical results to relevant human/aquatic water quality standards, USEPA Preliminary Remediation Goals (PRG) and Regional Screening Levels (RSL), USEPA Ecological Soil Screening Levels (EcoSSL), and available site-specific background metals concentrations that represent unimpacted naturally occurring areas near the sites.
- Prepare PA/SI report in accordance with USEPA Guidance - *Improving Site Assessment: Combined PA/SI Assessments* (USEPA 1999), and generally accepted procedures for characterization of abandoned mine sites and include results of previous studies.

The PA/SI report outline was developed following the USEPA guidance referenced above, with guidance from the USFS Contracting Officer's Representative (COR):

- Section 1 provides the introduction and objectives of the PA/SI;
- Section 2 provides the site background, including history, features, geographic setting, and results of PA research;
- Section 3 describes the SI field work and sampling;
- Section 4 presents the decision parameters;
- Section 5 presents the analytical results of the study;



- Section 6 addresses migration exposure pathways and targets;
 - Section 7 provides conclusions and recommendations; and
 - Section 8 provides references used in developing the report.
-
- Appendix A provides a PA/SI checklist based on USEPA guidance;
 - Appendix B features the PA Supporting Information and results of database searches;
 - Appendix C provides the laboratory analytical reports; and
 - Appendix D presents the analytical data validation and verification. Appendix E provides photographs from the SI.



2. SITE BACKGROUND

2.1 Site Location

The Site is located in SE ¼, SW ¼, Section 31, T43N R7W and NE1/4, NW1/4, Section 6, T42N, R7W in Ouray County, Colorado. Regional and site location maps are shown in Figures 2-1 and 2-2. The general latitude and longitude for the Site vicinity is 37.9337, -107.68266. Directions to the Irene Mine area are as follows:

- From Ouray, Colorado, go south on Colorado Highway 550 approximately 8 miles toward Ironton; and
- The Irene Mine is approximately three quarters of a mile south of Ironton on the west side of Highway 550 near the Richmond Pass Trail Head.

2.2 Mining Claim Evaluation

2.2.1 Mineral Resource Data System Evaluation

The United State Geological Survey (USGS) Mineral Resources Data System (MRDS) identifies the Irene Mine as Record ID 10008365, a molybdenum mine of “D” grade. The “D” grade refers to the general characteristics of the MRDS record for the Irene Mine, indicating that the information is not highly detailed and may contain defects such as a lack of bibliographic references. The characteristics of the MRDS record for the Irene Mine indicate:

- There may be one to two records indicating geological context of the deposit;
- No records describing economic aspects of the Irene Mine, including operations and workings;
- No comments categorized as development, production, workings, and other economic factors; and
- One reference likely to indicate locatable information resources.

The one reference listed by MRDS is Worcester, 1919 *Molybdenum Deposits of Colorado*. Colorado Geological Society Bulletin No. 14. This reference contained the following complete description of the Irene Mine:

“Messrs. G.C. McGee, of Ironton, and A.E. Ackerson, of Ouray, have a molybdenum claim, the Irene, which is situated about a half-mile north of Ironton, 400 feet above and parallel to the creek. The county rock is the Silverton volcanic series. It is cut by a quartz vein, which is from one to two feet wide, and which carries pyrite, traces of gold and silver, 7 percent lead and small amounts of molybdenite. The vein dips at a high angle to the west and strikes north and south. The molybdenite is fine-grained and is intimately mixed with quartz. Considerable



molybdenite is found in soft streaks in the vein, especially along the walls, and highly mixed with quartz.”

“The vein has been opened by a tunnel for 50 feet. The vein is very variable in thickness and the ore in the vein is variable in amount. Samples of the whole vein are said by Mr. McGee to have assayed 1 percent molybdenite, but samples furnished by him to the Survey only assayed 0.364 percent. On account of so small a vein, and ore of this grade, it is probable that the vein cannot be successfully worked for the molybdenite alone. If the lead ore is rich enough and a suitable process devised for the economical separation of the lead and the molybdenite, it may be that the property can be worked for a profit.”

The MRDS ID is D000453, and the Irene Mine was alternately or previously known as the Jumbo No. 2 Mine. Molybdenum was the primary commodity listed for this mine, hosted in volcanic rock (aphanitic). The development status is categorized as “Occurrence”. The Irene Mine is described in MRDS as not significant. The complete MRDS information for the Irene Mine is included in Appendix B.

2.2.2 Current Mining Claims Evaluation

Active, pending and closed mine claims were evaluated using the US Bureau of Land Management (BLM) Legacy Rehost 2000 (LR2000) online data management system (<https://reports.blm.gov/content/lr2000/about/>) to determine if active mining claims are located within the Meridian, Township, Range and Section (MRTS) of the Irene Mine. Mining claims reports available through the LR2000 system pertain to unpatented claims on federal land and provide information on mining claim names, claimant name and address, and approximate location (typically at a quarter section scale) of the claim.

The Site includes portions of two MRTS locations (see Section 2.1); both were queried via the LR2000 Public Mine Claims Geographic Index Report system. Findings are summarized below.

- “Irene” and “Jumbo” were not among the claim names listed within the MRTS locations of the Site.
- The following active claims were identified in the NW ¼ of S06 T42N R7W, one of the two quarter sections in which the Site is located:
 - Elsie No. 5
 - Mayflower No. 3
- No active claims were identified in the SW ¼ of S31 T43N R7W, the other quarter section in which the Site is located.

The serial register page for the active Elsie No. 5 claim indicates that the claim encompasses 20.66 acres that are located in portions of the NE and SE quarters of Section 1 in T42N R8W, along with the NW ¼ of Section 6 in T42N R7W, where the site is located. Additional information about the location and activity associated with the claim is not available.



The serial register page for the active Mayflower No. 3 claim indicates that the claim encompasses 20.66 acres that are located in the NE $\frac{1}{4}$ of Section 1 in T42N R8W, the SE $\frac{1}{4}$ of Section 36 in T43N R8W, and the NW $\frac{1}{4}$ of Section 6 in T42N R7W, where the site is located. Additional information about the location and activity associated with the claim is not available.

The LR2000 geographic index report for the two queried MRTS locations, along with the serial register pages for the Elsie No. 5 and Mayflower No. 3 claims, are shown in Appendix B.

2.3 Environmental Setting

2.3.1 Climatology

Climatology data were researched at the USDA Natural Resources Conservation Center (NRCS) website interactive map that features SNOTEL Station #538 (Idarado) at 9,800 feet above mean sea level (AMSL) within approximately 1,000 feet southeast of the Irene Mine (Figure 2-3).

The Snotel data indicates that the snow-adjusted average annual precipitation accumulation between 1981 and 2019 at this site was 32.5 inches. The lowest snow-adjusted precipitation year was 1989 (20.5 inches), and the highest snow-adjusted precipitation year was 1983 (43.2 inches). Snotel precipitation data for the Idarado site for the period October 2019 through October 2020 are presented graphically on Figure 2-5.

Average air temperature between 1987 and 2019 ranged from a minimum of 25 ° F in 1991 to a maximum of 39 ° F in 2012. The overall average temperature over this period was 35.5 ° F.

2.3.2 Topography and Hydrology

The Irene Mine is situated at approximately 10,000 feet AMSL along eastern flank of Hayden Mountain between McIntyre Gulch to the southwest and Monument Gulch to the northeast. The Site is situated along Highway 550, within the Red Mountain Creek valley. Steep mountainous terrain is located both to the east and west of the Red Mountain Creek valley with nearby peaks up to 13,000 feet AMSL. Google Earth® imagery also indicates a large historical avalanche slide area located approximately 2,000 feet southwest of the Irene Mine. The USGS Ironton, Colorado Quadrangle (Figure 2-3) indicates that there are several steep gulches in the vicinity of the Irene Mine that flow into Red Mountain Creek from both the east and west sides of the valley, though the Site is located along a minor ridge and not within a local draw. The Site is located along the western edge of Highway 550, and a small culvert allows stormwater to flow from the Site to the east where a 0.65 acre Freshwater Forested/Shrub Wetland habitat is classified as a PSS1B, palustrine, scrub-shrubs of broad-leaved deciduous trees and saplings, that is seasonally saturated. Approximately 0.7 miles downgradient along Red Mountain Creek is Ironton Park wetlands consisting of Freshwater Forested Shrub Wetlands, Freshwater Emergent Wetlands, and Freshwater Ponds, including the 16.7 acre Crystal Lake. Within the 15 mile distance downgradient from the Site, Red Mountain Creek and the Uncompahgre River are classified as



R3UBH, an upper perennial river system characterized by high gradients and some flow expected throughout the year.

Red Mountain Creek flows northeast as a tributary to the Uncompahgre River, located approximately 4 miles north of the Irene Mine.

2.3.3 Geology and Mineralogy

The Geologic Map of the Ironton Quadrangle (USGS 1964, Figure 2-6) shows that Quaternary-aged alluvial cone deposits associated with Red Mountain Creek are the youngest unit in the vicinity of the Irene Mine. These deposits are underlain by the Miocene-aged Burns Formation, a member of the Silverton Volcanic Group. The Burns formation is described as medium to dark thick massive flows and flow breccias, tuffs, and fluidal-banded flows of mainly rhyodacitic composition. Three vertical faults are mapped in the Burns Formation in the vicinity of the Irene Mine. Two of the faults are aligned north-south parallel to Red Mountain Creek, and one fault is aligned east west (USGS, 1964).

On a regional scale, the Irene Mine is situated on the northwest side of the San Juan caldera, where Miocene-aged volcanic flows were deposited unconformably against the steep slopes of the caldera wall (USGS, 1973). The caldera subsidence preceded the volcanic flows. The San Juan caldera spans approximately 20 kilometers, and is amongst the major calderas (Uncompahgre, Silverton, and Lake City) in the western San Juan Mountains. The sequence of mid-Cenozoic volcanic events in the western San Juan Mountains is closely analogous to that elsewhere in the San Juan volcanic field. The Lake Fork, Picayune, and San Juan Formations were erupted from a cluster of central volcanoes from 35 to 30 million years ago, when dominant activity shifted to more silicic ash-flow eruptions with accompanying caldera collapses. The Uncompahgre and San Juan calderas, each about 20 km across, formed mainly from eruption of the 28 million years old Sapinero Mesa Tuff. Collapse occurred concurrently with eruption, and intra-caldera tuffs accumulated to a thickness of more than 700 m. Both calderas were resurgently domed together; the northeast-trending Eureka graben formed along the distended crest of that dome. The Uncompahgre caldera was then flooded by several 27 to 28 million years old ash-flow sheets from easterly sources, and also by one apparently erupted from the Silverton caldera nested within the older San Juan caldera.

Mineralization related to the different ash-flow calderas in the San Juan field occurred mostly late in the local cycle, during and spatially associated with post-subsidence magmatic activity. The activity typically emplaced lavas and intrusives along ring fractures and outward-extending radial fractures of the calderas and was related in time and space to the mineralization. These generalizations seem valid for the individual calderas in the western San Juan Mountains, but the multiple caldera cycles resulted in several periods of mineralization (USGS, 1973).

The western San Juan Mountains are one of the major mineralized areas in the Rocky Mountain region, with about one-half billion dollars total metal production in the last 100 years (USGS, 1973). The geology of this region has been studied intensively for many years. Geologic folios



date back to 1899 and were among the first studies anywhere to determine detailed stratigraphic relations in propylitically and hydrothermally-altered Tertiary volcanic rocks (USGS, 1973).

2.4 Sensitive Species Assessment

The US Fish and Wildlife Service (USFWS) Environmental Conservation Online System (ECOS) was used to identify potential sensitive species for the study area, including the Uncompahgre National Forest (see Appendix B). The study area evaluated consisted of approximately 3 square miles of the Uncompahgre National Forest surrounding the Irene Mine. The complete ECOS report for this area is provided in Appendix B.

The ECOS system identified the following endangered and/or threatened species (one mammal species, one bird species, and four fish species) associated with this area:

- Canada Lynx (*Lynx canadensis*) – Threatened. Note: There is final critical habitat for this species. The area of study is outside the critical habitat.
- Mexican Spotted Owl (*Strix occidentalis lucida*) – Threatened. Note: There is final critical habitat for this species. The area of study is outside the critical habitat.
- Bonytail (*Gila elegans*) – Endangered. Note: There is final critical habitat for this species. The area of study is outside the critical habitat.
- Colorado Pikeminnow (squawfish – *Ptychocheilus Lucius*) – Endangered. Note: There is final critical habitat for this species. The area of study is outside the critical habitat.
- Humpback Chub (*Gila cypha*) – Endangered. Note: There is final critical habitat for this species. The area of study is outside the critical habitat.
- Razorback Sucker (*Xyrauchen texanus*) – Endangered. Note: There is final critical habitat for this species. The area of study is outside the critical habitat.

In addition, ECOS recognized the following birds because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in the vicinity of the Irene Mine. These birds include:

- Black Swift (*Cypseloides niger*) – This is a BCC throughout its range in the continental US and Alaska.
- Brewer's Sparrow (*Spizella breweri*) – This is a BCC only in particular Bird Conservation Regions (BCRs) in the continental US.
- Rufous Hummingbird (*Selasphorus rufus*) - This is a BCC throughout its range in the continental US and Alaska.
- Virginia's Warbler (*Vermivora virginiae*) - This is a BCC throughout its range in the continental US and Alaska.

The complete ECOS report in Appendix B addresses the probability of presence of these birds in the Irene Mine vicinity.



In addition to the USFWS ECOS system, the USFWS National Wetlands Inventory (NWI) of surface waters and wetlands was queried to evaluate the presence of wetlands and aquatic habitats in the vicinity of the Site subject to regulation under Section 404 of the Clean Water Act. Outputs from NWI are shown in Figure 2-5. A 0.65-acre, seasonally saturated freshwater forested/shrub wetland habitat (classification PSS1B) is located approximately 200 feet to the south of the Site; this wetland appears to be connected to Site drainage via a highway culvert (see Section 3.1). Additionally, 0.38-acre freshwater forested/shrub wetland (classification PEM1B) is located approximately 1000 feet northeast of the Site. Red Mountain Creek, located approximately 550 feet to the south of the Site, is classified as a R3UBH Riverine habitat, indicating a high gradient, unconsolidated bottom, permanently flooded riverine system.

2.5 Known or Suspected Contaminant Sources

Suspected contaminant sources include the Irene Mine adit and the two waste piles shown on a site feature map presented in Figure 2-8. The results of previous investigations are addressed in Section 2.6. Section 3 provides the details of sampling and waste pile volume estimates performed on July 8, 2020.

2.6 Records Review

AI researched the following sources of records and data for the Irene Mine and summarized results of research below.

2.6.1 USFS and Colorado Geological Survey AML Inventory

AI researched for the Irene Mine location on the USFS and Colorado Geological Survey (CGS) interactive map of AML sites, identified on the Colorado Department of Public Health and Environment (CDPHE) AML Information Hub <https://erams.com/map/>. This interactive map does not identify the Irene Mine by name and does not show the location of the mine adjacent to Colorado Highway 550. As shown on Figure 2-9, the Irene location is grouped with a number of vicinity locations titled “Adits and Prospect Pits North of McIntyre Gulch, USFS-CGS AML Inventory.”

The same information hub contains a Colorado AML Water Quality Information feature. Figure 2-9 shows the vicinity of the Irene Mine and Red Mountain creek indicating “Draining mines with recent investigation or restoration project in progress.”

2.6.2 CDPHE Water Quality Assessment Map

AI conducted online research of the CDPHE Water Quality Control Division Geographic Information Systems (GIS) Map of stream segmentation for the nearest surface water body (Red Mountain Creek) and downstream stream segments within a 15-mile radius of the Site. In addition, AI researched the 2020 Colorado Integrated Water Quality Monitoring and Assessment



Report (IR) (CDPHE 2020) for these segments. These stream segments are shown on Figure 2-10 and summarized below in order of proximity to the Site.

- The nearest surface water body to the Site is Red Mountain Creek, located approximately 650 feet to the south of the Site waste piles, and approximately 450 feet to the south of a wetland area where discharge from the Site appears to terminate (see Section 3.0).
 - Identification: COGUUN06b_A
 - IR Category: 1. All attaining
 - Aquatic Life Tier: None
 - Recreational Tier: N – No Primary Use (i.e., not suitable or intended for recreational activities where the ingestion of small quantities of water is likely to occur (e.g., swimming, rafting, kayaking, tubing, windsurfing, water-skiing, and frequent water play by children))
 - Miles: 8.3
 - Aquatic Life Use: NA – not applicable
 - Recreational Use: F – Fully supporting
 - Agricultural Use: F – Fully supporting
 - Water Supply Use: NA – not applicable
 - The segment is not listed among specific segments requiring Total Maximum Daily Loads (TMDLs).
- Red Mountain Creek discharges to the mainstem of the Uncompahgre River, classified as segment COGUUN03a_A, approximately five miles downstream of the Site.
 - Identification: COGUUN03a_A
 - IR Category: 5. 303(d)
 - Aquatic Life Tier: C1-Class 1 Cold Water Aquatic Life
 - Recreational Tier: E – Existing Primary Contact Use
 - Miles: 3.3
 - Aquatic Life Use: N – not supported
 - Recreational Use: F – Fully supporting
 - Agricultural Use: F – Fully supporting
 - Water Supply Use: N – not supported
 - Affected uses in this segment are impacted by dissolved zinc (aquatic life use), pH (aquatic life use), and dissolved manganese (water supply use)
- The mainstem of the Uncompahgre River downstream of the confluence with Cascade Creek is classified as segment COGUUN03b_A, located approximately 8.3 miles downstream of the Site.
 - Identification: COGUUN03b_A
 - IR Category: 5. 303(d)
 - Aquatic Life Tier: C1-Class 1 Cold Water Aquatic Life
 - Recreational Tier: E – Existing Use
 - Miles: 2.6
 - Aquatic Life Use: T-TMDL



- Recreational Use: F – Fully supporting
 - Agricultural Use: F – Fully supporting
 - Water Supply Use: N – not supported
 - Affected uses in this segment are impacted by dissolved manganese (water supply use)
- The mainstem of the Uncompahgre River downstream of the confluence with Dexter Creek is classified as segment COGUUN03c_A, located approximately 10.9 miles from the Site.
 - Identification: COGUUN03c_A
 - IR Category: 5. 303(d)
 - Aquatic Life Tier: C1-Class 1 Cold Water Aquatic Life
 - Recreational Tier: E – Existing Primary Contact Use
 - Miles: 10.9
 - Aquatic Life Use: T-tmdl
 - Recreational Use: F – Fully supporting
 - Agricultural Use: F – Fully supporting
 - Water Supply Use: N – not supported
 - Affected uses in this segment are impacted by dissolved manganese (water supply use)

A direct surface water pathway from the Site to Red Mountain Creek and downstream segments was not identified during this SI; however, a potential surface water pathway was identified from the Site to a down-gradient wetland (see Section 3.1) located approximately 450 feet to the north of Red Mountain Creek. No evidence was identified to suggest the wetland is tributary. Therefore, surface water samples collected from the Site were compared to CDPHE Water Quality Control Commission (WQCC) Regulation 31 narrative standards as required for non-tributary wetlands, as opposed to site-specific stream segment screening levels.

2.6.3 Superfund Enterprise Management System (SEMS) (Formerly CERCLIS)

In accordance with USEPA Guidance, *Improving Site Assessment: Combined PA/SI Assessments* (USEPA 1999), the Combined PA/SI Assessment Checklist includes whether the subject Sites appear in the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS). USEPA has recently replaced CERCLIS with the Superfund Enterprise Management System (SEMS), which houses former CERCLIS data. A SEMS search for archived and active sites in Ouray County, Colorado was made via the USEPA SEMS database, found at: <https://www.epa.gov/enviro/sems-search>. The Irene Mine was not listed in SEMS, and there were no SEMS sites identified within a mile of the Irene Mine.

2.6.4 Colorado Division of Water Resources – Well Survey

AI researched the Colorado Division of Water Resources (CDWR) interactive map <https://gis.colorado.gov/dnrviewer/Index.html?viewer=mapviewer> for permitted groundwater



wells and/or permit applications within a four-mile radius of the Irene Mine. Sixteen well permit applications were identified within this radius; however, none of them were in a down-gradient position from the Site (Figure 2-11).

2.7 Previous Investigations

The Irene Mine was previously investigated by the USEPA in September 2019. The media investigated and results are summarized below. The USEPA Pre-CERCLA investigation report and laboratory quality assurance/quality control report is shown in Appendix C.

During the September 2019 sampling effort, USEPA collected X-Ray Fluorescence (XRF) measurements and five discrete grab samples from waste pile 1 (WP1). Composite samples were collected from both WP1 (IRN-SO-MP01-1) and waste pile 2 (WP2, IRN-SO-MP02-01). Discrete and composite waste pile samples were analyzed for TAL metals. Additionally, the composite sample collected from WP1 underwent Synthetic Precipitation Leachate Procedure (SPLP) prior to TAL metals analysis for evaluation of soil leachability. An additional background composite surface soil sample (IRN-SO-BKG-01) was collected from a background location located approximately 37 feet up-gradient from the northeast edge of WP1.

Text Table 1 through Text Table 4 present metal results in waste pile soil composite samples (IRN-SO-MP01-01 and IRN-SO-MP02-01) that exceed 3 times (3x) the same metal result in the background composite sample (IRN-SO-BKG-01), which is evidence of a manmade release (USEPA, 1992b). The metals in these tables are then compared to human health and ecological screening levels (SLs) that are described further in Section 4.0. To compare analytical results with human health and ecological SLs, exceedance factors (EFs) were calculated as follows:

$$EF = \frac{C}{SL}$$

where:

EF = Exceedance factor

C = Measured concentration

SL = Screening level

In Text Table 1, nine metals results from WP1 (IRN-SO-MP01-01) exceeded the 3x background soil result with background exceedance factors ranging from 4.8 (iron) to 310 (lead). However, only lead exceeded the human health SLs, by a factor of 50.

Text Table 1. IRN-SO-MP01-01 Composite Waste Rock Soil Results for Analytes that Exceed 3x Background Soil in Comparison to Human Health Screening Levels

Analyte	Result (mg/kg)	Flag	BKG Soil Result (mg/kg)	BKG EF	Recreation SL (mg/kg) ¹	Recreation SL EF	Industrial SL (mg/kg) ²	Industrial SL EF
Antimony	7.2	D	0.253	28	782	<0.1	470	<0.1
Cadmium	11	D	0.535	21	1780	<0.1	980	<0.1



Copper	321	D	10.2	31	78200	<0.1	47000	<0.1
Iron	49800	D	10300	4.8	1000000	<0.1	820000	<0.1
Lead	40000	BD	131	310	800	50	800	50
Mercury	0.5	D	0.03	17	271	<0.1	46	<0.1
Selenium	9.98	JD	0.478	21	9780	<0.1	5800	<0.1
Silver	47.6	D	0.265	180	9780	<0.1	5800	<0.1
Zinc	4850	D	98.4	49	587000	<0.1	350000	<0.1

¹ Cox, 2017. BLM Technical Memorandum: Screening Assessment Approaches for Metals in Soil at BLM HazMat/AML Sites. United States Bureau of Land Management. September.

² USEPA 2020. Regional Screening Levels (RSLs) – Generic Tables. Last updated May 2020.

Values in **red** represent Background EF > 3 or SL EF > 1

B = The analyte was detected in the sample as well as in the associated blank

BKG = Background

D = Sample diluted prior to analysis; reported result is for undiluted sample

EF = Exceedance Factor

J = Laboratory quality control review indicates that this result is considered estimated

mg/kg - milligrams per kilogram

SL = Screening Level

In Text Table 2, eight metals results from WP2 (IRN-SO-MP02-01) exceeded the 3x background soil result with background exceedance factors ranging from 5 (arsenic and cadmium) to 290 (silver). However, only lead exceeded both human health SLs, by a factor of 42, and arsenic exceeded only the industrial SL by a factor of 7.5.

Text Table 2. IRN-SO-MP02-01 Composite Waste Rock Soil Results for Analytes that Exceed 3x Background Soil in Comparison to Human Health Screening Levels

Analyte	Result (mg/kg)	Flag	BKG Soil Result (mg/kg)	BKG EF	Recreation SL (mg/kg) ¹	Recreation SL EF	Industrial SL (mg/kg) ²	Industrial SL EF
Antimony	37.5	D	0.253	150	782	<0.1	470	<0.1
Arsenic	22.4	D	4.5	5	30.6	0.73	3	7.5
Cadmium	2.73	D	0.535	5.1	1780	<0.1	980	<0.1
Copper	74.9	D	10.2	7.3	78200	<0.1	47000	<0.1
Lead	33800	BD	131	260	800	42	800	42
Mercury	0.52	D	0.03	17	271	<0.1	46	<0.1
Selenium	55.1	JD	0.478	120	9780	<0.1	5800	<0.1
Silver	77.5	D	0.265	290	9780	<0.1	5800	<0.1

¹ Cox, 2017. BLM Technical Memorandum: Screening Assessment Approaches for Metals in Soil at BLM HazMat/AML Sites. United States Bureau of Land Management. September.

² USEPA 2020. Regional Screening Levels (RSLs) – Generic Tables. Last updated May 2020.

Values in **red** represent Background EF > 3 or SL EF > 1

B = The analyte was detected in the sample as well as in the associated blank

BKG = Background

D = Sample diluted prior to analysis; reported result is for undiluted sample

EF = Exceedance Factor

J = Laboratory quality control review indicates that this result is considered estimated

mg/kg - milligrams per kilogram

SL = Screening Level



In Text Table 3, in WP1 (IRN-SO-MP01-01) four metals exceeded the plants and invertebrates (P&I) SL with lead as the major risk driver (EF of 330) and seven metals exceeded the birds and mammals (B&M) SL with lead as the risk driver (EF of 3600).

Text Table 3. IRN-SO-MP01-01 Composite Waste Rock Soil Results for Analytes that Exceed 3x Background Soil in Comparison to Ecological Screening Levels

Analyte	Result (mg/kg)	Flag	Background Soil Result (mg/kg)	BKG EF	P&I SL ¹ (mg/kg)	P&I EF	B&M SL ¹ (mg/kg)	B&M EF
Antimony	7.2	D	0.253	28	78	<0.1	0.27	27
Cadmium	11	D	0.535	21	140	<0.1	0.36	31
Copper	321	D	10.2	31	70	4.6	28	11
Iron	49800	D	10300	4.8	NE	NA	NE	NA
Lead	40000	BD	131	310	120	330	11	3600
Mercury	0.5	D	0.03	17	NE	NA	NE	NA
Selenium	9.98	JD	0.478	21	0.52	19	0.63	16
Silver	47.6	D	0.265	180	560	<0.1	14	3.4
Zinc	4850	D	98.4	49	120	40	46	110

¹ Available at: <http://www.epa.gov/ecotox/ecoss/> , developed according to USEPA (2005)

Values in red represent Background EF > 3 or SL EF > 1

B = The analyte was detected in the sample as well as in the associated blank

B&M = Birds & mammals

D = Sample diluted prior to analysis; reported result is for undiluted sample

EF = Exceedance Factor

J = Laboratory quality control review indicates that this result is considered estimated

mg/kg - milligrams per kilogram

NA – Not applicable

NE – Not established

P&I = Plants & invertebrates

SL = Screening Level

In Text Table 4, in WP2 (IRN-SO-MP02-01) four metals exceeded the P&I SL with lead as the major risk driver (EF of 280) and seven metals exceeded the B&M SL with lead as the risk driver (EF of 3100).

Table 4. IRN-SO-MP02-01 Composite Waste Rock Soil Results for Analytes that Exceed 3x Background Soil in Comparison to Ecological Screening Levels

Analyte	Result (mg/kg)	Flag	Background Soil Result (mg/kg)	BKG EF	P&I SL ¹ (mg/kg)	P&I EF	B&M SL ¹ (mg/kg)	B&M EF
Antimony	37.5	D	0.253	150	78	0.48	0.27	140
Arsenic	22.4	D	4.5	5	18	1.2	43	0.52
Cadmium	2.73	D	0.535	5.1	140	<0.1	0.36	7.6
Copper	74.9	D	10.2	7.3	70	1.1	28	2.7
Lead	33800	BD	131	260	120	280	11	3100
Mercury	0.52	D	0.03	17	NE	NA	NE	NA
Selenium	55.1	JD	0.478	120	0.52	110	0.63	87
Silver	77.5	D	0.265	290	560	0.14	14	5.5

¹ Available at: <http://www.epa.gov/ecotox/ecoss/> , developed according to USEPA (2005)



Values in **red** represent Background EF > 3 or SL EF > 1

B = The analyte was detected in the sample as well as in the associated blank

B&M = Birds & mammals

D = Sample diluted prior to analysis; reported result is for undiluted sample

EF = Exceedance Factor

J = Laboratory quality control review indicates that this result is considered estimated

mg/kg - milligrams per kilogram

NA – Not applicable

NE – Not established

P&I = Plants & invertebrates

SL = Screening Level

Text Table 5 presents the SPLP results from WP1 (IRN-SO-MP01-01) compared to Safe Drinking Water Act (SDWA) maximum contaminant levels (MCLs) with a Dilution Attenuation Factor (DAF) of 20 applied (20x MCL). Lead exceeded the 20x MCL SL by a factor of 20.

Text Table 5. IRN-SO-MP01-01 Waste Rock SPLP Results for Analytes that Exceed 3x Background Soil in Comparison to MCLs with 20x Dilution Attenuation Factor

Analyte	Result (ug/L)	Flag	20x MCL ¹ (ug/L)	20x MCL EF
Antimony*	60	U	120	0.5
Arsenic*	10	U	200	<0.1
Cadmium	39.1		100	0.39
Copper	1040		26000	<0.1
Lead	6090		300	20
Selenium	35	UJ	1000	<0.1
Silver	0.49	J	NE	NA
Zinc	10800		NE	NA

¹ USEPA Maximum Contaminant Level (MCL), National Primary Drinking Water Regulations

Values in **red** represent SL EF > 1

*Result was undetectable, but detection limit was below applicable SL

EF = Exceedance factor

J = Result is considered estimated

MCL = Maximum contaminant level

ug/L = micrograms per liter

SL = Screening level

U = Laboratory analysis indicates that the analyte was undetected at the concentration shown

USEPA also collected a sample of the draining adit water (IRN-SW-A01-01) for analysis of total and dissolved metals. No background water sample was collected for comparison due to the lack of surface water adjacent to the Site. In Text Table 6 below, adit water results were compared to SDWA MCLs for human health evaluation. Lead, thallium, and cadmium exceeded their MCLs in the unfiltered sample, with lead as the risk driver, exceeding the MCL by a factor of 13.

Text Table 6. IRN-SW-A01-01 Adit Water Results Compared to Human Health SLs

Analyte	Result (ug/L)	Flag	MCL ¹ (ug/L)	MCL EF
Cadmium, Total	7.09	D	5	1.4
Lead, Total	188	D	15	13
Thallium, Total*	5	U	2	2.5



¹ USEPA Maximum Contaminant Level (MCL), National Primary Drinking Water Regulations

Values in **red** represent SL EF > 1

*Result was undetectable, but detection limit was below applicable SL

D = Sample diluted prior to analysis; reported result is for undiluted sample

EF = Exceedance factor

MCL - Maximum contaminant level

ug/L - micrograms per liter

SL = Screening level

U = Laboratory analysis indicates that the analyte was undetected at the concentration shown

In Text Table 7, adit water results were compared to Colorado Department of Health and the Environment (CDPHE) chronic and acute water quality standards for freshwater aquatic life in Regulation 31, which are generally a function of hardness in units of mg/L calcium carbonate. Seven metals exceeded their hardness based SL, with lead (EF of 34) and aluminum (EF of 98) as the risk drivers.

Text Table 7. IRN-SW-A01-01 Adit Water Results Compared to Ecological SLs

Analyte	Result (ug/L)	Flag	Site-specific Chronic SL ¹	Chronic EF	Site-specific Acute ESV ¹	Acute EF
Aluminum, Total	8520		87	98	8500	1
Cadmium, Dissolved	6.88		0.7	9.8	3	2.3
Copper, Dissolved	66.3		16	4.2	25	2.6
Iron, Total	8390		1000	8.4	NE	NA
Lead, Dissolved	177		5.2	34	130	1.3
Silver, Dissolved*	0.5	U	0.24	2.1	6.4	<0.1
Zinc, Dissolved	1760		220	7.9	290	6
Hardness as CaCO ₃	195,000		NE	NA	NE	NA

¹ Hardness-based value in accordance with Colorado Department of Public Health and Environment Water Quality Control Commission, 2018. Regulation No. 31

Values in **red** represent SL EF > 1

*Result was undetectable, but detection limit was below applicable SL

D = Sample diluted prior to analysis; reported result is for undiluted sample

EF = Exceedance factor

J = Laboratory quality control review indicates that this result is considered estimated

ug/L - micrograms per liter

NA = Not applicable/Not analyzed

SL = Screening level

U = Laboratory analysis indicates that the analyte was undetected at the concentration shown



3. SITE INSPECTION

3.1 Site Inspection and Sampling

Primary SI field work was performed on July 8, 2020 by Jeff Hart, AI Registered Geologist (RG), and John DeAngelis, AI Certified Professional Geologist (CPG). The SI was preceded by brief site visit on the same morning by Seth Ehret the USFS Government Technical Monitor (GTM) and Curtis Cross, the USFS Engineering and Minerals Staff Officer, to review the site conditions with AI personnel. Additional sampling occurred at Waste Pile 3 (WP3), on November 5, 2020 by Bryan Barrett, USFS Engineer and USFS COR.

Descriptions of the Site adit and waste piles are provided in the sections below. In addition to these features, a highway culvert inlet is present approximately 116 feet to the southeast of Waste Pile 1. No surface flow was observed in the vicinity of the culvert at the time of the Site reconnaissance. However, Site topography suggests that surface runoff and/or seasonal increases to adit discharge from the Site would be directed to this culvert and then flow underneath the highway, through an approximately 220-foot outlet channel on the south side of Highway 550, and then to a wetland located approximately 450 feet to the north of Red Mountain Creek.

3.1.1 Irene Adit Water and Sediment Sampling

The adit portal is approximately 5 feet high with timbers holding a corrugated metal sheeting overhead. The portal is in poor condition and was not entered for health and safety considerations. It appears that the adit is collapsed inside the portal within approximately 12 to 15 feet of the portal.

The adit seep observed on July 8, 2020 was a nearly stagnant trickle, with flow too minimal to be measured. A sample of the water was obtained by digging a hole in front of the adit and allowing water to collect in a small depression lined with plastic. Sampling methods are described below. Sampling locations and identification numbers are shown on Figure 3-1.

The adit water sample was identified as IR-DA-SWT-1 (total metals) and IR-DA-SWD-1 (dissolved metals). One duplicate sample was obtained, IR-DA-SWT-2 and IR-DA-SWD-2.

Discrete (grab) sediment samples were collected co-located with surface water samples and included:

- IR-DA-SD-1; and
- Duplicate sample IR-DA-SD-2.

The adit water sample was collected using a peristaltic pump and disposable tubing. The water sample for total metals was collected directly into 250 milliliter containers from the laboratory that were pre-preserved with nitric acid. Samples for dissolved metals were collected separately



and field-filtered using disposable 0.45 micron filters. The filtered dissolved metal samples were also preserved with nitric acid.

3.1.2 Irene Adit Water Quality Measurements

Water quality data measurements collected during sampling of the adit are summarized below:

- pH: 3.04;
- Temperature: 20.0 °C;
- Specific Conductance: 887 microSiemens per centimeter ($\mu\text{S}/\text{cm}$);
- Dissolved oxygen: 2.42 milligrams per liter (mg/L);
- Oxidation Reduction Potential (ORP): 411.3 millivolts (mV); and
- Turbidity: 2.52 Nephelometric Turbidity Units (NTU).

The acidic pH measurement and ORP suggest that potential leaching of metals could occur under oxidizing conditions. The laboratory results for metals analysis are addressed in Section 5.

3.1.3 Irene Soil Sampling

Soil sampling performed for the Irene Mine included:

- Background: One composite background sample was collected (sampling methods are discussed below) from areas upgradient and appearing unaffected by remnant mine features. The sample was identified as IR-SS-BKG-1.
- Waste Piles: Two waste piles were identified during prior investigations. Waste Pile 1 (WP1) is located directly southeast of the adit and northwest of Highway 550. Waste pile 2 (WP2) is located approximately 225 ft southwest of the adit, also northwest of highway 550. The two waste piles are connected by a dirt road that is the parking area for the Richmond Pass Hiking trail. WP1 had evidence of recent camping, including a fire ring adjacent to the adit. A third waste pile, WP3, was identified by USFS for inclusion in this PA/SI in November 2020 located approximately 150 feet to the north of WP1. The following samples were collected:
 - WP1: One composite sample identified as IR-SS-WP1-1
 - WP1: One duplicate composite sample identified as IR-SS-WP1-2
 - WP2: One composite sample identified as IR-SS-WP2-1
 - WP3: One composite sample identified as IR-SS-WP3-1
 - WP3: One duplicate composite sample identified as IR-SS-WP3-2

Both the background and surface soil composites were collected using the following methods in accordance with the project SAP:



- Composite samples consisted of a sample of at least 30 subsamples, roughly equally spaced, collected from the top three inches of soil in accordance with the USGS Sampling Strategy for the Rapid Screening of Mine-Waste Dumps on Abandoned Mine Lands (USGS, 2000); and
- For WP1 and WP2 composite samples, each composite sample was sieved in the field to <2 mm using a 10-mesh stainless steel sieve. The >2 mm fraction was discarded on the waste pile, and the <2 mm fraction was retained for laboratory analysis.
- The WP3 composite sample and duplicate were sieved at the analytical laboratory, with the <2 mm fraction retained for analysis.

Per the SAP, in addition to the normal and duplicated samples collected above, the sampling program included collection of quality assurance/quality control (QA/QC) samples (matrix spike [MS] and matrix spike duplicates [MSD]). A summary of sample IDs, location descriptions, and QA/QC samples collected is shown in Table 3-1.

3.1.4 Waste Pile Volume Estimates

Volume estimates of the waste piles were surveyed on July 8, 2020 using a LTI Tripulse 360 laser range finder unit. Multiple survey shots of the toe of the waste pile and top (profile) of the waste pile were collected. The range finder measures distance, angle, and azimuth for each survey shot and automatically triangulates the survey points and the temporary control points established around the perimeter of the pile. The survey points are recorded using Mapsmart® field data collection software that calculates the estimated volume in the field.

The volume of WP1 was estimated at approximately 836 cubic yards (CY) and the volume of WP2 was estimated at approximately 578 CY. The volume estimate survey points and diagrams of the piles are provided in Appendix D. The volume of WP3 was not determined as part of this investigation.

3.2 Sample Analyses, Sample Handling, QA/QC, and Documentation

3.2.1 Analytical Methods

Soil and sediment samples were analyzed for Target Analyte List (TAL) metals by USEPA Method 6010. TAL Metals include: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, sodium, selenium, silver, thallium, vanadium and zinc. In addition, Mercury was analyzed by USEPA Method 7471.

In addition, Synthetic Precipitation Leaching Procedure (SPLP) extractions by Method 1312 from both WP1 and WP2 waste pile samples were analyzed for TAL metals to determine the leachability of TAL metals in these piles under natural conditions. The WP3 waste pile sample underwent SPLP analysis prior to analysis of arsenic, cadmium, copper, lead, and zinc.



Water samples (surface water from the draining adit) were analyzed for the list of TAL metals above, including total and dissolved metals. All TAL metals water samples were analyzed by USEPA Method 6010, and Mercury by USEPA Method 7470. Surface water samples were also analyzed for Hardness by USEPA Method 130.2.

3.2.2 Sample Handling, Quality Control, Decontamination

Discrete sediment samples were collected directly into certified pre-cleaned four-ounce glass jars provided by the laboratory. As indicated above, the composite soil samples from waste piles were collected in subsample increments at a minimum of 30 increments per composite sample. The bulk samples were double-bagged in Ziploc bags for delivery to the laboratory.

Decontamination of equipment was limited to the stainless steel sampling spoons used to collect soil and sediment samples, and the 10-mesh stainless steel sieves. The spoons were sprayed with an Alconox® solution wash and distilled water rinse between collection of discrete and composite soil and sediment samples. The sieves were dry-brushed with stainless steel brushes and then cleaned with an Alconox® solution wash and distilled water rinse.

All field samples were preserved in coolers on ice and maintained following chain-of-custody procedures per the SAP. The samples were maintained on ice until they were delivered to the project laboratory, Pace Analytical distribution center in Lakewood, Colorado, where the samples were re-packed with ice and shipped to Pace Analytical laboratory in Mt. Juliet, Tennessee.



4. DECISION PARAMETERS

The purpose of CERCLA SI studies is to identify the nature of the potential risk to human health and the environment from COPCs and contaminants of potential ecological concern (COPECs). The initial screening step for determining COPCs and COPECs included compare results of environmental media samples to risk-based or technology-based screening levels (SLs) associated with standard human and environmental receptors in similar environments, including conservative exposure parameters associated with their anticipated exposure to each Site. If these conservative SLs are exceeded for a target contaminant in a media of concern, that contaminant will be carried forward in the COPC or COPEC screening process. The second screening step for naturally-occurring constituents such as metals is to compare the constituent concentration to background concentrations. If the constituent concentration exceeds background by a certain threshold, the constituent will be considered a COPC or COPEC. If the exposure pathway for a COPC or COPEC is potentially complete and not insignificant, a response action or further evaluation may be warranted. If future studies are conducted, consideration should include focused risk assessments that will characterize the extent of the risk of these COPCs and COPECs to receptors at the Site. The human and ecological risk criteria that were used to evaluate the Sites and prepare this PA/SI report are described in detail in the project Work Plan and Sampling and Analysis Plan (AI, 2020) and in the sections below.

4.1 Human Health Screening Levels

Human health screening for COPCs in surface soil/waste rock was conducted using the recreational exposure scenario and exposure parameters developed by Cox (2017) and the USEPA Industrial exposure scenarios and associated exposure parameters (USEPA, 2020a) as a more conservative scenario for comparison purposes. Table 4-1 presents the SLs that were used for human health screening.

Recreational visitors are the most common group of human receptors at the Irene Mine Site. This is a broad category that can cover a range of possible activities, including camping, hiking, hunting, biking, ATV riding, horseback riding, etc., all with somewhat different exposure profiles. Most USFS managed land, including the Irene Mine Site, has no formal use or access restrictions, so conservative, yet realistic, assumptions must be made regarding the frequency of recreational use. Cox (2017) has developed a set of recreational SLs for metals most commonly found at AML sites that account for the limited exposures associated with most recreational activities. The yearly recreational exposure frequency is assumed to be 14 days/year, based on the annual limitation of 14 days for camping on USFS and Bureau of Land Management (BLM) managed land. The exposure duration assumed for recreational visitors, 26 years, is the default exposure duration recommended by EPA for residents. It has been assumed that two years of the exposure occur as a child and 24 years as an adult; appropriate exposure parameters have been included in the calculations to account for these integrated age groups. Due to the differing exposure scenarios that are evaluated, recreational SLs developed by Cox (2017) are higher than industrial SLs for TAL metals, with the exception of lead, which has an SL of 800 mg/kg under both scenarios (see Table 4-1). The identical value for lead in recreational and industrial SLs is due to the fact



that there is no consensus reference dose (RfD) or oral slope factor (SFO) for inorganic lead; therefore, SLs cannot be developed for this analyte in the same manner as other TAL metals. The industrial SL for lead has been developed using a USEPA Adult Lead Model based on blood-lead modeling and assumes chronic exposure to soil. For this reason, it is considered sufficiently conservative and is retained for the recreational SL in Cox (2017) and this PA/SI.

Human health screening for COPCs in surface water were conducted using SDWA MCLs for total metals associated with acid mine drainage (AMD) features, also presented in Table 4-1. Additionally, both dissolved and total metal concentrations in surface were evaluated alongside USEPA Residential Tap Water Regional Screening Levels (RSLs). USEPA states that the decision to compare Tap Water RSLs with dissolved or total concentrations is a site-specific one (USEPA, 2020b); in the case of this PA/SI both total and dissolved metals were evaluated for comparative purposes only and were not used in the selection of COPCs. Where receiving streams are not a known or designated drinking water source, these screening levels are presented simply for comparative purposes. As described in Section 2.5.2, no screening levels for metals are established for Segment 6b of Red Mountain Creek. According to CDPHE Regulation No. 35 – Classifications and Numeric Standards for Gunnison and Lower Dolores River Basins, Red Mountain Creek has been “found to be so severely impacted by past and current human activities that no metals numbers were assigned as standards and virtually no beneficial uses were in evidence to be protected.”

4.2 Ecological Risk-Based Screening Levels

Ecological screening of surface soil/waste rock results for COPECs was conducted using EPA Ecological Soil Screening Levels (ECO-SSLs) (<https://cfpub.epa.gov/ecotox/>). ECO-SSLs are established for birds and mammals (B&M) and plants & invertebrates (P&I).

Ecological screening for toxicity in sediments in water bodies was performed through NPS Screening Level Ecological Risk Assessment (SLERA) ESVs for freshwater sediment (NPS, 2018), which were developed from the following sources:

- MacDonald et al. (2000); consensus-based threshold effect concentration (TEC) and probable effect concentration (PEC).
- Ingersoll, et al. (1996); Threshold Effect Level (TEL) and Probable Effect Level (PEL) for total extraction of sediment (BT) samples from *Hyaella azteca* 28-day (HA28) tests.
- Los Alamos National Laboratory (LANL) (2017); ECORISK Database (Release 4.1).

Soil and sediment ecological SLs used in the assessment are shown in Table 4-2.

A direct surface water pathway from the Site to Red Mountain Creek was not identified during this SI; however, a potential surface water pathway was identified from the Site to a down-gradient wetland (see Section 3.1) located approximately 450 feet to the north of Red Mountain Creek. Therefore, surface water samples collected from the Site were compared to CDPHE Water



Quality Control Commission (WQCC) Regulation 31 Basic Standards and Methodologies for Surface Water (CDPHE 2018). These standards include hardness-dependent values for some analytes and varying requirements for total and dissolved concentrations that are outlined in Table 4-3 for acute toxicity and for chronic toxicity.



5. ANALYTICAL RESULTS

This Section presents the analytical results for TAL metals in potentially mine-impacted surface soil, sediments, and surface water for the investigation samples collected on July 8, 2020 and November 5, 2020. Analytical results are described below and presented in Table 5-1 through Table 5-9. Laboratory data packages are provided in Appendix E and data quality is summarized in Appendix F. As in Section 2.7, EFs were calculated to compare analytical results with human health and ecological SLs.

5.1 Surface Soil Results

Background and waste pile sampling locations and protocols are described in Section 3.2.1 and are depicted in Figure 3-1.

5.1.1 Waste Pile Surface Soil Comparison to Human Health Screening Levels

Analytical results for the Site waste pile surface soil samples in comparison to human health SLs are shown in Table 5-1. A comparison of waste pile surface soil analytical results with human health SLs are summarized below.

Recreational SLs were exceeded in waste pile samples for:

- Lead (all waste piles), with EFs ranging from 17 in WP2 to 97 in WP3.

USEPA Industrial SLs were exceeded in waste pile samples for:

- Arsenic (all waste piles), with EFs ranging from 1.9 in WP1 to 6.4 in WP1; and
- Lead (all waste piles), with an EFs ranging from 17 in WP2 to 97 in WP3.

5.1.2 Comparison to Ecological Screening Levels

Analytical results for the Site waste pile surface soil samples in comparison to ESVs are shown in Table 5-2. A comparison of waste pile surface soil analytical results with EPA SLs are summarized below.

EPA B&M SLs were exceeded in waste pile samples for:

- Antimony, cadmium, copper, lead, selenium, silver, and zinc;
- At WP1, EFs ranged from 2.2 (silver) to 3000 (lead);
- At WP2, EFs ranged from 3.3 (silver) to 1200 (lead); and
- At WP3, EFs ranged from 3.9 (silver) to 7100 (lead).

EPA P&I ESVs were exceeded in waste pile samples for:



- Arsenic, copper, lead, selenium, and zinc;
- At WP1, EFs ranging from 12 (copper) to 280 (lead);
- At WP2, EFs ranged from 1.1 (arsenic) to 110 (lead); and
- At WP3, EFs ranged from 11 (copper) to 650 (lead).

5.1.3 Comparison to Background

Background surface soil concentrations are shown in Table 5-3. Site waste pile surface soil analytical results are shown in comparison to maximum background soil concentrations in Table 5-4. USEPA Hazard Ranking System (HRS) guidance sets a threshold of 3x background to identify an observed release (1992b). A comparison of background metals results to the maximum waste pile soil metal results (normal and duplicate maximum) that exceeded either human health or ecological SLs are summarized below:

- Cadmium exceeded background in all waste piles by factors ranging from 13 (WP2) to 130 (WP3);
- Copper exceeded background in all waste piles by factors ranging from 4.3 (WP2) to 89 (WP1);
- Lead exceeded background in all waste piles by factors ranging from 52 (WP2) to 300 (WP3);
- Selenium exceeded background in all waste piles by factors ranging from 7.6 (WP1) to 18 (WP2 and WP3);
- Silver exceeded background in all waste piles by factors ranging from 76 (WP1) to 200 (WP3); and
- Zinc exceeded background in all waste piles by factors ranging from 13 (WP2) to 150 (WP3).

The data provided above indicates that a release of TAL metals has been observed in WP1, WP2, and WP3 and that these metals also exceed one or more human health and/or ecological SLs.

5.1.4 Leaching potential

Waste pile soils underwent SPLP analysis (see Section 3.2.1) to evaluate their potential for leaching to groundwater. Results were compared to USEPA MCLs, with a 20x dilution attenuation factor (DAF) applied. Analytical results in comparison to 20x USEPA MCLs SL are shown in Table 5-5 and summarized below.

- Lead exceeded the 20x MCL in all waste piles ranging from an EF of 16 (WP3) to an EF of 58 (WP2).



5.2 Sediment Results

Sediment sampling locations and protocols are described in Section 3.1.2 and depicted in Figure 3-1. Sediments were not compared to human health SLs because none were appropriate at the Site.

5.2.1 Comparison to Ecological Screening Levels

Analytical results for adit sediment samples in comparison to ecological SLs are shown in Table 5-6. A comparison of sediment results with NPS SLERA ESVs is summarized below.

NPS SLERA ESVs were exceeded in duplicate adit sediment samples IR-DA-SD-1/IR-DA-SD-2 for:

- Copper, with EFs of 1.9 to 2.6;
- Iron, with EFs of 7 to 8.6;
- Lead, with EFs of 2.2 to 2.5; and
- Selenium, with EFs of 4.8 to 7.2.

Additionally, silver concentrations were below method detection limits (MDLs); however, MDLs for silver in adit sediment exceeded the NPS SLERA SL.

The adit flow is not directly connected to an adjacent surface water body from which background sediments TAL metals could be compared; however, comparisons to TAL metal concentrations in background soil indicates an observed release (greater than 3x background) of copper, iron, and selenium.

5.3 Surface Water

Adit water sampling locations and protocols are described in Section 3.2.1 and are depicted in Figure 3-2. Duplicate adit water samples were collected from the on-site adit. As discussed, adit water drainage was minimal and sampling required excavation of a small depression to allow water to seep in and become captured. Total metal sample results may have been affected by this process.

5.3.1 Dissolved Metals Comparison to Human Health Standards

A comparison of dissolved metal concentrations in adit water with USEPA Tapwater SLs is shown in Table 5-7 and indicates the following:

- Concentrations of dissolved cobalt, lead, and manganese exceeded USEPA Tapwater SLs in duplicate adit water samples, with EFs ranging from 3.6 (manganese) to 12 (lead).

Additionally, dissolved arsenic and thallium were below MDLs; however, MDLs exceeded USEPA Tapwater SLs for these constituents.



5.3.2 Total Metals Comparison to Human Health Standards

A comparison of total metal concentrations in adit water with USEPA Tapwater SLs and USEPA MCLs is shown in Table 5-8 and is summarized below.

- Total concentrations of cobalt, lead, and manganese in adit water exceeded USEPA Tapwater SLs, with EFs ranging from 3.7 (manganese) to 12 (lead); and
- Total concentrations of cadmium and lead exceeded USEPA MCLs, with EFs ranging from 1.9 (cadmium) to 12 (lead).

Additionally, total arsenic and thallium were below MDLs; however, MDLs for arsenic exceeded USEPA Tapwater SLs, and MDLs for thallium exceeded USEPA Tapwater SLs and USEPA MCLs.

5.3.3 Surface Water Results in Comparison to Ecological Screening Values

A comparison of metal concentrations in Site adit water compared to applicable ESVs is shown in Table 5-9 and summarized below.

Hardness-based acute ESVs were exceeded for the following constituents in duplicate samples collected from Site adit water:

- Cadmium, with an EF of 3 in both duplicate samples;
- Copper, with an EF of 4 in both duplicate samples;
- Lead, with EFs of 1.3 and 1.4, respectively, in the duplicate samples; and
- Zinc, with an EF of 5.5 in both duplicate samples.

Hardness-based chronic ESVs were exceeded for the following constituents in duplicate samples collected from Site adit water:

- Aluminum, with an EF of 80 in both duplicate samples;
- Cadmium, with an EF of 13 in both duplicate samples;
- Copper, with EFs of 6.3 and 6.4, respectively, in the duplicate samples;
- Iron, with an EF of 13 in both duplicate samples;
- Lead, with an EF of 35 in both duplicate samples; and
- Zinc, with an EF of 7.2 and 7.3, respectively, in the duplicate samples.

Additionally, mercury, selenium, and silver were below MDLs; however, MDLs exceeded hardness-based chronic ESVs for these constituents.

The adit flow is not directly connected to an adjacent surface water body from which background surface water TAL metals could be compared, therefore no background comparisons were made in this report. The Red Mountain Creek Idarado Compliance Point was measured for comparative



purposes, but is not considered a pristine background location, being located downgradient from the Irene Adit and influenced by surface water outfall from multiple mining operations in the study area.

5.3.4 Red Mountain Creek Idarado Compliance Point

Red Mountain Creek is located approximately 700 feet to the south of the Site and is the nearest stream to the Irene Mine. A direct surface water pathway from the Site to Red Mountain Creek was not identified during this assessment; however, during periods of runoff or seasonal increases to adit discharge, drainage from the Site is believed to have a pathway through a highway culvert to a wetland located approximately 450 feet to the north of Red Mountain Creek.

Impacts to Red Mountain Creek from historic mining activity are being addressed by the Idarado Mine (now Newmont Mining Corporation) after the State of Colorado filed suit against the company for natural resource damages under CERCLA. Remedial actions have occurred within the Idarado Natural Resource Damage Site (NRDS) since 1992. Among the performance objectives of Idarado NRDS remedial action was a 50% decrease in zinc loading in Red Mountain Creek. This objective was not achieved by 2012, and a Contingency Plan is currently being implemented to reduce zinc loading in the watershed (UWP, 2018). Additionally, a use attainability analysis (UAA) conducted on lower Red Mountain Creek, Champion Gulch, and Corkscrew Gulch by Colorado Water Quality Control Division (WQCD) in 2006 determined that these segments had been heavily impacted by cadmium, copper, lead, and zinc and did not meet regulatory thresholds to support aquatic life. Further, the 2006 UAA determined that full compliance with Idarado NRDS performance goals would not result in conditions that would support aquatic life in these segments (UWP, 2018).

An Idarado NRDS compliance sampling point is located on Red Mountain Creek immediately downstream of the confluence with Corkscrew Gulch in a down-gradient position from the Site. As part of this assessment, AI collected a surface water sample from this compliance sampling point to provide contextual information about the water quality of the receiving stream. Total and dissolved metal results from the sampling point in comparison to human health screening levels are shown in Table 5-10 and Table 5-11, respectively. A comparison of Idarado compliance point surface water results with ecological screening values is shown in Table 5-12.

5.4 COPC/COPEC Screening Results

For the purposes of this PA/SI, contaminants are considered COPCs or COPECs for in soil samples if:

- 1) The measured concentration exceeds an SL; and
- 2) There was a directly observed release or the measured concentration exceeds the maximum background concentration by a factor of 3 (USEPA, 1992b).



A direct pathway between adit water and sediment and other surface water bodies was not observed at the time of the Site reconnaissance, and background surface water and sediment comparisons could not be made. Therefore, contaminants in adit water and sediment were identified as COPCs or COPECs if the measured concentration exceeded an SL.

Using these criteria, the following human health COPCs were identified, considering recreational camping and industrial use SLs for exposure to waste piles, and MCLs for exposure to adit water:

- Lead in both waste pile surface soil (recreational and industrial use scenarios); and
- Cadmium and lead in adit water (drinking water scenario).

The following ecological receptor COPECs were identified:

- Cadmium, copper, lead, selenium, silver, and zinc in waste pile surface soil (B&M and P&I receptors);
- Copper, iron, lead, and selenium in adit sediment (freshwater sediment ecological receptors); and
- Aluminum, cadmium, copper, iron, lead, and zinc in adit water (aquatic ecological receptors).

5.5 Quality Assurance/Quality Control

Pace Analytical Laboratory conducted the chemical analyses for preliminary constituents of concern and provided USEPA Level 3 data packages for data review. These laboratory packages are provided as Appendix E. A summary of the data validation parameters is provided as Appendix F. All data was determined to be useable for PA/SI decision-making.



6. MIGRATION/EXPOSURE PATHWAYS AND TARGETS

This section provides more detailed information on environmental pathways and preliminary data required to evaluate environmental hazards from Site contaminants in accordance with USEPA guidance for conducting PA/SIs (USEPA 1991, 1992a, and 1999). The information and data will support assessment of exposure pathways and whether potential risks are posed to human health or the environment based on current and future land use.

Each identified exposure route is categorized as follows:

- Complete (includes all of the following elements: chemical source(s), chemical release and transport mechanisms, routes of exposure, and human or environmental receptors).
- Potentially complete (includes all of the following elements: chemical source(s), chemical release and transport mechanisms, potential routes of exposure, and potential human or environmental receptors).
- Potentially complete but insignificant (exposure pathways identified as potentially complete, but not likely to pose a potential for adverse effects).
- Incomplete (exposure pathways that are not complete and therefore will not affect receptors).

6.1 Human Health and Ecological Compounds of Potential Concern

TAL metals are the contaminants that are anticipated to be present at the Sites based on mining activities and Site features, such as waste rock piles. As the native material is removed from the ground and crushed, its metals can become available to Site receptors via direct exposure, indirect exposure via ingestion of metals that uptake or bioaccumulate into food resources, and including exposure to metals via erosion into receiving streams. Additionally, more surface area is available from which metals can be leached into groundwater and receiving streams. Further, when native sulfide minerals are exposed to air and oxygenated water, acidic water is generated, enhancing metal dissolution and exposure to aquatic life.

In Section 5, concentrations of TAL metals in WP1, WP2, and WP3 were compared to recreational and industrial SLs and relevant ecological SLs. TAL metals that exceeded SLs were then compared to 3x background concentrations in soil to define a release. TAL metals that exceeded SLs and 3x background are considered COPCs and/or COPECs for WP1, WP2, and WP3. Based on this evaluation:

- Lead is a COPC for waste pile soil; and
- Cadmium, copper, lead, selenium, silver, and zinc are COPECs for waste pile soil.

In Section 5, concentrations of TAL metals in sediments were compared to ecological SLs for freshwater aquatic receptors. TAL metals that exceeded ecological SLs were compared to 3x background concentrations in soil because no upgradient sediments were available in the study



area. TAL metals that exceeded relevant SLs and 3x background are considered COPECs for sediments. Based on this evaluation:

- No COPCs were identified; and
- Copper, iron, and selenium are COPECs for adit sediments.

In Section 5, concentrations of TAL metals in adit water in total (unfiltered) and dissolved (filtered) aliquots were compared to tapwater RSLs and MCLs for human receptors, and relevant ecological SLs for aquatic receptors. No background comparisons were made because there are no appropriate background surface water sources in the study area. TAL metals that exceeded SLs are considered COPCs and/or COPECs in adit water. Based on this evaluation:

- Cadmium, cobalt, lead, and manganese are COPCs in adit water; and
- Aluminum, cadmium, copper, iron, lead, and zinc are COPECs in adit water.

6.2 Soil Pathway

The human receptors that could be exposed to Site contaminants via surface soil exposure pathways include recreational visitors, including campers; and Site workers, including USFS personnel and their contractors. An industrial exposure scenario is not applicable to these Sites. The primary exposure pathways for both human receptors are direct dermal contact, incidental ingestion, and inhalation of wind-blown particles of soil. Lead was identified as a COPC in waste pile soils.

Ecological receptors, such as birds, mammals, plants and invertebrates could also be exposed to waste pile soils at the Site. Plants and invertebrates at the Sites are directly exposed to contaminants in the soil, and birds and mammals may then eat the plants and invertebrates. Burrowing mammals may also come in contact with subsurface soil at the Sites. Cadmium, copper, lead, selenium, silver, and zinc were identified as COPECs in waste pile soils.

Based on the assessment of surface soil in waste piles at the Sites, the surface soil exposure pathways are:

- Complete and significant for USFS workers and recreational visitors (Campers) at the Site; and
- Complete for ecological receptors at the Site.

6.3 Sediment Pathway

At AML sites, waste rock and soil resulting from the erosion of waste rock has the potential to migrate to downgradient streams, via gravity and surface water run-off to become sediments in the probable point of entry (PPE) stream beds directly adjacent to the site. In many cases, PPE streams collect surface water and sediments directly from



the mine site via overland sheet flow during flooding or adit water flow. Sediments in the PPE stream are then transported to receiving streams during high seasonal flow periods, such as storm events and spring snowmelt seasonal actions. Contaminants are transported in these particles to the stream beds and may adversely affect the aquatic and benthic habitat. No appropriate human health SLs were identified, and the potential for human exposure to sediment at the Sites is considered insignificant.

At the Irene Mine Site, as discussed in Section 5.4, copper, iron, lead, and selenium were identified as COPECs in adit sediment. A PPE drainage and highway culvert inlet are present to the southeast of Waste Pile 1 (see Section 3.1), with surface runoff or seasonal increases in adit discharge from the Site likely to result in the transport of Site sediments through the culvert beneath Highway 550 before depositing in a wetland located approximately 450 feet from Red Mountain Creek.

Based on this assessment, the sediment pathway is:

- Potentially complete but insignificant for USFS workers and recreational visitors; and
- Potentially complete and significant for ecological receptors.

6.4 Surface-Water Pathway

The adit seep observed on July 8, 2020 was a nearly stagnant trickle, with flow too minimal to be measured and did not migrate offsite. However, a PPE drainage and highway culvert inlet are present to the southeast of Waste Pile 1 (see Section 3.1). Observation of topography at the Site suggests that runoff events or seasonal increases to adit discharge would likely result in surface water flow from the Site traveling through the culvert beneath Highway 550 before depositing in a wetland located approximately 450 feet from Red Mountain Creek.

Cadmium and lead exceeded USEPA MCLs in adit water and were identified as COPCs. Aluminum, cadmium, copper, iron, lead, and zinc exceeded ecological SLs in adit water and were identified as COPECs. While human and ecological SL exceedances were noted in this assessment, USEPA MCLs apply to drinking water scenarios, and the ingestion of adit, PPE drainage, or wetlands surface water by human receptors is considered unlikely. Based on this assessment, the surface-water pathway is:

- Potentially complete but insignificant for USFS workers and recreational visitors; and
- Potentially complete and significant for ecological receptors.

6.5 Groundwater Pathway

As indicated in Section 2.5.3, no records of groundwater wells were identified in proximity of the Site. During the SI, no wells were observed at the Site, and no groundwater samples were collected. Based on this assessment, the groundwater pathway is:



- Incomplete for human receptors; and
- Incomplete for ecological receptors.

6.6 Air Pathway

Airborne dust samples for the evaluation of the air pathway were not collected because no dust-generating activities are currently taking place at the Site that would impact current receptors. Under current Site use conditions, it is unlikely that soil from the waste piles will be disturbed and become airborne. Lead was identified as a COPC in waste pile surface soils, and cadmium, copper, lead, selenium, silver, and zinc were identified as COPECs in waste pile soils. These contaminants may be an airborne dust concern for human and ecological receptors if dust-generating activities or weather conditions are present at the Sites. Based on this assessment, the air pathway is:

- Potentially complete for human receptors; and
- Potentially complete for ecological receptors.

Air monitoring would be needed during dust-generating activities to determine if this pathway is significant.



7. CONCLUSIONS AND RECOMMENDATIONS

In accordance with the USFS SOW, AI has conducted a PA/SI for the Irene Mine on the Uncompahgre NF in Ouray County, Colorado. This PA/SI entailed a PA that included historical and database research and an SI that included samples of surface soil, sediment, and surface water for chemical analysis of TAL metals. The chemical analytical results were compared to risk-based and technology-based human and ecological health screening levels. As stated in Section 1.0, the primary objective of the PA/SI is to determine whether there have been releases of hazardous substances warranting a cleanup action under CERCLA (following EPA guidance for PA/SIs and the USFS SOW). Based on the information and data collected, the conclusions and recommendations of the PA/SI follow.

7.1 Waste Pile Surface Soil

At the Irene Mine Site, analytical results for mine-impacted waste pile soils at the Site indicate the following:

- Lead is a COPC in waste pile soil at the Site, and the pathway is complete and significant for Site workers and recreational visitors and ecological receptors; and
- Cadmium, copper, selenium, silver, and zinc are COPECs in waste pile soil at the Site, and the pathway is potentially complete for ecological receptors.

In addition, the Site is located at the trail head for hikers and is available for non-permitted camping on USFS managed land. A fire pit was observed within the sampled area of WP1 during the July 2020 field effort and similar evidence of camping at the Site has been observed historically. Finally, the Site is available for ecological receptors to forage, though very little vegetation is observed on WP1, WP2, and WP3, indicating poor quality for ecological habitation.

Based on these findings, there is evidence of an observed release and of human recreational exposure to toxic heavy metal concentrations in waste pile soil at the Site. Waste pile soils likely present a significant risk to human health and the environment for direct exposure at the Site and may be transported off the Site during periods of flooding in surface water run-off. It is recommended that USFS continue to follow the CERCLA process to address these threats to human health and the environment from Site-related contaminants.

7.2 Sediment

At the Irene Mine Site, sediments were sampled from a saturated area impacted by adit water. A PPE drainage and highway culvert inlet are present to the southeast of Waste Pile 1 (see Section 3.1), with surface runoff or seasonal increases in adit discharge from the Site likely to result in the transport of Site sediments through the culvert beneath Highway 550 before depositing in a wetland located approximately 450 feet from Red Mountain Creek. Analytical results for mine-impacted sediment at the Site indicate the following:



- Copper, iron, lead, and selenium are COPECs in adit sediment and this pathway is complete and significant for ecological receptors; and
- The sediment pathway is potentially complete but insignificant for workers and recreational visitors.

Based on these findings, there is potential for ecological receptors to become exposed to metals in sediments at the Site at concentrations that present an unacceptable risk and a risk of migration to off-Site locations. It is recommended that USFS continue to follow the CERCLA process to address these risks identified at the Site.

7.3 Surface Water

At the Irene Site, surface water was sampled from the on-Site adit. At the time of the SI, the adit seep was a nearly stagnant trickle, with flow too minimal to be measured. However, a PPE drainage and highway culvert inlet are present to the southeast of Waste Pile 1 (see Section 3.1). Observation of topography at the Site suggests that runoff events or seasonal increases to adit discharge may result in surface water flow from the Site traveling through the culvert beneath Highway 550 before depositing in a wetland located approximately 450 feet from Red Mountain Creek.

Analytical results for surface water samples collected from the Site adit indicate the following:

- Cadmium and lead are COPCs in adit water under a drinking water scenario and the pathway is potentially complete; however, the drinking water pathway is considered insignificant for human receptors and
- Aluminum, cadmium, copper, iron, lead, and zinc are COPECs in adit water, and the surface water pathway is considered complete and significant for ecological receptors.

Based on these findings, it is recommended that USFS continue to follow the CERCLA process to address these risks identified at the Site.

7.4 Groundwater

No groundwater samples were collected, and no groundwater wells were identified in proximity to the Site. It is unlikely that groundwater affected by mining activity at the Site will be used for consumptive purposes. The groundwater pathway is considered incomplete for both human and ecological receptors.

However, waste pile soil samples collected for SPLP analysis indicate potential for leaching of lead from WP1 and WP2 to groundwater at concentrations that would exceed MCLs established by USEPA by factors of 29 and 58, respectively. Therefore, while this pathway is not considered complete, USFS should consider the leaching potential of these soils to groundwater when evaluating a potential removal and/or disposal action, if necessary.



7.5 Air

Although air was not sampled during the SI, an evaluation of the air pathway was conducted in proximity to the Site from other sampled media:

- Lead was identified as a COPCs in waste pile soils; and
- Cadmium, copper, lead, selenium, silver, and zinc were identified as COPECs in waste pile soil.

Under undisturbed site-use conditions, it is unlikely that soil from the waste piles will become airborne. However, these contaminants may be an airborne dust concern if dust-generating activities such as recreational vehicles or weather conditions are present at the Site. Therefore, AI recommends additional evaluation of the airborne pathway for the soil COPC and COPECs at the Site if dust-generating activities are planned.



8. REFERENCES

- Applied Intellect (AI), 2020. Final Work Plan, Sampling and Analysis Plan, and Health and Safety Plan, PA/SIs at Five Abandoned Tronox Sites. June 29.
- Colorado Department of Public Health and Environment (CDPHE), 2020. Colorado Integrated Water Quality Monitoring and Assessment Report. Water Quality Control Division. April.
- CDPHE Water Quality Control Commission (WQCC), 2018b. Regulation No. 31 – The Basic Standards and Methodologies for Surface Water. 5 CCR 1002-31. Effective January 31.
- CDPHE WQCC, 20. Regulation No. 35 – Classifications and Numeric Standards for Gunnison and Lower Dolores River Basins. 5 CCR 1002-35. Effective June 30.
- Cox, 2017. BLM Technical Memorandum: Screening Assessment Approaches for Metals in Soil at BLM HazMat/AML Sites. United States Bureau of Land Management. September.
- Ingersoll, C.G., P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, and N.E. Kemble. 1996. Calculation and evaluation of sediment effect concentrations for the amphipod *Hyalella azteca* and the midge *Chironomus riparius*. EPA 905-R96- 008.
- Los Alamos National Laboratory (LANL), 2017. *ECORISK Database (Release 4.1)*. LA-UR-12-24548, Los Alamos National Laboratory, Los Alamos, New Mexico, September. <http://www.lanl.gov/environmental/protection/eco-risk-assessment.php>
- MacDonald, D.D., Ingersoll, C.G., and Berger, T.A. 2000. Development and Evaluation of Consensus-Based Sediment quality Guidelines for Freshwater Ecosystems. Archives of Environmental Contamination and Toxicology. January 13.
- NPS 2018. NPS Protocol for the Selection and Use of Ecological Screening Values for Non-Radiological Analytes. National Park Service Environmental Compliance and Response Branch. November.
- Uncompahgre Watershed Partnership (UWP), 2018. Uncompahgre Watershed Plan, accessed October 27, 2020: <http://www.uncompahgrewatershed.org/reports-plans/>
- United States Environmental Protection Agency (USEPA), 1991. Guidance for Performing Preliminary Assessments Under CERCLA. EPA/540/G-91/013. September.
- USEPA 1992a. Guidance for Performing Site Inspections Under CERCLA. EPA-540-R-92-021. September.
- USEPA 1992b. The Hazard Ranking System Guidance Manual. EPA-540-R-92-026. November.



USEPA 1999. Improving Site Assessment: Combined PA/SI Assessments. EPA-540-F-98-038. OSWER 9375.2-10FS. October.

USEPA. 2005. Ecological soil screening levels. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. <http://www.epa.gov/ecotox/ecossl/>.

USEPA 2020a. Regional Screening Levels (RSLs) – Generic Tables. Last updated May 2020. <https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables>.

USEPA 2020b. Regional Screening Levels (RSLs) – Frequent Questions. Last updated May 2020. <https://www.epa.gov/risk/regional-screening-levels-frequent-questions>.

USGS 1964. Geologic Map of the Ironton Quadrangle, Colorado. GQ-291. W.S. Burbank and R.G. Luedke.

USGS 1973. Revised Volcanic History of the San Juan, Uncompahgre, Silverton, and Lake City Calderas in the Western San Juan Mountains, Colorado. Journal Research of the USGS. Volume 1, No. 6. November-December.

USGS 2000. Sampling Strategy for the Rapid Screening of Mine-Waste Dumps on Abandoned Mine Lands. USGS Open File Report 2000-16.

Worcester 1919. *Molybdenum Deposits of Colorado*. Colorado Geological Society Bulletin No. 14.



TABLES



Table 3-1. Sampling Summary

Sample Id	Date	Sample Media	Location Description	Analyses	GPS Location		QA/QC	
					Latitude	Longitude	Duplicate ID	MS/MSD
IR-SS-BKG-1	July 8, 2020	Surface Soil	Composite background soil	TAL Metals and Mercury ¹	37.93942	-107.82983		
IR-SS-WP1-1	July 8, 2020	Surface Soil	Composite background soil	SPLP, TAL Metals and Mercury	37.93389	-107.68204	IR-SS-WP1-2	Yes
IR-DA-SWT-1	July 8, 2020	Surface Water	Seep in front of mine adit (Total Metals)	TAL Metals and Mercury, Hardness ²	37.93398	-107.68296	IR-DA-SWT-2	
IR-DA-SWD-1	July 8, 2020	Surface Water	Seep in front of mine adit (Dissolved Metals)	TAL Metals and Mercury	37.93398	-107.68296	IR-DA-SWD-2	

¹ Soil and sediment samples were analyzed for: Target Analyte List (TAL) Metals by USEPA Method 6010, including Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Nickel, Potassium, Sodium, Selenium, Silver, Thallium, Vanadium and Zinc, and Mercury by USEPA Method 7471.

² Water samples were analyzed for: TAL Metals (total and dissolved) as listed above by USEPA Method 6010, and Mercury by USEPA Method 7470. Hardness was analyzed by USEPA Method 130.2.

QA/QC – Quality assurance/quality control samples, including duplicates, matrix spike/spike duplicates and rinsate samples.

TAL Metals -Target Analyte List metals



Table 4-1. Human Health Risk-Based Screening Levels

Analyte	CAS Number	Soil		Water	
		BLM Recreation SL ¹ (mg/kg)	USEPA Industrial RSL ² (mg/kg)	USEPA Tap water RSL ³ (µg/L)	USEPA MCL ⁴ (µg/L)
Aluminum	7429-90-5	1000000	1100000	20000	No MCL
Antimony	7440-36-0	782	470	7.8	6
Arsenic	7440-38-2	30.6	3	0.0052	10
Barium	7440-39-3	390000	220000	3800	2000
Beryllium	7440-41-7	3910	2300	25	4
Cadmium	7440-43-9	1780	980	9.2	5
Chromium ⁵	7440-47-3	1000000 ⁵	1800000 ⁶	22000 ⁶	100 ⁵
Cobalt	7440-48-4	586	350	6	No MCL
Copper	7440-50-8	78200	47000	800	1300
Iron	7439-89-6	1000000	820000	14000	No MCL
Lead	7439-92-1	800	800	15	15
Manganese	7439-96-5	46700	26000	430	No MCL
Mercury	7439-97-6	271	46	0.63	2
Nickel	7440-02-0	39000	22000	390	No MCL
Selenium	7782-49-2	9780	5800	100	50
Silver	7440-22-4	9780	5800	94	No MCL
Thallium	7440-28-0	19.6	12	0.2	2
Vanadium	7440-62-2	9850	5800	86	No MCL
Zinc	7440-66-6	587000	350000	6000	No MCL

¹ Bureau of Land Management Recreational Camper Screening Level (SL), (Cox 2017)
² USEPA Regional Screening Levels (RSLs) Industrial Soil, (USEPA, 2020)
³ USEPA Regional Screening Levels (RSLs) Tapwater, (USEPA, 2020)
⁴ USEPA Maximum Contaminant Level (MCL), National Primary Drinking Water Regulations are enforceable drinking water standards
⁵ Chromium SL is for Cr(total)
⁶ Chromium SL is for Cr(III)
CAS Number – Chemical Abstract Service Lookup numbers unique to each chemical.
mg/kg – milligrams per kilogram
mg/L – milligrams per liter



Table 4-2. Ecological Risk-Based Screening Levels for Soil and Sediments

Analyte	CAS Number	Soil		Sediment
		ECO-SSL Birds & Mammals ¹ (mg/kg)	ECO-SSL Plants & Invertebrates ² (mg/kg)	NPS SLERA ESV ³ (mg/kg)
Aluminum	7429-90-5	[4]	[4]	25000
Antimony	7440-36-0	0.27	78	No ESV
Arsenic	7440-38-2	43	18	9.7
Barium	7440-39-3	2000	330	150
Beryllium	7440-41-7	21	40	No ESV
Cadmium	7440-43-9	0.36	140	0.583
Chromium	7440-47-3	26 ⁵	No SSL	36.2 ⁶
Cobalt	7440-48-4	120	13	No ESV
Copper	7440-50-8	28	70	28
Iron	7439-89-6	[7]	[7]	20000
Lead	7439-92-1	11	120	35
Manganese	7439-96-5	4000	220	460
Mercury	7439-97-6	No SSL	No SSL	0.18
Nickel	7440-02-0	130	280	19.5
Selenium	7782-49-2	0.63	0.52	0.72
Silver	7440-22-4	14	560	0.5
Thallium	7440-28-0	No SSL	No SSL	No ESV
Vanadium	7440-62-2	280	No SSL	No ESV
Zinc	7440-66-6	46	120	98

¹ Available at: <http://www.epa.gov/ecotox/ecossl/> , developed according to USEPA (2005)
² Available at: <http://www.epa.gov/ecotox/ecossl/> , developed according to USEPA (2005)
³ From NPS (2018)
⁴ A numeric ECO-SSL is not derived for aluminum. Potential toxicity may be present if soil pH is below 5.5 (see https://www.epa.gov/sites/production/files/2015-09/documents/eco-ssl_aluminum.pdf)
⁵ SL refers to Chromium(III)
⁶ SL refers to Chromium(total)
⁷ A numeric ECO-SSL is not derived for iron. Potential toxicity is based on soil pH and Eh (see https://www.epa.gov/sites/production/files/2015-09/documents/eco-ssl_iron.pdf)
CAS Number – Chemical Abstract Service Lookup numbers unique to each chemical.
ECO-SSL – Ecological soil screening level
ESV – Ecological screening value
mg/kg – milligrams per kilogram
NPS – National Park Service
SLERA – Screening Level Ecological Risk Assessment



Table 4-3. Colorado Hardness Function Coefficients for Aquatic Life Table Value Standards (TVS)¹, Acute and Chronic³

Analyte	Acute Coefficients			
	A	B	C	D
Aluminum ⁴	1	0	1.3695	1.8308
Arsenic	340	0	0	0
Cadmium ⁵	1.136672	0.041838	0.9151	-3.6236
Chromium (III)	50	0	0.819	2.5736
Chromium (VI)	16	0	0	0
Copper	1	0	0.9422	-1.7408
Lead	1.46203	0.145712	1.273	-1.46
Manganese	1	0	0.3331	6.4676
Nickel	1	0	0.846	2.253
Selenium	18.4	0	0	0
Silver	0.5	0	1.72	-6.52
Zinc	0.978	0	0.9094	0.9095
Analyte	Chronic Coefficients			
	A	B	C	D
Aluminum ^{4,6}	1	0	1.3695	-0.1158
Arsenic	150	0	0	0
Cadmium	1.101672	0.041838	0.7998	-4.4451
Chromium (III)	1	0	0.819	0.534
Chromium (VI)	11	0	0	0
Copper	1	0	0.8545	-1.7428
Iron ⁴	1000	0	0	0
Lead	1.46203	0.145712	1.273	-4.705
Manganese	1	0	0.3331	5.8743
Mercury ⁴	0.01	0	0	0
Nickel	1	0	0.846	0.0554
Selenium	4.6	0	0	0
Silver ⁵	1	0	1.72	-10.51
Zinc ^{7,8}	7440-66-6	1	0	2.14
Zinc ^{7,9}	7440-66-6	0.986	0	0.9094

¹ Hardness-based TVS are calculated as follows: $A_m - \{\ln(\text{hardness})(B_m)\} * e^{(C_m \{\ln(\text{hardness})\} + D_m)}$, where A_m , B_m , C_m and D_m are the metal-specific CCC coefficients above, and hardness is expressed as mg/L as CaCO₃. Calculated TVS are in µg/L.

² Colorado Department of Public Health and Environment Water Quality Control Commission, 2018. Regulation No. 31: The Basic Standards and Methodologies for Surface Water, Effective January 31. Hardness-based TVS values are based on a maximum hardness value of 400 mg/L as CaCO₃ for all analytes except aluminum, which is based on a maximum hardness value of 220 mg/L as CaCO₃. Hardness-based TVS are stated as dissolved concentrations unless noted otherwise.

⁴ TSV based on total metal concentration

⁵ TSV assumes trout-bearing surface water

⁶ Where pH is ≥ 7 after mixing, the chronic hardness-dependent coefficients and equation will apply. Where pH is < 7 after mixing, either 87 µg/L or the TSV resulting from the chronic hardness-dependent equation will apply, whichever is more stringent.

⁷ Assumes mottled sculpin-bearing surface water

⁸ Applicable when hardness is < 102 mg/L as CaCO₃

⁹ Applicable when hardness is > 102 mg/L as CaCO₃



Table 5-1. Waste Pile Surface Soil Results Compared to Human Health Screening Levels

Analyte	CAS No.	Screening Levels		IR-SS-WP1-1					IR-SS-WP1-2					IR-SS-WP2-1				
		Recreational SL (mg/kg)	EPA Industrial SL (mg/kg)	Result (mg/kg)	Flag	MDL (mg/kg)	BLM Recreational SL EF	EPA Industrial SL EF	Result (mg/kg)	Flag	MDL (mg/kg)	Recreational SL EF	EPA Industrial SL EF	Result (mg/kg)	Flag	MDL (mg/kg)	Recreational SL EF	EPA Industrial SL EF
Aluminum	7429-90-5	1000000	1100000	2570		41.0	<0.1	<0.1	3360		41.0	<0.1	<0.1	1570		41.0	<0.1	<0.1
Antimony	7440-36-0	782	470	4.10	J	2.50	<0.1	<0.1	<2.50		2.50	<0.1*	<0.1*	<2.50		2.50	<0.1*	<0.1*
Arsenic	7440-38-2	30.6	3	12.2		2.30	0.4	4.1	8.02	J	2.30	0.26	2.7	19.2		2.30	0.63	6.4
Barium	7440-39-3	390000	220000	70.8		1.20	<0.1	<0.1	72.4		1.20	<0.1	<0.1	176		1.20	<0.1	<0.1
Beryllium	7440-41-7	3910	2300	<0.400		0.400	<0.1*	<0.1*	<0.400		0.400	<0.1*	<0.1*	<0.400		0.400	<0.1*	<0.1*
Cadmium	7440-43-9	1780	980	11.0		0.405	<0.1	<0.1	32.7		0.405	<0.1	<0.1	4.86		0.405	<0.1	<0.1
Chromium	7440-47-3	1000000	1800000	<1.25		1.25	<0.1*	<0.1*	<1.25		1.25	<0.1*	<0.1*	<1.25		1.25	<0.1*	<0.1*
Cobalt	7440-48-4	586	350	1.70	J	1.15	<0.1	<0.1	1.28	J	1.15	<0.1	<0.1	<1.15		1.15	<0.1*	<0.1*
Copper	7440-50-8	78200	47000	1670		2.53	<0.1	<0.1	831		2.53	<0.1	<0.1	81.1		2.53	<0.1	<0.1
Iron	7439-89-6	1000000	820000	65600		25.0	<0.1	<0.1	54800		25.0	<0.1	<0.1	18600		25.0	<0.1	<0.1
Lead	7439-92-1	800	800	33400		1.04	42	42	27000		1.04	34	34	13500		1.04	17	17
Manganese	7439-96-5	46700	26000	77.8		1.22	<0.1	<0.1	117		1.22	<0.1	<0.1	66.6		1.22	<0.1	<0.1
Mercury	7439-97-6	271	46	0.537		0.0180	<0.1	<0.1	0.538	J6 O1	0.0180	<0.1	<0.1	0.679		0.0180	<0.1	<0.1
Nickel	7440-02-0	39000	22000	<2.45		2.45	<0.1*	<0.1*	<2.45		2.45	<0.1*	<0.1*	<2.45		2.45	<0.1*	<0.1*
Selenium	7782-49-2	9780	5800	9.63	J	3.08	<0.1	<0.1	8.72	J	3.08	<0.1	<0.1	20.7		3.08	<0.1	<0.1
Silver	7440-22-4	9780	5800	37.1		1.14	<0.1	<0.1	31.3		1.14	<0.1	<0.1	46.7		1.14	<0.1	<0.1
Thallium	7440-28-0	19.6	12	<1.77		1.77	<0.1*	0.15*	<1.77		1.77	<0.1*	0.15*	<1.77		1.77	<0.1*	0.15*
Vanadium	7440-62-2	9850	5800	6.00	J	3.44	<0.1	<0.1	9.10	J	3.44	<0.1	<0.1	<3.44		3.44	<0.1*	<0.1*
Zinc	7440-66-6	587000	350000	3630		4.70	<0.1	<0.1	9280		9.39	<0.1	<0.1	1180		4.70	<0.1	<0.1



Table 5-1. Waste Pile Surface Soil Results Compared to Human Health Screening Levels (continued)

Analyte	CAS No.	Screening Levels		IR-SS-WP3-1					IR-SS-WP3-2				
		Recreational SL (mg/kg)	EPA Industrial SL (mg/kg)	Result (mg/kg)	Flag	MDL (mg/kg)	Recreational SL EF	EPA Industrial SL EF	Result (mg/kg)	Flag	MDL (mg/kg)	Recreational SL EF	EPA Industrial SL EF
Aluminum	7429-90-5	1000000	1100000	1210		30.4	<0.1	<0.1	1750		60.8	<0.1	<0.1
Antimony	7440-36-0	782	470	38.1		2.72	<0.1	<0.1	35.6		5.44	<0.1	<0.1
Arsenic	7440-38-2	30.6	3	7.03	J	2.59	0.23	2.3	5.74	J	5.18	0.19	1.9
Barium	7440-39-3	390000	220000	43.2		0.426	<0.1	<0.1	48.7		0.852	<0.1	<0.1
Beryllium	7440-41-7	3910	2300	<0.158		0.158	<0.1*	<0.1*	<0.315		0.315	<0.1*	<0.1*
Cadmium	7440-43-9	1780	980	48.0		0.236	<0.1	<0.1	29.6		0.471	<0.1	<0.1
Chromium	7440-47-3	1000000	1800000	<0.665		0.665	<0.1*	<0.1*	<1.33		1.33	<0.1*	<0.1*
Cobalt	7440-48-4	586	350	1.34	B J	0.406	<0.1	<0.1	<0.811		0.811	<0.1*	<0.1*
Copper	7440-50-8	78200	47000	783		2.00	<0.1	<0.1	770		4.00	<0.1	<0.1
Iron	7439-89-6	1000000	820000	38800		11.2	<0.1	<0.1	49100		22.4	<0.1	<0.1
Lead	7439-92-1	800	800	52100		2.08	65	65	77900		2.08	97	97
Manganese	7439-96-5	46700	26000	78.7		0.665	<0.1	<0.1	56.2		1.33	<0.1	<0.1
Mercury	7439-97-6	271	46	0.435	J3 J6 O1	0.0180	<0.1	<0.1	0.0272	J	0.0180	<0.1	<0.1
Nickel	7440-02-0	39000	22000	<0.660		0.660	<0.1*	<0.1*	<1.32		1.32	<0.1*	<0.1*
Selenium	7782-49-2	9780	5800	11.1		3.82	<0.1	<0.1	20.0		7.64	<0.1	<0.1
Silver	7440-22-4	9780	5800	54.5		0.635	<0.1	<0.1	83.2		1.27	<0.1	<0.1
Thallium	7440-28-0	19.6	12	<1.97		1.97	0.1*	0.16*	<3.94		3.94	0.2*	0.33*
Vanadium	7440-62-2	9850	5800	<2.53		2.53	<0.1*	<0.1*	<5.06		5.06	<0.1*	<0.1*
Zinc	7440-66-6	587000	350000	13900		8.32	<0.1	<0.1	8910		8.32	<0.1	<0.1

Values in red indicate EF > 1
* Analyte not present above MDL; value calculated from MDL
¹ Chromium SL is for Cr(III)
BLM – Bureau of Land Management
CAS – Chemical Abstracts Service
EF – Exceedance Factor
EPA – United States Environmental Protection Agency
J – The identification of the analyte is acceptable; the reported value is an estimate.
J3 – The associated batch QC was outside the established quality control range for precision.
J6 – The sample matrix interfered with the ability to make any accurate determination; spike value is low
MDL – Laboratory Method Detection Limit
mg/kg – Milligrams per kilogram
NA - Not applicable
NE – Not established
O1 -- The analyte failed the method required serial dilution test and/or subsequent post-spike criteria. These failures indicate matrix interference.
SL – Screening Level



Table 5-2. Waste Pile Surface Soil Results Compared to Ecological Screening Values

Analyte	CAS No.	Screening Levels		IR-SS-WP1-1					IR-SS-WP1-2					IR-SS-WP2-1				
		EPA B&M SSL (mg/kg)	EPA P&I SSL (mg/kg)	Result (mg/kg)	Flag	MDL (mg/kg)	EPA B&M EF	EPA P&I EF	Result (mg/kg)	Flag	MDL (mg/kg)	EPA B&M EF	EPA P&I EF	Result (mg/kg)	Flag	MDL (mg/kg)	EPA B&M EF	EPA P&I EF
Aluminum	7429-90-5	NE	NE	2570		41.0	NA	NA	3360		41.0	NA	NA	1570		41.0	NA	NA
Antimony	7440-36-0	0.27	78	4.10	J	2.50	15	<0.1	<2.50		2.50	9.3*	<0.1*	<2.50		2.50	9.3*	<0.1*
Arsenic	7440-38-2	43	18	12.2		2.30	0.28	0.68	8.02	J	2.30	0.19	0.45	19.2		2.30	0.45	1.1
Barium	7440-39-3	2000	330	70.8		1.20	<0.1	0.21	72.4		1.20	<0.1	0.22	176		1.20	<0.1	0.53
Beryllium	7440-41-7	21	40	<0.400		0.400	<0.1*	<0.1*	<0.400		0.400	<0.1*	<0.1*	<0.400		0.400	<0.1*	<0.1*
Cadmium	7440-43-9	0.36	140	11.0		0.405	31	<0.1	32.7		0.405	91	0.23	4.86		0.405	14	<0.1
Calcium	7440-70-2	NE	NE	151	J	150.	NA	NA	167	J	150.	NA	NA	<150.		150.	NA	NA
Chromium	7440-47-3	26	NE	<1.25		1.25	<0.1*	NA	<1.25		1.25	<0.1*	NA	<1.25		1.25	<0.1*	NA
Cobalt	7440-48-4	120	13	1.70	J	1.15	<0.1	0.13	1.28	J	1.15	<0.1	<0.1	<1.15		1.15	<0.1*	<0.1*
Copper	7440-50-8	28	70	1670		2.53	60	24	831		2.53	30	12	81.1		2.53	2.9	1.2
Iron	7439-89-6	NE	NE	65600		25.0	NA	NA	54800		25.0	NA	NA	18600		25.0	NA	NA
Lead	7439-92-1	11	120	33400		1.04	3000	280	27000		1.04	2500	220	13500		1.04	1200	110
Magnesium	7439-95-4	NE	NE	300	J	102.	NA	NA	725		102.	NA	NA	174	J	102.	NA	NA
Manganese	7439-96-5	4000	220	77.8		1.22	<0.1	0.35	117		1.22	<0.1	0.53	66.6		1.22	<0.1	0.3
Mercury	7439-97-6	NE	NE	0.537		0.0180	NA	NA	0.538	J6 O1	0.0180	NA	NA	0.679		0.0180	NA	NA
Nickel	7440-02-0	130	280	<2.45		2.45	<0.1*	<0.1*	<2.45		2.45	<0.1*	<0.1*	<2.45		2.45	<0.1*	<0.1*
Potassium	7440-09-7	NE	NE	1610		104.	NA	NA	1560		104.	NA	NA	1290		104.	NA	NA
Selenium	7782-49-2	0.63	0.52	9.63	J	3.08	15	19	8.72	J	3.08	14	17	20.7		3.08	33	40
Silver	7440-22-4	14	560	37.1		1.14	2.6	<0.1	31.3		1.14	2.2	<0.1	46.7		1.14	3.3	<0.1
Sodium	7440-23-5	NE	NE	<166.		166.	NA	NA	<166.		166.	NA	NA	<166.		166.	NA	NA
Thallium	7440-28-0	NE	NE	<1.77		1.77	NA	NA	<1.77		1.77	NA	NA	<1.77		1.77	NA	NA
Vanadium	7440-62-2	280	NE	6.00	J	3.44	<0.1	NA	9.10	J	3.44	<0.1	NA	<3.44		3.44	<0.1*	NA
Zinc	7440-66-6	46	120	3630		4.70	79	30	9280		9.39	200	77	1180		4.70	26	9.8



Table 5-2. Waste Pile Surface Soil Results Compared to Ecological Screening Values (continued)

Analyte	CAS No.	Screening Levels		IR-SS-WP3-1					IR-SS-WP3-2				
		EPA B&M SSL (mg/kg)	EPA P&I SSL (mg/kg)	Result (mg/kg)	Flag	MDL (mg/kg)	EPA B&M EF	EPA P&I EF	Result (mg/kg)	Flag	MDL (mg/kg)	EPA B&M EF	EPA P&I EF
Aluminum	7429-90-5	NE	NE	1210		30.4	NA	NA	1750		60.8	NA	NA
Antimony	7440-36-0	0.27	78	38.1		2.72	140	0.49	35.6		5.44	130	0.46
Arsenic	7440-38-2	43	18	7.03	J	2.59	0.16	0.39	5.74	J	5.18	0.13	0.32
Barium	7440-39-3	2000	330	43.2		0.426	<0.1	0.13	48.7		0.852	<0.1	0.15
Beryllium	7440-41-7	21	40	<0.158		0.158	<0.1*	<0.1*	<0.315		0.315	<0.1*	<0.1*
Cadmium	7440-43-9	0.36	140	48.0		0.236	130	0.34	29.6		0.471	82	0.21
Calcium	7440-70-2	NE	NE	<53.0		53.0	NA	NA	<106.		106.	NA	NA
Chromium	7440-47-3	26	NE	<0.665		0.665	<0.1*	NA	<1.33		1.33	<0.1*	NA
Cobalt	7440-48-4	120	13	1.34	B J	0.406	<0.1	0.1	<0.811		0.811	<0.1*	<0.1*
Copper	7440-50-8	28	70	783		2.00	28	11	770		4.00	28	11
Iron	7439-89-6	NE	NE	38800		11.2	NA	NA	49100		22.4	NA	NA
Lead	7439-92-1	11	120	52100		2.08	4700	430	77900		2.08	7100	650
Magnesium	7439-95-4	NE	NE	156	J	36.9	NA	NA	239	J	73.8	NA	NA
Manganese	7439-96-5	4000	220	78.7		0.665	<0.1	0.36	56.2		1.33	<0.1	0.26
Mercury	7439-97-6	NE	NE	0.435	J3 J6 O1	0.0180	NA	NA	0.0272	J	0.0180	NA	NA
Nickel	7440-02-0	130	280	<0.660		0.660	<0.1*	<0.1*	<1.32		1.32	<0.1*	<0.1*
Potassium	7440-09-7	NE	NE	914		104.	NA	NA	1110		209.	NA	NA
Selenium	7782-49-2	0.63	0.52	11.1		3.82	18	21	20.0		7.64	32	38
Silver	7440-22-4	14	560	54.5		0.635	3.9	<0.1	83.2		1.27	5.9	0.15
Sodium	7440-23-5	NE	NE	<206.		206.	NA	NA	<412.		412.	NA	NA
Thallium	7440-28-0	NE	NE	<1.97		1.97	NA	NA	<3.94		3.94	NA	NA
Vanadium	7440-62-2	280	NE	<2.53		2.53	<0.1*	NA	<5.06		5.06	<0.1*	NA
Zinc	7440-66-6	46	120	13900		8.32	300	120	8910		8.32	190	74

Values in red indicate EF > 1
* Analyte not present above MDL; value calculated from MDL
B&M – Birds and Mammals
CAS – Chemical Abstracts Service
EF – Exceedance factor
ESV – Ecological Screening Value
J – The identification of the analyte is acceptable; the reported value is an estimate
J3 – The associated batch QC was outside the established quality control range for precision.
J6 – The sample matrix interfered with the ability to make any accurate determination; spike value is low
MDL – Laboratory Method Detection Limit



mg/kg – Milligrams per kilogram
NA - Not applicable
NE – Not established
NPS – National Park Service
O1 -- The analyte failed the method required serial dilution test and/or subsequent post-spike criteria. These failures indicate matrix interference.
P&I – Plants and Invertebrates



Table 5-3. Background Surface Soil Results

Analyte	CAS No.	IR-SS-BKG-1		
		Result (mg/kg)	Flags	MDL (mg/kg)
Aluminum	7429-90-5	11700		8.20
Antimony	7440-36-0	1.64	J	0.500
Arsenic	7440-38-2	6.65		0.460
Barium	7440-39-3	130		0.240
Beryllium	7440-41-7	0.354		0.0800
Cadmium	7440-43-9	0.369	J	0.0810
Calcium	7440-70-2	2500		30.0
Chromium	7440-47-3	6.18		0.250
Cobalt	7440-48-4	3.76		0.230
Copper	7440-50-8	18.7		0.506
Iron	7439-89-6	42000		5.00
Lead	7439-92-1	261		0.208
Magnesium	7439-95-4	2970		20.5
Manganese	7439-96-5	247		0.245
Mercury	7439-97-6	0.0283	J	0.0180
Nickel	7440-02-0	3.76		0.490
Potassium	7440-09-7	1930		20.9
Selenium	7782-49-2	1.14	J	0.617
Silver	7440-22-4	0.411	J	0.228
Sodium	7440-23-5	83.3	J	33.2
Thallium	7440-28-0	<0.354		0.354
Vanadium	7440-62-2	20.8		0.687
Zinc	7440-66-6	93.0		0.939

CAS – Chemical Abstracts Service
J – The identification of the analyte is acceptable; the reported value is an estimate.
MDL – Method detection limit
mg/kg – Milligrams per kilogram



Table 5-4. Waste Pile Surface Soil Results Compared to Background Surface Soil Results

Analyte	CAS No.	Maximum Background Soil Concentration (mg/kg)	IR-SS-WP1-1				IR-SS-WP1-2				IR-SS-WP2-1			
			Result (mg/kg)	Flag	MDL (mg/kg)	Background Exceedance Factor	Result (mg/kg)	Flag	MDL (mg/kg)	Background Exceedance Factor	Result (mg/kg)	Flag	MDL (mg/kg)	Background Exceedance Factor
Aluminum	7429-90-5	11700	2570		41.0		3360		41.0		1570		41.0	
Antimony	7440-36-0	1.64	4.10	J	2.50	2.5	<2.50		2.50		<2.50		2.50	
Arsenic	7440-38-2	6.65	12.2		2.30	1.8	8.02	J	2.30	1.2	19.2		2.30	2.9
Barium	7440-39-3	130	70.8		1.20		72.4		1.20		176		1.20	1.4
Beryllium	7440-41-7	0.354	<0.400		0.400		<0.400		0.400		<0.400		0.400	
Cadmium	7440-43-9	0.369	11.0		0.405	30	32.7		0.405	89	4.86		0.405	13
Calcium	7440-70-2	2500	151	J	150		167	J	150		<150		150	
Chromium	7440-47-3	6.18	<1.25		1.25		<1.25		1.25		<1.25		1.25	
Cobalt	7440-48-4	3.76	1.70	J	1.15		1.28	J	1.15		<1.15		1.15	
Copper	7440-50-8	18.7	1670		2.53	89	831		2.53	44	81.1		2.53	4.3
Iron	7439-89-6	42000	65600		25.0	1.6	54800		25.0	1.3	18600		25.0	
Lead	7439-92-1	261	33400		1.04	130	27000		1.04	100	13500		1.04	52
Magnesium	7439-95-4	2970	300	J	102		725		102		174	J	102	
Manganese	7439-96-5	247	77.8		1.22		117		1.22		66.6		1.22	
Mercury	7439-97-6	0.0283	0.537		0.0180	19	0.538	J6 O1	0.0180	19	0.679		0.0180	24
Nickel	7440-02-0	3.76	<2.45		2.45		<2.45		2.45		<2.45		2.45	
Potassium	7440-09-7	1930	1610		104		1560		104		1290		104	
Selenium	7782-49-2	1.14	9.63	J	3.08	8.4	8.72	J	3.08	7.6	20.7		3.08	18
Silver	7440-22-4	0.411	37.1		1.14	90	31.3		1.14	76	46.7		1.14	110
Sodium	7440-23-5	83.3	<166		166		<166		166		<166		166	
Thallium	7440-28-0	<MDL	<1.77		1.77		<1.77		1.77		<1.77		1.77	
Vanadium	7440-62-2	20.8	6.00	J	3.44		9.10	J	3.44		<3.44		3.44	
Zinc	7440-66-6	93.0	3630		4.70	39	9280		9.39	100	1180		4.70	13



Table 5-4. Waste Pile Surface Soil Results Compared to Background Surface Soil Results (continued)

Analyte	CAS No.	Maximum Background Soil Concentration (mg/kg)	IR-SS-WP3-1				IR-SS-WP3-2			
			Result (mg/kg)	Flag	MDL (mg/kg)	Background Exceedance Factor	Result (mg/kg)	Flag	MDL (mg/kg)	Background Exceedance Factor
Aluminum	7429-90-5	11700	1210		30.4		1750		60.8	
Antimony	7440-36-0	1.64	38.1		2.72	23	35.6		5.44	22
Arsenic	7440-38-2	6.65	7.03	J	2.59	1.1	5.74	J	5.18	
Barium	7440-39-3	130	43.2		0.426		48.7		0.852	
Beryllium	7440-41-7	0.354	<0.158		0.158		<0.315		0.315	
Cadmium	7440-43-9	0.369	48.0		0.236	130	29.6		0.471	80
Calcium	7440-70-2	2500	<53.0		53.0		<106		106	
Chromium	7440-47-3	6.18	<0.665		0.665		<1.33		1.33	
Cobalt	7440-48-4	3.76	1.34	B J	0.406		<0.811		0.811	
Copper	7440-50-8	18.7	783		2.00	42	770		4.00	41
Iron	7439-89-6	42000	38800		11.2		49100		22.4	1.2
Lead	7439-92-1	261	52100		2.08	200	77900		2.08	300
Magnesium	7439-95-4	2970	156	J	36.9		239	J	73.8	
Manganese	7439-96-5	247	78.7		0.665		56.2		1.33	
Mercury	7439-97-6	0.0283	0.435	J3 J6 O1	0.0180	15	0.0272	J	0.0180	
Nickel	7440-02-0	3.76	<0.660		0.660		<1.32		1.32	
Potassium	7440-09-7	1930	914		104		1110		209	
Selenium	7782-49-2	1.14	11.1		3.82	9.7	20.0		7.64	18
Silver	7440-22-4	0.411	54.5		0.635	130	83.2		1.27	200
Sodium	7440-23-5	83.3	<206		206		<412		412	
Thallium	7440-28-0	<MDL	<1.97		1.97		<3.94		3.94	
Vanadium	7440-62-2	20.8	<2.53		2.53		<5.06		5.06	
Zinc	7440-66-6	93.0	13900		8.32	150	8910		8.32	96

Values in red indicate >3x maximum background
CAS – Chemical Abstracts Service
J – The identification of the analyte is acceptable; the reported value is an estimate
J3 – The associated batch QC was outside the established quality control range for precision.
J6 – The sample matrix interfered with the ability to make any accurate determination; spike value is low
mg/kg – Milligrams per kilogram
MDL – Laboratory Method Detection Limit
O1 -- The analyte failed the method required serial dilution test and/or subsequent post-spike criteria. These failures indicate matrix interference.



Table 5-5. Waste Pile Surface Soil Synthetic Precipitation Leaching Procedure (SPLP) Results Compared to USEPA MCLs

Analyte	CAS No.	Screening Levels	IR-SS-WP1-1				IR-SS-WP2-1				IR-SS-WP3-1			
		20x EPA MCL (ug/L)	Result (ug/L)	Flag	MDL (ug/L)	20x EPA MCL EF	Result (ug/L)	Flag	MDL (ug/L)	20x EPA MCL EF	Result (ug/L)	Flag	MDL (ug/L)	20x EPA MCL EF
Aluminum	7429-90-5	NE	210		70.4	NA	273		70.4	NA				
Antimony	7440-36-0	120	<4.30		4.30	<0.1*	<4.30		4.30	<0.1*				
Arsenic	7440-38-2	200	<4.40		4.40	<0.1*	<4.40		4.40	<0.1*	<4.40		4.40	<0.1*
Barium	7440-39-3	40000	47.2		0.895	<0.1	72.6		0.895	<0.1				
Beryllium	7440-41-7	80	<0.460		0.460	<0.1*	<0.460		0.460	<0.1*				
Cadmium	7440-43-9	100	4.73		0.563	<0.1	1.83	J	0.563	<0.1	79.6		0.479	0.8
Calcium	7440-70-2	NE	2940		389	NA	2150		389	NA				
Chromium	7440-47-3	2000	<5.00		5.00	<0.1*	<5.00		5.00	<0.1*				
Cobalt	7440-48-4	NE	0.905	J	0.807	NA	<0.807		0.807	NA				
Copper	7440-50-8	26000	130		4.69	<0.1	76.8		4.69	<0.1	1580		3.68	<0.1
Iron	7439-89-6	NE	2900		45.8	NA	252		45.8	NA				
Lead	7439-92-1	300	8570		2.95	29	17300		2.95	58	4760		2.99	16
Magnesium	7439-95-4	NE	519	J	111	NA	555	J	111	NA				
Manganese	7439-96-5	NE	90.2		3.27	NA	47.4		3.27	NA				
Mercury	7439-97-6	40	<0.100		0.100	<0.1*	<0.100		0.100	<0.1*				
Nickel	7440-02-0	NE	3.64	J	2.98	NA	<2.98		2.98	NA				
Potassium	7440-09-7	NE	2720		510	NA	3390		510	NA				
Selenium	7782-49-2	1000	<7.35		7.35	<0.1*	<7.35		7.35	<0.1*				
Silver	7440-22-4	NE	<1.91		1.91	NA	<1.91		1.91	NA				
Sodium	7440-23-5	NE	15900		1400	NA	3610		1400	NA				
Thallium	7440-28-0	40	<4.31		4.31	0.11*	<4.31		4.31	0.11*				
Vanadium	7440-62-2	NE	<6.34		6.34	NA	<6.34		6.34	NA				
Zinc	7440-66-6	NE	1650		9.16	NA	524		9.16	NA	20200		32.6	NA

Values in red indicate EF > 1
CAS – Chemical Abstracts Service
J – The identification of the analyte is acceptable; the reported value is an estimate
mg/kg – Milligrams per kilogram
MCL – Maximum contaminant level
MDL – Laboratory Method Detection Limit
NA – Not applicable
NE – Not established



Table 5-6. Sediment Results Compared to Ecological Screening Values

Analyte	CAS No.	NPS SLERA ESV Sediments (mg/kg)	IR-DA-SD-1				IR-DA-SD-2			
			Result (mg/kg)	Flag	MDL (mg/kg)	ESV EF	Result (mg/kg)	Flag	MDL (mg/kg)	ESV EF
Antimony	7440-36-0	NE	5.97	J	2.50	NA	5.22	J	2.50	NA
Arsenic	7440-38-2	9.7	<2.30		2.30	0.24*	<2.30		2.30	0.24*
Barium	7440-39-3	150	12.6		1.20	<0.1	9.83		1.20	<0.1
Beryllium	7440-41-7	NE	<0.400		0.400	NA	<0.400		0.400	NA
Cadmium	7440-43-9	0.583	<0.405		0.405	0.69*	<0.405		0.405	0.69*
Calcium	7440-70-2	NE	<150		150	NA	<150		150	NA
Chromium	7440-47-3	36.2	<1.25		1.25	<0.1*	<1.25		1.25	<0.1*
Cobalt	7440-48-4	NE	<1.15		1.15	NA	<1.15		1.15	NA
Copper	7440-50-8	28	73.0		2.53	2.6	53.0		2.53	1.9
Iron	7439-89-6	2e+04	173000		25.0	8.6	139000		25.0	7
Lead	7439-92-1	35	86.5		1.04	2.5	78.7		1.04	2.2
Magnesium	7439-95-4	NE	104	J	102	NA	<102		102	NA
Manganese	7439-96-5	460	11.0		1.22	<0.1	8.40		1.22	<0.1
Mercury	7439-97-6	0.18	0.0304	J	0.0180	0.17	0.0208	J	0.0180	0.12
Nickel	7440-02-0	19.5	<2.45		2.45	0.13*	<2.45		2.45	0.13*
Potassium	7440-09-7	NE	155	J	104	NA	171	J	104	NA
Selenium	7782-49-2	0.72	5.16	J	3.08	7.2	3.42	J	3.08	4.8
Silver	7440-22-4	0.5	<1.14		1.14	2.3*	<1.14		1.14	2.3*
Sodium	7440-23-5	NE	<166		166	NA	<166		166	NA
Thallium	7440-28-0	NE	<1.77		1.77	NA	<1.77		1.77	NA
Vanadium	7440-62-2	NE	6.95	J	3.44	NA	4.64	J	3.44	NA
Zinc	7440-66-6	98	70.1		4.70	0.72	49.7		4.70	0.51

Values in red indicate EF > 1
* Analyte not present above MDL; value calculated from MDL
CAS – Chemical Abstracts Service
EF – Exceedance factor
J – The identification of the analyte is acceptable; the reported value is an estimate.
MDL – Method detection limit
mg/kg – Milligrams per kilogram
NA – Not applicable
NE – Not established
NPS – National Park Service
SLERA ESV – Screening Level Ecological Risk Assessment Ecological Screening Value



Table 5-7. Adit Water Sample Results Compared to Human Health Screening Levels (Dissolved Metals)

Analyte	CAS No.	EPA Tapwater RSL (ug/L)	IR-DA-SWD-1				IR-DA-SWD-2			
			Result (ug/L)	Flag	MDL (ug/L)	EPA Tapwater EF	Result (ug/L)	Flag	MDL (ug/L)	EPA Tapwater EF
Aluminum, Dissolved	7429-90-5	20000	6920		70.4	0.35	6890		70.4	0.34
Antimony, Dissolved	7440-36-0	7.8	6.74	J	4.30	0.86	<4.30		4.30	0.55*
Arsenic, Dissolved	7440-38-2	0.052	<4.40		4.40	85*	<4.40		4.40	85*
Barium, Dissolved	7440-39-3	3800	8.06		0.895	<0.1	7.81		0.895	<0.1
Beryllium, Dissolved	7440-41-7	25	1.31	J	0.460	<0.1	1.30	J	0.460	<0.1
Cadmium, Dissolved	7440-43-9	9.2	8.96		0.563	0.97	9.07		0.563	0.99
Calcium, Dissolved	7440-70-2	NE	56800		389	NA	56700		389	NA
Chromium, Dissolved	7440-47-3	22000 ¹	<5.00		5.00	<0.1*	<5.00		5.00	<0.1*
Cobalt, Dissolved	7440-48-4	6	34.9		0.807	5.8	34.9		0.807	5.8
Copper, Dissolved	7440-50-8	800	98.7		4.69	0.12	100		4.69	0.12
Iron, Dissolved	7439-89-6	14000	11400		45.8	0.81	11900		45.8	0.85
Lead, Dissolved	7439-92-1	15	176		2.95	12	175		2.95	12
Magnesium, Dissolved	7439-95-4	NE	11500		111	NA	11500		111	NA
Manganese, Dissolved	7439-96-5	430	1560		3.27	3.6	1540		3.27	3.6
Mercury, Dissolved	7439-97-6	0.63	<0.100		0.100	0.16*	<0.100		0.100	0.16*
Nickel, Dissolved	7440-02-0	390	15.8		2.98	<0.1	15.8		2.98	<0.1
Potassium, Dissolved	7440-09-7	NE	1390	J	510	NA	1430	J	510	NA
Selenium, Dissolved	7782-49-2	100	<7.35		7.35	<0.1*	<7.35		7.35	<0.1*
Silver, Dissolved	7440-22-4	94	<1.91		1.91	<0.1*	<1.91		1.91	<0.1*
Sodium, Dissolved	7440-23-5	NE	6990		1400	NA	7000		1400	NA
Thallium, Dissolved	7440-28-0	0.2	<4.31		4.31	22*	<4.31		4.31	22*
Vanadium, Dissolved	7440-62-2	86	<6.34		6.34	<0.1*	<6.34		6.34	<0.1*
Zinc, Dissolved	7440-66-6	6000	1590		9.16	0.26	1580		9.16	0.26

Values in red indicate EF > 1
* Analyte not present above MDL; value calculated from MDL
¹ Chromium SL is for Cr(III)
CAS – Chemical Abstracts Service
EF – Exceedance Factor
EPA – US Environmental Protection Agency
J – The identification of the analyte is acceptable; the reported value is an estimate.
MDL – Method detection limit
NA – Not applicable



NE – Not established
µg/L – micrograms per liter
RSL – Regional Screening Level



Table 5-8. Adit Water Samples Compared to Human Health Screening Levels (Total Metals)

Analyte	CAS No.	Screening Levels		IR-DA-SWT-1					IR-DA-SWT-2				
		EPA Tapwater RSL (ug/L)	EPA MCL (ug/L)	Result (ug/L)	Flag	MDL (ug/L)	EPA Tapwater EF	EPA MCL EF	Result (ug/L)	Flag	MDL (ug/L)	EPA Tapwater EF	EPA MCL EF
Aluminum	7429-90-5	20000	NE	6940		70.4	0.35	NA	6940		70.4	0.35	NA
Antimony	7440-36-0	7.8	6	<4.30		4.30	0.55*	0.72*	<4.30		4.30	0.55*	0.72*
Arsenic	7440-38-2	0.052	10	<4.40		4.40	85*	0.44*	<4.40		4.40	85*	0.44*
Barium	7440-39-3	3800	2000	8.54		0.895	<0.1	<0.1	8.23		0.895	<0.1	<0.1
Beryllium	7440-41-7	25	4	1.30	J	0.460	<0.1	0.32	1.35	J	0.460	<0.1	0.34
Cadmium	7440-43-9	9.2	5	9.34		0.563	1	1.9	9.32		0.563	1	1.9
Calcium	7440-70-2	NE	NE	56800		389	NA	NA	56900		389	NA	NA
Chromium	7440-47-3	22000*	100	<5.00		5.00	<0.1*	<0.1*	<5.00		5.00	<0.1*	<0.1*
Cobalt	7440-48-4	6	NE	36.2		0.807	6	NA	36.1		0.807	6	NA
Copper	7440-50-8	800	1300	108		4.69	0.14	<0.1	109		4.69	0.14	<0.1
Hardness	471-34-1	NE	NE	191000		457	NA	NA	191000		457	NA	NA
Iron	7439-89-6	14000	NE	13300		45.8	0.95	NA	13000		45.8	0.93	NA
Lead	7439-92-1	15	15	180		2.95	12	12	180		2.95	12	12
Magnesium	7439-95-4	NE	NE	12000		111	NA	NA	12000		111	NA	NA
Manganese	7439-96-5	430	NE	1580		3.27	3.7	NA	1570		3.27	3.7	NA
Mercury	7439-97-6	0.63	2	<0.100		0.100	0.16*	<0.1*	<0.100		0.100	0.16*	<0.1*
Nickel	7440-02-0	390	NE	15.7		2.98	<0.1	NA	15.2		2.98	<0.1	NA
Potassium	7440-09-7	NE	NE	1420	J	510	NA	NA	1500	J	510	NA	NA
Selenium	7782-49-2	100	50	<7.35		7.35	<0.1*	0.15*	<7.35		7.35	<0.1*	0.15*
Silver	7440-22-4	94	NE	<1.91		1.91	<0.1*	NA	<1.91		1.91	<0.1*	NA
Sodium	7440-23-5	NE	NE	7020		1400	NA	NA	7020		1400	NA	NA
Thallium	7440-28-0	0.2	2	<4.31		4.31	22*	2.2*	<4.31		4.31	22*	2.2*
Vanadium	7440-62-2	86	NE	<6.34		6.34	<0.1*	NA	<6.34		6.34	<0.1*	NA
Zinc	7440-66-6	6000	NE	1620		9.16	0.27	NA	1620		9.16	0.27	NA

Values in red indicate EF > 1
* Analyte not present above MDL; value calculated from MDL
¹ Chromium SL is for Cr(III)
CAS – Chemical Abstracts Service
EF – Exceedance Factor
EPA – US Environmental Protection Agency
J – The identification of the analyte is acceptable; the reported value is an estimate.
MCL – Maximum Contaminant Level
MDL – Method detection limit



NA – Not applicable
NE – Not established
µg/L – micrograms per liter
RSL – Regional Screening Level



Table 5-9. Adit Water Sample Results Compared to Ecological Screening Levels

Analyte	CAS No.	IR-DA-SW-1							IR-DA-SW-2						
		Result (ug/L)	Flag	MDL (ug/L)	SS Acute ESV (ug/L)	SS Chronic ESV (ug/L)	SS Acute EF	SS Chronic EF	Result (ug/L)	Flag	MDL (ug/L)	SS Acute ESV (ug/L)	SS Chronic ESV (ug/L)	SS Acute EF	SS Chronic EF
Aluminum, total	7429-90-5	6940		70.4	8300	87	0.84	80	6940		70.4	8300	87	0.84	80
Antimony, dissolved	7440-36-0	6.74	J	4.30	NE	NE	NA	NA	<4.30		4.30	NE	NE	NA	NA
Arsenic, dissolved	7440-38-2	<4.40		4.40	340	150	<0.1*	<0.1*	<4.40		4.40	340	150	<0.1*	<0.1*
Barium, dissolved	7440-39-3	8.06		0.895	NE	NE	NA	NA	7.81		0.895	NE	NE	NA	NA
Beryllium, dissolved	7440-41-7	1.31	J	0.460	NE	NE	NA	NA	1.30	J	0.460	NE	NE	NA	NA
Cadmium, dissolved	7440-43-9	8.96		0.563	3	0.69	3	13	9.07		0.563	3	0.69	3	13
Calcium, dissolved	7440-70-2	56800		389	NE	NE	NA	NA	56700		389	NE	NE	NA	NA
Chromium, dissolved	7440-47-3	<5.00		5.00	48000	130	<0.1*	<0.1*	<5.00		5.00	48000	130	<0.1*	<0.1*
Cobalt, dissolved	7440-48-4	34.9		0.807	NE	NE	NA	NA	34.9		0.807	NE	NE	NA	NA
Copper, dissolved	7440-50-8	98.7		4.69	25	16	4	6.3	100		4.69	25	16	4	6.4
Iron, total	7439-89-6	13300		45.8	NE	1000	NA	13	13000		45.8	NE	1000	NA	13
Lead, dissolved	7439-92-1	176		2.95	130	5.1	1.4	35	175		2.95	130	5.1	1.3	35
Magnesium, dissolved	7439-95-4	11500		111	NE	NE	NA	NA	11500		111	NE	NE	NA	NA
Manganese, dissolved	7439-96-5	1560		3.27	3700	2000	0.42	0.76	1540		3.27	3700	2000	0.42	0.75
Mercury, total	7439-97-6	<0.100		0.100	NE	0.01	NA	10*	<0.100		0.100	NE	0.01	NA	10*
Nickel, dissolved	7440-02-0	15.8		2.98	810	90	<0.1	0.18	15.8		2.98	810	90	<0.1	0.18
Potassium, dissolved	7440-09-7	1390	J	510	NE	NE	NA	NA	1430	J	510	NE	NE	NA	NA
Selenium, dissolved	7782-49-2	<7.35		7.35	18	4.6	0.4*	1.6*	<7.35		7.35	18	4.6	0.4*	1.6*
Silver, dissolved	7440-22-4	<1.91		1.91	6.2	0.23	0.31*	8.4*	<1.91		1.91	6.2	0.23	0.31*	8.4*
Sodium, dissolved	7440-23-5	6990		1400	NE	NE	NA	NA	7000		1400	NE	NE	NA	NA
Thallium, dissolved	7440-28-0	<4.31		4.31	NE	NE	NA	NA	<4.31		4.31	NE	NE	NA	NA
Vanadium, dissolved	7440-62-2	<6.34		6.34	NE	NE	NA	NA	<6.34		6.34	NE	NE	NA	NA
Zinc, dissolved	7440-66-6	1590		9.16	290	220	5.5	7.3	1580		9.16	290	220	5.5	7.2
Hardness as CaCO3	471-34-1	191000		457	NE	NE	NA	NA	191000		457	NE	NE	NA	NA

Values in red indicate EF > 1
* Analytical results below MDL; result calculated from MDL
EF – Exceedance factor
ESV – Ecological Screening Level
J – The identification of the analyte is acceptable; the reported value is an estimate.
MDL – Laboratory Method Detection Limit
NA – Not applicable
NE – Not established



SS – Site-specific value calculated from hardness
µg/L – micrograms per liter



Table 5-10. Idarado Compliance Point Surface Water Sample Results Compared to Human Health Screening Levels (Dissolved Metals)

Analyte	CAS No.	EPA Tapwater RSL (ug/L)	IC-SWD-REC-BKG			
			Result (ug/L)	Flag	MDL (ug/L)	EPA Tapwater EF
Aluminum, Dissolved	7429-90-5	20000	25600		70.4	1.3
Antimony, Dissolved	7440-36-0	7.8	<4.30		4.30	0.55*
Arsenic, Dissolved	7440-38-2	0.052	<4.40		4.40	85*
Barium, Dissolved	7440-39-3	3800	19.1		0.895	<0.1
Beryllium, Dissolved	7440-41-7	25	0.777	J	0.460	<0.1
Cadmium, Dissolved	7440-43-9	9.2	4.64		0.563	0.5
Calcium, Dissolved	7440-70-2	NE	59600		389	NA
Chromium, Dissolved	7440-47-3	22000 ¹	<5.00		5.00	<0.1*
Cobalt, Dissolved	7440-48-4	6	38.9		0.807	6.5
Copper, Dissolved	7440-50-8	800	1010		4.69	1.3
Iron, Dissolved	7439-89-6	14000	14300		45.8	1
Lead, Dissolved	7439-92-1	15	49.6		2.95	3.3
Magnesium, Dissolved	7439-95-4	NE	4450		111	NA
Manganese, Dissolved	7439-96-5	430	851		3.27	2
Mercury, Dissolved	7439-97-6	0.63	<0.100		0.100	0.16*
Nickel, Dissolved	7440-02-0	390	30.9		2.98	<0.1
Potassium, Dissolved	7440-09-7	NE	578	J	510	NA
Selenium, Dissolved	7782-49-2	100	<7.35		7.35	<0.1*
Silver, Dissolved	7440-22-4	94	<1.91		1.91	<0.1*
Sodium, Dissolved	7440-23-5	NE	2850	J	1400	NA
Thallium, Dissolved	7440-28-0	0.2	<4.31		4.31	22*
Vanadium, Dissolved	7440-62-2	86	<6.34		6.34	<0.1*
Zinc, Dissolved	7440-66-6	6000	1190		9.16	0.2

Values in red indicate EF > 1
* Analyte not present above MDL; value calculated from MDL
¹ Chromium SL is for Cr(III)
CAS – Chemical Abstracts Service
EF – Exceedance Factor
EPA – US Environmental Protection Agency
J – The identification of the analyte is acceptable; the reported value is an estimate.
MDL – Method detection limit
NA – Not applicable



NE – Not established
µg/L – micrograms per liter
RSL – Regional Screening Level



Table 5-11. Idarado Compliance Point Surface Water Sample Results Compared to Human Health Screening Levels (Total Metals)

Analyte	CAS No.	Screening Levels		IC-SWT-REC-BKG				
		EPA Tapwater RSL (ug/L)	EPA MCL (ug/L)	Result (ug/L)	Flag	MDL (ug/L)	EPA Tapwater EF	EPA MCL EF
Aluminum	7429-90-5	20000	NE	25100		70.4	1.3	NA
Antimony	7440-36-0	7.8	6	<4.30		4.30	0.55*	0.72*
Arsenic	7440-38-2	0.052	10	18.7		4.40	360	1.9
Barium	7440-39-3	3800	2000	20.0		0.895	<0.1	<0.1
Beryllium	7440-41-7	25	4	0.855	J	0.460	<0.1	0.21
Cadmium	7440-43-9	9.2	5	4.89		0.563	0.53	0.98
Calcium	7440-70-2	NE	NE	58600		389	NA	NA
Chromium	7440-47-3	22000	100	5.93	J	5.00	<0.1	<0.1
Cobalt	7440-48-4	6	NE	39.5		0.807	6.6	NA
Copper	7440-50-8	800	1300	1030		4.69	1.3	0.79
Hardness	471-34-1	NE	NE	165000		457	NA	NA
Iron	7439-89-6	14000	NE	29300		45.8	2.1	NA
Lead	7439-92-1	15	15	54.4		2.95	3.6	3.6
Magnesium	7439-95-4	NE	NE	4560		111	NA	NA
Manganese	7439-96-5	430	NE	858		3.27	2	NA
Mercury	7439-97-6	0.63	2	<0.100		0.100	0.16*	<0.1*
Nickel	7440-02-0	390	NE	31.3		2.98	<0.1	NA
Potassium	7440-09-7	NE	NE	670	J	510	NA	NA
Selenium	7782-49-2	100	50	<7.35		7.35	<0.1*	0.15*
Silver	7440-22-4	94	NE	<1.91		1.91	<0.1*	NA
Sodium	7440-23-5	NE	NE	2880	J	1400	NA	NA
Thallium	7440-28-0	0.2	2	<4.31		4.31	22*	2.2*
Vanadium	7440-62-2	86	NE	6.62	J	6.34	<0.1	NA
Zinc	7440-66-6	6000	NE	1190		9.16	0.2	NA

Values in red indicate EF > 1

* Analyte not present above MDL; value calculated from MDL

¹ Chromium SL is for Cr(III)

CAS – Chemical Abstracts Service

EF – Exceedance Factor

EPA – US Environmental Protection Agency

J – The identification of the analyte is acceptable; the reported value is an estimate.

MCL – Maximum Contaminant Level

MDL – Method detection limit

NA – Not applicable



NE – Not established
µg/L – micrograms per liter
RSL – Regional Screening Level



Table 5-12. Idarado Compliance Point Surface Water Sample Results Compared to Ecological Screening Levels

Analyte	CAS No.	IC-SW-REC-BKG						
		Result (ug/L)	Flag	MDL (ug/L)	SS Acute ESV (ug/L)	SS Chronic ESV (ug/L)	SS Acute EF	SS Chronic EF
Aluminum, total	7429-90-5	25100		70.4	6800	87	3.7	290
Antimony, dissolved	7440-36-0	<4.30		4.30	NE	NE	NA	NA
Arsenic, dissolved	7440-38-2	<4.40		4.40	340	150	<0.1*	<0.1*
Barium, dissolved	7440-39-3	19.1		0.895	NE	NE	NA	NA
Beryllium, dissolved	7440-41-7	0.777	J	0.460	NE	NE	NA	NA
Cadmium, dissolved	7440-43-9	4.64		0.563	2.6	0.62	1.8	7.5
Calcium, dissolved	7440-70-2	59600		389	NE	NE	NA	NA
Chromium, dissolved	7440-47-3	<5.00		5.00	43000	110	<0.1*	<0.1*
Cobalt, dissolved	7440-48-4	38.9		0.807	NE	NE	NA	NA
Copper, dissolved	7440-50-8	1010		4.69	22	14	47	74
Hardness as CaCO3	471-34-1	165000		457	NE	NE	NA	NA
Iron, total	7439-89-6	29300		45.8	NE	1000	NA	29
Lead, dissolved	7439-92-1	49.6		2.95	110	4.3	0.45	11
Magnesium, dissolved	7439-95-4	4450		111	NE	NE	NA	NA
Manganese, dissolved	7439-96-5	851		3.27	3500	1900	0.24	0.44
Mercury, dissolved	7439-97-6	<0.100		0.100	NE	0.01	NA	10*
Nickel, dissolved	7440-02-0	30.9		2.98	720	79	<0.1	0.39
Potassium, dissolved	7440-09-7	578	J	510	NE	NE	NA	NA
Selenium, dissolved	7782-49-2	<7.35		7.35	18	4.6	0.4*	1.6*
Silver, dissolved	7440-22-4	<1.91		1.91	4.8	0.18	0.4*	11*
Sodium, dissolved	7440-23-5	2850	J	1400	NE	NE	NA	NA
Thallium, dissolved	7440-28-0	<4.31		4.31	NE	NE	NA	NA
Vanadium, dissolved	7440-62-2	<6.34		6.34	NE	NE	NA	NA
Zinc, dissolved	7440-66-6	1190		9.16	250	190	4.7	6.2

Values in red indicate EF > 1
* Analytical results below MDL; result calculated from MDL
EF – Exceedance factor
ESV – Ecological Screening Level
J – The identification of the analyte is acceptable; the reported value is an estimate.
MDL – Laboratory Method Detection Limit
NA – Not applicable
NE – Not established



SS – Site-specific value calculated from hardness
µg/L – micrograms per liter



FIGURES

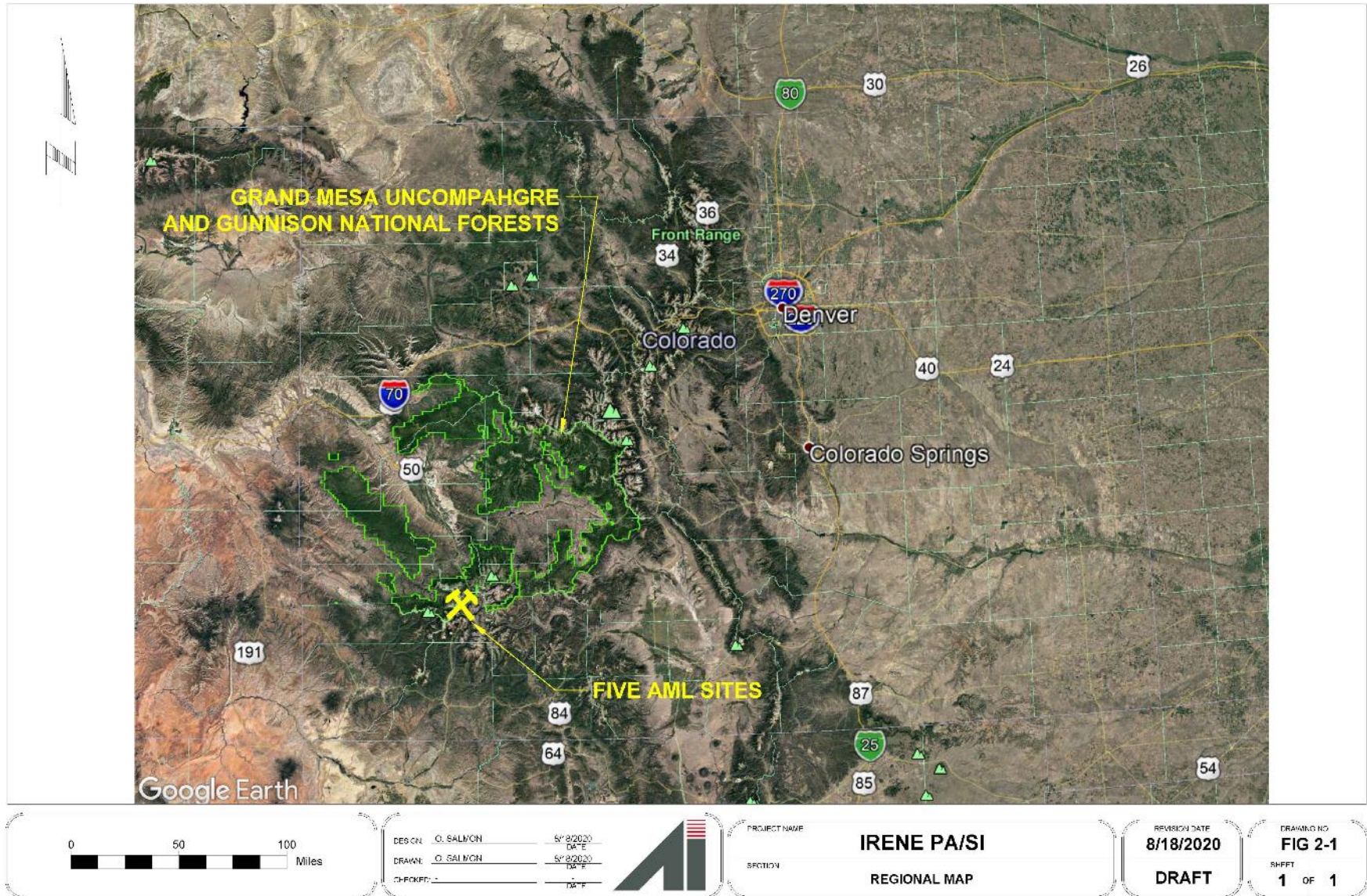
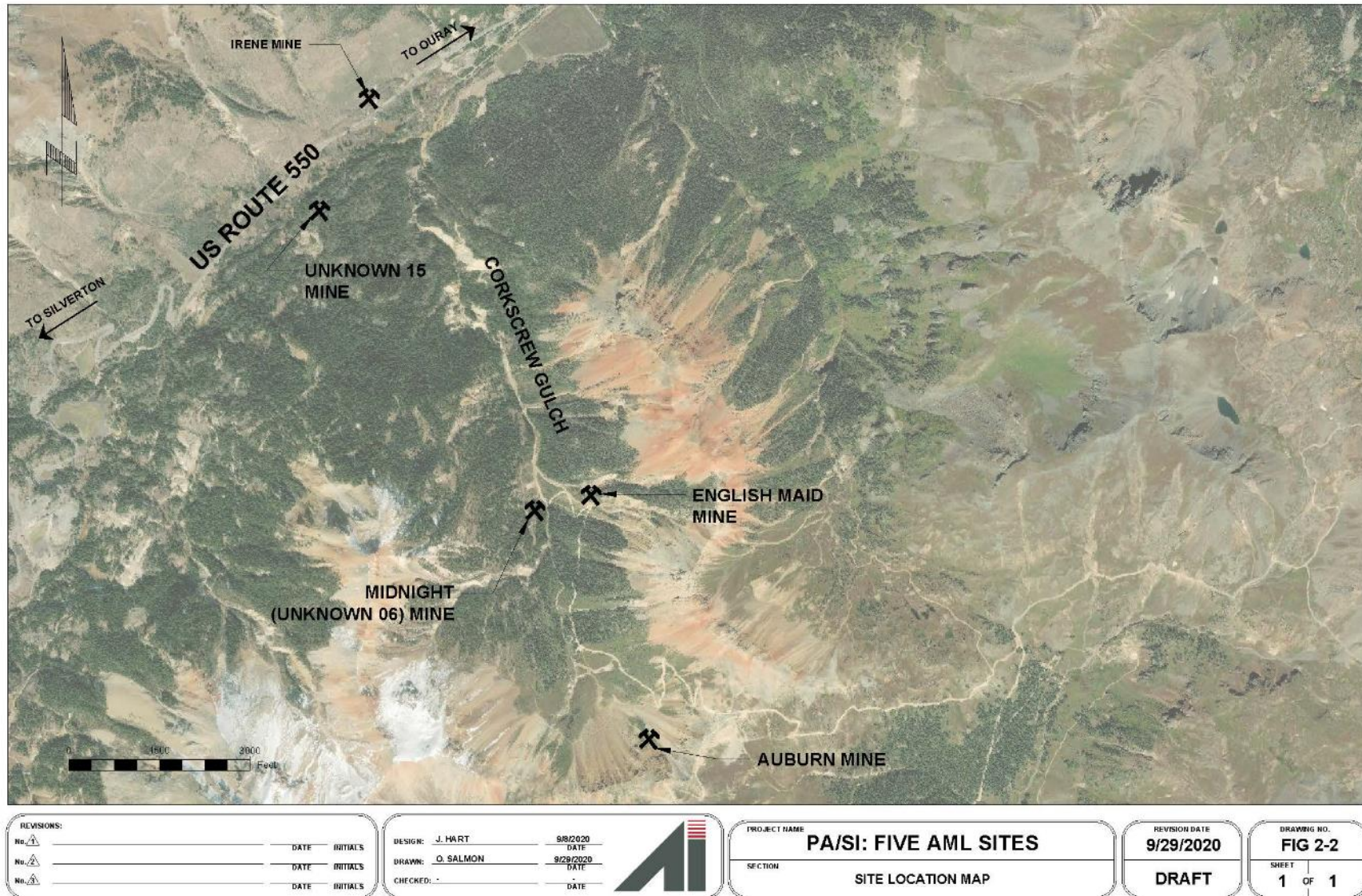


Figure | 1



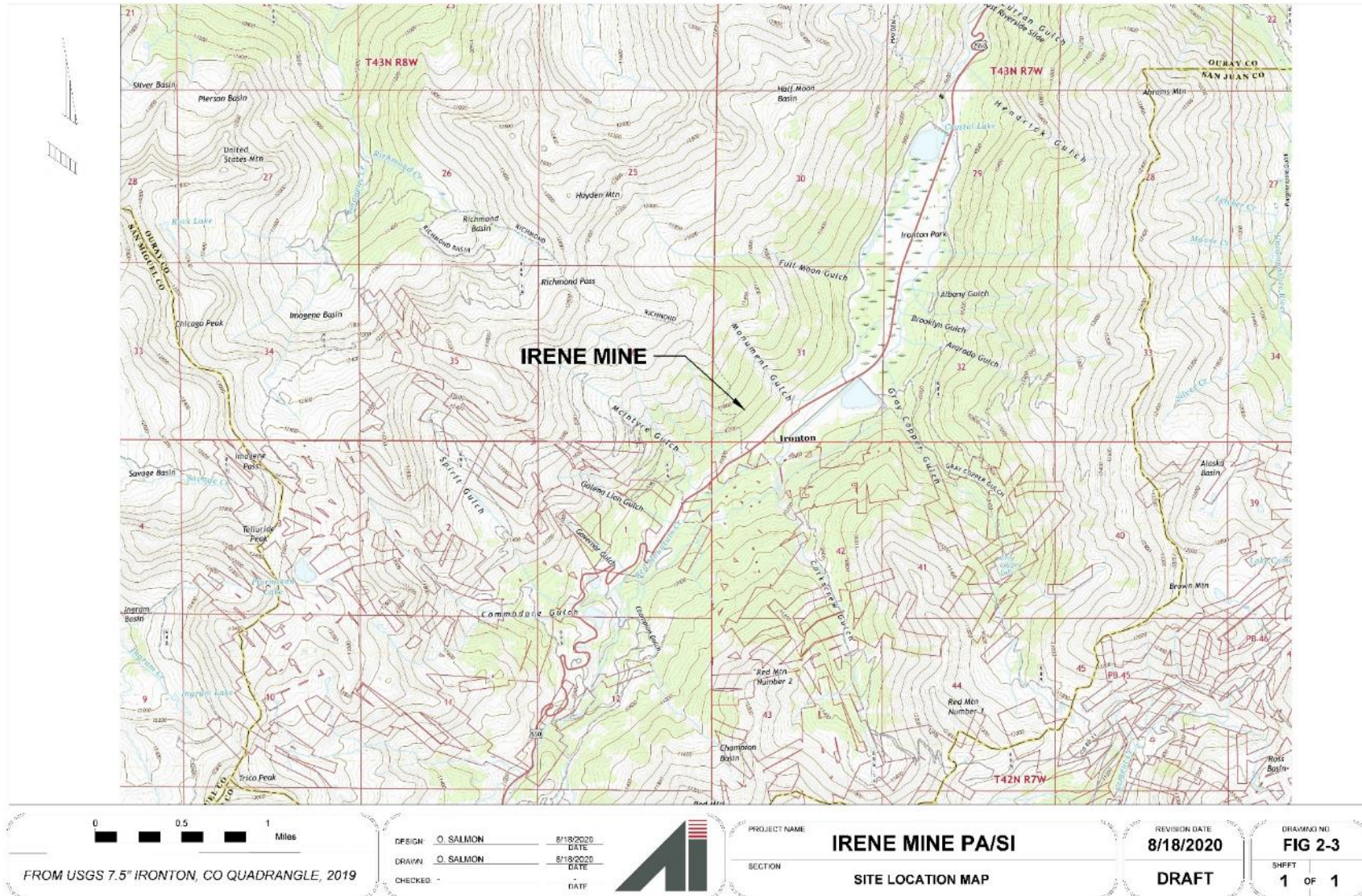


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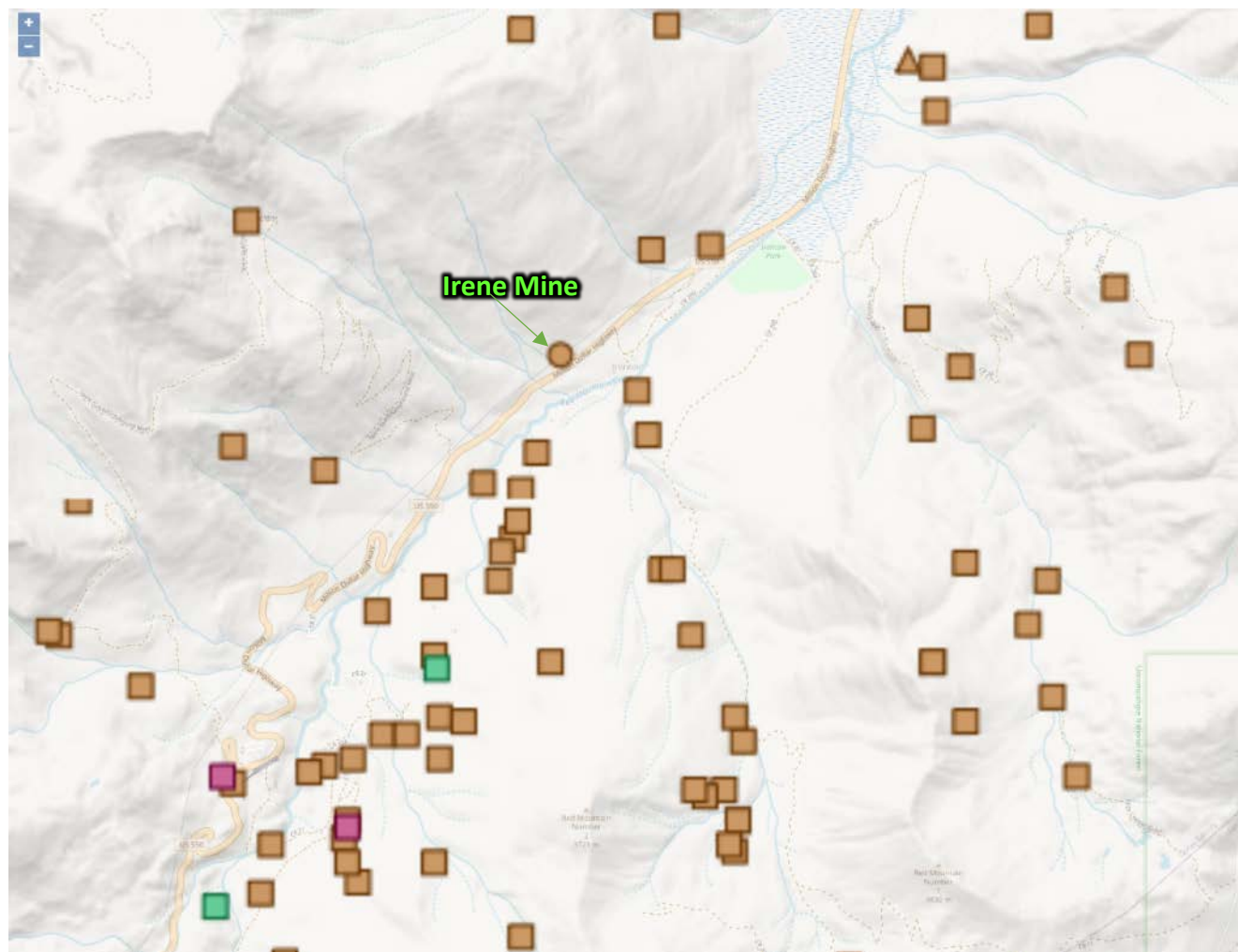
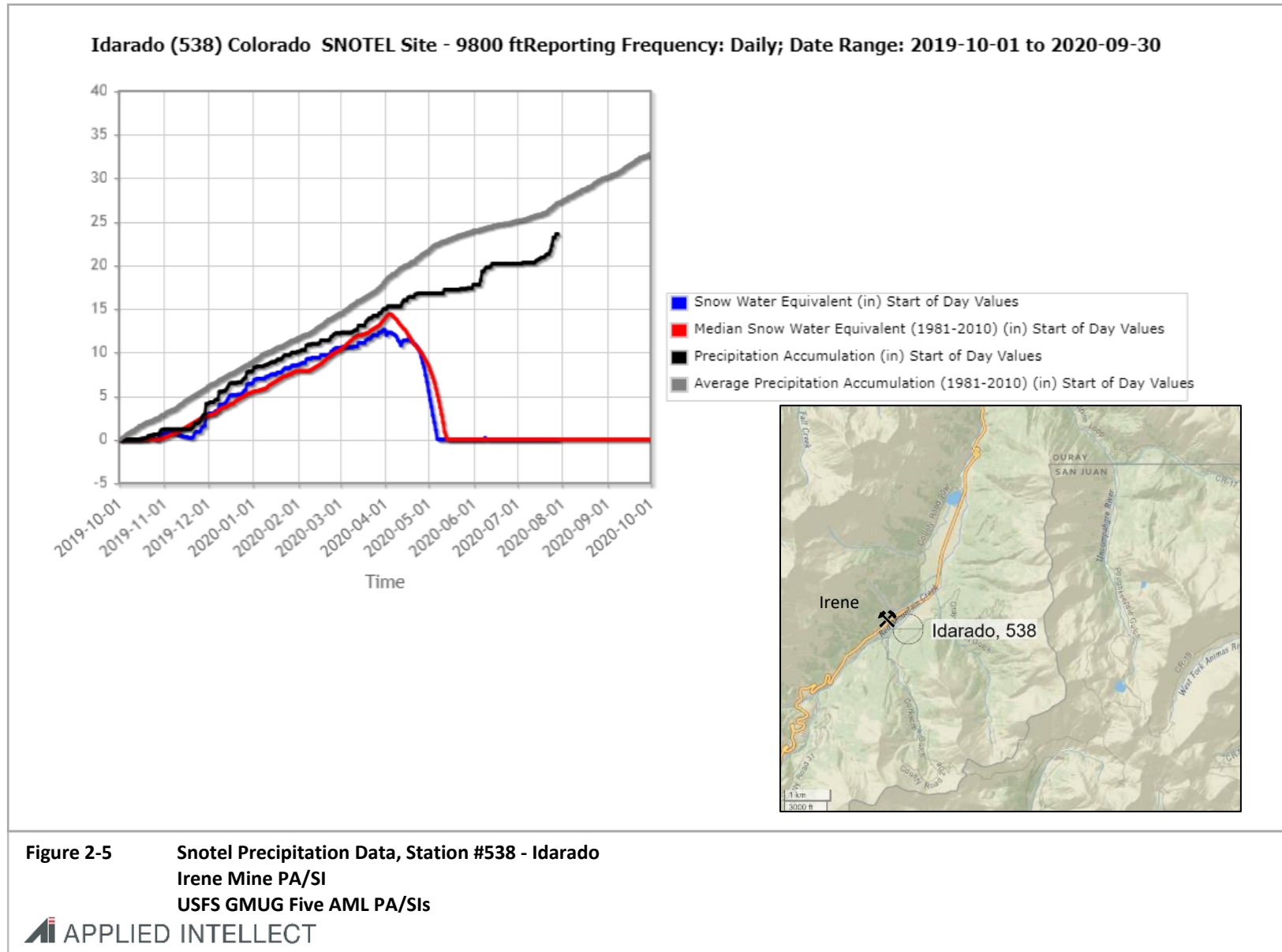
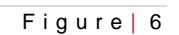


Figure 2-4 MRDS Location Map
Irene Mine PA/SI
USFS GMUG Five AML PA/SIs





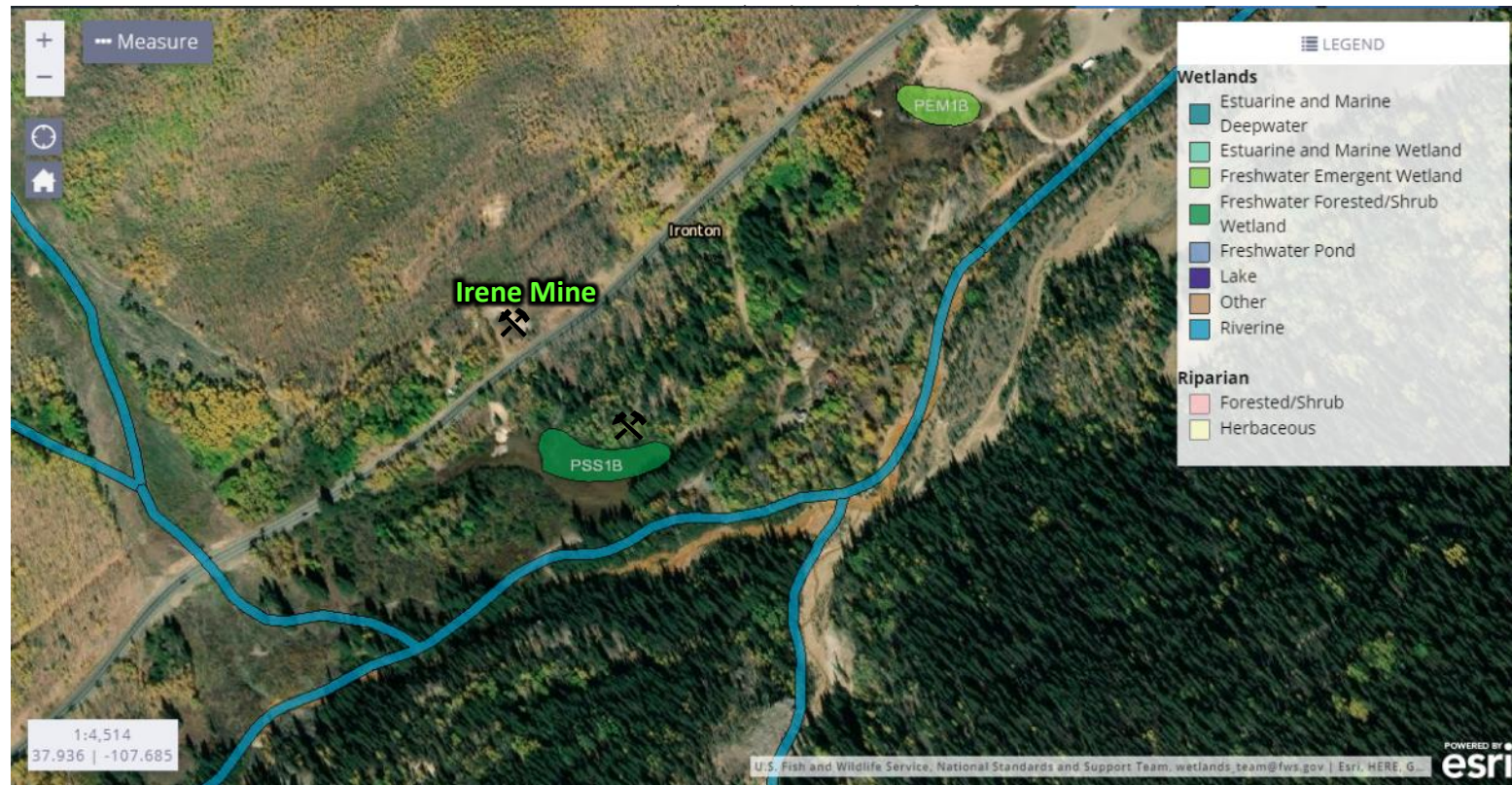


Figure 2-7 National Wetlands and Surface Water Inventory
Irene Mine PA/SI
USFS GMUG Five AML PA/SIs

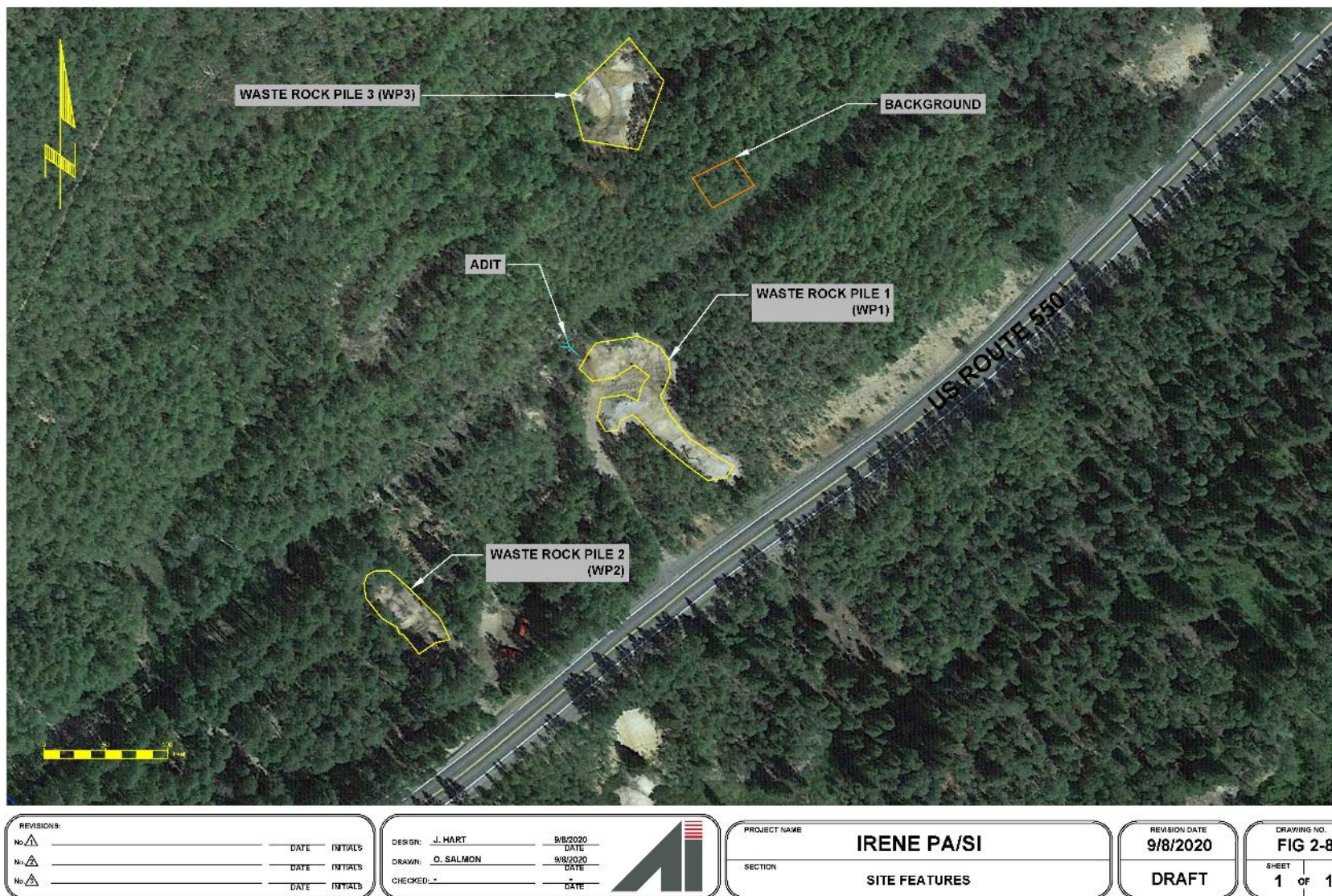


Figure | 8

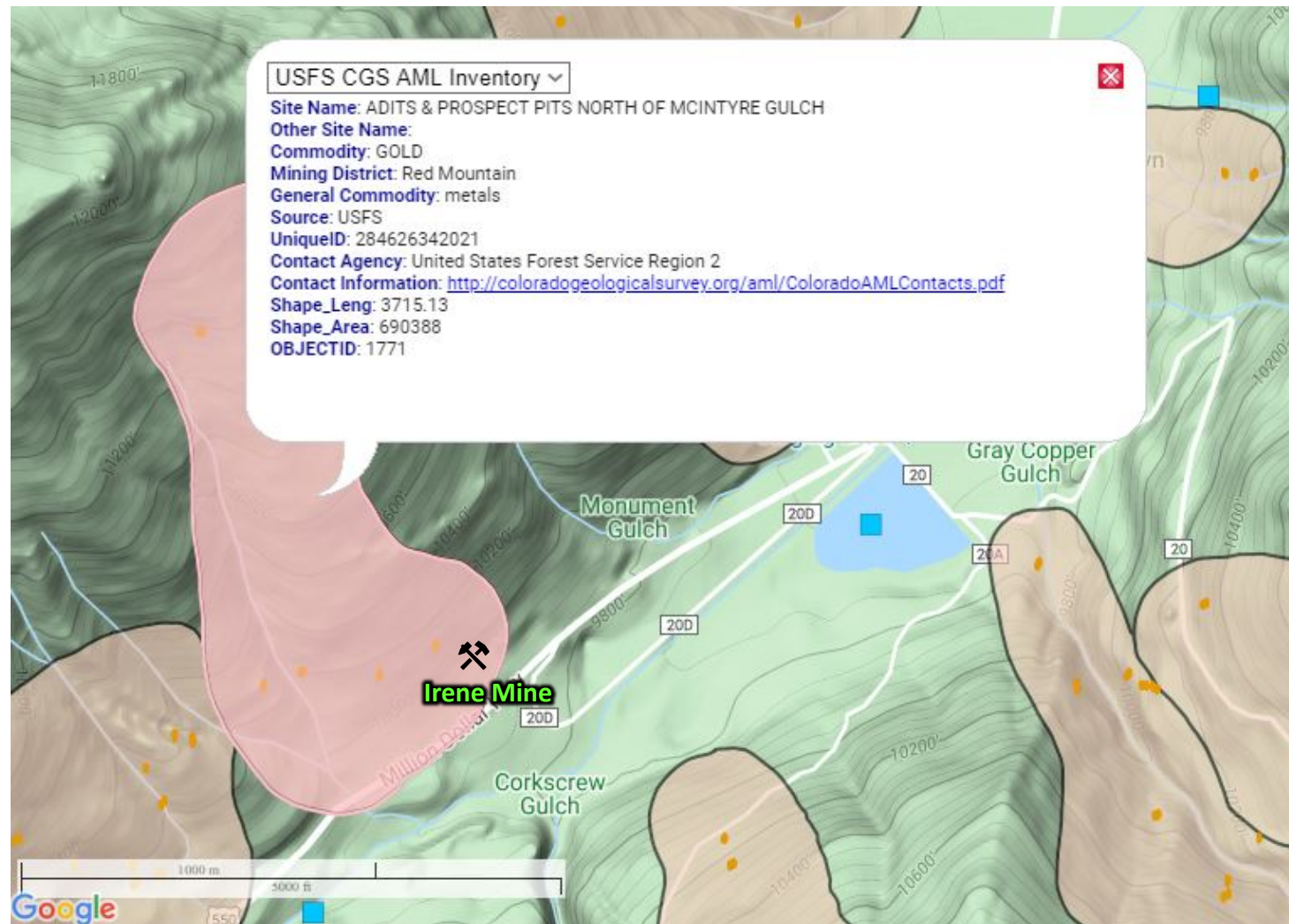


Figure 2-9 USFS and Colorado Geological Survey AML Inventory
Irene Mine PA/SI
USFS GMUG Five AML PA/SIs

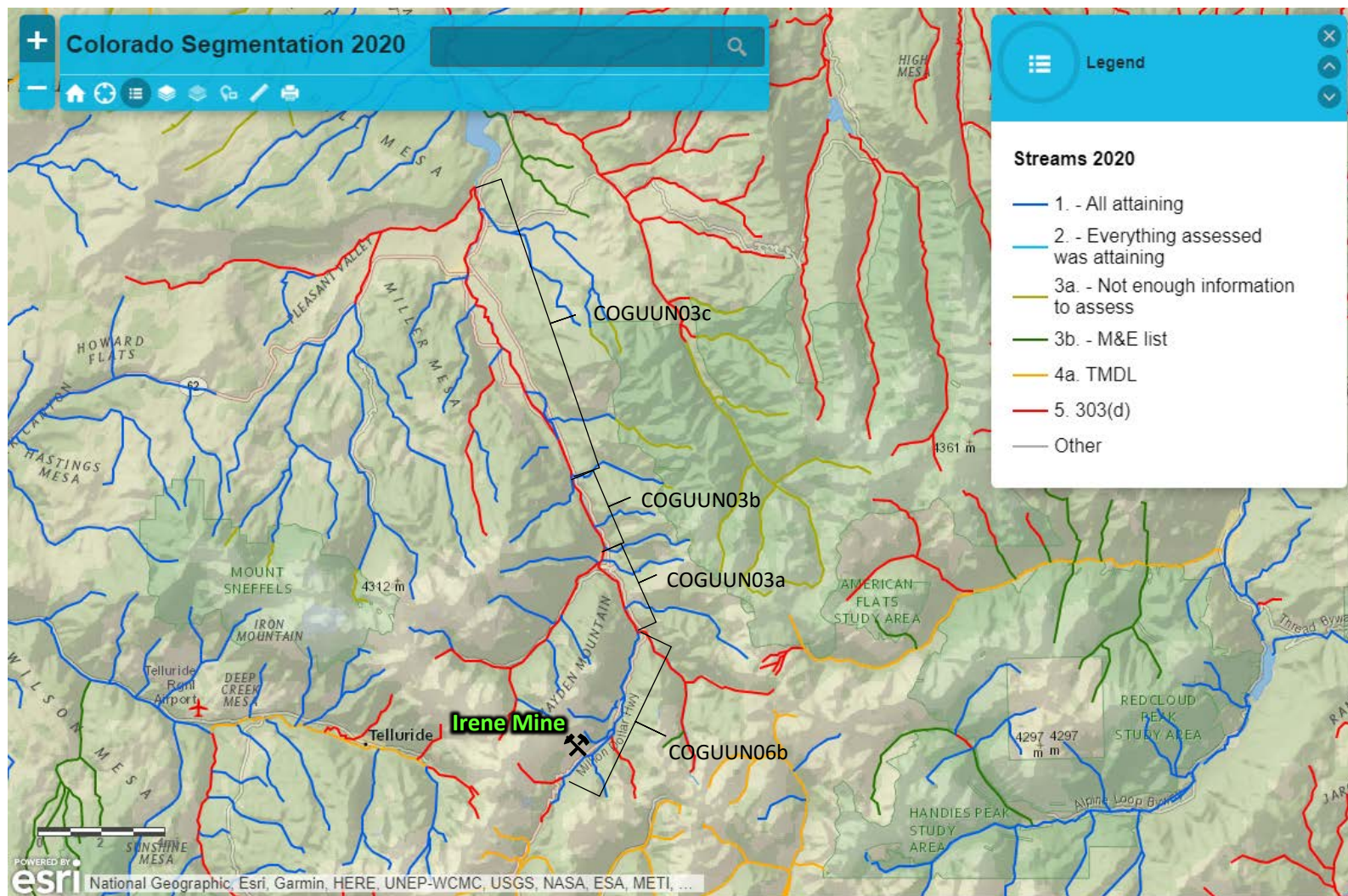
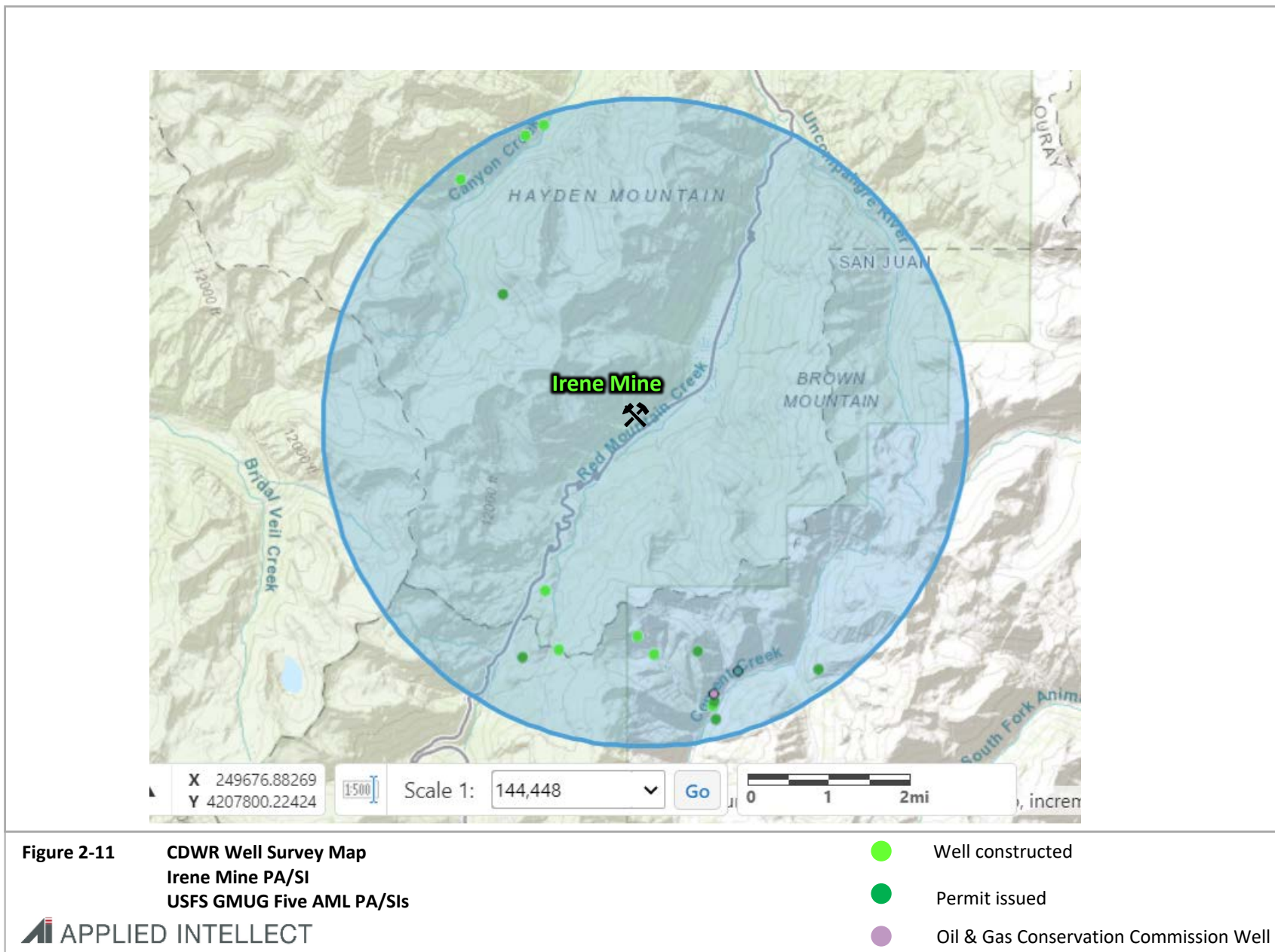
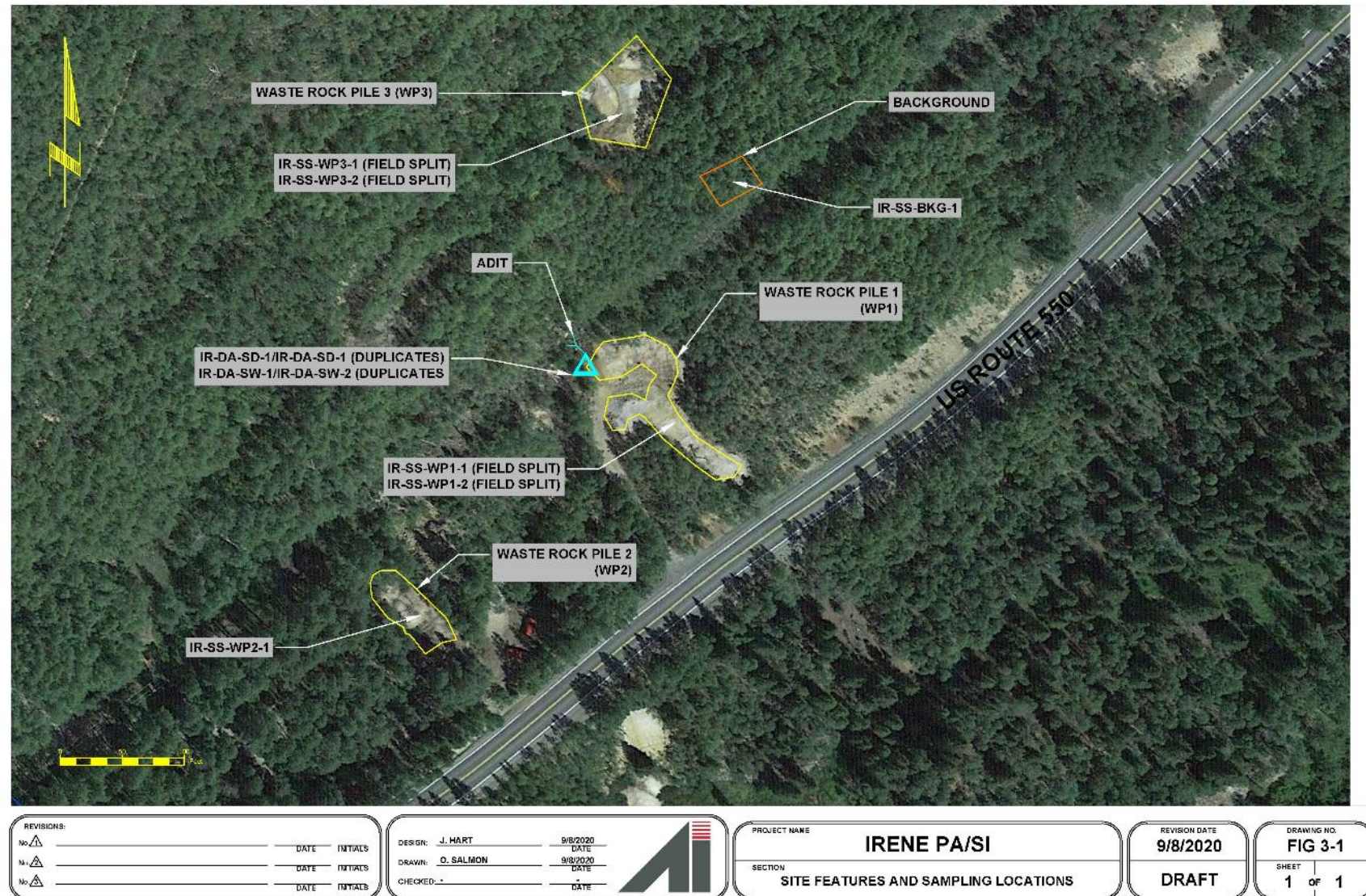


Figure 2-10 CDPHE Integrated Water Quality Map
Irene Mine PA/SI
USFS GMUG Five AML PA/SIs







APPENDIX A

– Combined PA/SI Assessment Checklist



COMBINED PA/SI ASSESSMENT CHECKLIST – Irene Mine, Ouray County, CO

Activities performed during a combined PA/SI assessment must still meet the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) listed below. This checklist can be used to assist in determining whether the combined PA/SI assessment meets the requirements and is designed to accompany the final PA/SI report. The items listed below can be found in Section 300.420 of the NCP.

Site Name: Irene Mine

Previous Names (if any): Jumbo No. 2

Site Location: NW1/4, NW1/4, Section 6, T42N, R7W in the Uncompahgre National Forest, Colorado.

Complete the following checklist. If “no” is marked, please explain below.	Yes	No
1. Does the site appear in CERCLIS?		x
2. Has a review of existing information about the release, such as pathway(s) of exposure, targets, sources and nature of the release been performed?	x	
3. Has an off-site reconnaissance been performed?	x	
4. Has a sampling and analysis plan been developed that provides a process for obtaining data of sufficient quality and quantity to satisfy data needs?	x	
5. Does the sampling and analysis plan include:		
a) A field sampling plan, which describes the number, type, and location of samples, and the type of analyses, and	x	
b) A quality assurance project plan, which describes policy, organization, and functional activities, and the data quality objectives and measures necessary to achieve adequate data for use in site evaluation and hazard ranking system activities?	x	
6. Once the combined PA/SI report has been prepared, are the following elements included?		
a) A description/history/nature of waste handling	x	
b) A description of known contaminants	x	
c) A description of the release	x	
d) A description of the probable nature of the release	x	
e) A description of pathways of migration of contaminants	x	
f) An identification and description of human end environmental targets	x	
g) A recommendation on whether further action is warranted	x	
Please provide a brief explanation for “no” responses above: Item 1, the site does not appear in CERCLIS; however, the objective of the USFS GMUG PA/SI is to determine whether there have been releases of hazardous substances warranting a cleanup action under CERCLA,		



following the latest edition of the U.S. Environmental Protection Agency (EPA) <i>Guidance for Performing Preliminary Assessments Under CERCLA</i> and <i>Guidance for Performing Site Inspections Under CERCLA</i> .		
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Note: Checklist adapted from *Improving Site Assessment: Combined PA/SI Assessments* (USEPA, 1999)



APPENDIX B

PA Database Search Results

- USGS MRDS information**
- LR 2000 Claims Reports**
- USFWS ECOS Information**

-



Appendix B

- USGS MRDS information

Irene

Occurrence in Ouray county in Colorado, United States with commodity Molybdenum

[Map](#) [XML](#) [JSON](#) [KML](#) [D](#)

Geologic information

Identification information	
Deposit ID	10008365
MRDS ID	D000453
Record type	Site
Current site name	Irene
Alternate or previous names	Jumbo No. 2

Geographic coordinates	
Geographic coordinates:	-107.68397, 37.93333 (WGS84)
Political divisions (FIPS codes)	
Ouray (county)	
Colorado (state)	
United States (country)	
North America (continent)	
Land (continent)	
USGS map quadrangles	
Ironton (quadrangle 1:24,000 scale)	
Silverton (quadrangle 1:100,000 scale)	
Durango (quadrangle 1:250,000 scale)	
Hydrologic units (watersheds)	
Uncompahange (hydrologic unit)	
Gunnison (hydrologic accounting unit)	
Gunnison (hydrologic subregion)	
Upper Colorado (hydrologic region)	
Federal lands	

Geographic areas		
Country	State	County
United States	Colorado	Ouray

Public Land Survey System information					
Meridian	Township	Range	Section	Fraction	State
New Mexico	042N	007W	06		Colorado

Commodities	
Commodity	Importance
Molybdenum	Primary

Materials information	
Materials	Type of material
Molybdenite	Ore

Host and associated rocks	
Host or associated	Host
Rock type	Volcanic Rock (Aphanitic)
Stratigraphic age (youngest)	Pliocene

Nearby scientific data	
(1)	Intra-ash flow andesitic lavas List Map

Economic information

Economic information about the deposit and operations	
Development status	Occurrence
Commodity type	Metallic
Significant	No

Reference information

Links to other databases				
Agency	Database name	Acronym	Record ID	Notes
USGS	Mineral Resources Data System	MRDS	D000453	

Bibliographic references	
Deposit	
WORCESTER, 1919, MOLYBDENUM DEPOSITS OF COLO.: COLO. G.S. BULL. 14	

Reporter information				
Type	Date	Name	Affiliation	Comment
Reporter	01-JUL-1974	King, Robert U.	U.S. Geological Survey	

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
MINING CLAIMS
(MASS) Serial Register Page

Run Date/Time: 8/19/2020 10:29 AM

Page 1 Of 1

01 05-10-1872;017STAT0091;30USC26,28,34

Case Type 384101: LODE CLAIM

Claim Name: ELSIE NO. 5

Case Disposition: ACTIVE

Required Maintenance Fee: \$165.00

Total Acres

20.66

Serial Number

CMC288743

Lead File Number

CMC288740

Name & Address

Interest Relationship

CLARK JACK E JR
PO BOX 767
3815 COUNTY ROAD 2 SILVERTON, CO 81433-0767

CLAIMANT

County / State

District

OURAY COUNTY, CO

SOUTHWEST DO

Mer Twp Rng Sec

Subdivision

23 0420N 0080W 001
23 0420N 0070W 006

NE SE
NW

Act Date	Code	Action Text	Action Remarks	Receipt Number
10/07/2016	403	LOCATION DATE		
12/02/2016	395	RECORDATION NOTICE RECD	1	3713515
08/22/2019	483	SMALL MINER CERT FILED	2020	
08/22/2019	480	EVID OF ASSMT FILED	2019	4540173
08/22/2019	481	NOTICE OF INTENT TO HOLD	2019	4540173
08/10/2018	483	SMALL MINER CERT FILED	2019	
08/10/2018	480	EVID OF ASSMT FILED	2018	4235142
08/10/2018	481	NOTICE OF INTENT TO HOLD	2018	4235142
08/09/2017	483	SMALL MINER CERT FILED	2018	
08/09/2017	480	EVID OF ASSMT FILED	2017	3929679
08/09/2017	481	NOTICE OF INTENT TO HOLD	2017	3929690
12/02/2016	484	LOCATION YEAR / MAINTENAN	2017;\$155	3713515
05/16/2019	669	LAND STATUS CHECKED	LS	
12/02/2016	500	MAP IN LEAD FILE	CMC288740;	
12/02/2016	501	ACCT ADV IN LEAD FILE	CMC288740-288749	
11/01/2016	404	COUNTY RECORDATION	217311;0;0	

Line Nr

Remarks

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
MINING CLAIMS
(MASS) Serial Register Page

Run Date/Time: 8/19/2020 10:31 AM

Page 1 Of 1

01 05-10-1872;017STAT0091;30USC26,28,34

Case Type 384101: LODE CLAIM

Claim Name: MAYFLOWER NO. 3

Case Disposition: ACTIVE

Required Maintenance Fee: \$165.00

Total Acres

20.66

Serial Number

CMC288745

Lead File Number

CMC288740

Name & Address

Interest Relationship

CLARK JACK E JR
PO BOX 767
3815 COUNTY ROAD 2 SILVERTON, CO 81433-0767

CLAIMANT

County / State

District

OURAY COUNTY, CO

SOUTHWEST DO

Mer Twp Rng Sec

Subdivision

23 0420N 0080W 001
23 0420N 0070W 006
23 0430N 0080W 036

NE
NW
SE

Act Date	Code	Action Text	Action Remarks	Receipt Number
10/07/2016	403	LOCATION DATE		
12/02/2016	395	RECORDATION NOTICE RECD	1	3713515
08/22/2019	483	SMALL MINER CERT FILED	2020	
08/22/2019	480	EVID OF ASSMT FILED	2019	4540173
08/22/2019	481	NOTICE OF INTENT TO HOLD	2019	4540173
08/10/2018	483	SMALL MINER CERT FILED	2019	
08/10/2018	480	EVID OF ASSMT FILED	2018	4235142
08/10/2018	481	NOTICE OF INTENT TO HOLD	2018	4235142
08/09/2017	483	SMALL MINER CERT FILED	2018	
08/09/2017	480	EVID OF ASSMT FILED	2017	3929679
08/09/2017	481	NOTICE OF INTENT TO HOLD	2017	3929690
12/02/2016	484	LOCATION YEAR / MAINTENAN	2017;\$155	3713515
05/16/2019	669	LAND STATUS CHECKED	LS	
12/02/2016	500	MAP IN LEAD FILE	CMC288740;	
12/02/2016	501	ACCT ADV IN LEAD FILE	CMC288740-288749	
11/01/2016	404	COUNTY RECORDATION	217313;0;0	

Line Nr

Remarks



Appendix B

- LR 2000 Claims Reports

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
MINING CLAIMS

MINING CLAIM GEOGRAPHIC REPORT

Serial Number	Lead Serial Number	Mer Twn Rng Sec	Quad	Claim Name	Claimant Name	Case Type	Status	Loc Date	Last Assmt Yr
CMC135010	CMC134898	23 0430N 0070W 031	NE	B S #2	IDARADO MINING CO	LODE	CLOSED	11/05/1968	2005
CMC135011	CMC134898	23 0430N 0070W 031	NE	B S #3	IDARADO MINING CO	LODE	CLOSED	11/05/1968	2005
CMC135012	CMC134898	23 0430N 0070W 031	NE	B S #4	IDARADO MINING CO	LODE	CLOSED	11/05/1968	2005
CMC135013	CMC134898	23 0430N 0070W 031	NE	B S #5	IDARADO MINING CO	LODE	CLOSED	11/05/1968	2005
CMC135014	CMC134898	23 0430N 0070W 031	NE	B S #6	IDARADO MINING CO	LODE	CLOSED	11/06/1968	2005
CMC178094	CMC178092	23 0430N 0070W 031	NE	SILVER TIP #2	SILVER TIP MNG & M	LODE	CLOSED	05/07/1981	0000
CMC92372	CMC92368	23 0430N 0070W 031	NE	MOLLY #5	DUCKETT ANNA M	LODE	CLOSED	08/05/1932	0000
CMC92373	CMC92368	23 0430N 0070W 031	NE	MAMMOTH	DUCKETT ANNA M	LODE	CLOSED	04/16/1938	0000
CMC92377	CMC92368	23 0430N 0070W 031	NE	MAMMOTH #5	DUCKETT ANNA M	LODE	CLOSED	10/09/1950	0000
CMC135028	CMC134898	23 0430N 0070W 031	NE,NW	B S #20	IDARADO MINING CO	LODE	CLOSED	11/06/1968	2005
CMC135029	CMC134898	23 0430N 0070W 031	NE,NW	B S #21	IDARADO MINING CO	LODE	CLOSED	11/06/1968	2005
CMC135030	CMC134898	23 0430N 0070W 031	NE,NW	B S #22	IDARADO MINING CO	LODE	CLOSED	11/06/1968	2005
CMC135031	CMC134898	23 0430N 0070W 031	NE,NW	B S #23	IDARADO MINING CO	LODE	CLOSED	11/06/1968	2005
CMC158648	CMC158647	23 0430N 0070W 031	NE,NW	BS 35	IDARADO MINING CO	LODE	CLOSED	09/30/1980	1998
CMC286498	CMC286495	23 0430N 0070W 031	NE,NW	GOODINGS	WILLIAMS KEVIN	LODE	ACTIVE	05/02/2014	2021
CMC286498	CMC286495	23 0430N 0070W 031	NE,NW	GOODINGS	WILLIAMS ROBERT	LODE	ACTIVE	05/02/2014	2021
CMC44907	CMC44906	23 0430N 0070W 031	NE,NW	BS 35	IDARADO MINING CO	LODE	CLOSED	05/24/1978	2005
CMC135032	CMC134898	23 0430N 0070W 031	NE,NW,SW,SE	B S #24	IDARADO MINING CO	LODE	CLOSED	11/06/1968	2005
CMC135009	CMC134898	23 0430N 0070W 031	NE,SE	B S #1 AMDT	IDARADO MINING CO	LODE	CLOSED	11/05/1968	2005
CMC135282	CMC134898	23 0430N 0070W 031	NE,SE	M W #35	IDARADO MINING CO	LODE	CLOSED	06/30/1975	2005
CMC158647	CMC158647	23 0430N 0070W 031	NE,SE	BS 34	IDARADO MINING CO	LODE	CLOSED	06/24/1980	1998
CMC178092	CMC178092	23 0430N 0070W 031	NE,SE	RIO TINTO #2	SILVER TIP MNG & M	LODE	CLOSED	05/06/1981	0000
CMC44906	CMC44906	23 0430N 0070W 031	NE,SE	BS 34	IDARADO MINING CO	LODE	CLOSED	05/19/1978	2005
CMC92371	CMC92368	23 0430N 0070W 031	NE,SE	MOLLY #4	DUCKETT ANNA M	LODE	CLOSED	06/06/1936	0000
CMC92374	CMC92368	23 0430N 0070W 031	NE,SE	MAMMOTH #2	DUCKETT ANNA M	LODE	CLOSED	04/16/1938	0000
CMC135033	CMC134898	23 0430N 0070W 031	NW,SW,SE	B S #25	IDARADO MINING CO	LODE	CLOSED	11/20/1968	2005
CMC135047	CMC134898	23 0430N 0070W 031	SE	C J #1	IDARADO MINING CO	LODE	CLOSED	09/25/1974	2005
CMC135048	CMC134898	23 0430N 0070W 031	SE	C J #2	IDARADO MINING CO	LODE	CLOSED	09/25/1974	2005
CMC135049	CMC134898	23 0430N 0070W 031	SE	C J #3	IDARADO MINING CO	LODE	CLOSED	09/26/1974	2005
CMC135050	CMC134898	23 0430N 0070W 031	SE	C J #4	IDARADO MINING CO	LODE	CLOSED	09/26/1974	2005
CMC135052	CMC134898	23 0430N 0070W 031	SE	C J #6	IDARADO MINING CO	LODE	CLOSED	09/26/1974	2005
CMC135280	CMC134898	23 0430N 0070W 031	SE	M W #33	IDARADO MINING CO	LODE	CLOSED	07/01/1975	2005
CMC135281	CMC134898	23 0430N 0070W 031	SE	M W #34	IDARADO MINING CO	LODE	CLOSED	06/24/1975	2005
CMC178093	CMC178092	23 0430N 0070W 031	SE	GOLD CROWN #2	SILVER TIP MNG & M	LODE	CLOSED	05/07/1981	0000
CMC199243	CMC199224	23 0430N 0070W 031	SE	IP #37	IRONTON PARK CO	LODE	CLOSED	07/21/1983	1991
CMC135036	CMC134898	23 0430N 0070W 031	SW	B S #28	IDARADO MINING CO	LODE	CLOSED	11/20/1968	2005
CMC135034	CMC134898	23 0430N 0070W 031	SW,SE	B S #26	IDARADO MINING CO	LODE	CLOSED	11/20/1968	2005
CMC135035	CMC134898	23 0430N 0070W 031	SW,SE	B S #27	IDARADO MINING CO	LODE	CLOSED	11/20/1968	2005

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
MINING CLAIMS

MINING CLAIM GEOGRAPHIC REPORT

Serial Number	Lead Serial Number	Mer Twn Rng Sec	Quad	Claim Name	Claimant Name	Case Type	Status	Loc Date	Last Assmt Yr
CMC135049	CMC134898	23 0420N 0070W 006	NE	C J #3	IDARADO MINING CO	LODE	CLOSED	09/26/1974	2005
CMC135050	CMC134898	23 0420N 0070W 006	NE	C J #4	IDARADO MINING CO	LODE	CLOSED	09/26/1974	2005
CMC135051	CMC134898	23 0420N 0070W 006	NE	C J #5	IDARADO MINING CO	LODE	CLOSED	09/26/1974	2005
CMC135052	CMC134898	23 0420N 0070W 006	NE	C J #6	IDARADO MINING CO	LODE	CLOSED	09/26/1974	2005
CMC199224	CMC199224	23 0420N 0070W 006	NE	IP #37	IRONTON PARK CO	LODE	CLOSED	07/21/1983	1991
CMC135274	CMC134898	23 0420N 0070W 006	NE,NW	M W #26	IDARADO MINING CO	LODE	CLOSED	09/22/1974	1984
CMC135275	CMC134898	23 0420N 0070W 006	NE,NW	M W #27	IDARADO MINING CO	LODE	CLOSED	09/22/1974	1984
CMC64796	CMC64794	23 0420N 0070W 006	NE,NW,SE	RED #3	KERR MCGEE CORP	LODE	CLOSED	05/06/1970	1988
CMC64797	CMC64794	23 0420N 0070W 006	NE,SE	RED #4	KERR MCGEE CORP	LODE	CLOSED	05/06/1970	1988
CMC64798	CMC64794	23 0420N 0070W 006	NE,SE	RED #5	KERR MCGEE CORP	LODE	CLOSED	05/06/1970	1988
CMC64799	CMC64794	23 0420N 0070W 006	NE,SE	RED #6	KERR MCGEE CORP	LODE	CLOSED	05/06/1970	1988
CMC64800	CMC64794	23 0420N 0070W 006	NE,SE	RED #7	KERR MCGEE CORP	LODE	CLOSED	05/06/1970	1988
CMC135272	CMC134898	23 0420N 0070W 006	NW	M W #24	IDARADO MINING CO	LODE	CLOSED	10/15/1974	1984
CMC135273	CMC134898	23 0420N 0070W 006	NW	M W #25	IDARADO MINING CO	LODE	CLOSED	09/20/1974	2005
CMC288743	CMC288740	23 0420N 0070W 006	NW	ELSIE NO. 5	CLARK JACK E JR	LODE	ACTIVE	10/07/2016	2020
CMC288745	CMC288740	23 0420N 0070W 006	NW	MAYFLOWER NO. 3	CLARK JACK E JR	LODE	ACTIVE	10/07/2016	2020
CMC64772	CMC64770	23 0420N 0070W 006	SE	HOME	KERR MCGEE CORP	LODE	CLOSED	12/02/1969	1988
CMC64807	CMC64794	23 0420N 0070W 006	SE	RED #14	KERR MCGEE CORP	LODE	CLOSED	05/06/1970	1988
CMC64809	CMC64794	23 0420N 0070W 006	SE	RED #16	KERR MCGEE CORP	LODE	CLOSED	05/06/1970	1988
CMC64810	CMC64794	23 0420N 0070W 006	SE	RED #17	KERR MCGEE CORP	LODE	CLOSED	05/06/1970	1988
CMC64811	CMC64794	23 0420N 0070W 006	SE	RED #18	KERR MCGEE CORP	LODE	CLOSED	05/06/1970	1988
CMC64812	CMC64794	23 0420N 0070W 006	SE	RED #19	KERR MCGEE CORP	LODE	CLOSED	05/06/1970	1988
CMC64813	CMC64794	23 0420N 0070W 006	SE	RED #20	KERR MCGEE CORP	LODE	CLOSED	05/06/1970	1988
CMC13384	CMC13353	23 0420N 0070W 006	SW	CYA-12	BAUMGARTNER F W	LODE	CLOSED	07/09/1975	1992
CMC13472	CMC13353	23 0420N 0070W 006	SW	LEFT BOWER	BAUMGARTNER F W	LODE	CLOSED	07/13/1904	1992
CMC13485	CMC13353	23 0420N 0070W 006	SW	MAUD	BAUMGARTNER F W	LODE	CLOSED	09/19/1935	1992
CMC135270	CMC134898	23 0420N 0070W 006	SW	M W #21	IDARADO MINING CO	LODE	CLOSED	09/22/1974	1984
CMC135271	CMC134898	23 0420N 0070W 006	SW	M W #22	IDARADO MINING CO	LODE	CLOSED	09/21/1974	1984
CMC135278	CMC134898	23 0420N 0070W 006	SW	M W #31	IDARADO MINING CO	LODE	CLOSED	10/18/1974	1984
CMC211982	CMC211982	23 0420N 0070W 006	SW	LITTLE JOHN 3	BAUMGARTNER F W	LODE	CLOSED	08/04/1985	1986
CMC293523	CMC293523	23 0420N 0070W 006	SW	DVD-1	RED MOUNTAIN TRU	LODE	ACTIVE	07/17/2019	2020
CMC293524	CMC293523	23 0420N 0070W 006	SW	DVD-2	RED MOUNTAIN TRU	LODE	ACTIVE	07/17/2019	2020
CMC291462	CMC291462	23 0420N 0070W 006	SW,SE	DVD	DOOSE ELI	LODE	ACTIVE	10/25/2018	2020
CMC291463	CMC291462	23 0420N 0070W 006	SW,SE	VON DOOSE	DOOSE ELI	LODE	ACTIVE	10/25/2018	2020
CMC64792	CMC64792	23 0420N 0070W 006	SW,SE	GALENA #1	KERR MCGEE CORP	LODE	CLOSED	12/01/1968	1988
CMC64793	CMC64792	23 0420N 0070W 006	SW,SE	GALENA #2	KERR MCGEE CORP	LODE	CLOSED	12/01/1968	1988
CMC64886	CMC64794	23 0420N 0070W 006	SW,SE	RED #93	KERR MCGEE CORP	LODE	CLOSED	10/17/1970	1988
CMC64887	CMC64794	23 0420N 0070W 006	SW,SE	RED #94	KERR MCGEE CORP	LODE	CLOSED	10/17/1970	1988
CMC64889	CMC64794	23 0420N 0070W 006	SW,SE	RED #96	KERR MCGEE CORP	LODE	CLOSED	10/17/1970	1988



Appendix B

- USFWS ECOS Information

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Project information

NAME

USFS GMUG Tronox PA-SI

LOCATION

Ouray County, Colorado



DESCRIPTION

PA-SI Irene Mine

Local office

Western Colorado Ecological Services Field Office

☎ (970) 628-7180

📠 (970) 245-6933

445 West Gunnison Avenue, Suite 240
Grand Junction, CO 81501-5711

<http://www.fws.gov/mountain-prairie/es/Colorado/>

<http://www.fws.gov/platteriver/>

NOT FOR CONSULTATION

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Log in to IPaC.
2. Go to your My Projects list.
3. Click PROJECT HOME for this project.
4. Click REQUEST SPECIES LIST.

Listed species¹ and their critical habitats are managed by the [Ecological Services Program](#) of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries²).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact [NOAA Fisheries](#) for [species under their jurisdiction](#).

1. Species listed under the [Endangered Species Act](#) are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the [listing status page](#) for more information.
2. [NOAA Fisheries](#), also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME

STATUS

Canada Lynx *Lynx canadensis*

Threatened

There is **final** critical habitat for this species. Your location is outside the critical habitat.

<https://ecos.fws.gov/ecp/species/3652>

Birds

NAME

STATUS

Mexican Spotted Owl *Strix occidentalis lucida*

Threatened

There is **final** critical habitat for this species. Your location is outside the critical habitat.

<https://ecos.fws.gov/ecp/species/8196>

Fishes

NAME

STATUS

Bonytail *Gila elegans*

Endangered

This species only needs to be considered if the following condition applies:

- Water depletions in the upper Colorado River basin adversely affect this species and its critical habitat. This species does not need to be considered if the project is outside of its occupied habitat and does not deplete water from the basin.

There is **final** critical habitat for this species. Your location is outside the critical habitat.

<https://ecos.fws.gov/ecp/species/1377>

Colorado Pikeminnow (=squawfish) *Ptychocheilus lucius*

Endangered

This species only needs to be considered if the following condition applies:

- Water depletions in the upper Colorado River basin adversely affect this species and its critical habitat. This species does not need to be considered if the project is outside of its occupied habitat and does not deplete water from the basin.

There is **final** critical habitat for this species. Your location is outside the critical habitat.

<https://ecos.fws.gov/ecp/species/3531>

Humpback Chub *Gila cypha*

Endangered

This species only needs to be considered if the following condition applies:

- Water depletions in the upper Colorado River basin adversely affect this species and its critical habitat. This species does not need to be considered if the project is outside of its occupied habitat and does not deplete water from the basin.

There is **final** critical habitat for this species. Your location is outside the critical habitat.

<https://ecos.fws.gov/ecp/species/3930>

Razorback Sucker *Xyrauchen texanus*

Endangered

This species only needs to be considered if the following condition applies:

- Water depletions in the upper Colorado River basin adversely affect this species and its critical habitat. This species does not need to be considered if the project is outside of its occupied habitat and does not deplete water from the basin.

There is **final** critical habitat for this species. Your location is outside the critical habitat.

<https://ecos.fws.gov/ecp/species/530>

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act¹ and the Bald and Golden Eagle Protection Act².

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described [below](#).

1. The [Migratory Birds Treaty Act](#) of 1918.
2. The [Bald and Golden Eagle Protection Act](#) of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern <http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php>

- Measures for avoiding and minimizing impacts to birds
<http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php>
- Nationwide conservation measures for birds
<http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf>

The birds listed below are birds of particular concern either because they occur on the [USFWS Birds of Conservation Concern](#) (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ [below](#). This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the [E-bird data mapping tool](#) (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found [below](#).

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME

BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)

Black Swift *Cypseloides niger*

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

<https://ecos.fws.gov/ecp/species/8878>

Breeds Jun 15 to Sep 10

Brewer's Sparrow *Spizella breweri*

This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

<https://ecos.fws.gov/ecp/species/9291>

Breeds May 15 to Aug 10

Rufous Hummingbird *selasphorus rufus*

Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

<https://ecos.fws.gov/ecp/species/8002>

Virginia's Warbler *Vermivora virginiae*

Breeds May 1 to Jul 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

<https://ecos.fws.gov/ecp/species/9441>

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is $0.25/0.25 = 1$; at week 20 it is $0.05/0.25 = 0.2$.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (■)

Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (I)

Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

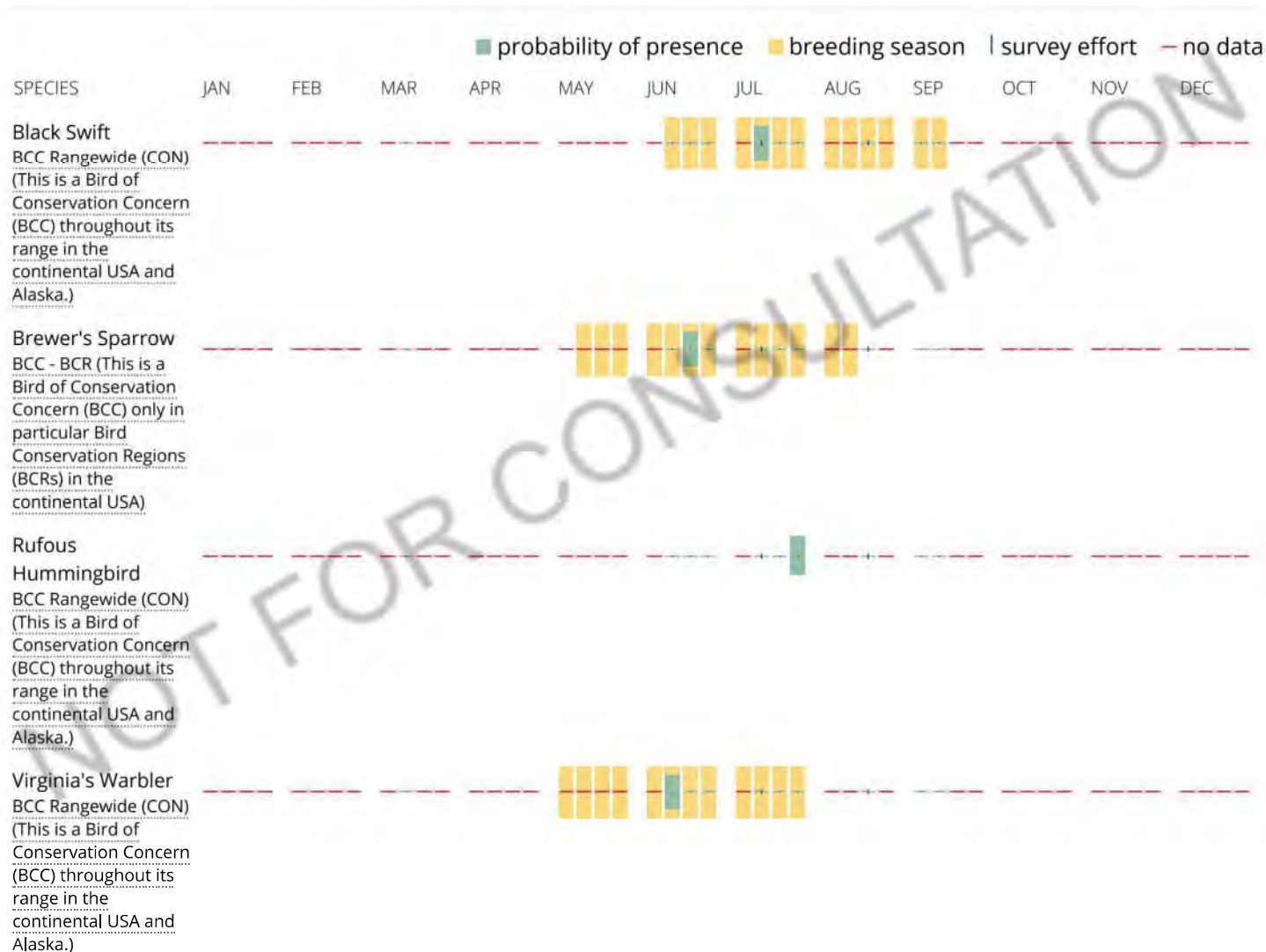
To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (—)

A week is marked as having no data if there were no survey events for that week.

Survey Timeframe

Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

[Nationwide Conservation Measures](#) describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. [Additional measures](#) and/or [permits](#) may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS [Birds of Conservation Concern \(BCC\)](#) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the [Avian Knowledge Network \(AKN\)](#). The AKN data is based on a growing collection of [survey, banding, and citizen science datasets](#) and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle ([Eagle Act](#) requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the [AKN Phenology Tool](#).

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the [Avian Knowledge Network \(AKN\)](#). This data is derived from a growing collection of [survey, banding, and citizen science datasets](#).

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: [The Cornell Lab of Ornithology All About Birds Bird Guide](#), or (if you are unsuccessful in locating the bird of interest there), the [Cornell Lab of Ornithology Neotropical Birds guide](#). If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are [Birds of Conservation Concern \(BCC\)](#) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the [Eagle Act](#) requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the [Northeast Ocean Data Portal](#). The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the [NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf](#) project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the [Diving Bird Study](#) and the [nanotag studies](#) or contact [Caleb Spiegel](#) or [Pam Loring](#).

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to [obtain a permit](#) to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the [National Wildlife Refuge](#) system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS AT THIS LOCATION.

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to [NWI wetlands](#) and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local [U.S. Army Corps of Engineers District](#).

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER EMERGENT WETLAND

[PEM1B](#)

FRESHWATER FORESTED/SHRUB WETLAND

[PSS1B](#)

RIVERINE

[R3UBH](#)

[R3UBG](#)

[R5UBH](#)

A full description for each wetland code can be found at the [National Wetlands Inventory website](#)

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tubercid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

NOT FOR CONSULTATION



Appendix B

- CDPHE Integrated Water Quality Report Information

COGUUN02_A Mainstem of the Uncompahgre River from the source (Poughkeepsie Gulch) to a point immediately above the confluence with Red Mountain Creek.

IR Category	Aquatic Life Tier	Recreational Tier	Miles
5. - 303(d)	C1 - Class 1 Cold Water Aquatic Life	P - Potential Use	5.5
Aquatic Life Use	Recreational Use	Agriculture Use	Water Supply Use
N - not supported	F - fully supporting	F - fully supporting	N - not supported

COGUUN03a_A Mainstem of the Uncompahgre River from a point immediately above the confluence with Red Mountain Creek to a point immediately above the confluence with Cascade Creek.

IR Category	Aquatic Life Tier	Recreational Tier	Miles
5. - 303(d)	C1 - Class 1 Cold Water Aquatic Life	E - Existing Use	3.3
Aquatic Life Use	Recreational Use	Agriculture Use	Water Supply Use
N - not supported	F - fully supporting	F - fully supporting	N - not supported

COGUUN03b_A Mainstem of the Uncompahgre River from a point immediately above the confluence with Cascade Creek to a point immediately above the confluence with Dexter Creek.

IR Category	Aquatic Life Tier	Recreational Tier	Miles
5. - 303(d)	C1 - Class 1 Cold Water Aquatic Life	E - Existing Use	2.6
Aquatic Life Use	Recreational Use	Agriculture Use	Water Supply Use
T - tmdl	F - fully supporting	F - fully supporting	N - not supported

COGUUN03c_A Mainstem of the Uncompahgre River from a point immediately above the confluence with Dexter Creek to a point immediately below the confluence with Dallas Creek.

IR Category	Aquatic Life Tier	Recreational Tier	Miles
5. - 303(d)	C1 - Class 1 Cold Water Aquatic Life	E - Existing Use	10.9
Aquatic Life Use	Recreational Use	Agriculture Use	Water Supply Use
T - tmdl	F - fully supporting	F - fully supporting	N - not supported

COGUUN03d_A Mainstem of the Uncompahgre River from a point immediately below the confluence with Dallas Creek to the inlet of Ridgway Reservoir.

IR Category	Aquatic Life Tier	Recreational Tier	Miles
4a. - TMDL	C1 - Class 1 Cold Water Aquatic Life	E - Existing Use	0.0
Aquatic Life Use	Recreational Use	Agriculture Use	Water Supply Use
T - tmdl	F - fully supporting	X - not assessed	X - not assessed

COGUUN03e_B Mainstem of the Uncompahgre River from the outlet of Ridgway Reservoir to a point immediately above the confluence with Broman Canyon.

IR Category	Aquatic Life Tier	Recreational Tier	Miles
5. - 303(d)	C1 - Class 1 Cold Water Aquatic Life	E - Existing Use	8.1
Aquatic Life Use	Recreational Use	Agriculture Use	Water Supply Use
N - not supported	F - fully supporting	F - fully supporting	F - fully supporting

COGUUN03e_C Mainstem of the Uncompahgre River from the confluence with Broman Canyon to a point immediately above the outlet of the South Canal near Uncompahgre.

IR Category	Aquatic Life Tier	Recreational Tier	Miles
5. - 303(d)	C1 - Class 1 Cold Water Aquatic Life	E - Existing Use	3.3
Aquatic Life Use	Recreational Use	Agriculture Use	Water Supply Use
N - not supported	F - fully supporting	F - fully supporting	F - fully supporting

COGUUN03f_A Mainstem of the Uncompahgre River from a point immediately above the outlet of the South Canal to a point immediately above the Highway 90 bridge in Montrose.

IR Category	Aquatic Life Tier	Recreational Tier	Miles
4a. - TMDL	C1 - Class 1 Cold Water Aquatic Life	E - Existing Use	11.1
Aquatic Life Use	Recreational Use	Agriculture Use	Water Supply Use
T - tmdl	F - fully supporting	F - fully supporting	F - fully supporting

COGUUN04a_B Mainstem of the Uncompahgre River from Cedar Creek to Gunnison Road.

IR Category	Aquatic Life Tier	Recreational Tier	Miles
5. - 303(d)	W1 - Class 1 Warm Water Aquatic Life	E - Existing Use	6.2
	Aquatic Life Use	Recreational Use	Agriculture Use
	N - not supported	F - fully supporting	F - fully supporting

COGUUN04a_C Mainstem of the Uncompahgre River from the Highway 90 bridge at Montrose to Cedar Creek.

IR Category	Aquatic Life Tier	Recreational Tier	Miles
3b. - M&E list	W1 - Class 1 Warm Water Aquatic Life	E - Existing Use	3.8
	Aquatic Life Use	Recreational Use	Agriculture Use
	I - insufficient information	F - fully supporting	F - fully supporting

COGUUN04b_A Mainstem of the Uncompahgre River from Gunnison Road to the upstream boundary of Confluence Park.

IR Category	Aquatic Life Tier	Recreational Tier	Miles
5. - 303(d)	W2 - Class 2 Warm Water Aquatic Life	P - Potential Use	18.6
	Aquatic Life Use	Recreational Use	Agriculture Use
	T - tmdl	F - fully supporting	F - fully supporting

COGUUN04c_A Mainstem of the Uncompahgre River from the upstream boundary of Confluence Park to the confluence with the Gunnison River.

IR Category	Aquatic Life Tier	Recreational Tier	Miles
4a. - TMDL	W1 - Class 1 Warm Water Aquatic Life	E - Existing Use	0.5
	Aquatic Life Use	Recreational Use	Agriculture Use
	T - tmdl	F - fully supporting	F - fully supporting

COGUUN05_B Commodore Gulch and its tributaries

IR Category	Aquatic Life Tier	Recreational Tier	Miles
5. - 303(d)	C2 - Class 2 Cold Water Aquatic Life	E - Existing Use	1.8
	Aquatic Life Use	Recreational Use	Agriculture Use
	N - not supported	F - fully supporting	F - fully supporting

COGUUN05_C Governor Basin

IR Category	Aquatic Life Tier	Recreational Tier	Miles
5. - 303(d)	C2 - Class 2 Cold Water Aquatic Life	E - Existing Use	0.7
	Aquatic Life Use	Recreational Use	Agriculture Use
	N - not supported	F - fully supporting	N - not supported

COGUUN05_D Silver Creek

IR Category	Aquatic Life Tier	Recreational Tier	Miles
3b. - M&E list	C2 - Class 2 Cold Water Aquatic Life	E - Existing Use	0.9
	Aquatic Life Use	Recreational Use	Agriculture Use
	I - insufficient information	F - fully supporting	F - fully supporting

COGUUN05_E Sneffels Creek below Governor Basin

IR Category	Aquatic Life Tier	Recreational Tier	Miles
5. - 303(d)	C2 - Class 2 Cold Water Aquatic Life	E - Existing Use	0.5
	Aquatic Life Use	Recreational Use	Agriculture Use
	N - not supported	F - fully supporting	N - not supported

COGUUN05_F All tributaries to the Uncompahgre River, including all wetlands, from the source to a point immediately below the confluence with Dexter Creek, except for specific listings in Segments 1, 6a, 6b, and 7 through 9 and segment portions.

IR Category	Aquatic Life Tier	Recreational Tier	Miles
1. - All attaining	C2 - Class 2 Cold Water Aquatic Life	E - Existing Use	37.0
Aquatic Life Use	Recreational Use	Agriculture Use	Water Supply Use
F - fully supporting	F - fully supporting	X - not assessed	F - fully supporting

COGUUN06a_A Mainstem of Red Mountain Creek from the source to immediately above the confluence with the East Fork of Red Mountain Creek.

IR Category	Aquatic Life Tier	Recreational Tier	Miles
5. - 303(d)	C2 - Class 2 Cold Water Aquatic Life	N - No Primary Use	0.7
Aquatic Life Use	Recreational Use	Agriculture Use	Water Supply Use
N - not supported	F - fully supporting	F - fully supporting	NA - not applicable

COGUUN06b_A Mainstem of Red Mountain Creek from immediately above the confluence with the East Fork of Red Mountain Creek to the confluence with the Uncompahgre River. All tributaries to Red Mountain Creek within Corkscrew and Champion basins.

IR Category	Aquatic Life Tier	Recreational Tier	Miles
1. - All attaining	none	N - No Primary Use	8.3
Aquatic Life Use	Recreational Use	Agriculture Use	Water Supply Use
NA - not applicable	F - fully supporting	F - fully supporting	NA - not applicable

COGUUN07_A Mainstem of Gray Copper Gulch from the source to the confluence with Red Mountain Creek.

IR Category	Aquatic Life Tier	Recreational Tier	Miles
5. - 303(d)	C2 - Class 2 Cold Water Aquatic Life	P - Potential Use	2.3
Aquatic Life Use	Recreational Use	Agriculture Use	Water Supply Use
N - not supported	F - fully supporting	F - fully supporting	F - fully supporting

Appendix C

USEPA Sampling Results, Irene Mine September 2019

Pre-CERCLA Screening Checklist/Decision Form



This form is used in conjunction with a site map and any additional information required by the EPA Region to document completion of a Pre-CERCLA Screening (PCS). The form includes a decision on whether a site should be added to the Superfund program's active site inventory for further investigation.

EPA Region: 8 **State:** Colorado

EPA ID No. (If Available): Not Applicable

Site Category: Tronox Mines	Select a Site Name (Primary): Irene Mine
Site Number: Not Applicable	
Date of Site Visit: Sep 18, 2019	Time of Site Visit: 09:42

Checklist Preparer

Title: Site Assessment/Project Manager

Name: Jean Wyatt

Organization: EPA

Street Address: 1595 Wynkoop St

City: Golden

State: Colorado Zip Code: 80202

Phone: (303) 312-6258

Site Information (Preliminary)

Site Name (Alternate 1): N/A

Site Name (Alternate 2): N/A

Region: 8

State: Colorado

County: Ouray

Congressional District: 3

Spatial Location

Latitude: 37.933843606187

Longitude: -107.682874482225

Collection Method: GPS (handheld, Smartphone, other device with < 25m accuracy)

Horizontal Accuracy in Meters: 10

Site Description of this Spatial Location:

Approximate Center of Site

Mine Site Contact

Title:

Name:

Organization:

Street Address:

City:

State:

Zip Code:

Phone:

Preliminary Assessment - Historical Data

CERCLA 105d Petition for Preliminary Assessment:	No
Petition Date:	Not Applicable
RCRA Subtitle C Site Status:	Not Applicable
Is site in RCRAInfo?	No
RCRAInfo Handler ID #:	Not Applicable
Additional RCRAInfo ID #:	Not Applicable
State ID:	None
Other ID:	None
Ownership Type:	Forest Service
Site Type:	Abandoned Mine Site
Site Sub-Type:	Hard Rock Mining
Federal Facility/Federal Facility Owner:	Not Applicable
Formerly Used Defense Site (FUDS):	No
Federal Facility Docket:	No
Federal Facility Docket Listing Date:	Not Applicable
Federal Facility Docket Reporting Mechanism:	Not Applicable
Native American Interest:	Unknown
Tribe/Additional Tribe:	Unknown

Site Description - Physical Setting

Abandoned Mine Site:	Yes
Buildings:	Buildings Not Present
Mill or Milling Equipment or Tailing Present:	No
Steep Waste Piles:	No
Safety Hazards Present:	Yes
Safety Hazards:	Low pH Water/Leachate Miscellaneous Debris Potential for contact (human/eco) with open acidic mine drainage stream Debris/silt causes blockage of drainage or stream may result in flooding
Accessibility:	Easy access, Located Along Main Road
Time it takes to reach this site (Hours:Minutes):	One Minute from Road
Detailed description of how the site was accessed:	Off Highway 550, approx. 10 miles south from Ouray
Adjacent to Resident/Adjacent Residential Features:	No
Mountainous Steep Terrain:	Yes
Vegetation Present/Vegetation Density:	Yes; Heavy
Surface Water Body on or Adjacent to the Site:	Yes
Open Fields:	No
Waste Pile Erosion Observed:	Yes
Describe Waste Pile Run Off:	Drainage off of pile observed
Tailings Erosion Observed:	No
Draining Adits or Seeps Discharge from the Site:	Yes
Adits Flow Rate from Site:	Minor
Describe Adit Flow from Site:	Adit draining but low flow due to Fall/low flow conditions
Draining Adits or Seeps Discharge Across Waste Piles:	Yes
Draining Adits or Seeps Discharge to Adjacent Habitat:	Yes
Adit Flows into what habitat:	Riparian
Habitat Name:	
Physical Setting and Access Features:	Designated recreational area
Physical Setting Field Notes:	Easy access to site, adjacent to highway and trailhead. Extremely high lead measured by XRF on pile (4.4%) on pile downstream from adit; campfire rings present on pile; Water draining from adit into surrounding upland and wetland habitats.

Site Description - Land Use

Roads/Trails:	Yes	Road/Trail Type:	Major Road or Highway
Human Activity:	Yes	Human Activity Type:	Moderate
Residential:	No	Residential Density:	Not Applicable
Recreational Use:	Yes	Recreational Density:	Moderate
Camping:	Yes	Camping Frequency:	Minimal
Fishing:	No	Fishing Frequency:	Not Applicable
Hiking:	Yes	Hiking Frequency:	Moderate
Biking:	Yes	Biking Frequency:	Moderate
Picnicking:	Yes	Picnicking Frequency:	Minimal
Ecological Activity:	Yes	Ecological Activity:	Heavy

Observed/likely fishing/consumption of fish/aquatic organisms at the mine site or within ¼ miles downstream: Unknown

Are there other observed sensitive environments on-site or downstream of the waste area(s) within ¼ mile? Unknown

Sensitive Environment (wetland, stream, creek, river, known to be in the vicinity of a National Park, designated federal/state wildlife or scenic area, fish hatchery/spawning area, designated for wildlife or game management, known to be used by or designated critical habitat for Threatened or Endangered Species, or any other sensitive environment critical to supporting wildlife): Other Sensitive Environments

Land Use Field Notes: Moderate use of trail for biking/hiking expected. Observed campfire rings in a few different areas. Short dirt road off hwy leads to parking area adjacent to secondary pile. Strong sulfur odor present. Trash also observed on site.

Site Surface Description

Draining Adit:	Yes
Draining Adit Type:	Collapsed portal with discharging adit
Waste Piles/Number of Waste Piles:	Yes/2
Airborne Release of Fine Material/Dust:	Unknown
Surface Water on or Immediately Adjacent:	No
Wetlands on or Adjacent to Site:	Yes
Forested on or Adjacent to the Site:	Yes
Riparian on or Adjacent to the Site:	Yes
Site Surface Field Notes:	1 Large pile below adit and adjacent to hwy and 1 secondary pile next to trail. Short dirt road and parking lot connects piles.
Groundwater Seeps Observed?	Unknown
Groundwater Seeps Field Notes:	None observed but orange drainage channel surfaces from secondary pile and flows to gully next to hwy.
Primary Drainage Name:	Red Mountain Creek
Previous Investigations:	No
Cleanup Activities:	No
Previous Regulatory Actions (Permitting and Enforcement):	No
Institutional Controls:	No
Community Interest:	Yes; Uncompahgre Watershed Partnership

Survey Form

1. An initial search for the site in EPA's Superfund active, archive and non-site inventories should be performed prior to starting a PCS. Is this a new site that does not already exist in these site inventories?	Yes
2. Is there evidence of an actual release or a potential to release? Evidence of Potential Release: <div style="padding-left: 40px;">Evidence of waste pile runoff/erosion (channels, rills, run off), Draining mine adit water discharge, Draining mine adit discharging into wetlands or surrounding environment, Draining Mine Adit Water discharging over waste material, Potential for contact (human/eco) with open acidic mine drainage stream</div>	Yes
3. Are there possible targets that could be impacted by a release of contamination at the site?	Yes
4. Is there documentation indicating that a target has been exposed to a hazardous substance released from the site?	Unknown
5. Is the release of a naturally occurring substance in its unaltered form, or is it altered solely through naturally occurring processes or phenomena, from a location where it is naturally found?	No
6. Is the release from products which are part of the structure of, and result in exposure within, residential buildings or business or community structures?	No
7. If there has been a release into a public or private drinking water supply, is it due to deterioration of the system through ordinary use?	No
8. Are the hazardous substances possibly released at the site, or is the release itself, excluded from being addressed under CERCLA?	No
9. Is the site being addressed under RCRA corrective action or by the Nuclear Regulatory Commission?	No
10. Is another federal, state, tribe or local government environmental cleanup program other than site assessment actively involved with the site (e.g., state voluntary cleanup program)?	No
11. Is there sufficient documentation or evidence that demonstrates there is no likelihood of a significant release that could cause adverse environmental or human health impacts?	No
12. Are there OTHER site-specific situations or factors that warrant further CERCLA remedial/integrated assessment or response?	No

Preparer's Recommendation

Preparer's Recommendation: Do not add site to the Superfund active site inventory.

Please explain recommendation below: Site located adjacent to highway and at a popular hiking trailhead. Lead detected from 8,000 ppm to 40,000 ppm in piles. Campfire rings present & highly active recreational use evident onsite. Adit discharge concentrations are elevated above water quality standards for cadmium, copper, lead & zinc with active drainage into Red Mountain Creek watershed.

Site Assessor's Name: Jean Wyatt

Site Assessor's Signature:

A handwritten signature in black ink that reads "Jean Wyatt". The signature is written in a cursive, flowing style.

Date: Sep 18, 2019

EPA Regional Review and
Pre-CERCLA Screening Decision

EPA Region 8 Reviewer's Name: Jean Wyatt

EPA Region 8 Reviewer's Signature:

A handwritten signature in black ink, appearing to read "Jean Wyatt", with a stylized, cursive script.

Date: Sep 18, 2019

Site Location



Irene Mine - 2019 Data Summary

Surface Water

[illegible]

^a Sample-specific hardness calculated using dissolved calcium and magnesium concentrations for use in assessing hardness-based in accordance with Colorado Water Quality Control Commission, Regulation 31 (https://www.colorado.gov/pacific/sites/default/files/31_2018%2801%29.pdf).

U = Laboratory analysis indicates that the analyte was undetected at the concentration shown

j = Laboratory quality control review indicates that this result is considered estimated

D = Sample diluted prior to analysis; reported result is for undiluted sample

Field-Measured Water Quality Parameters

STATION ID	ANALYSIS	MATRIX	SAMPLE DATE	SAMPLE TIME	pH	Temp.	Dissolved Oxygen	Conductivity	Flow	Flow Measurement
					Stand. Unit	°C	mg/L	µS/cm	cms	Equipment
IRN-SW-A01-01	In Situ Measure	Surface Water	9/18/2019	10:42	3.21	10.5	1.74	836	NC	See note

NC = Not collected

Surface Water - Anions and Alkalinity

STATION ID	ANALYSIS	MATRIX	SAMPLE DATE	SAMPLE TIME	Chloride mg/L	Fluoride mg/L	Nitrate/Nitrite as N mg/L	Sulfate as SO4 mg/L	Total Alkalinity mg CaCO3 / L
IRN-SW-A01-01	Wet Chemistry	Surface Water	9/18/2019	10:42	5 U	2.8 D	2.5 UJ	282 D	5 U

U = Laboratory analysis indicates that the analyte was undetected at the concentration shown

J = Laboratory quality control review indicates that this result is considered estimated

D = Sample diluted prior to analysis; reported result is for undiluted sample

Surface Soil

STATION ID	ANALYSIS	MATRIX	SAMPLE DATE	SAFETY	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Niobium	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Uranium	Vanadium	Zinc	
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
(RIN-SM-MP01-01)	Total Recoverable Metals	Sol	09/18/2019	11:21	4010	2.90	11.0	89.0	0.4810	0.9830	3.40	2.210	8.770	360	52500	82700	82.70	24.50	1170	1.380	6500	6.50	7.70	24.0	0.1610	2.90			
(RIN-SM-MP02-02 (gr))	Total Recoverable Metals	Sol	09/18/2019	11:38	4430	2.90	11.0	89.0	0.4810	0.9830	3.40	2.210	8.770	360	52500	82700	82.70	24.50	1170	1.380	6500	6.50	7.70	24.0	0.1610	2.90			
(RIN-SM-MP03-03 (gr))	Total Recoverable Metals	Sol	09/18/2019	12:03	4400	4.770	14.0	41.6	0.460	0.940	19.70	2.50	9.90	0.00	11.1	205	10000	83000	82.70	24.50	0.90	12.0	4.970	7.80	16.0	4.80	1.80	5400	
(RIN-SM-MP04-04 (gr))	Total Recoverable Metals	Sol	09/18/2019	12:06	3620	5.31	9.40	18.9	0.4810	6.790	48.1	0.886	0.375	31.7	36300	18500	82.10	32.60	0.131	361.0	0.0400	9610	16.10	12.0	0.090	1.00	7.0	3000	
(RIN-SM-MP05-05 (gr))	Total Recoverable Metals	Sol	09/18/2019	12:10	7810	1.70	4.890	3.790	0.490	4.890	4.890	0.490	4.890	9.70	35000	18500	82.10	32.60	0.131	361.0	0.0400	2160	6.70	26.0	12.0	8.00	0.320	24.0	1800
(RIN-SM-MP06-06 (gr))	Total Recoverable Metals	Sol	09/18/2019	12:13	7810	1.70	4.890	3.790	0.490	4.890	4.890	0.490	4.890	9.70	35000	18500	82.10	32.60	0.131	361.0	0.0400	2160	6.70	26.0	12.0	8.00	0.320	24.0	1800
(RIN-SM-MP07-07)	Total Recoverable Metals	Sol	09/18/2019	11:45	9860	3.70	22.50	60.3	0.460	0.940	2.710	0.52	0.62	4.0	74.0	17800	18000	106.0	18.0	0.52	5720	9330.0	7970	55.10	77.50	14.0	12.0	0.810	25.0
(RIN-SM-BRG-01)	Total Recoverable Metals	Sol	09/18/2019	12:39	6000	0.253	0.40	15.4	0.4780	0.5350	3760	4.05	3.78	10.0	13000	13000	31.00	38.00	37.0	0.038	6.526	3.56	12.0	0.478	0.320	25.0	4.0	88.0	

U = Laboratory analysis indicates that the analyte was undetected at the concentration shown

J = Laboratory quality control review indicates that this result is considered estimated

D = Sample diluted prior to analysis; reported result is for undiluted sample

B = The analyte was detected in the sample as well as in the associated blank

Soil Synthetic Precipitation Leaching Procedure Leachate

STATION ID	ANALYSIS	MATRIX	SAMPLE DATE	SAMPLE TIME	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
					ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
IRN-SO-MQPI-01	SP/L	Leachate	09/18/2019	11:21	5270	60 U	10 U	36 J	0.5 J	39.1	4000 J	10 U	6.4 J	1040	9620	6090	1170 J	35 L	3.5 J	265 J	35 U	0.49 J	3850 J	25 U	50 U	10800

U = Laboratory analysis indicates that the analyte was undetected at the concentration shown

J = Laboratory quality control review indicates that this result is considered estimated

[illegible]



Figure A.1
2019 Phase 1 Pre-CERCLA
Screening of Tronox Mines
Surface Water & Soil Sample Locations

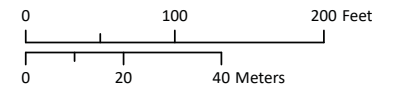
Irene Mine, Ironton
Uncompahgre National Forest
Ouray County, Colorado
Tronox Site ID - 10008365

- Irene Mine
- Surface Water Grab Sample Locations
- Soil Grab Sample Locations
- Center of Soil Composite Sample Locations

Date: April 08, 2020

Map Projection: UTM Zone 13N, WGS84, Meters

Data Sources:
 Mine & Sample Locations: U.S. EPA (2019);
 Base Map: Esri World Imagery (Clarity) Web Service (2019).



Area Enlarged



Figure A.2
2019 Phase 1 Pre-CERCLA
Screening of Tronox Mines
XRF Survey Locations & Lead Results

Irene Mine, Ironton

Uncompahgre National Forest
Ouray County, Colorado

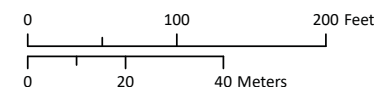
- ☒ Irene Mine
- Lead (mg/kg)
- < Instrument Level of Detection (LOD)
 - < Residential Regional Screening Level (RSL)
 - > Residential Regional Screening Level
 - > Industrial Regional Screening Level
 - > 2x Industrial Regional Screening Level
 - > 4x Industrial Regional Screening Level
- Lead Residential RSL = 400 mg/kg
 Lead Industrial RSL = 800 mg/kg

Date: April 06, 2020

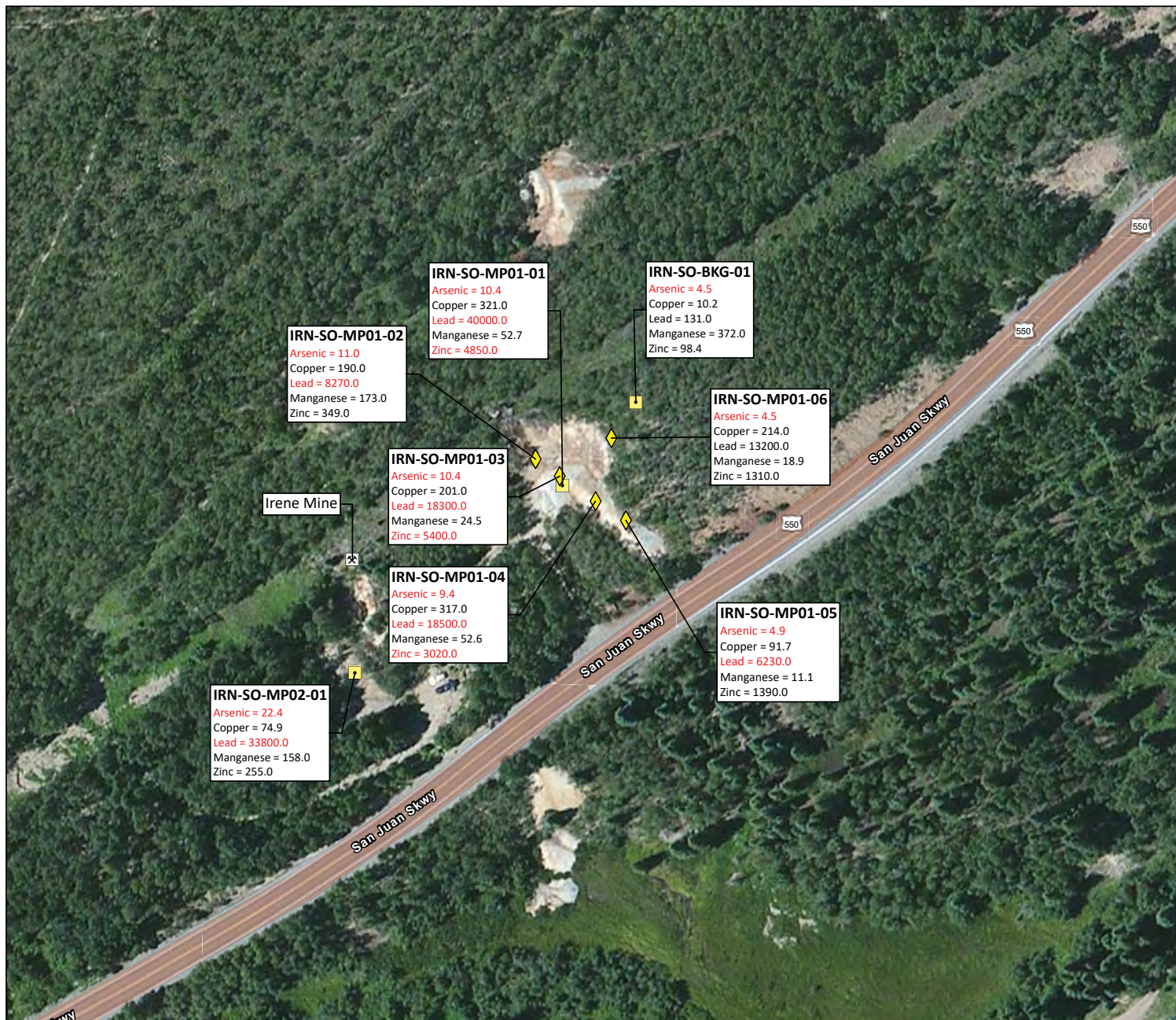
Map Projection: UTM Zone 13N, WGS84, Meters

Data Sources:

Mine Locations: U.S. EPA (2019);
 Sample Locations & Lead Levels: U.S. EPA (2019);
 RSL: <https://semspub.epa.gov/work/HQ/199626.pdf>;
 Base Map: Esri World Imagery (Clarity) Web Service (2020).



Area Enlarged



Tronox Mine on Forest Service-Managed Land in Colorado

Irene Mine Soil Laboratory Results September 2019

- Soil Grab Sample Locations
 - Composite Soil Sample Locations
Analytical Results presented in mg/kg dry weight
 - Irene Mine
- *RED color indicates an exceedance of EPA Human Health Regional Soil Screening Levels (RSLs).

	Arsenic	Copper	Lead	Manganese	Zinc
Residential	0.68	3100	400	1800	23,000
Industrial	3.0	47,000	800	26,000	350,000

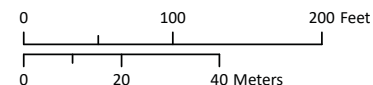
Regional screening Levels for Residential and Industrial are in mg/kg dry weight.

Date: February 7, 2020

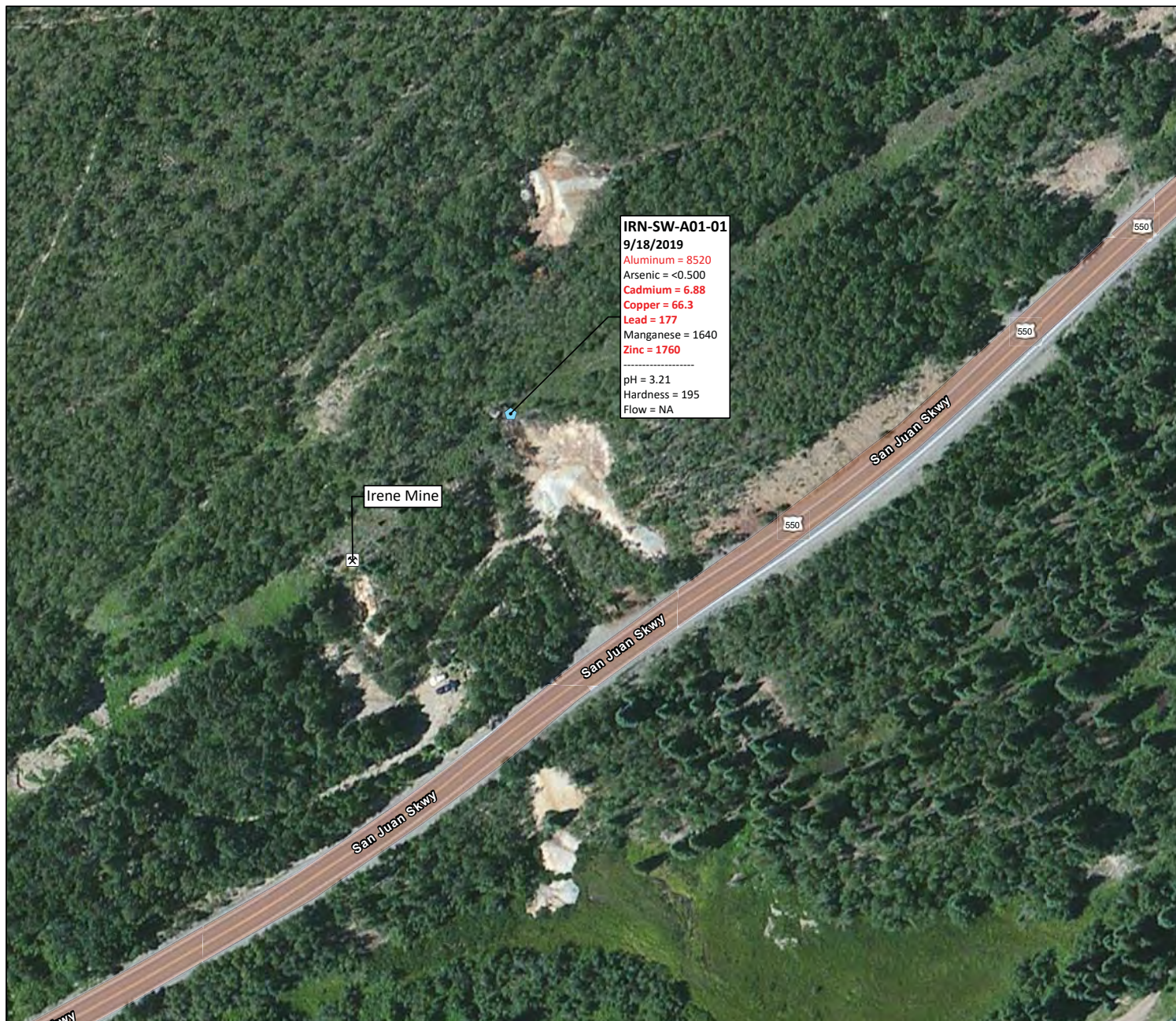
Map Projection: UTM Zone 13N, WGS84, Meters

Data Sources:

Sample Locations & Analytical Results: U.S. EPA (2019);
Base Map: Esri World Imagery (Clarity) Web Service (2020).



Area Enlarged



Tronox Mine on Forest Service-Managed Land in Colorado

Irene Mine

Surface Water Laboratory Results September 2019

- Surface Water Sample Locations
Dissolved Metals: units = µg/L
Total Recoverable Aluminum: units = µg/L
Flow: units = cfs
pH: units = standard units
Hardness: units = mg of CaCO₃/L

Irene Mine

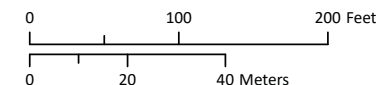
*RED color indicates an exceedance to a Chronic Water Quality Standard.
RED BOLD color indicates an exceedance to both an Acute and Chronic Water Quality Standard.

Date: February 6, 2020

Map Projection: UTM Zone 13N, WGS84, Meters

Data Sources:

Sample Locations & Analytical Results: U.S. EPA (2019);
Base Map: Esri World Imagery (Clarity) Web Service (2020).



Area Enlarged

Photographs



Irene Mine: From Center/top of pile in front of lower adit



Irene Mine: Lower Adit pooling water at base



Irene Mine: Side view of pile from top including campfire ring



Irene Mine: Secondary pile behind trees, south of main pile, adjacent to Richmond Trailhead & Trail parking area



Irene Mine: Front view of pile from center top



Irene Mine: Drainage from secondary pile, flows down to gully adjacent to hwy



Irene Mine: Another side view of pile from side/base



Irene Mine: Secondary pile front face adjacent to trail and parking area

Appendix C: Irene Mine - 2019 Data Summary , USEPA Pre-CERCLA Assessment

Table 1. Surface Water

STATION_ID	ANALYSIS	MATRIX	SAMPLE DATE	SAMPLE TIME	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Polybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Uranium	Thallium	Vanadium	Zinc	Hardness
IRN-SW-A01-01	Total Recoverable Metals	Surface Water	9/18/2019	10:42	8520	2.5 U	2.5 U	25 U	2 U	7.09 D	56500	5 U	37.8 D	78.7 D	8390	188 D	12500	1650	0.1 U	5 U	13.3 D	958 J	5 U	2.5 U	7280	0.5 U	5 U	10 U	1670	NA
	Dissolved Metals	Surface Water	9/18/2019	10:24	8170	0.5 U	0.5 U	7.14 J	2 U	6.88	57600	1 U	34.2	66.3	8150	177	12500	1640	NA	1 U	12.1	921 J	1 U	0.5 U	6620	0.253 J	1 U	2 U	1760	195000

¹ Sample-specific hardness calculated using dissolved calcium and magnesium concentrations for use in assessing hardness-based in accordance with Colorado Water Quality Control Commission, Regulation 31 (https://www.colorado.gov/pacific/sites/default/files/31_2018%2801%29.pdf)

NA = Not analyzed

U = Laboratory analysis indicates that the analyte was undetected at the concentration shown

J = Laboratory quality control review indicates that this result is considered estimated

D = Sample diluted prior to analysis; reported result is for undiluted sample

Table 2. Field-Measured Water Quality Parameters

STATION_ID	ANALYSIS	MATRIX	SAMPLE DATE	SAMPLE TIME	pH	Temp.	Dissolved Oxygen	Conductivity	Flow	Flow Measurement
					Stand. Unit	°C	mg/L	µS/cm	cfs	Equipment
IRN-SW-A01-01	In Situ Measure	Surface Water	9/18/2019	10:42	3.21	10.5	1.74	836	NC	See note

NC = Not collected

Table 3. Surface Water - Anions and Alkalinity

STATION_ID	ANALYSIS	MATRIX	SAMPLE DATE	SAMPLE TIME	Chloride	Fluoride	Nitrate/Nitrite as N	Sulfate as SO4	Total Alkalinity
					mg/L	mg/L	mg/L	mg/L	mg CaCO3 / L
IRN-SW-A01-01	Wet Chemistry	Surface Water	9/18/2019	10:42	5 U	2.8 D	2.5 UJ	282 D	5 U

U = Laboratory analysis indicates that the analyte was undetected at the concentration shown

J = Laboratory quality control review indicates that this result is considered estimated

D = Sample diluted prior to analysis; reported result is for undiluted sample

Table 4. Surface Soil

STATION_ID	ANALYSIS	MATRIX	SAMPLE DATE	SAMPLE TIME	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Polybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Uranium	Vanadium	Zinc
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
IRN-SO-MP01-01	Total Recoverable Metals	Soil	09/18/2019	11:21	2070 D	7.2 D	10.4 D	50.9 D	0.489 U	11 D	176 D	0.802 JD	1.95 D	321 D	49800 D	40000 BD	353 D	52.7 D	0.50 D	285 D	1.22 D	1350 D	9.98 JD	47.6 D	122 U	1.05 D	0.118 D	7.42 D	4850 D
IRN-SO-MP01-02 (grab)	Total Recoverable Metals	Soil	09/18/2019	11:58	4430 D	2.99 D	11 D	85.9 D	0.484 U	0.683 D	304 D	2.23 D	0.797 D	190 D	52500 D	8270 BD	1970 D	173 D	0.42 D	311 D	1.38 D	1630 D	6.55 JD	7.7 D	243 JD	0.6 JD	0.161 D	25.9 D	349 D
IRN-SO-MP01-03 (grab)	Total Recoverable Metals	Soil	09/18/2019	12:03	1400 D	4.77 D	10.4 D	43.6 D	0.469 U	19.7 D	255 D	0.939 U	11.3 D	201 D	107000 D	18300 BD	82.7 JD	24.5 D	0.99 D	122 D	4.97 D	738 D	16.7 JD	45.9 D	117 U	0.939 U	0.0968 JD	1.88 U	5400 D
IRN-SO-MP01-04 (grab)	Total Recoverable Metals	Soil	09/18/2019	12:06	1620 D	5.33 JD	9.4 D	38.9 D	0.491 U	6.29 JD	49.1 U	0.896 JD	0.375 D	317 D	36300 D	18500 BD	211 JD	52.6 JD	0.31 D	361 JD	0.604 D	1290 D	9.63 D	16.7 JD	123 U	1.09 D	0.112 D	17 D	3020 JD
IRN-SO-MP01-05 (grab)	Total Recoverable Metals	Soil	09/18/2019	12:10	769 D	9.71 D	4.89 D	57.9 D	0.489 U	4.99 D	48.9 U	0.489 U	0.45 D	91.7 D	15500 D	6230 BD	52.2 JD	11.1 D	1.11 D	561 D	0.244 U	1210 D	6.77 D	20.6 D	122 U	4.89 D	0.103 D	2.42 D	1390 D
IRN-SO-MP01-06 (grab)	Total Recoverable Metals	Soil	09/18/2019	12:13	1070 D	5.73 D	4.47 D	40 D	0.484 U	3.23 D	69.5 JD	0.533 JD	0.237 D	214 D	24200 D	13200 BD	126 D	18.9 D	0.48 JD	268 D	0.242 U	1030 D	8.35 D	13.6 D	121 U	1.73 D	0.0826 JD	9.71 D	1310 D
IRN-SO-MP02-01	Total Recoverable Metals	Soil	09/18/2019	11:45	986 D	37.5 D	22.4 D	69.3 D	0.498 U	2.73 D	62.2 JD	0.62 JD	0.46 D	74.9 D	17800 D	33800 BD	106 JD	158 D	0.52 D	5720 D	0.332 JD	797 D	55.1 JD	77.5 D	124 U	1.21 D	0.181 D	4.12 D	255 D
IRN-SO-BKG-01	Total Recoverable Metals	Soil	09/18/2019	12:19	6920 D	0.253 JD	4.5 D	154 D	0.478 U	0.535 D	3760 D	4.65 D	3.78 D	10.2 D	10300 D	131 BD	2930 D	372 D	0.03 JD	0.526 D	3.56 D	1190 D	0.478 UJ	0.265 JD	120 U	0.478 U	0.322 D	15.4 D	98.4 D

U = Laboratory analysis indicates that the analyte was undetected at the concentration shown

J = Laboratory quality control review indicates that this result is considered estimated

D = Sample diluted prior to analysis; reported result is for undiluted sample

B = The analyte was detected in the sample as well as in the associated blank

Table 5. Soil Synthetic Precipitation Leaching Procedure Leachate

STATION_ID	ANALYSIS	MATRIX	SAMPLE DATE	SAMPLE TIME	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
					ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
IRN-SO-MP01-01	SPLP	Leachate	09/18/2019	11:21	5270	60 U	10 U	36 J	0.5 J	39.1	4000 J	10 U	6.4 J	1040	9620	6090	1170 J	351	3.5 J	265 J	35 UJ	0.49 J	3850 J	25 U	50 U	10800

U = Laboratory analysis indicates that the analyte was undetected at the concentration shown

J = Laboratory quality control review indicates that this result is considered estimated

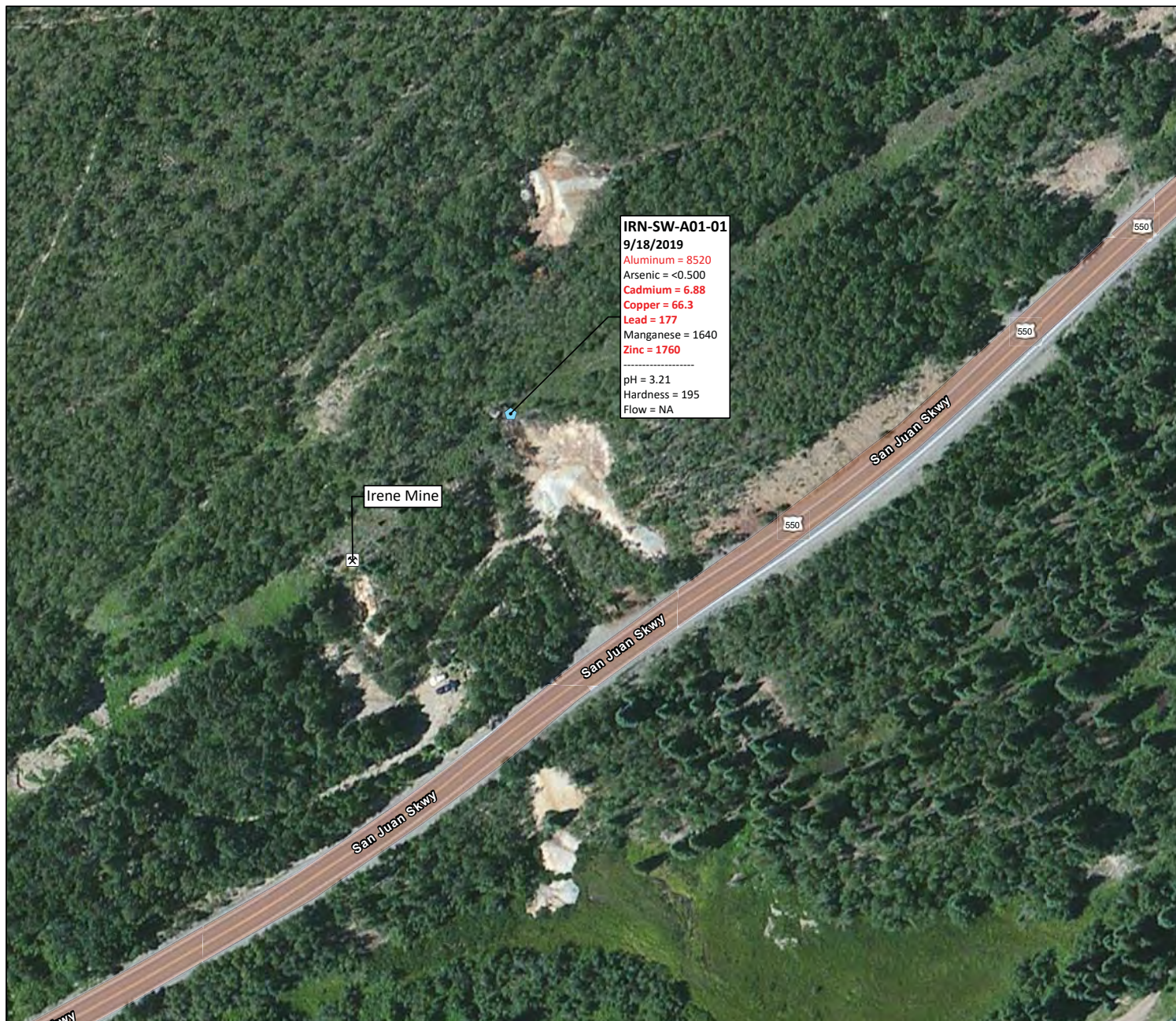
Table 6. X-Ray Fluorescence (XRF) Spectrometry Soil Survey Results

Mine Name	XRF Sample ID	Latitude	Longitude	Date	Time	Units	Ti	Ti +/-	Cr	Cr +/-	Mn	Mn +/-	Fe	Fe +/-	Co	Co +/-	Ni	Ni +/-	Cu	Cu +/-	Zn	Zn +/-	As	As +/-	Se	Se +/-	Rb	Rb +/-	Sr	Sr +/-
Irene Mine	IRN-SO-MP01-01-X001	37.93394	-107.68288	18-Sep-19	10:55	mg/kg	7305	674	<LOD	181	190	56	59897	935	1174	144	<LOD	104	201	18	6303	111	<LOD	241	<LOD	24	162	6	37	3
Irene Mine	IRN-SO-MP01-01-X002	37.9337845	-107.6828687	18-Sep-19	11:02	mg/kg	5990	476	<LOD	122	183	39	34747	466	614	89	<LOD	78	165	13	3988	63	<LOD	148	<LOD	15	190	5	112	4
Irene Mine	IRN-SO-MP01-01-X003	37.93381583	-107.6827557	18-Sep-19	11:03	mg/kg	3303	400	<LOD	109	289	38	29232	378	244	75	<LOD	67	81	10	465	15	<LOD	113	<LOD	12	181	4	186	4
Irene Mine	IRN-SO-MP01-01-X004	37.93380767	-107.6827927	18-Sep-19	11:06	mg/kg	5021	451	<LOD	127	182	36	14107	229	211	59	<LOD	78	135	13	4336	68	<LOD	198	<LOD	19	226	6	74	3
Irene Mine	IRN-SO-MP01-01-X005	37.93378083	-107.6827315	18-Sep-19	11:07	mg/kg	4736	383	<LOD	100	128	28	13833	196	<LOD	147	<LOD	58	105	10	192	9	<LOD	91	<LOD	10	276	5	104	3
Irene Mine	IRN-SO-MP01-01-X006	37.933708	-107.6826662	18-Sep-19	11:10	mg/kg	4989	542	<LOD	146	163	44	24836	397	513	87	<LOD	96	317	20	6896	110	<LOD	260	<LOD	25	214	6	136	5
Irene Mine	IRN-SO-MP01-01-X007	37.93376317	-107.6826535	18-Sep-19	11:10	mg/kg	5762	621	<LOD	161	424	60	18215	344	349	85	<LOD	130	652	31	13612	220	<LOD	424	<LOD	40	165	7	63	5
Irene Mine	IRN-SO-MP02-01-X001	37.93336367	-107.6834635	18-Sep-19	11:39	mg/kg	7025	655	<LOD	172	534	64	24952	449	385	96	<LOD	124	88	17	133	15	<LOD	412	44	14	175	7	142	6

Table 6. X-Ray Fluorescence (XRF) Spectrometry Soil Survey Results (Continued)

Mine Name	XRF Sample ID	Latitude	Longitude	Date	Time	Units	Zr	Zr +/-	Mo	Mo +/-	Ag	Ag +/-	Cd	Cd +/-	Sn	Sn +/-	Sb	Sb +/-	Ba	Ba +/-	Hg	Hg +/-	Pb	Pb +/-
Irene Mine	IRN-SO-MP01-01-X001	37.93394	-107.68288	18-Sep-19	10:55	mg/kg	170	5	57	4	<LOD	48	<LOD	51	<LOD	76	<LOD	84	<LOD	1074	<LOD	41	15122	229
Irene Mine	IRN-SO-MP01-01-X002	37.9337845	-107.6828687	18-Sep-19	11:02	mg/kg	242	5	262	6	<LOD	39	<LOD	42	<LOD	65	<LOD	73	<LOD	734	<LOD	27	8464	109
Irene Mine	IRN-SO-MP01-01-X003	37.93381583	-107.6827557	18-Sep-19	11:03	mg/kg	183	4	118	4	<LOD	37	<LOD	40	<LOD	61	<LOD	68	879	228	<LOD	22	5583	71
Irene Mine	IRN-SO-MP01-01-X004	37.93380767	-107.6827927	18-Sep-19	11:06	mg/kg	154	4	65	4	<LOD	40	<LOD	43	<LOD	66	<LOD	73	<LOD	711	<LOD	36	14497	181
Irene Mine	IRN-SO-MP01-01-X005	37.93378083	-107.6827315	18-Sep-19	11:07	mg/kg	174	4	215	4	<LOD	34	<LOD	37	<LOD	57	<LOD	64	669	202	23	6	3994	50
Irene Mine	IRN-SO-MP01-01-X006	37.933708	-107.6826662	18-Sep-19	11:10	mg/kg	189	5	606	10	<LOD	44	<LOD	48	<LOD	72	<LOD	81	<LOD	900	<LOD	42	20920	285
Irene Mine	IRN-SO-MP01-01-X007	37.93376317	-107.6826535	18-Sep-19	11:10	mg/kg	105	5	289	7	<LOD	49	<LOD	57	<LOD	78	<LOD	87	<LOD	1004	<LOD	69	44385	656
Irene Mine	IRN-SO-MP02-01-X001	37.93336367	-107.6834635	18-Sep-19	11:39	mg/kg	97	5	1935	31	<LOD	49	<LOD	51	<LOD	77	<LOD	85	<LOD	1024	<LOD	69	41958	629

LOD = limit of detection; Ti = titanium; Cr = chromium; Mn = manganese; Fe = iron; Co = cobalt; Ni = nickel; Cu = copper; Zn = zinc; As = arsenic; Se = selenium; Rb = rubidium; Sr = strontium; Zr = zirconium; Mo = molybdenum; Ag = silver; Cd = cadmium; Sn = tin; Sb = antimony; Ba = barium; Hg = mercury; Pb = lead



Tronox Mine on Forest Service-Managed Land in Colorado

Irene Mine

Surface Water Laboratory Results September 2019

- Surface Water Sample Locations
Dissolved Metals: units = $\mu\text{g/L}$
Total Recoverable Aluminum: units = $\mu\text{g/L}$
Flow: units = cfs
pH: units = standard units
Hardness: units = mg of CaCO_3/L

Irene Mine

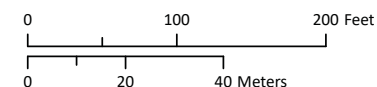
*RED color indicates an exceedance to a Chronic Water Quality Standard.
RED BOLD color indicates an exceedance to both an Acute and Chronic Water Quality Standard.

Date: February 6, 2020

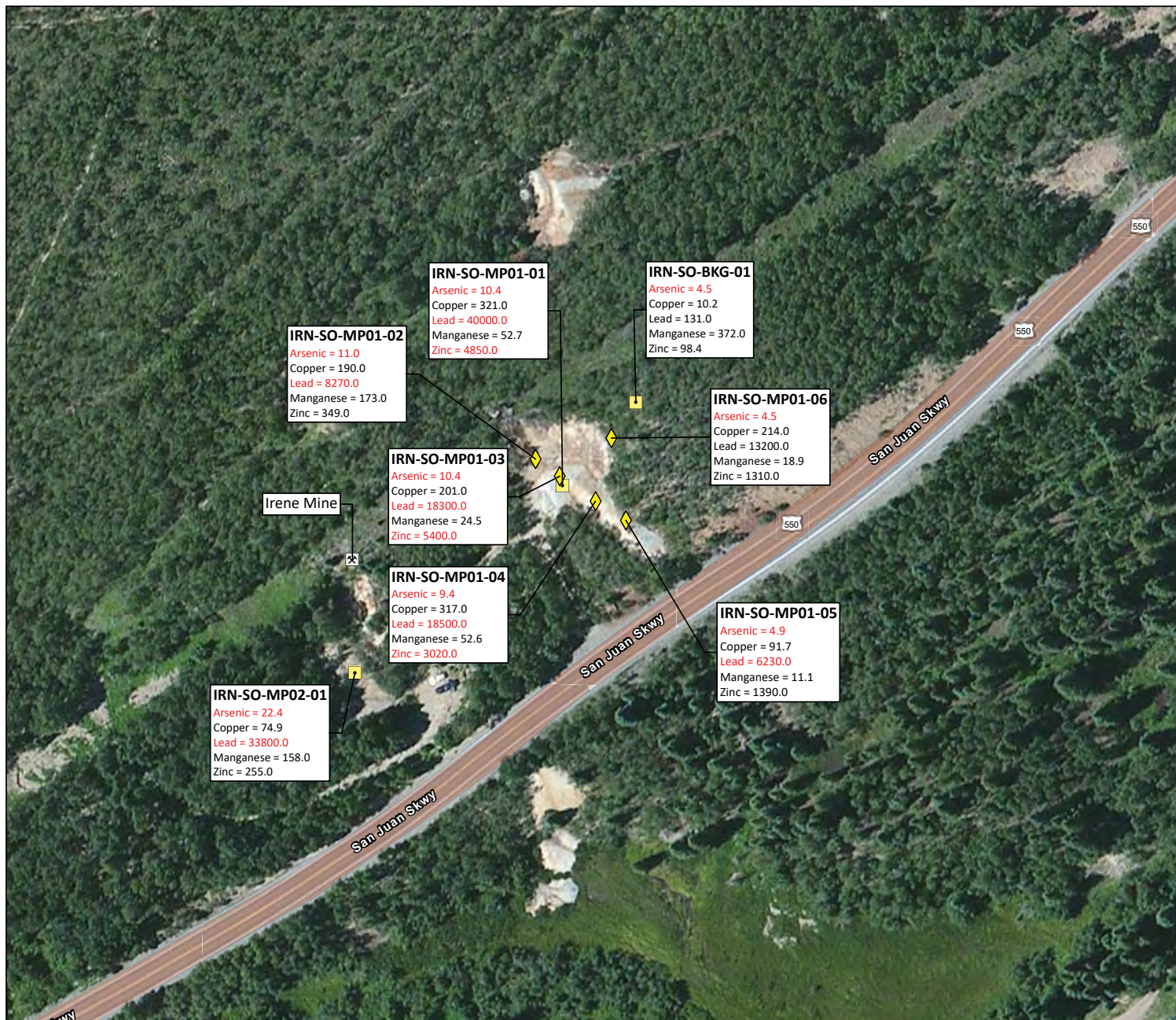
Map Projection: UTM Zone 13N, WGS84, Meters

Data Sources:

Sample Locations & Analytical Results: U.S. EPA (2019);
Base Map: Esri World Imagery (Clarity) Web Service (2020).



Area Enlarged



Tronox Mine on Forest Service-Managed Land in Colorado

Irene Mine Soil Laboratory Results September 2019

- ◆ Soil Grab Sample Locations
 - Composite Soil Sample Locations
Analytical Results presented in mg/kg dry weight
 - ☒ Irene Mine
- *RED color indicates an exceedance of EPA Human Health Regional Soil Screening Levels (RSLs).

	Arsenic	Copper	Lead	Manganese	Zinc
Residential	0.68	3100	400	1800	23,000
Industrial	3.0	47,000	800	26,000	350,000

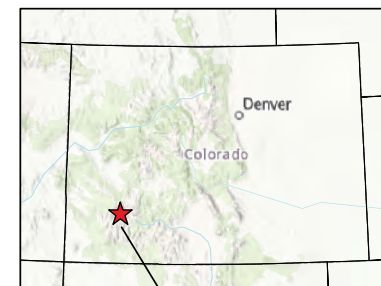
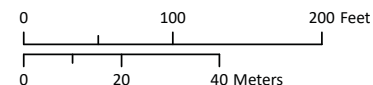
Regional screening Levels for Residential and Industrial are in mg/kg dry weight.

Date: February 7, 2020

Map Projection: UTM Zone 13N, WGS84, Meters

Data Sources:

Sample Locations & Analytical Results: U.S. EPA (2019);
Base Map: Esri World Imagery (Clarity) Web Service (2020).



Area Enlarged



TechLaw, Inc.
Environmental Services Assistance Team
1 Denver Federal Center, Building 25, Denver, CO 80225

Task Order: 0002 - Analytical Support and Data Validation

Document Type: LA - Laboratory Analysis Results (e.g., Chemistry, Asbestos)

Contract: EP-W-13-028 DCN: 03072-7-02-A223-LA-0804

TDF#: A223

Line Item: All

TDF Status: In Progress

Date: 10/21/2019

To: Don Goodrich, USEPA, Region 8 Task Order Project Officer

From: Janelle Lohman, ESAT Data Assistant

Through: Scott Walker, Region 8 ESAT Team Manager

Subject: Tronox Mining Sites_Soil_SEP_2019

Comments: 09/20/2019 - ESAT Received 34 Soil samples for the following analyses:

Total Recoverable Metals by ICP-OE
Total Recoverable Metals by ICP-MS
TM_Mercury 7473 (solids)



U.S. Environmental Protection Agency
Region 8
Technical and Management Services

Laboratory Services Program

Certificate of Analysis

Ref: 8TMS-L

MEMORANDUM

Date: 10/18/19

Subject: Analytical Results--- **Tronox Mining Sites_Soil_SEP_2019_A223 / A-223**

From: Don Goodrich; EPA Region 8 Analytical Chemistry WAM

To: Jean Wyatt
Superfund
8EPR-F

Received Sample Set(s), [Work Order : Date Received]:
[C190918 : 09/20/2019]

Attached are the analytical results for the samples received from the Tronox Mining Sites_Soil_SEP_2019_A223 sampling event, according to TDF A-223. All analyses were performed within their method specified holding times unless otherwise noted in the following narrative.

These samples were prepared, analyzed, and verified by the Environmental Services Assistance Team Laboratory (ESAT) according to the requirements of the Technical Direction Form (TDF).

Note: The laboratory herewith transmits this deliverable to the program/project partner for determination of "final data usability" which may include data validation and data quality assessment per and in accordance with EPA QA/G-8, *Guidance on Environmental Data Verification and Data Validation*, November 2002, EPA/240/R-02/004. Laboratory data qualifiers are applied based on the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, October 2004, referred to as "NFGI".

Laboratory policy is to dispose of any remaining sample 60 days after data analysis packages are delivered to EPA. If you would like the laboratory to retain the samples for a period longer than 60 days, please contact Don Goodrich within the 60 day period at (303) 312-6687.

TDF #: A-223

Case Narrative

C190918

Quality Assessment: Unless indicated by exception, the QA/QC associated with this sample set produced data within the TDF-specified criteria.

Holding Times: All samples were analyzed within their method-specified technical holding time(s).

Sample Receipt: Cooler temperature(s) were all within acceptable range less than or equal to 6 degrees celsius.

1. Initial and Continuing calibration blanks (ICBs and CCBs).
Exceptions: None.
2. Preparation (PB) / Method blanks (MB)
Exceptions: In ICP-MS batch 1909208, cadmium and lead were detected in the prep blank. Lead results are valid since sample detections were significantly higher than the level of contamination. The reporting limit for cadmium was raised to 40 ug/Kg. In ICP-MS batch 1909209, chromium and lead were detected in the prep blank. Lead results are valid since the sample levels are significantly higher than the level of contamination. The reporting limit for chromium was raised to 300 ug/Kg.
3. Interference Checks (ICSA / ICSAB) for ICP-MS and ICP-OE analyses only.
Exceptions: In ICP-MS sequence 1910119, the ICV, CCV1, and CCV3 recovered high for Se and was J-flagged for all samples.
4. Initial and Continuing calibration verification analyses (ICVs, SCVs and CCVs).
Exceptions: In sequence 1910120, the CCV2 recovered high for Se and was J-flagged for corresponding samples.
5. Laboratory Control Sample (LCS) or second source analysis or SRM.
Exceptions: None.
6. Laboratory Fortified blank (LFB) / Blank spike (BS), same source as used for the matrix spikes.
PBS performed with analyses/methods requiring preparation or digestion prior to analysis.
Exceptions: None.
7. Contract Reporting Detection Limit Standard, labeled as CRA, CRDL or CRL.
Exceptions: None.
8. Laboratory Duplicate (DUP). "Source" identifies field sample duplicated in the laboratory. If either the "source" or the duplicate result is <5X the reporting limit, the %D limit of 20% does not apply.
Exceptions: In ICP-OE batch 1909209, zinc recovered low in the DUP. The source sample was qualified "J" as estimated for zinc. In ICP-MS batch 1909208, vanadium and arsenic recovered high in the DUP. The source sample was qualified "J" as estimated for these analytes. In ICP-MS batch 1909209, cadmium recovered low in the DUP. The source sample was qualified "J" as estimated for cadmium.
9. Laboratory Matrix Spike (MS) and spike duplicate (MSD). "Source" defines original field sample fortified prior to analysis. Percent recovery (%R) limits do not apply when sample concentration(s) exceed the corresponding analyte spike level by a factor of 4 or greater.
Exceptions: In ICP-MS batch 1909208, antimony and barium recovered outside acceptable limits in the MS2. In ICP-MS batch 1909209, silver, cadmium, and antimony recovered low in the MS2. The source sample was qualified "J" as estimated for these analytes. In sequence Hg 1909191, the matrix spike 2 recovered high so the source sample was 'J' flagged. In ICP-OE batch 1909208, manganese recovered high in the MS1. In ICP-OE batch 1909209, magnesium and manganese recovered outside the acceptable range for the MS1. The source samples were qualified "J" as estimated for these analytes.
10. Serial Dilution sample analysis (SRD). "Source" is parent field sample diluted 1:5 in the laboratory. Performed for ICP-OE and ICP-MS metals analyses. Percent difference (%D) limits do not apply when analyte concentration(s) are below 50x the source sample's MDL (or 10x it's PQL).
Exceptions: In ICP-MS sequence 1910120, molybdenum, silver, cadmium, and antimony recovered high in the SRD. The source sample was qualified "J" as estimated for these analytes.
11. Internal standards, criteria specified for ICP-MS analyses only, monitored at the instrument.
Exceptions: In ICP-MS sequence 1910120, indium recovered high in sample C190918-18. Associated analytes (molybdenum, silver, cadmium, and antimony) were qualified "J" as estimated.
12. Any calibration using more than two-points produced a correlation coefficient equal to or greater than 0.995.
Exceptions: None.

Comments: None.

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

TDF #: A-223

Acronyms and Definitions:

ESAT	Environmental Services Assistance Team
J	Data Estimated qualifier (also applied to all data less than PQL, greater than or equal to MDL)
MDL	Method Detection Limit
PQL	Practical Quantitation Limit, also known as reporting limit.
RPD	Relative Percent Difference (difference divided by the mean)
%D	Percent difference, serial dilution criteria unit, difference divided by the original result.
%R	Percent recovery, analyzed (less sample contribution) divided by true value
<	Analyte NOT DETECTED at or above the Method Detection Limit (MDL)
mg/L	Parts per million (milligrams per liter). Solids equivalent = mg/Kg.
ug/L	Parts per billion (micrograms per liter). Solids equivalent = ug/Kg.
NR	No Recovery (matrix spike) - Often seen for calcium/magnesium when their concentration exceeds the spike level by > 4x.
NFGI	USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, October 2004
RE	Sample Re-analysis. Usually seen on raw data and sequences for required sample dilutions due to over-range analytes.
U	Analyte not detected at or above MDL qualifier
D	Diluted value qualifier.

Method(s) Summary:

As defined in the Technical Direction Form (TDF), some or all of the methods listed below were used for the determination of the reported target analytes.

From EPA's *Methods for the Determination of Metals in Environmental Samples*, Supplement I, May 1994, dissolved, total, and/or total recoverable metals were determined by:

- Method 200.7 / 6010B using a PE Optima ICP-OE (ICP).
- Method 200.8 / 6020 using a Perkin-Elmer DRC IIe ICP-MS.
- Method 200.2 for total recoverable metals (only) digestion.
- Method 245.1 using a Perkin-Elmer FIMS CVAA (aqueous mercury only).

From *Standard Methods for the Examination of Water and Wastewater*, 18th Edition, 1992, Method 2340B was used for the calculated hardness determination. Hardness is reported as mg (milligram) equivalent CaCO₃ per liter (L) determined as follows:

$$\text{Calculated hardness} = 2.497 * (\text{Calcium, mg/L}) + 4.118 * (\text{Magnesium, mg/L}).$$

From EPA's *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846*,

- Method 3015A was used for microwave assisted total metals digestion.
- Method 7473 was used for mercury in solids.

From EPA's *Determination of Inorganic Anions by Ion Chromatography*, Revision 2.1, 1993, Method 300.0 was used to determine the anions.

From EPA's *Methods for Chemical Analysis of Water and Wastes*, March 1983:

- Method 310.1 was followed for the alkalinity determination.
- Method 160.1 was followed for gravimetric total dissolved solids (TDS) determination.
- Method 160.2 was used for gravimetric total suspended solids (TSS) determination.
- Method 415.3 was used for total organic carbon (TOC) determination using either an Apollo 9000 or Phoenix 8000 Non-Dispersive IR (NDIR) system. Also known as dissolved organic carbon (DOC) when performed on the dissolved sample fraction.

The quality control procedures listed in the TDF request were utilized by ESAT to verify accuracy of the results and to evaluate any matrix interferences.

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: ABR-SO-BKG-01
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 15:34
Matrix: SoilWorkorder: C190918
Lab Number: C190918-01 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.05		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	3100	J	ug/kg dry wt	242	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Arsenic	57900	J	ug/kg dry wt	242	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Barium	55700	J	ug/kg dry wt	242	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cadmium	68.8	J	ug/kg dry wt	48.5	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Chromium	3120		ug/kg dry wt	485	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cobalt	1500		ug/kg dry wt	48.5	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Copper	23200		ug/kg dry wt	242	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Lead	81800		ug/kg dry wt	48.5	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Molybdenum	5440		ug/kg dry wt	485	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Nickel	2090		ug/kg dry wt	242	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Selenium	2330	J	ug/kg dry wt	485	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Silver	429	J	ug/kg dry wt	242	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Thallium	< 970	U	ug/kg dry wt	485	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Uranium	355		ug/kg dry wt	48.5	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Vanadium	19100	J	ug/kg dry wt	970	5	09/30/2019	MCB	1909208
EPA 200.2/200.7	Aluminum	3500		mg/kg dry wt	9.70	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Beryllium	< 2.42	U	mg/kg dry wt	0.485	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Calcium	238		mg/kg dry wt	48.5	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Iron	33900		mg/kg dry wt	48.5	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Magnesium	776		mg/kg dry wt	48.5	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Manganese	101	J	mg/kg dry wt	0.970	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Potassium	1260		mg/kg dry wt	121	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Sodium	< 485	U	mg/kg dry wt	121	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Zinc	22.8		mg/kg dry wt	4.85	5	10/08/2019	SV	1909208

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: ABR-SO-MP01-01
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 13:17
Matrix: SoilWorkorder: C190918
Lab Number: C190918-02 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	1.35		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	60800		ug/kg dry wt	247	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Arsenic	300000		ug/kg dry wt	247	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Barium	55900		ug/kg dry wt	247	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cadmium	2220		ug/kg dry wt	49.4	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Chromium	1070		ug/kg dry wt	494	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cobalt	2340		ug/kg dry wt	49.4	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Copper	393000		ug/kg dry wt	247	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Lead	520000		ug/kg dry wt	49.4	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Molybdenum	13400		ug/kg dry wt	494	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Nickel	1340		ug/kg dry wt	247	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Selenium	12600	J	ug/kg dry wt	494	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Silver	39900		ug/kg dry wt	247	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Thallium	2560		ug/kg dry wt	494	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Uranium	420		ug/kg dry wt	49.4	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Vanadium	14300		ug/kg dry wt	989	5	09/30/2019	MCB	1909208
EPA 200.2/200.7	Aluminum	1060		mg/kg dry wt	9.89	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Beryllium	< 2.47	U	mg/kg dry wt	0.494	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Calcium	< 124	U	mg/kg dry wt	49.4	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Iron	78500		mg/kg dry wt	49.4	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Magnesium	< 124	U	mg/kg dry wt	49.4	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Manganese	2.04	J	mg/kg dry wt	0.989	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Potassium	11800		mg/kg dry wt	124	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Sodium	312	J	mg/kg dry wt	124	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Zinc	551		mg/kg dry wt	4.94	5	10/08/2019	SV	1909208

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: ABR-SO-MP01-01

Date / Time Sampled: 09/18/19 13:17

Workorder: C190918

EPA Tag No.: No Tag Prefix-A

Matrix: Soil

Lab Number: C190918-03 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	1.07		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	79900		ug/kg dry wt	250	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Arsenic	336000		ug/kg dry wt	250	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Barium	60100		ug/kg dry wt	250	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cadmium	4680		ug/kg dry wt	49.9	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Chromium	1110		ug/kg dry wt	499	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cobalt	2840		ug/kg dry wt	49.9	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Copper	490000		ug/kg dry wt	250	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Lead	644000		ug/kg dry wt	49.9	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Molybdenum	21000		ug/kg dry wt	499	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Nickel	2470		ug/kg dry wt	250	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Selenium	12100	J	ug/kg dry wt	499	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Silver	45800		ug/kg dry wt	250	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Thallium	2240		ug/kg dry wt	499	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Uranium	434		ug/kg dry wt	49.9	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Vanadium	10300		ug/kg dry wt	998	5	09/30/2019	MCB	1909208
EPA 200.2/200.7	Aluminum	1080		mg/kg dry wt	9.98	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Beryllium	< 2.50	U	mg/kg dry wt	0.499	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Calcium	< 125	U	mg/kg dry wt	49.9	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Iron	70700		mg/kg dry wt	49.9	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Magnesium	< 125	U	mg/kg dry wt	49.9	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Manganese	2.18	J	mg/kg dry wt	0.998	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Potassium	9770		mg/kg dry wt	125	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Sodium	255	J	mg/kg dry wt	125	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Zinc	928		mg/kg dry wt	4.99	5	10/08/2019	SV	1909208

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: ABR-SO-MP01-02
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 15:10
Matrix: SoilWorkorder: C190918
Lab Number: C190918-04 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	3.74		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	58300		ug/kg dry wt	246	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Arsenic	558000		ug/kg dry wt	246	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Barium	45500		ug/kg dry wt	246	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cadmium	47600		ug/kg dry wt	49.2	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Chromium	1810		ug/kg dry wt	492	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cobalt	2170		ug/kg dry wt	49.2	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Copper	205000		ug/kg dry wt	246	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Lead	1010000		ug/kg dry wt	49.2	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Molybdenum	5230		ug/kg dry wt	492	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Nickel	994		ug/kg dry wt	246	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Selenium	8800	J	ug/kg dry wt	492	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Silver	13100		ug/kg dry wt	246	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Thallium	< 985	U	ug/kg dry wt	492	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Uranium	1100		ug/kg dry wt	49.2	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Vanadium	1980		ug/kg dry wt	985	5	09/30/2019	MCB	1909208
EPA 200.2/200.7	Aluminum	936		mg/kg dry wt	9.85	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Beryllium	< 2.46	U	mg/kg dry wt	0.492	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Calcium	< 123	U	mg/kg dry wt	49.2	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Iron	29900		mg/kg dry wt	49.2	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Magnesium	< 123	U	mg/kg dry wt	49.2	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Manganese	4.14		mg/kg dry wt	0.985	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Potassium	162	J	mg/kg dry wt	123	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Sodium	< 492	U	mg/kg dry wt	123	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Zinc	13800		mg/kg dry wt	4.92	5	10/08/2019	SV	1909208

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: ABR-SO-MP01-03

Date / Time Sampled: 09/18/19 15:16

Workorder: C190918

EPA Tag No.: No Tag Prefix-A

Matrix: Soil

Lab Number: C190918-05 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.17		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	23900		ug/kg dry wt	477	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Arsenic	302000		ug/kg dry wt	477	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Barium	39500		ug/kg dry wt	477	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cadmium	675		ug/kg dry wt	95.3	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Chromium	< 1910	U	ug/kg dry wt	953	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cobalt	1350		ug/kg dry wt	95.3	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Copper	306000		ug/kg dry wt	477	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Lead	617000		ug/kg dry wt	95.3	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Molybdenum	27600		ug/kg dry wt	953	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Nickel	1060		ug/kg dry wt	477	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Selenium	24100	J	ug/kg dry wt	953	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Silver	22100		ug/kg dry wt	477	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Thallium	5980		ug/kg dry wt	953	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Uranium	< 191	U	ug/kg dry wt	95.3	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Vanadium	22000		ug/kg dry wt	1910	10	09/30/2019	MCB	1909208
EPA 200.2/200.7	Aluminum	493		mg/kg dry wt	9.53	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Beryllium	< 2.38	U	mg/kg dry wt	0.477	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Calcium	< 119	U	mg/kg dry wt	47.7	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Iron	134000		mg/kg dry wt	47.7	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Magnesium	< 119	U	mg/kg dry wt	47.7	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Manganese	1.19	J	mg/kg dry wt	0.953	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Potassium	27400		mg/kg dry wt	119	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Sodium	650		mg/kg dry wt	119	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Zinc	131		mg/kg dry wt	4.77	5	10/08/2019	SV	1909208

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: ABR-SO-MP01-04
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 15:29
Matrix: SoilWorkorder: C190918
Lab Number: C190918-06 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.33		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	15700		ug/kg dry wt	493	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Arsenic	429000		ug/kg dry wt	493	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Barium	32300		ug/kg dry wt	493	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cadmium	107	J	ug/kg dry wt	98.7	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Chromium	1610	J	ug/kg dry wt	987	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cobalt	2880		ug/kg dry wt	98.7	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Copper	196000		ug/kg dry wt	493	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Lead	882000		ug/kg dry wt	98.7	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Molybdenum	48300		ug/kg dry wt	987	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Nickel	2500		ug/kg dry wt	493	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Selenium	40300	J	ug/kg dry wt	987	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Silver	4320		ug/kg dry wt	493	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Thallium	6160		ug/kg dry wt	987	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Uranium	< 197	U	ug/kg dry wt	98.7	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Vanadium	16400		ug/kg dry wt	1970	10	09/30/2019	MCB	1909208
EPA 200.2/200.7	Aluminum	1400		mg/kg dry wt	9.87	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Beryllium	< 2.47	U	mg/kg dry wt	0.493	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Calcium	< 123	U	mg/kg dry wt	49.3	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Iron	148000		mg/kg dry wt	49.3	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Magnesium	< 123	U	mg/kg dry wt	49.3	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Manganese	4.81		mg/kg dry wt	0.987	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Potassium	31900		mg/kg dry wt	123	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Sodium	585		mg/kg dry wt	123	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Zinc	20.1		mg/kg dry wt	4.93	5	10/08/2019	SV	1909208

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: ABR-SO-MP01-05
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 15:24
Matrix: SoilWorkorder: C190918
Lab Number: C190918-07 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	2.47		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	17500		ug/kg dry wt	250	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Arsenic	24300		ug/kg dry wt	250	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Barium	39600		ug/kg dry wt	250	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cadmium	1000		ug/kg dry wt	50.0	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Chromium	703	J	ug/kg dry wt	500	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cobalt	9290		ug/kg dry wt	50.0	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Copper	169000		ug/kg dry wt	250	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Lead	160000		ug/kg dry wt	50.0	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Molybdenum	10700		ug/kg dry wt	500	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Nickel	5160		ug/kg dry wt	250	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Selenium	4090	J	ug/kg dry wt	500	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Silver	4620		ug/kg dry wt	250	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Thallium	< 999	U	ug/kg dry wt	500	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Uranium	165		ug/kg dry wt	50.0	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Vanadium	1630		ug/kg dry wt	999	5	09/30/2019	MCB	1909208
EPA 200.2/200.7	Aluminum	971		mg/kg dry wt	9.99	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Beryllium	< 2.50	U	mg/kg dry wt	0.500	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Calcium	< 125	U	mg/kg dry wt	50.0	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Iron	70100		mg/kg dry wt	50.0	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Magnesium	< 125	U	mg/kg dry wt	50.0	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Manganese	1.12	J	mg/kg dry wt	0.999	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Potassium	399	J	mg/kg dry wt	125	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Sodium	< 500	U	mg/kg dry wt	125	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Zinc	182		mg/kg dry wt	5.00	5	10/08/2019	SV	1909208

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: COB-SO-BKG-01

Date / Time Sampled: 09/18/19 17:03

Workorder: C190918

EPA Tag No.: No Tag Prefix-A

Matrix: Soil

Lab Number: C190918-08 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.02	J	mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	243	J	ug/kg dry wt	241	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Arsenic	10500		ug/kg dry wt	241	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Barium	193000		ug/kg dry wt	241	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cadmium	372		ug/kg dry wt	48.1	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Chromium	2740		ug/kg dry wt	481	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cobalt	3230		ug/kg dry wt	48.1	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Copper	12100		ug/kg dry wt	241	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Lead	80200		ug/kg dry wt	48.1	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Molybdenum	719		ug/kg dry wt	481	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Nickel	2300		ug/kg dry wt	241	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Selenium	< 962	J, U	ug/kg dry wt	481	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Silver	377	J	ug/kg dry wt	241	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Thallium	< 962	U	ug/kg dry wt	481	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Uranium	251		ug/kg dry wt	48.1	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Vanadium	11900		ug/kg dry wt	962	5	09/30/2019	MCB	1909208
EPA 200.2/200.7	Aluminum	4490		mg/kg dry wt	9.62	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Beryllium	< 2.41	U	mg/kg dry wt	0.481	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Calcium	2870		mg/kg dry wt	48.1	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Iron	9010		mg/kg dry wt	48.1	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Magnesium	1070		mg/kg dry wt	48.1	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Manganese	782		mg/kg dry wt	0.962	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Potassium	1090		mg/kg dry wt	120	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Sodium	< 481	U	mg/kg dry wt	120	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Zinc	80.8		mg/kg dry wt	4.81	5	10/08/2019	SV	1909208

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: COB-SO-MP01-01

Date / Time Sampled: 09/18/19 17:00

Workorder: C190918

EPA Tag No.: No Tag Prefix-A

Matrix: Soil

Lab Number: C190918-09 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.13		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	1580		ug/kg dry wt	239	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Arsenic	95100		ug/kg dry wt	239	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Barium	91800		ug/kg dry wt	239	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cadmium	192		ug/kg dry wt	47.8	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Chromium	1450		ug/kg dry wt	478	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cobalt	3060		ug/kg dry wt	47.8	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Copper	115000		ug/kg dry wt	239	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Lead	1670000		ug/kg dry wt	47.8	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Molybdenum	77000		ug/kg dry wt	478	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Nickel	1020		ug/kg dry wt	239	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Selenium	1600	J	ug/kg dry wt	478	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Silver	9200		ug/kg dry wt	239	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Thallium	< 957	U	ug/kg dry wt	478	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Uranium	66.6	J	ug/kg dry wt	47.8	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Vanadium	12100		ug/kg dry wt	957	5	09/30/2019	MCB	1909208
EPA 200.2/200.7	Aluminum	4270		mg/kg dry wt	9.57	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Beryllium	< 2.39	U	mg/kg dry wt	0.478	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Calcium	705		mg/kg dry wt	47.8	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Iron	20800		mg/kg dry wt	47.8	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Magnesium	2000		mg/kg dry wt	47.8	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Manganese	1610		mg/kg dry wt	0.957	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Potassium	1520		mg/kg dry wt	120	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Sodium	< 478	U	mg/kg dry wt	120	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Zinc	160		mg/kg dry wt	4.78	5	10/08/2019	SV	1909208

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: EGM-SO-BKG-01
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 16:10
Matrix: SoilWorkorder: C190918
Lab Number: C190918-10 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.07		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	547		ug/kg dry wt	247	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Arsenic	18700		ug/kg dry wt	247	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Barium	328000		ug/kg dry wt	247	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cadmium	371		ug/kg dry wt	49.3	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Chromium	5090		ug/kg dry wt	493	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cobalt	4550		ug/kg dry wt	49.3	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Copper	9530		ug/kg dry wt	247	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Lead	164000		ug/kg dry wt	49.3	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Molybdenum	1650		ug/kg dry wt	493	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Nickel	4250		ug/kg dry wt	247	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Selenium	< 986	J, U	ug/kg dry wt	493	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Silver	524		ug/kg dry wt	247	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Thallium	< 986	U	ug/kg dry wt	493	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Uranium	423		ug/kg dry wt	49.3	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Vanadium	19300		ug/kg dry wt	986	5	09/30/2019	MCB	1909208
EPA 200.2/200.7	Aluminum	7640		mg/kg dry wt	9.86	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Beryllium	< 2.47	U	mg/kg dry wt	0.493	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Calcium	4530		mg/kg dry wt	49.3	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Iron	21000		mg/kg dry wt	49.3	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Magnesium	3040		mg/kg dry wt	49.3	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Manganese	2360		mg/kg dry wt	0.986	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Potassium	1500		mg/kg dry wt	123	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Sodium	< 493	U	mg/kg dry wt	123	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Zinc	92.0		mg/kg dry wt	4.93	5	10/08/2019	SV	1909208

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: EGM-SO-MP01-01
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 16:49
Matrix: SoilWorkorder: C190918
Lab Number: C190918-11 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.35		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	7870		ug/kg dry wt	243	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Arsenic	72700		ug/kg dry wt	243	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Barium	131000		ug/kg dry wt	243	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cadmium	3360		ug/kg dry wt	48.6	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Chromium	4920		ug/kg dry wt	486	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cobalt	946		ug/kg dry wt	48.6	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Copper	84600		ug/kg dry wt	243	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Lead	3850000		ug/kg dry wt	48.6	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Molybdenum	11700		ug/kg dry wt	486	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Nickel	1760		ug/kg dry wt	243	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Selenium	2580	J	ug/kg dry wt	486	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Silver	9930		ug/kg dry wt	243	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Thallium	< 973	U	ug/kg dry wt	486	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Uranium	270		ug/kg dry wt	48.6	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Vanadium	18600		ug/kg dry wt	973	5	09/30/2019	MCB	1909208
EPA 200.2/200.7	Aluminum	5500		mg/kg dry wt	9.73	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Beryllium	< 2.43	U	mg/kg dry wt	0.486	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Calcium	420		mg/kg dry wt	48.6	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Iron	25800		mg/kg dry wt	48.6	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Magnesium	4100		mg/kg dry wt	48.6	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Manganese	450		mg/kg dry wt	0.973	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Potassium	1500		mg/kg dry wt	122	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Sodium	< 486	U	mg/kg dry wt	122	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Zinc	1050		mg/kg dry wt	4.86	5	10/08/2019	SV	1909208

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: EGM-SO-MP01-01
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 16:49
Matrix: SoilWorkorder: C190918
Lab Number: C190918-12 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.39		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	14100		ug/kg dry wt	245	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Arsenic	110000		ug/kg dry wt	245	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Barium	121000		ug/kg dry wt	245	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cadmium	5150		ug/kg dry wt	49.1	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Chromium	4880		ug/kg dry wt	491	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cobalt	831		ug/kg dry wt	49.1	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Copper	127000		ug/kg dry wt	245	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Lead	4340000		ug/kg dry wt	49.1	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Molybdenum	11200		ug/kg dry wt	491	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Nickel	1460		ug/kg dry wt	245	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Selenium	2420	J	ug/kg dry wt	491	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Silver	15800		ug/kg dry wt	245	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Thallium	< 982	U	ug/kg dry wt	491	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Uranium	253		ug/kg dry wt	49.1	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Vanadium	16300		ug/kg dry wt	982	5	09/30/2019	MCB	1909208
EPA 200.2/200.7	Aluminum	4780		mg/kg dry wt	9.82	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Beryllium	< 2.45	U	mg/kg dry wt	0.491	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Calcium	372		mg/kg dry wt	49.1	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Iron	25000		mg/kg dry wt	49.1	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Magnesium	3180		mg/kg dry wt	49.1	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Manganese	353		mg/kg dry wt	0.982	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Potassium	1470		mg/kg dry wt	123	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Sodium	< 491	U	mg/kg dry wt	123	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Zinc	1630		mg/kg dry wt	4.91	5	10/08/2019	SV	1909208

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: IRN-SO-BKG-01

Date / Time Sampled: 09/18/19 12:19

Workorder: C190918

EPA Tag No.: No Tag Prefix-A

Matrix: Soil

Lab Number: C190918-13 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.03	J	mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	253	J	ug/kg dry wt	239	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Arsenic	4500		ug/kg dry wt	239	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Barium	154000		ug/kg dry wt	239	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cadmium	535		ug/kg dry wt	47.8	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Chromium	4650		ug/kg dry wt	478	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cobalt	3780		ug/kg dry wt	47.8	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Copper	10200		ug/kg dry wt	239	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Lead	131000		ug/kg dry wt	47.8	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Molybdenum	526		ug/kg dry wt	478	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Nickel	3560		ug/kg dry wt	239	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Selenium	< 957	J, U	ug/kg dry wt	478	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Silver	265	J	ug/kg dry wt	239	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Thallium	< 957	U	ug/kg dry wt	478	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Uranium	322		ug/kg dry wt	47.8	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Vanadium	15400		ug/kg dry wt	957	5	09/30/2019	MCB	1909208
EPA 200.2/200.7	Aluminum	6920		mg/kg dry wt	9.57	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Beryllium	< 2.39	U	mg/kg dry wt	0.478	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Calcium	3760		mg/kg dry wt	47.8	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Iron	10300		mg/kg dry wt	47.8	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Magnesium	2930		mg/kg dry wt	47.8	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Manganese	372		mg/kg dry wt	0.957	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Potassium	1190		mg/kg dry wt	120	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Sodium	< 478	U	mg/kg dry wt	120	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Zinc	98.4		mg/kg dry wt	4.78	5	10/08/2019	SV	1909208

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: IRN-SO-MP01-01
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 11:21
Matrix: SoilWorkorder: C190918
Lab Number: C190918-14 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.50		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	7200		ug/kg dry wt	244	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Arsenic	10400		ug/kg dry wt	244	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Barium	50900		ug/kg dry wt	244	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cadmium	11000		ug/kg dry wt	48.9	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Chromium	802	J	ug/kg dry wt	489	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cobalt	1950		ug/kg dry wt	48.9	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Copper	321000		ug/kg dry wt	244	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Lead	40000000		ug/kg dry wt	48.9	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Molybdenum	285000		ug/kg dry wt	489	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Nickel	1220		ug/kg dry wt	244	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Selenium	9980	J	ug/kg dry wt	489	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Silver	47600		ug/kg dry wt	244	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Thallium	1050		ug/kg dry wt	489	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Uranium	118		ug/kg dry wt	48.9	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Vanadium	7420		ug/kg dry wt	977	5	09/30/2019	MCB	1909208
EPA 200.2/200.7	Aluminum	2070		mg/kg dry wt	9.77	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Beryllium	< 2.44	U	mg/kg dry wt	0.489	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Calcium	176		mg/kg dry wt	48.9	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Iron	49800		mg/kg dry wt	48.9	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Magnesium	353		mg/kg dry wt	48.9	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Manganese	52.7		mg/kg dry wt	0.977	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Potassium	1350		mg/kg dry wt	122	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Sodium	< 489	U	mg/kg dry wt	122	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Zinc	4850		mg/kg dry wt	4.89	5	10/08/2019	SV	1909208

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: IRN-SO-MP01-01
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 11:21
Matrix: SoilWorkorder: C190918
Lab Number: C190918-15 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.58		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	6800		ug/kg dry wt	240	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Arsenic	10100		ug/kg dry wt	240	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Barium	52200		ug/kg dry wt	240	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cadmium	12100		ug/kg dry wt	48.0	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Chromium	942	J	ug/kg dry wt	480	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cobalt	1500		ug/kg dry wt	48.0	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Copper	342000		ug/kg dry wt	240	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Lead	33100000		ug/kg dry wt	48.0	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Molybdenum	257000		ug/kg dry wt	480	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Nickel	1000		ug/kg dry wt	240	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Selenium	9030	J	ug/kg dry wt	480	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Silver	37200		ug/kg dry wt	240	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Thallium	1050		ug/kg dry wt	480	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Uranium	124		ug/kg dry wt	48.0	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Vanadium	8320		ug/kg dry wt	960	5	09/30/2019	MCB	1909208
EPA 200.2/200.7	Aluminum	2190		mg/kg dry wt	9.60	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Beryllium	< 2.40	U	mg/kg dry wt	0.480	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Calcium	199		mg/kg dry wt	48.0	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Iron	44800		mg/kg dry wt	48.0	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Magnesium	425		mg/kg dry wt	48.0	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Manganese	61.7		mg/kg dry wt	0.960	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Potassium	1400		mg/kg dry wt	120	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Sodium	< 480	U	mg/kg dry wt	120	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Zinc	5390		mg/kg dry wt	4.80	5	10/08/2019	SV	1909208

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: IRN-SO-MP01-02

Date / Time Sampled: 09/18/19 11:58

Workorder: C190918

EPA Tag No.: No Tag Prefix-A

Matrix: Soil

Lab Number: C190918-16 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.42		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	2990		ug/kg dry wt	242	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Arsenic	11000		ug/kg dry wt	242	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Barium	85900		ug/kg dry wt	242	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cadmium	683		ug/kg dry wt	48.4	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Chromium	2230		ug/kg dry wt	484	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cobalt	797		ug/kg dry wt	48.4	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Copper	190000		ug/kg dry wt	242	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Lead	8270000		ug/kg dry wt	48.4	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Molybdenum	311000		ug/kg dry wt	484	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Nickel	1380		ug/kg dry wt	242	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Selenium	6550	J	ug/kg dry wt	484	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Silver	7700		ug/kg dry wt	242	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Thallium	600	J	ug/kg dry wt	484	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Uranium	161		ug/kg dry wt	48.4	5	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Vanadium	25900		ug/kg dry wt	968	5	09/30/2019	MCB	1909208
EPA 200.2/200.7	Aluminum	4430		mg/kg dry wt	9.68	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Beryllium	< 2.42	U	mg/kg dry wt	0.484	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Calcium	304		mg/kg dry wt	48.4	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Iron	52500		mg/kg dry wt	48.4	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Magnesium	1970		mg/kg dry wt	48.4	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Manganese	173		mg/kg dry wt	0.968	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Potassium	1630		mg/kg dry wt	121	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Sodium	243	J	mg/kg dry wt	121	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Zinc	349		mg/kg dry wt	4.84	5	10/08/2019	SV	1909208

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: IRN-SO-MP01-03

Date / Time Sampled: 09/18/19 12:03

Workorder: C190918

EPA Tag No.: No Tag Prefix-A

Matrix: Soil

Lab Number: C190918-17 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.99		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	4770		ug/kg dry wt	469	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Arsenic	10400		ug/kg dry wt	469	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Barium	43600		ug/kg dry wt	469	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cadmium	19700		ug/kg dry wt	93.9	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Chromium	< 1880	U	ug/kg dry wt	939	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Cobalt	11300		ug/kg dry wt	93.9	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Copper	201000		ug/kg dry wt	469	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Lead	18300000		ug/kg dry wt	93.9	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Molybdenum	122000		ug/kg dry wt	939	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Nickel	4970		ug/kg dry wt	469	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Selenium	16700	J	ug/kg dry wt	939	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Silver	45900		ug/kg dry wt	469	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Thallium	< 1880	U	ug/kg dry wt	939	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Uranium	96.8	J	ug/kg dry wt	93.9	10	09/30/2019	MCB	1909208
EPA 200.2 / 200.8	Vanadium	< 2820	U	ug/kg dry wt	1880	10	09/30/2019	MCB	1909208
EPA 200.2/200.7	Aluminum	1400		mg/kg dry wt	9.39	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Beryllium	< 2.35	U	mg/kg dry wt	0.469	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Calcium	255		mg/kg dry wt	46.9	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Iron	107000		mg/kg dry wt	46.9	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Magnesium	82.7	J	mg/kg dry wt	46.9	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Manganese	24.5		mg/kg dry wt	0.939	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Potassium	738		mg/kg dry wt	117	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Sodium	< 469	U	mg/kg dry wt	117	5	10/08/2019	SV	1909208
EPA 200.2/200.7	Zinc	5400		mg/kg dry wt	4.69	5	10/08/2019	SV	1909208

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: IRN-SO-MP01-04
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 12:06
Matrix: SoilWorkorder: C190918
Lab Number: C190918-18 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.31		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	5330	J	ug/kg dry wt	245	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Arsenic	9400		ug/kg dry wt	245	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Barium	38900		ug/kg dry wt	245	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cadmium	6290	J	ug/kg dry wt	49.1	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Chromium	896	J	ug/kg dry wt	491	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cobalt	375		ug/kg dry wt	49.1	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Copper	317000		ug/kg dry wt	245	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Lead	18500000		ug/kg dry wt	49.1	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Molybdenum	361000	J	ug/kg dry wt	491	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Nickel	604		ug/kg dry wt	245	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Selenium	9630		ug/kg dry wt	491	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Silver	16700	J	ug/kg dry wt	245	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Thallium	1090		ug/kg dry wt	491	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Uranium	112		ug/kg dry wt	49.1	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Vanadium	17000		ug/kg dry wt	982	5	09/30/2019	MCB	1909209
EPA 200.2/200.7	Aluminum	1620		mg/kg dry wt	9.82	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Beryllium	< 2.45	U	mg/kg dry wt	0.491	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Calcium	< 123	U	mg/kg dry wt	49.1	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Iron	36300		mg/kg dry wt	49.1	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Magnesium	211	J	mg/kg dry wt	49.1	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Manganese	52.6	J	mg/kg dry wt	0.982	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Potassium	1290		mg/kg dry wt	123	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Sodium	< 491	U	mg/kg dry wt	123	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Zinc	3020	J	mg/kg dry wt	4.91	5	10/08/2019	SV	1909209

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: IRN-SO-MP01-05

Date / Time Sampled: 09/18/19 12:10

Workorder: C190918

EPA Tag No.: No Tag Prefix-A

Matrix: Soil

Lab Number: C190918-19 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	1.11		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	9710		ug/kg dry wt	244	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Arsenic	4890		ug/kg dry wt	244	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Barium	57900		ug/kg dry wt	244	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cadmium	4990		ug/kg dry wt	48.9	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Chromium	< 1470	U	ug/kg dry wt	489	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cobalt	450		ug/kg dry wt	48.9	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Copper	91700		ug/kg dry wt	244	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Lead	6230000		ug/kg dry wt	48.9	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Molybdenum	561000		ug/kg dry wt	489	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Nickel	< 489	U	ug/kg dry wt	244	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Selenium	6770		ug/kg dry wt	489	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Silver	20600		ug/kg dry wt	244	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Thallium	4890		ug/kg dry wt	489	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Uranium	103		ug/kg dry wt	48.9	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Vanadium	2420		ug/kg dry wt	978	5	09/30/2019	MCB	1909209
EPA 200.2/200.7	Aluminum	769		mg/kg dry wt	9.78	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Beryllium	< 2.44	U	mg/kg dry wt	0.489	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Calcium	< 122	U	mg/kg dry wt	48.9	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Iron	15500		mg/kg dry wt	48.9	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Magnesium	52.2	J	mg/kg dry wt	48.9	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Manganese	11.1		mg/kg dry wt	0.978	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Potassium	1210		mg/kg dry wt	122	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Sodium	< 489	U	mg/kg dry wt	122	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Zinc	1390		mg/kg dry wt	4.89	5	10/08/2019	SV	1909209

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: IRN-SO-MP01-06

Date / Time Sampled: 09/18/19 12:13

Workorder: C190918

EPA Tag No.: No Tag Prefix-A

Matrix: Soil

Lab Number: C190918-20 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.48	J	mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	5730		ug/kg dry wt	242	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Arsenic	4470		ug/kg dry wt	242	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Barium	40000		ug/kg dry wt	242	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cadmium	3230		ug/kg dry wt	48.4	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Chromium	533	J	ug/kg dry wt	484	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cobalt	237		ug/kg dry wt	48.4	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Copper	214000		ug/kg dry wt	242	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Lead	13200000		ug/kg dry wt	48.4	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Molybdenum	268000		ug/kg dry wt	484	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Nickel	< 484	U	ug/kg dry wt	242	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Selenium	8350		ug/kg dry wt	484	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Silver	13600		ug/kg dry wt	242	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Thallium	1730		ug/kg dry wt	484	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Uranium	82.6	J	ug/kg dry wt	48.4	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Vanadium	9710		ug/kg dry wt	969	5	09/30/2019	MCB	1909209
EPA 200.2/200.7	Aluminum	1070		mg/kg dry wt	9.69	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Beryllium	< 2.42	U	mg/kg dry wt	0.484	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Calcium	69.5	J	mg/kg dry wt	48.4	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Iron	24200		mg/kg dry wt	48.4	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Magnesium	126		mg/kg dry wt	48.4	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Manganese	18.9		mg/kg dry wt	0.969	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Potassium	1030		mg/kg dry wt	121	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Sodium	< 484	U	mg/kg dry wt	121	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Zinc	1310		mg/kg dry wt	4.84	5	10/08/2019	SV	1909209

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: IRN-SO-MP02-01
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 11:45
Matrix: SoilWorkorder: C190918
Lab Number: C190918-21 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.52		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	37500		ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Arsenic	22400		ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Barium	69300		ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cadmium	2730		ug/kg dry wt	49.8	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Chromium	620	J	ug/kg dry wt	498	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cobalt	460		ug/kg dry wt	49.8	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Copper	74900		ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Lead	33800000		ug/kg dry wt	49.8	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Molybdenum	5720000		ug/kg dry wt	498	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Nickel	332	J	ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Selenium	55100	J	ug/kg dry wt	498	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Silver	77500		ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Thallium	1210		ug/kg dry wt	498	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Uranium	181		ug/kg dry wt	49.8	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Vanadium	4120		ug/kg dry wt	996	5	09/30/2019	MCB	1909209
EPA 200.2/200.7	Aluminum	986		mg/kg dry wt	9.96	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Beryllium	< 2.49	U	mg/kg dry wt	0.498	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Calcium	62.2	J	mg/kg dry wt	49.8	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Iron	17800		mg/kg dry wt	49.8	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Magnesium	106	J	mg/kg dry wt	49.8	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Manganese	158		mg/kg dry wt	0.996	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Potassium	797		mg/kg dry wt	124	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Sodium	< 498	U	mg/kg dry wt	124	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Zinc	255		mg/kg dry wt	4.98	5	10/08/2019	SV	1909209

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: UNK02-SO-MP01-01

Date / Time Sampled: 09/18/19 11:52

Workorder: C190918

EPA Tag No.: No Tag Prefix-A

Matrix: Soil

Lab Number: C190918-22 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	1.82		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	1290		ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Arsenic	33900		ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Barium	168000		ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cadmium	390		ug/kg dry wt	49.8	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Chromium	917	J	ug/kg dry wt	498	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cobalt	7330		ug/kg dry wt	49.8	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Copper	17300		ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Lead	263000		ug/kg dry wt	49.8	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Molybdenum	13200		ug/kg dry wt	498	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Nickel	1360		ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Selenium	781	J	ug/kg dry wt	498	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Silver	688		ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Thallium	< 996	U	ug/kg dry wt	498	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Uranium	433		ug/kg dry wt	49.8	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Vanadium	4010		ug/kg dry wt	996	5	09/30/2019	MCB	1909209
EPA 200.2/200.7	Aluminum	5650		mg/kg dry wt	9.96	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Beryllium	1.57	J	mg/kg dry wt	0.498	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Calcium	1580		mg/kg dry wt	49.8	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Iron	23800		mg/kg dry wt	49.8	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Magnesium	3470		mg/kg dry wt	49.8	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Manganese	11700		mg/kg dry wt	0.996	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Potassium	1020		mg/kg dry wt	125	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Sodium	< 498	U	mg/kg dry wt	125	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Zinc	192		mg/kg dry wt	4.98	5	10/08/2019	SV	1909209

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: UNK02-SO-MP01-01

Date / Time Sampled: 09/18/19 11:52

Workorder: C190918

EPA Tag No.: No Tag Prefix-A

Matrix: Soil

Lab Number: C190918-23 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	1.72		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	1570		ug/kg dry wt	246	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Arsenic	37000		ug/kg dry wt	246	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Barium	179000		ug/kg dry wt	246	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cadmium	364		ug/kg dry wt	49.2	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Chromium	928	J	ug/kg dry wt	492	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cobalt	7380		ug/kg dry wt	49.2	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Copper	18200		ug/kg dry wt	246	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Lead	284000		ug/kg dry wt	49.2	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Molybdenum	13100		ug/kg dry wt	492	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Nickel	1410		ug/kg dry wt	246	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Selenium	721	J	ug/kg dry wt	492	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Silver	794		ug/kg dry wt	246	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Thallium	< 983	U	ug/kg dry wt	492	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Uranium	496		ug/kg dry wt	49.2	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Vanadium	4020		ug/kg dry wt	983	5	09/30/2019	MCB	1909209
EPA 200.2/200.7	Aluminum	5700		mg/kg dry wt	9.83	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Beryllium	1.71	J	mg/kg dry wt	0.492	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Calcium	1360		mg/kg dry wt	49.2	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Iron	24900		mg/kg dry wt	49.2	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Magnesium	3470		mg/kg dry wt	49.2	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Manganese	12700		mg/kg dry wt	0.983	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Potassium	1070		mg/kg dry wt	123	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Sodium	< 492	U	mg/kg dry wt	123	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Zinc	211		mg/kg dry wt	4.92	5	10/08/2019	SV	1909209

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: UNK06-SO-BKG-01
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 14:57
Matrix: SoilWorkorder: C190918
Lab Number: C190918-24 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.05		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	639		ug/kg dry wt	247	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Arsenic	51900		ug/kg dry wt	247	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Barium	281000		ug/kg dry wt	247	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cadmium	286		ug/kg dry wt	49.5	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Chromium	4610		ug/kg dry wt	495	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cobalt	3210		ug/kg dry wt	49.5	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Copper	12200		ug/kg dry wt	247	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Lead	93900		ug/kg dry wt	49.5	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Molybdenum	1360		ug/kg dry wt	495	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Nickel	3190		ug/kg dry wt	247	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Selenium	860	J	ug/kg dry wt	495	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Silver	411	J	ug/kg dry wt	247	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Thallium	< 990	U	ug/kg dry wt	495	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Uranium	388		ug/kg dry wt	49.5	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Vanadium	21700		ug/kg dry wt	990	5	09/30/2019	MCB	1909209
EPA 200.2/200.7	Aluminum	6450		mg/kg dry wt	9.90	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Beryllium	< 2.47	U	mg/kg dry wt	0.495	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Calcium	3550		mg/kg dry wt	49.5	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Iron	29500		mg/kg dry wt	49.5	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Magnesium	2170		mg/kg dry wt	49.5	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Manganese	915		mg/kg dry wt	0.990	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Potassium	1790		mg/kg dry wt	124	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Sodium	< 495	U	mg/kg dry wt	124	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Zinc	61.9		mg/kg dry wt	4.95	5	10/08/2019	SV	1909209

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: UNK06-SO-MP01-01
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 14:52
Matrix: SoilWorkorder: C190918
Lab Number: C190918-25 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	5.85		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	49200		ug/kg dry wt	246	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Arsenic	356000		ug/kg dry wt	246	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Barium	274000		ug/kg dry wt	246	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cadmium	15900		ug/kg dry wt	49.3	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Chromium	743	J	ug/kg dry wt	493	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cobalt	165		ug/kg dry wt	49.3	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Copper	463000		ug/kg dry wt	246	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Lead	7190000		ug/kg dry wt	49.3	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Molybdenum	2800		ug/kg dry wt	493	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Nickel	259	J	ug/kg dry wt	246	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Selenium	4320	J	ug/kg dry wt	493	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Silver	71300		ug/kg dry wt	246	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Thallium	< 986	U	ug/kg dry wt	493	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Uranium	691		ug/kg dry wt	49.3	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Vanadium	2790		ug/kg dry wt	986	5	09/30/2019	MCB	1909209
EPA 200.2/200.7	Aluminum	1050		mg/kg dry wt	9.86	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Beryllium	< 2.46	U	mg/kg dry wt	0.493	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Calcium	< 123	U	mg/kg dry wt	49.3	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Iron	8440		mg/kg dry wt	49.3	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Magnesium	106	J	mg/kg dry wt	49.3	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Manganese	17.4		mg/kg dry wt	0.986	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Potassium	568		mg/kg dry wt	123	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Sodium	< 493	U	mg/kg dry wt	123	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Zinc	4680		mg/kg dry wt	4.93	5	10/08/2019	SV	1909209

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: UNK09-SO-BKG-01
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 12:22
Matrix: SoilWorkorder: C190918
Lab Number: C190918-26 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.07		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	692		ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Arsenic	11100		ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Barium	157000		ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cadmium	103		ug/kg dry wt	49.9	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Chromium	3910		ug/kg dry wt	499	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cobalt	2030		ug/kg dry wt	49.9	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Copper	7050		ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Lead	51500		ug/kg dry wt	49.9	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Molybdenum	1320		ug/kg dry wt	499	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Nickel	2380		ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Selenium	572	J	ug/kg dry wt	499	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Silver	1120		ug/kg dry wt	249	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Thallium	< 997	U	ug/kg dry wt	499	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Uranium	351		ug/kg dry wt	49.9	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Vanadium	15300		ug/kg dry wt	997	5	09/30/2019	MCB	1909209
EPA 200.2/200.7	Aluminum	6000		mg/kg dry wt	9.97	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Beryllium	< 2.49	U	mg/kg dry wt	0.499	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Calcium	2880		mg/kg dry wt	49.9	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Iron	8680		mg/kg dry wt	49.9	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Magnesium	1220		mg/kg dry wt	49.9	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Manganese	724		mg/kg dry wt	0.997	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Potassium	1100		mg/kg dry wt	125	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Sodium	< 499	U	mg/kg dry wt	125	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Zinc	52.4		mg/kg dry wt	4.99	5	10/08/2019	SV	1909209

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: UNK09-SO-BKG-01
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 12:22
Matrix: SoilWorkorder: C190918
Lab Number: C190918-27 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.06		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	496		ug/kg dry wt	242	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Arsenic	10800		ug/kg dry wt	242	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Barium	159000		ug/kg dry wt	242	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cadmium	127		ug/kg dry wt	48.4	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Chromium	3890		ug/kg dry wt	484	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cobalt	2060		ug/kg dry wt	48.4	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Copper	6620		ug/kg dry wt	242	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Lead	48600		ug/kg dry wt	48.4	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Molybdenum	1230		ug/kg dry wt	484	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Nickel	2400		ug/kg dry wt	242	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Selenium	490	J	ug/kg dry wt	484	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Silver	898		ug/kg dry wt	242	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Thallium	< 969	U	ug/kg dry wt	484	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Uranium	329		ug/kg dry wt	48.4	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Vanadium	15400		ug/kg dry wt	969	5	09/30/2019	MCB	1909209
EPA 200.2/200.7	Aluminum	6250		mg/kg dry wt	9.69	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Beryllium	< 2.42	U	mg/kg dry wt	0.484	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Calcium	2890		mg/kg dry wt	48.4	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Iron	8400		mg/kg dry wt	48.4	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Magnesium	1240		mg/kg dry wt	48.4	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Manganese	666		mg/kg dry wt	0.969	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Potassium	1100		mg/kg dry wt	121	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Sodium	< 484	U	mg/kg dry wt	121	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Zinc	51.3		mg/kg dry wt	4.84	5	10/08/2019	SV	1909209

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: UNK09-SO-MP01-01

Date / Time Sampled: 09/18/19 12:04

Workorder: C190918

EPA Tag No.: No Tag Prefix-A

Matrix: Soil

Lab Number: C190918-28 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	2.42		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	105000		ug/kg dry wt	237	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Arsenic	243000		ug/kg dry wt	237	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Barium	95900		ug/kg dry wt	237	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cadmium	2660		ug/kg dry wt	47.4	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Chromium	1170	J	ug/kg dry wt	474	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cobalt	8060		ug/kg dry wt	47.4	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Copper	333000		ug/kg dry wt	237	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Lead	1610000		ug/kg dry wt	47.4	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Molybdenum	7740		ug/kg dry wt	474	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Nickel	5240		ug/kg dry wt	237	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Selenium	9400	J	ug/kg dry wt	474	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Silver	15100		ug/kg dry wt	237	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Thallium	< 949	U	ug/kg dry wt	474	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Uranium	1260		ug/kg dry wt	47.4	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Vanadium	1900		ug/kg dry wt	949	5	09/30/2019	MCB	1909209
EPA 200.2/200.7	Aluminum	799		mg/kg dry wt	9.49	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Beryllium	< 2.37	U	mg/kg dry wt	0.474	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Calcium	< 119	U	mg/kg dry wt	47.4	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Iron	42800		mg/kg dry wt	47.4	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Magnesium	71.8	J	mg/kg dry wt	47.4	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Manganese	4.12		mg/kg dry wt	0.949	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Potassium	626		mg/kg dry wt	119	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Sodium	< 474	U	mg/kg dry wt	119	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Zinc	905		mg/kg dry wt	4.74	5	10/08/2019	SV	1909209

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: UNK09-SO-MP01-01

Date / Time Sampled: 09/18/19 12:04

Workorder: C190918

EPA Tag No.: No Tag Prefix-A

Matrix: Soil

Lab Number: C190918-29 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	1.70		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	111000		ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Arsenic	234000		ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Barium	102000		ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cadmium	2820		ug/kg dry wt	48.3	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Chromium	1140	J	ug/kg dry wt	483	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cobalt	7200		ug/kg dry wt	48.3	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Copper	328000		ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Lead	1500000		ug/kg dry wt	48.3	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Molybdenum	7880		ug/kg dry wt	483	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Nickel	4620		ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Selenium	8960	J	ug/kg dry wt	483	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Silver	14200		ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Thallium	< 966	U	ug/kg dry wt	483	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Uranium	1030		ug/kg dry wt	48.3	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Vanadium	1840		ug/kg dry wt	966	5	09/30/2019	MCB	1909209
EPA 200.2/200.7	Aluminum	865		mg/kg dry wt	9.66	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Beryllium	< 2.41	U	mg/kg dry wt	0.483	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Calcium	< 121	U	mg/kg dry wt	48.3	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Iron	41900		mg/kg dry wt	48.3	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Magnesium	73.2	J	mg/kg dry wt	48.3	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Manganese	3.74		mg/kg dry wt	0.966	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Potassium	636		mg/kg dry wt	121	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Sodium	< 483	U	mg/kg dry wt	121	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Zinc	937		mg/kg dry wt	4.83	5	10/08/2019	SV	1909209

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: UNK11-SO-BKG-01
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 11:40
Matrix: SoilWorkorder: C190918
Lab Number: C190918-30 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.05		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	303	J	ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Arsenic	14000		ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Barium	119000		ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cadmium	232		ug/kg dry wt	48.3	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Chromium	6330		ug/kg dry wt	483	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cobalt	4920		ug/kg dry wt	48.3	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Copper	16700		ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Lead	47300		ug/kg dry wt	48.3	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Molybdenum	1740		ug/kg dry wt	483	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Nickel	4090		ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Selenium	551	J	ug/kg dry wt	483	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Silver	< 483	U	ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Thallium	< 966	U	ug/kg dry wt	483	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Uranium	575		ug/kg dry wt	48.3	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Vanadium	22800		ug/kg dry wt	966	5	09/30/2019	MCB	1909209
EPA 200.2/200.7	Aluminum	10700		mg/kg dry wt	9.66	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Beryllium	< 2.41	U	mg/kg dry wt	0.483	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Calcium	2010		mg/kg dry wt	48.3	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Iron	23000		mg/kg dry wt	48.3	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Magnesium	2570		mg/kg dry wt	48.3	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Manganese	604		mg/kg dry wt	0.966	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Potassium	1180		mg/kg dry wt	121	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Sodium	< 483	U	mg/kg dry wt	121	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Zinc	61.8		mg/kg dry wt	4.83	5	10/08/2019	SV	1909209

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: UNK11-SO-MP01-01
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 11:18
Matrix: SoilWorkorder: C190918
Lab Number: C190918-31 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	1.10		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	1460		ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Arsenic	24800		ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Barium	43900		ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cadmium	< 96.4	U	ug/kg dry wt	48.2	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Chromium	2520		ug/kg dry wt	482	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cobalt	819		ug/kg dry wt	48.2	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Copper	5400		ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Lead	192000		ug/kg dry wt	48.2	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Molybdenum	2190		ug/kg dry wt	482	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Nickel	2540		ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Selenium	645	J	ug/kg dry wt	482	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Silver	618		ug/kg dry wt	241	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Thallium	< 964	U	ug/kg dry wt	482	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Uranium	148		ug/kg dry wt	48.2	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Vanadium	4900		ug/kg dry wt	964	5	09/30/2019	MCB	1909209
EPA 200.2/200.7	Aluminum	1920		mg/kg dry wt	9.64	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Beryllium	< 2.41	U	mg/kg dry wt	0.482	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Calcium	275		mg/kg dry wt	48.2	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Iron	14200		mg/kg dry wt	48.2	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Magnesium	812		mg/kg dry wt	48.2	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Manganese	115		mg/kg dry wt	0.964	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Potassium	1290		mg/kg dry wt	120	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Sodium	< 482	U	mg/kg dry wt	120	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Zinc	21.9		mg/kg dry wt	4.82	5	10/08/2019	SV	1909209

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: UNK11-SO-MP01-01
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 11:18
Matrix: SoilWorkorder: C190918
Lab Number: C190918-32 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.67		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	1450		ug/kg dry wt	243	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Arsenic	26400		ug/kg dry wt	243	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Barium	53300		ug/kg dry wt	243	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cadmium	50.1	J	ug/kg dry wt	48.7	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Chromium	2820		ug/kg dry wt	487	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cobalt	856		ug/kg dry wt	48.7	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Copper	5590		ug/kg dry wt	243	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Lead	191000		ug/kg dry wt	48.7	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Molybdenum	2260		ug/kg dry wt	487	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Nickel	2610		ug/kg dry wt	243	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Selenium	752	J	ug/kg dry wt	487	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Silver	646		ug/kg dry wt	243	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Thallium	< 973	U	ug/kg dry wt	487	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Uranium	166		ug/kg dry wt	48.7	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Vanadium	5000		ug/kg dry wt	973	5	09/30/2019	MCB	1909209
EPA 200.2/200.7	Aluminum	2080		mg/kg dry wt	9.73	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Beryllium	< 2.43	U	mg/kg dry wt	0.487	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Calcium	486		mg/kg dry wt	48.7	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Iron	14800		mg/kg dry wt	48.7	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Magnesium	969		mg/kg dry wt	48.7	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Manganese	160		mg/kg dry wt	0.973	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Potassium	1300		mg/kg dry wt	122	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Sodium	< 487	U	mg/kg dry wt	122	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Zinc	23.3		mg/kg dry wt	4.87	5	10/08/2019	SV	1909209

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: UNK14-SO-BKG-01

Date / Time Sampled: 09/18/19 12:15

Workorder: C190918

EPA Tag No.: No Tag Prefix-A

Matrix: Soil

Lab Number: C190918-33 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.03	J	mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	392	J	ug/kg dry wt	248	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Arsenic	8040		ug/kg dry wt	248	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Barium	80700		ug/kg dry wt	248	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cadmium	127		ug/kg dry wt	49.6	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Chromium	3750		ug/kg dry wt	496	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cobalt	1870		ug/kg dry wt	49.6	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Copper	5870		ug/kg dry wt	248	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Lead	47500		ug/kg dry wt	49.6	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Molybdenum	1050		ug/kg dry wt	496	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Nickel	2240		ug/kg dry wt	248	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Selenium	< 992	J, U	ug/kg dry wt	496	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Silver	271	J	ug/kg dry wt	248	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Thallium	< 992	U	ug/kg dry wt	496	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Uranium	333		ug/kg dry wt	49.6	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Vanadium	16800		ug/kg dry wt	992	5	09/30/2019	MCB	1909209
EPA 200.2/200.7	Aluminum	6270		mg/kg dry wt	9.92	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Beryllium	< 2.48	U	mg/kg dry wt	0.496	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Calcium	1620		mg/kg dry wt	49.6	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Iron	9010		mg/kg dry wt	49.6	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Magnesium	1270		mg/kg dry wt	49.6	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Manganese	131		mg/kg dry wt	0.992	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Potassium	809		mg/kg dry wt	124	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Sodium	< 496	U	mg/kg dry wt	124	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Zinc	20.9		mg/kg dry wt	4.96	5	10/08/2019	SV	1909209

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: UNK14-SO-MP01-01
EPA Tag No.: No Tag Prefix-ADate / Time Sampled: 09/18/19 12:06
Matrix: SoilWorkorder: C190918
Lab Number: C190918-34 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
7473	Mercury	0.18		mg/kg dry wt	0.02	1	10/02/2019	axm	1909190
EPA 200.2 / 200.8	Antimony	1440		ug/kg dry wt	244	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Arsenic	29000		ug/kg dry wt	244	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Barium	140000		ug/kg dry wt	244	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cadmium	141		ug/kg dry wt	48.9	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Chromium	1790		ug/kg dry wt	489	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Cobalt	167		ug/kg dry wt	48.9	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Copper	11900		ug/kg dry wt	244	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Lead	645000		ug/kg dry wt	48.9	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Molybdenum	6420		ug/kg dry wt	489	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Nickel	341	J	ug/kg dry wt	244	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Selenium	2850	J	ug/kg dry wt	489	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Silver	1100		ug/kg dry wt	244	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Thallium	918	J	ug/kg dry wt	489	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Uranium	485		ug/kg dry wt	48.9	5	09/30/2019	MCB	1909209
EPA 200.2 / 200.8	Vanadium	3870		ug/kg dry wt	978	5	09/30/2019	MCB	1909209
EPA 200.2/200.7	Aluminum	1280		mg/kg dry wt	9.78	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Beryllium	< 2.44	U	mg/kg dry wt	0.489	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Calcium	< 122	U	mg/kg dry wt	48.9	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Iron	15500		mg/kg dry wt	48.9	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Magnesium	192		mg/kg dry wt	48.9	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Manganese	5.70		mg/kg dry wt	0.978	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Potassium	671		mg/kg dry wt	122	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Sodium	< 489	U	mg/kg dry wt	122	5	10/08/2019	SV	1909209
EPA 200.2/200.7	Zinc	32.3		mg/kg dry wt	4.89	5	10/08/2019	SV	1909209

"J" Qualifier indicates an estimated value

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
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ICPMS-PE DRC-II

Batch 1909208 - 200.2 - TR Metals

Solid (dry wt basis)

ICPMS-PE DRC-II

Method Blank (1909208-BLK2)

Dilution Factor: 5

Prepared & Analyzed: 09/30/19

Vanadium	< 1000	1500	ug/kg dry wt
Chromium	738.1	1000	"
Cobalt	< 50.0	100	"
Nickel	< 250	500	"
Copper	< 250	500	"
Arsenic	< 250	1000	"
Selenium	< 500	1000	"
Molybdenum	< 500	500	"
Silver	< 250	500	"
Cadmium	151.9	200	"
Antimony	368.5	500	"
Barium	< 250	500	"
Thallium	< 500	1000	"
Lead	2030	100	"
Uranium	< 50.0	100	"

Duplicate (1909208-DUP2)

Dilution Factor: 5

Source: C190918-01

Prepared & Analyzed: 09/30/19

Vanadium	35100	1490	ug/kg dry wt	19140	59	35
Chromium	3879	992	"	3124	22	35
Cobalt	1625	99.2	"	1501	8	35
Nickel	2048	496	"	2086	2	35
Copper	28800	496	"	23230	21	35
Arsenic	87160	992	"	57900	40	35
Selenium	3060	992	"	2332	27	35
Molybdenum	6148	496	"	5441	12	35
Silver	585.4	496	"	428.6	31	35
Cadmium	107.9	198	"	68.8	44	35
Antimony	3419	496	"	3099	10	35
Barium	68710	496	"	55740	21	35
Thallium	< 496	992	"	< 496		35
Lead	99430	99.2	"	81760	20	35
Uranium	401.4	99.2	"	354.7	12	35

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
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Batch 1909208 - 200.2 - TR Metals

Solid (dry wt basis)

ICPMS-PE DRC-II

Matrix Spike (1909208-MS2)

Dilution Factor: 5

Source: C190918-01

Prepared & Analyzed: 09/30/19

Vanadium	50620	1480	ug/kg dry wt	29700	19140	106	70-130
Chromium	38420	989	"	39600	3124	89	70-130
Cobalt	19450	98.9	"	19800	1501	91	70-130
Nickel	45100	495	"	49500	2086	87	70-130
Copper	54290	495	"	29700	23230	105	70-130
Arsenic	143200	989	"	79100	57900	108	70-130
Selenium	166200	989	"	198000	2332	83	70-130
Molybdenum	40100	495	"	39600	5441	88	70-130
Silver	7739	495	"	7420	428.6	99	70-130
Cadmium	18820	198	"	19800	68.8	95	70-130
Antimony	54820	495	"	79100	3099	65	70-130
Barium	91710	495	"	19800	55740	182	70-130
Thallium	185900	989	"	198000	< 495	94	70-130
Lead	195400	98.9	"	98900	81760	115	70-130
Uranium	10480	98.9	"	9890	354.7	102	70-130

Matrix Spike (1909208-MS4)

Dilution Factor: 5

Source: C190918-02

Prepared & Analyzed: 09/30/19

Vanadium	36820	1490	ug/kg dry wt	29800	14340	75	70-130
Chromium	35540	994	"	39800	1066	87	70-130
Cobalt	20230	99.4	"	19900	2345	90	70-130
Nickel	43730	497	"	49700	1345	85	70-130
Copper	627900	497	"	29800	392800	788	70-130
Arsenic	407500	994	"	79500	300000	135	70-130
Selenium	194200	994	"	199000	12600	91	70-130
Molybdenum	46700	497	"	39800	13350	84	70-130
Silver	53850	497	"	7460	39860	188	70-130
Cadmium	20090	199	"	19900	2225	90	70-130
Antimony	146800	497	"	79500	60790	108	70-130
Barium	75470	497	"	19900	55860	99	70-130
Thallium	194400	994	"	199000	2561	96	70-130
Lead	749700	99.4	"	99400	519900	231	70-130
Uranium	10800	99.4	"	9940	420.1	104	70-130

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
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Batch 1909208 - 200.2 - TR Metals

Solid (dry wt basis)

ICPMS-PE DRC-II

Reference (1909208-SRM2)

Dilution Factor: 20

Prepared & Analyzed: 09/30/19

Vanadium	107800	5970	ug/kg dry wt	125000	86	78.3-122
Chromium	55420	3980	"	64900	85	81.4-119
Cobalt	43880	398	"	45000	98	83.6-116
Nickel	142000	1990	"	147000	97	82.3-118
Copper	111100	1990	"	113000	98	82.7-117
Arsenic	53350	3980	"	58500	91	82.6-117
Selenium	150100	3980	"	145000	104	77.9-121
Molybdenum	70470	1990	"	76200	92	79.5-120
Silver	53640	1990	"	51000	105	78.6-121
Cadmium	244600	796	"	249000	98	82.3-118
Antimony	88010	1990	"	94100	94	0.01-206
Barium	163400	1990	"	183000	89	82-119
Thallium	181400	3980	"	188000	96	79.8-120
Lead	164600	398	"	161000	102	81.4-119
Uranium	51770	398	"	53500	97	73.3-127

Batch 1909209 - 200.2 - TR Metals

Solid (dry wt basis)

ICPMS-PE DRC-II

Method Blank (1909209-BLK2)

Dilution Factor: 5

Prepared & Analyzed: 09/30/19

Vanadium	< 1000	1500	ug/kg dry wt
Chromium	1331	1500	"
Cobalt	< 50.0	100	"
Nickel	< 250	500	"
Copper	< 250	500	"
Arsenic	< 250	1000	"
Selenium	< 500	1000	"
Molybdenum	< 500	500	"
Silver	< 250	500	"
Cadmium	< 50.0	100	"
Antimony	< 250	500	"
Barium	< 250	500	"
Thallium	< 500	1000	"
Lead	651.2	100	"
Uranium	< 50.0	100	"

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1909209 - 200.2 - TR Metals				Solid (dry wt basis)			ICPMS-PE DRC-II		
Duplicate (1909209-DUP2)		Dilution Factor: 5		Source: C190918-18		Prepared & Analyzed: 09/30/19			
Vanadium	17440	1490	ug/kg dry wt		17020			2	35
Chromium	903.6	1490	"		895.8			0.9	35
Cobalt	336.3	99.6	"		375.5			11	35
Nickel	363.0	498	"		604.5			50	35
Copper	295400	498	"		317100			7	35
Arsenic	9212	996	"		9402			2	35
Selenium	9262	996	"		9625			4	35
Molybdenum	339300	498	"		361400			6	35
Silver	16100	498	"		16680			3	35
Cadmium	2598	99.6	"		6295			83	35
Antimony	6022	498	"		5333			12	35
Barium	37750	498	"		38940			3	35
Thallium	1040	996	"		1090			5	35
Lead	16890000	99.6	"		18450000			9	35
Uranium	106.1	99.6	"		112.4			6	35
Matrix Spike (1909209-MS2)		Dilution Factor: 5		Source: C190918-18		Prepared & Analyzed: 09/30/19			
Vanadium	41170	1430	ug/kg dry wt	28500	17020	85	70-130		
Chromium	34340	1430	"	38000	895.8	88	70-130		
Cobalt	17420	95.0	"	19000	375.5	90	70-130		
Nickel	41240	475	"	47500	604.5	86	70-130		
Copper	312200	475	"	28500	317100	NR	70-130		
Arsenic	74030	950	"	76000	9402	85	70-130		
Selenium	187900	950	"	190000	9625	94	70-130		
Molybdenum	375200	475	"	38000	361400	36	70-130		
Silver	20610	475	"	7130	16680	55	70-130		
Cadmium	15380	95.0	"	19000	6295	48	70-130		
Antimony	46380	475	"	76000	5333	54	70-130		
Barium	58300	475	"	19000	38940	102	70-130		
Thallium	186100	950	"	190000	1090	97	70-130		
Lead	17450000	95.0	"	95000	18450000	NR	70-130		
Uranium	10540	95.0	"	9500	112.4	110	70-130		

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
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Batch 1909209 - 200.2 - TR Metals

Solid (dry wt basis)

ICPMS-PE DRC-II

Matrix Spike (1909209-MS4)

Dilution Factor: 5

Source: C190918-19

Prepared & Analyzed: 09/30/19

Vanadium	29370	1490	ug/kg dry wt	29800	2425	90	70-130
Chromium	37090	1490	"	39800	< 497	93	70-130
Cobalt	18820	99.4	"	19900	449.5	92	70-130
Nickel	44230	497	"	49700	< 249	89	70-130
Copper	119800	497	"	29800	91740	94	70-130
Arsenic	74970	994	"	79500	4887	88	70-130
Selenium	197800	994	"	199000	6769	96	70-130
Molybdenum	589800	497	"	39800	561500	71	70-130
Silver	27470	497	"	7460	20610	92	70-130
Cadmium	23780	99.4	"	19900	4991	95	70-130
Antimony	72390	497	"	79500	9714	79	70-130
Barium	71820	497	"	19900	57870	70	70-130
Thallium	200600	994	"	199000	4892	98	70-130
Lead	6814000	99.4	"	99400	6230000	588	70-130
Uranium	10910	99.4	"	9940	103.1	109	70-130

Reference (1909209-SRM2)

Dilution Factor: 20

Prepared & Analyzed: 09/30/19

Vanadium	111400	6000	ug/kg dry wt	125000		89	78.3-122
Chromium	57720	6000	"	64900		89	81.4-119
Cobalt	43580	400	"	45000		97	83.6-116
Nickel	138300	2000	"	147000		94	82.3-118
Copper	109900	2000	"	113000		97	82.7-117
Arsenic	57080	4000	"	58500		98	82.6-117
Selenium	159600	4000	"	145000		110	77.9-121
Molybdenum	73200	2000	"	76200		96	79.5-120
Silver	54090	2000	"	51000		106	78.6-121
Cadmium	262700	400	"	249000		105	82.3-118
Antimony	87020	2000	"	94100		92	0.01-206
Barium	169600	2000	"	183000		93	82-119
Thallium	199800	4000	"	188000		106	79.8-120
Lead	174500	400	"	161000		108	81.4-119
Uranium	56480	400	"	53500		106	73.3-127

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
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Batch 1910119 - 1909208

Solid (dry wt basis)

ICPMS-PE DRC-II

Serial Dilution (1910119-SRD2)

Dilution Factor: 25

Source: C190918-01

Prepared: 09/30/19 Analyzed: 10/15/19

Vanadium	19410	4850	ug/kg dry wt		19140			1	10
Chromium	3126	4850	"		3124			0.06	10
Cobalt	< 2420	4850	"		< 484.00				10
Nickel	< 2420	4850	"		< 484.00				10
Copper	23980	4850	"		23230			3	10
Arsenic	58500	4850	"		57900			1	10
Selenium	< 2420	4850	"		< 484.00				10
Molybdenum	5478	4850	"		5441			0.7	10
Silver	< 2420	4850	"		< 484.00				10
Cadmium	< 242	970	"		< 48.40				10
Antimony	3027	4850	"		3099			2	10
Barium	55710	4850	"		55740			0.07	10
Thallium	< 2420	4850	"		< 484.00				10
Lead	79850	4850	"		81760			2	10
Uranium	< 2420	4850	"		< 484.00				10

Batch 1910120 - 1909209

Solid (dry wt basis)

ICPMS-PE DRC-II

Serial Dilution (1910120-SRD2)

Dilution Factor: 25

Source: C190918-18

Prepared: 09/30/19 Analyzed: 10/15/19

Vanadium	16700	2450	ug/kg dry wt		17020			2	10
Chromium	< 1230	7360	"		< 246.00				10
Cobalt	< 1230	2450	"		< 246.00				10
Nickel	< 1230	2450	"		< 246.00				10
Copper	317400	2450	"		317100			0.09	10
Arsenic	9706	2450	"		9402			3	10
Selenium	9908	2450	"		9625			3	10
Molybdenum	451000	2450	"		361400			22	10
Silver	20910	2450	"		16680			23	10
Cadmium	8246	2450	"		6295			27	10
Antimony	6780	2450	"		5333			24	10
Barium	38970	2450	"		38940			0.08	10
Thallium	< 1230	2450	"		< 246.00				10
Lead	17750000	2450	"		18450000			4	10
Uranium	< 1230	2450	"		< 246.00				10

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
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ICPOE - PE Optima

Batch 1909208 - 200.2 - TR Metals

Solid (dry wt basis)

ICPOE - PE Optima

Method Blank (1909208-BLK1)	Dilution Factor: 1	Prepared: 09/30/19	Analyzed: 10/08/19
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Aluminum	< 2.00	5.00	mg/kg dry wt
Beryllium	< 0.100	0.500	"
Calcium	< 10.0	25.0	"
Iron	< 10.0	25.0	"
Potassium	< 25.0	100	"
Magnesium	< 10.0	25.0	"
Manganese	< 0.200	0.500	"
Sodium	< 25.0	100	"
Zinc	1.5623	2.00	"

Duplicate (1909208-DUP1)	Dilution Factor: 5	Source: C190918-01	Prepared: 09/30/19	Analyzed: 10/08/19
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Aluminum	4308.2	24.8	mg/kg dry wt	3499.0	21	35
Beryllium	< 0.496	2.48	"	< 0.496		35
Calcium	302.15	124	"	237.75	24	35
Iron	44127	124	"	33856	26	35
Potassium	1186.8	496	"	1257.4	6	35
Magnesium	937.94	124	"	775.51	19	35
Manganese	77.392	2.48	"	100.69	26	35
Sodium	< 124	496	"	< 124		35
Zinc	22.943	9.92	"	22.766	0.8	35

Matrix Spike (1909208-MS1)	Dilution Factor: 5	Source: C190918-01	Prepared: 09/30/19	Analyzed: 10/08/19
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Aluminum	5164.2	24.7	mg/kg dry wt	198	3499.0	842	70-130
Beryllium	20.006	2.47	"	19.8	< 0.495	101	70-130
Calcium	418.12	124	"	98.9	237.75	182	70-130
Iron	41904	124	"	297	33856	NR	70-130
Potassium	2264.9	495	"	989	1257.4	102	70-130
Magnesium	1288.2	124	"	198	775.51	259	70-130
Manganese	108.17	2.47	"	19.8	100.69	38	70-130
Sodium	353.66	495	"	297	< 124	119	70-130
Zinc	42.830	9.89	"	19.8	22.766	101	70-130

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
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Batch 1909208 - 200.2 - TR Metals

Solid (dry wt basis)

ICPOE - PE Optima

Matrix Spike (1909208-MS3)

Dilution Factor: 5

Source: C190918-02

Prepared: 09/30/19 Analyzed: 10/08/19

Aluminum	1394.7	24.9	mg/kg dry wt	199	1055.6	171	70-130		
Beryllium	20.248	2.49	"	19.9	< 0.497	102	70-130		
Calcium	119.27	124	"	99.4	< 49.7	120	70-130		
Iron	82558	124	"	298	78502	NR	70-130		
Potassium	12666	497	"	994	11819	85	70-130		
Magnesium	231.51	124	"	199	< 49.7	116	70-130		
Manganese	22.835	2.49	"	19.9	2.0376	105	70-130		
Sodium	640.59	497	"	298	312.16	110	70-130		
Zinc	677.90	9.94	"	19.9	551.11	638	70-130		

Reference (1909208-SRM1)

Dilution Factor: 5

Prepared: 09/30/19 Analyzed: 10/08/19

Aluminum	5878.4	24.9	mg/kg dry wt	8720		67	51.7-148		
Beryllium	61.386	2.49	"	59.7		103	82.6-118		
Calcium	4583.6	124	"	4600		100	81.1-119		
Iron	8782.3	124	"	13600		65	58.9-141		
Potassium	1667.1	498	"	2030		82	70-130		
Magnesium	1922.2	124	"	2310		83	75.8-124		
Manganese	214.64	2.49	"	219		98	81.7-119		
Sodium	2363.5	498	"	2430		97	73.3-126		
Zinc	120.60	9.95	"	121		100	80.2-119		

Batch 1909209 - 200.2 - TR Metals

Solid (dry wt basis)

ICPOE - PE Optima

Method Blank (1909209-BLK1)

Dilution Factor: 1

Prepared: 09/30/19 Analyzed: 10/08/19

Aluminum	< 2.00	5.00	mg/kg dry wt						
Beryllium	< 0.100	0.500	"						
Calcium	< 10.0	25.0	"						
Iron	< 10.0	25.0	"						
Potassium	< 25.0	100	"						
Magnesium	< 10.0	25.0	"						
Manganese	< 0.200	0.500	"						
Sodium	< 25.0	100	"						
Zinc	1.2247	2.00	"						

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1909209 - 200.2 - TR Metals			Solid (dry wt basis)				ICPOE - PE Optima		
Duplicate (1909209-DUP1)		Dilution Factor: 5	Source: C190918-18		Prepared: 09/30/19 Analyzed: 10/08/19				
Aluminum	1565.0	24.9	mg/kg dry wt		1623.5			4	35
Beryllium	< 0.498	2.49	"		< 0.498				35
Calcium	< 49.8	124	"		< 49.8				35
Iron	38750	124	"		36251			7	35
Potassium	1262.0	498	"		1289.6			2	35
Magnesium	216.69	124	"		211.03			3	35
Manganese	39.824	2.49	"		52.622			28	35
Sodium	< 124	498	"		< 124				35
Zinc	1316.6	9.96	"		3018.4			79	35
Matrix Spike (1909209-MS1)		Dilution Factor: 5	Source: C190918-18		Prepared: 09/30/19 Analyzed: 10/08/19				
Aluminum	2210.7	23.8	mg/kg dry wt	190	1623.5	309	70-130		
Beryllium	19.027	2.38	"	19.0	< 0.475	100	70-130		
Calcium	143.39	119	"	95.0	48.810	100	70-130		
Iron	36814	119	"	285	36251	198	70-130		
Potassium	2296.8	475	"	950	1289.6	106	70-130		
Magnesium	465.48	119	"	190	211.03	134	70-130		
Manganese	65.066	2.38	"	19.0	52.622	65	70-130		
Sodium	330.75	475	"	285	< 119	116	70-130		
Zinc	1261.1	9.50	"	19.0	3018.4	NR	70-130		
Matrix Spike (1909209-MS3)		Dilution Factor: 5	Source: C190918-19		Prepared: 09/30/19 Analyzed: 10/08/19				
Aluminum	1286.0	24.9	mg/kg dry wt	199	768.73	260	70-130		
Beryllium	19.824	2.49	"	19.9	< 0.497	100	70-130		
Calcium	123.91	124	"	99.4	< 49.7	125	70-130		
Iron	15434	124	"	298	15457	NR	70-130		
Potassium	2227.4	497	"	994	1207.5	103	70-130		
Magnesium	260.26	124	"	199	52.233	105	70-130		
Manganese	34.151	2.49	"	19.9	11.097	116	70-130		
Sodium	362.90	497	"	298	< 124	122	70-130		
Zinc	1658.0	9.94	"	19.9	1391.5	NR	70-130		

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
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Batch 1909209 - 200.2 - TR Metals

Solid (dry wt basis)

ICPOE - PE Optima

Reference (1909209-SRM1)

Dilution Factor: 5

Prepared: 09/30/19 Analyzed: 10/08/19

Aluminum	6416.6	25.0	mg/kg dry wt	8720	74	51.7-148
Beryllium	62.958	2.50	"	59.7	105	82.6-118
Calcium	4728.0	125	"	4600	103	81.1-119
Iron	9410.6	125	"	13600	69	58.9-141
Potassium	1768.1	500	"	2030	87	70-130
Magnesium	2004.7	125	"	2310	87	75.8-124
Manganese	221.16	2.50	"	219	101	81.7-119
Sodium	2418.5	500	"	2430	100	73.3-126
Zinc	121.20	10.0	"	121	100	80.2-119

Batch 1910065 - 1909209

Solid (dry wt basis)

ICPOE - PE Optima

Serial Dilution (1910065-SRD1)

Dilution Factor: 25

Source: C190918-01

Prepared: 09/30/19 Analyzed: 10/08/19

Aluminum	3494.7	121	mg/kg dry wt	3499.0	0.1	10
Beryllium	< 2.42	12.1	"	< 0.48		10
Calcium	< 242	606	"	< 48.40		10
Iron	33329	606	"	33856	2	10
Potassium	1256.1	2420	"	1257.4	0.1	10
Magnesium	801.49	606	"	775.51	3	10
Manganese	98.548	12.1	"	100.69	2	10
Sodium	< 606	2420	"	< 121.20		10
Zinc	< 24.2	48.5	"	< 4.84		10

Serial Dilution (1910065-SRD2)

Dilution Factor: 25

Source: C190918-18

Prepared: 09/30/19 Analyzed: 10/08/19

Aluminum	1597.8	123	mg/kg dry wt	1623.5	2	10
Beryllium	< 2.45	12.3	"	< 0.49		10
Calcium	< 245	614	"	< 49.00		10
Iron	35302	614	"	36251	3	10
Potassium	1248.0	2450	"	1289.6	3	10
Magnesium	< 245	614	"	< 49.00		10
Manganese	51.870	12.3	"	52.622	1	10
Sodium	< 614	2450	"	< 122.80		10
Zinc	3106.2	49.1	"	3018.4	3	10

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
NIC MA-3000									
Batch 1909190 - No Lab Prep Req'd			Solid (dry wt basis)				NIC MA-3000		
Method Blank (1909190-BLK1)		Dilution Factor: 1				Prepared: 09/27/19 Analyzed: 10/02/19			
Mercury	< 0.01	0.02	mg/kg dry wt						
Method Blank (1909190-BLK2)		Dilution Factor: 1				Prepared: 09/27/19 Analyzed: 10/02/19			
Mercury	< 0.01	0.02	mg/kg dry wt						
Duplicate (1909190-DUP1)		Dilution Factor: 1		Source: C190918-01		Prepared: 09/27/19 Analyzed: 10/02/19			
Mercury	0.05	0.05	mg/kg dry wt		0.05			1	35
Duplicate (1909190-DUP2)		Dilution Factor: 1		Source: C190918-20		Prepared: 09/27/19 Analyzed: 10/02/19			
Mercury	0.66	0.04	mg/kg dry wt		0.48			31	35
Matrix Spike (1909190-MS1)		Dilution Factor: 1		Source: C190918-01		Prepared: 09/27/19 Analyzed: 10/02/19			
Mercury	0.50	0.04	mg/kg dry wt	0.418	0.05	108	80-120		
Matrix Spike (1909190-MS2)		Dilution Factor: 1		Source: C190918-20		Prepared: 09/27/19 Analyzed: 10/02/19			
Mercury	1.06	0.04	mg/kg dry wt	0.397	0.48	147	80-120		
Matrix Spike Dup (1909190-MSD1)		Dilution Factor: 1		Source: C190918-01		Prepared: 09/27/19 Analyzed: 10/02/19			
Mercury	0.51	0.04	mg/kg dry wt	0.427	0.05	109	80-120	3	20
Matrix Spike Dup (1909190-MSD2)		Dilution Factor: 1		Source: C190918-20		Prepared: 09/27/19 Analyzed: 10/02/19			
Mercury	1.02	0.05	mg/kg dry wt	0.467	0.48	116	80-120	4	20
Reference (1909190-SRM1)		Dilution Factor: 1				Prepared: 09/27/19 Analyzed: 10/02/19			
Mercury	7.20	0.10	mg/kg dry wt	6.45		112	75-125		
Reference (1909190-SRM2)		Dilution Factor: 1				Prepared: 09/27/19 Analyzed: 10/02/19			
Mercury	7.07	0.10	mg/kg dry wt	6.45		110	75-125		

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
 RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

TechLaw Inc., ESAT Region 8
INORGANIC ANALYSES DATA SHEET
Initial and Continuing Calibration Blanks

Analytical Method: 7473

Analysis Name: TM Mercury 7473

Instrument: NIC MA-3000

Work Order: C190918

Analytical Sequence: 1909191 **Total**

Concentration Units: mg/kg dry wt

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Mercury	0.09	1	2	3	4	NA	1909190-BLK2	0.02
		0.49	0.18	0.13	0.27	NA	0.05	
		5	6	7	8			
		0.20						
	0.09	1	2	3	4	1909190-BLK1	NA	0.02
		0.49	0.18	0.13	0.27	0.21	NA	
		5	6	7	8			
		0.20						

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

TechLaw Inc., ESAT Region 8
INORGANIC ANALYSES DATA SHEET
Initial and Continuing Calibration Blanks

Analytical Method: EPA 200.2/200.7

Analysis Name: ICPOE Tot. Rec. Metals

Instrument: ICPOE - PE Optima

Work Order: C190918

Analytical Sequence: 1910065 Total Recoverable

Concentration Units: mg/kg dry wt

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Aluminum	-2.61	1	2	3	4	1909208-BLK1	NA	5.00
		-4.82	-5.20	-2.23	-2.53	-0.10	NA	
		5	6	7	8			
		-0.41	1.94					
	-2.61	1	2	3	4	1909209-BLK1	NA	5.00
		-4.82	-5.20	-2.23	-2.53	-8.24	NA	
		5	6	7	8			
		-0.41	1.94					
Beryllium	0.03	1	2	3	4	1909208-BLK1	NA	0.50
		0.01	-0.03	-0.02	0.00	0.00	NA	
		5	6	7	8			
		0.00	0.01					
	0.03	1	2	3	4	1909209-BLK1	NA	0.50
		0.01	-0.03	-0.02	0.00	-0.05	NA	
		5	6	7	8			
		0.00	0.01					
Calcium	3.99	1	2	3	4	1909209-BLK1	NA	25.00
		3.61	5.36	5.54	4.66	-23.35	NA	
		5	6	7	8			
		4.32	3.80					
	3.99	1	2	3	4	1909208-BLK1	NA	25.00
		3.61	5.36	5.54	4.66	-22.76	NA	
		5	6	7	8			
		4.32	3.80					
Iron	-0.23	1	2	3	4	1909209-BLK1	NA	25.00
		0.87	2.10	1.13	0.43	4.02	NA	
		5	6	7	8			
		2.17	2.32					
	-0.23	1	2	3	4	1909208-BLK1	NA	25.00
		0.87	2.10	1.13	0.43	12.03	NA	
		5	6	7	8			
		2.17	2.32					

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

TechLaw Inc., ESAT Region 8
INORGANIC ANALYSES DATA SHEET
Initial and Continuing Calibration Blanks

Analytical Method: EPA 200.2/200.7

Analysis Name: ICPOE Tot. Rec. Metals

Instrument: ICPOE - PE Optima

Work Order: C190918

Analytical Sequence: 1910065 Total Recoverable

Concentration Units: mg/kg dry wt

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Potassium	40.13	1	2	3	4	1909208-BLK1	NA	100.00
		32.21	68.57	48.15	34.74	155.78	NA	
		5	6	7	8			
		63.34	49.75					
	40.13	1	2	3	4	1909209-BLK1	NA	100.00
		32.21	68.57	48.15	34.74	106.19	NA	
		5	6	7	8			
		63.34	49.75					
Magnesium	-0.17	1	2	3	4	1909208-BLK1	NA	25.00
		-0.10	-0.24	0.09	0.01	-4.30	NA	
		5	6	7	8			
		-0.51	-0.16					
	-0.17	1	2	3	4	1909209-BLK1	NA	25.00
		-0.10	-0.24	0.09	0.01	-5.19	NA	
		5	6	7	8			
		-0.51	-0.16					
Manganese	-0.05	1	2	3	4	1909209-BLK1	NA	0.50
		-0.05	-0.04	0.01	-0.03	0.61	NA	
		5	6	7	8			
		-0.07	-0.05					
	-0.05	1	2	3	4	1909208-BLK1	NA	0.50
		-0.05	-0.04	0.01	-0.03	1.26	NA	
		5	6	7	8			
		-0.07	-0.05					
Sodium	-1.21	1	2	3	4	1909208-BLK1	NA	100.00
		9.98	9.17	4.59	1.48	98.34	NA	
		5	6	7	8			
		8.93	9.31					
	-1.21	1	2	3	4	1909209-BLK1	NA	100.00
		9.98	9.17	4.59	1.48	39.34	NA	
		5	6	7	8			
		8.93	9.31					

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

TechLaw Inc., ESAT Region 8
INORGANIC ANALYSES DATA SHEET
Initial and Continuing Calibration Blanks

Analytical Method: EPA 200.2/200.7

Analysis Name: ICPOE Tot. Rec. Metals

Instrument: ICPOE - PE Optima

Work Order: C190918

Analytical Sequence: 1910065 **Total Recoverable**

Concentration Units: mg/kg dry wt

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Zinc	0.83	1	2	3	4	1909208-BLK1	NA	2.00
		0.35	-0.67	1.17	0.08	15.62	NA	
		5	6	7	8			
		0.44	0.72					
	0.83	1	2	3	4	1909209-BLK1	NA	2.00
		0.35	-0.67	1.17	0.08	12.25	NA	
		5	6	7	8			
		0.44	0.72					

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

TechLaw Inc., ESAT Region 8
INORGANIC ANALYSES DATA SHEET
Initial and Continuing Calibration Blanks

Analytical Method: EPA 200.2 / 200.8Analysis Name: ICPMS Tot. Rec. MetalsInstrument: ICPMS-PE DRC-IIWork Order: C190918Analytical Sequence: 1910119 **Total Recoverable**Concentration Units: ug/kg dry wt

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Vanadium	-0.04	1	2	3	4	NA	1909208-BLK2	300.00
		-0.06	-0.04	0.01		NA	0.67	
		5	6	7	8			
	-0.04	1	2	3	4	NA	1909209-BLK2	300.00
		-0.06	-0.04	0.01		NA	1.66	
		5	6	7	8			
Chromium	-0.12	1	2	3	4	NA	1909209-BLK2	300.00
		-0.14	-0.12	-0.13		NA	2.66	
		5	6	7	8			
	-0.12	1	2	3	4	NA	1909208-BLK2	200.00
		-0.14	-0.12	-0.13		NA	1.48	
		5	6	7	8			
Cobalt	0.00	1	2	3	4	NA	1909208-BLK2	20.00
		0.00	0.00	0.00		NA	0.01	
		5	6	7	8			
	0.00	1	2	3	4	NA	1909209-BLK2	20.00
		0.00	0.00	0.00		NA	0.01	
		5	6	7	8			
Nickel	-0.01	1	2	3	4	NA	1909208-BLK2	100.00
		-0.01	0.00	-0.01		NA	0.02	
		5	6	7	8			
	-0.01	1	2	3	4	NA	1909209-BLK2	100.00
		-0.01	0.00	-0.01		NA	0.03	
		5	6	7	8			

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

TechLaw Inc., ESAT Region 8
INORGANIC ANALYSES DATA SHEET
Initial and Continuing Calibration Blanks

Analytical Method: EPA 200.2 / 200.8

Analysis Name: ICPMS Tot. Rec. Metals

Instrument: ICPMS-PE DRC-II

Work Order: C190918

Analytical Sequence: 1910119 Total Recoverable

Concentration Units: ug/kg dry wt

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Copper	-0.02	1	2	3	4	NA	1909209-BLK2	100.00
		0.00	-0.01	-0.03		NA	0.21	
		5	6	7	8			
	-0.02	1	2	3	4	NA	1909208-BLK2	100.00
		0.00	-0.01	-0.03		NA	0.07	
		5	6	7	8			
Arsenic	0.00	1	2	3	4	NA	1909208-BLK2	200.00
		0.01	0.04	-0.04		NA	-0.61	
		5	6	7	8			
	0.00	1	2	3	4	NA	1909209-BLK2	200.00
		0.01	0.04	-0.04		NA	0.08	
		5	6	7	8			
Selenium	-0.22	1	2	3	4	NA	1909209-BLK2	200.00
		-0.06	0.11	-0.10		NA	0.01	
		5	6	7	8			
	-0.22	1	2	3	4	NA	1909208-BLK2	200.00
		-0.06	0.11	-0.10		NA	0.14	
		5	6	7	8			
Molybdenum	0.01	1	2	3	4	NA	1909208-BLK2	100.00
		0.03	0.04	0.06		NA	0.14	
		5	6	7	8			
	0.01	1	2	3	4	NA	1909209-BLK2	100.00
		0.03	0.04	0.06		NA	0.19	
		5	6	7	8			

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

TechLaw Inc., ESAT Region 8
INORGANIC ANALYSES DATA SHEET
Initial and Continuing Calibration Blanks

Analytical Method: EPA 200.2 / 200.8

Analysis Name: ICPMS Tot. Rec. Metals

Instrument: ICPMS-PE DRC-II

Work Order: C190918

Analytical Sequence: 1910119 Total Recoverable

Concentration Units: ug/kg dry wt

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Silver	0.00	1	2	3	4	NA	1909209-BLK2	100.00
		0.00	0.00	0.01		NA	0.02	
		5	6	7	8			
	0.00	1	2	3	4	NA	1909208-BLK2	100.00
		0.00	0.00	0.01		NA	0.37	
		5	6	7	8			
Cadmium	0.00	1	2	3	4	NA	1909208-BLK2	40.00
		0.00	0.00	0.01		NA	0.30	
		5	6	7	8			
	0.00	1	2	3	4	NA	1909209-BLK2	20.00
		0.00	0.00	0.01		NA	0.03	
		5	6	7	8			
Antimony	0.04	1	2	3	4	NA	1909209-BLK2	100.00
		0.10	0.12	0.13		NA	0.45	
		5	6	7	8			
	0.04	1	2	3	4	NA	1909208-BLK2	100.00
		0.10	0.12	0.13		NA	0.74	
		5	6	7	8			
Barium	-0.01	1	2	3	4	NA	1909208-BLK2	100.00
		0.00	0.00	0.00		NA	0.03	
		5	6	7	8			
	-0.01	1	2	3	4	NA	1909209-BLK2	100.00
		0.00	0.00	0.00		NA	0.03	
		5	6	7	8			

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

TechLaw Inc., ESAT Region 8
INORGANIC ANALYSES DATA SHEET
Initial and Continuing Calibration Blanks

Analytical Method: EPA 200.2 / 200.8Analysis Name: ICPMS Tot. Rec. MetalsInstrument: ICPMS-PE DRC-IIWork Order: C190918Analytical Sequence: 1910119 **Total Recoverable**Concentration Units: ug/kg dry wt

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Thallium	0.00	1	2	3	4	NA	1909208-BLK2	200.00
		0.02	0.00	0.01		NA	0.01	
		5	6	7	8			
	0.00	1	2	3	4	NA	1909209-BLK2	200.00
		0.02	0.00	0.01		NA	0.00	
		5	6	7	8			
Lead	0.00	1	2	3	4	NA	1909208-BLK2	20.00
		0.00	0.03	0.14		NA	4.06	
		5	6	7	8			
	0.00	1	2	3	4	NA	1909209-BLK2	20.00
		0.00	0.03	0.14		NA	1.30	
		5	6	7	8			
Uranium	0.00	1	2	3	4	NA	1909209-BLK2	20.00
		0.00	0.00	0.00		NA	0.00	
		5	6	7	8			
	0.00	1	2	3	4	NA	1909208-BLK2	20.00
		0.00	0.00	0.00		NA	0.00	
		5	6	7	8			

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

TechLaw Inc., ESAT Region 8
INORGANIC ANALYSES DATA SHEET
Initial and Continuing Calibration Blanks

Analytical Method: EPA 200.2 / 200.8

Analysis Name: ICPMS Tot. Rec. Metals

Instrument: ICPMS-PE DRC-II

Work Order: C190918

Analytical Sequence: 1910120 Total Recoverable

Concentration Units: ug/kg dry wt

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Vanadium	0.01	1	2	3	4	NA	1909209-BLK2	300.00
		0.04	0.18	0.19		NA	1.66	
		5	6	7	8			
	0.01	1	2	3	4	NA	1909208-BLK2	300.00
		0.04	0.18	0.19		NA	0.67	
		5	6	7	8			
Chromium	-0.02	1	2	3	4	NA	1909209-BLK2	300.00
		-0.02	0.11	0.13		NA	2.66	
		5	6	7	8			
	-0.02	1	2	3	4	NA	1909208-BLK2	200.00
		-0.02	0.11	0.13		NA	1.48	
		5	6	7	8			
Cobalt	0.00	1	2	3	4	NA	1909208-BLK2	20.00
		0.00	0.00	0.00		NA	0.01	
		5	6	7	8			
	0.00	1	2	3	4	NA	1909209-BLK2	20.00
		0.00	0.00	0.00		NA	0.01	
		5	6	7	8			
Nickel	0.01	1	2	3	4	NA	1909208-BLK2	100.00
		0.02	0.01	0.02		NA	0.02	
		5	6	7	8			
	0.01	1	2	3	4	NA	1909209-BLK2	100.00
		0.02	0.01	0.02		NA	0.03	
		5	6	7	8			

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

TechLaw Inc., ESAT Region 8
INORGANIC ANALYSES DATA SHEET
Initial and Continuing Calibration Blanks

Analytical Method: EPA 200.2 / 200.8

Analysis Name: ICPMS Tot. Rec. Metals

Instrument: ICPMS-PE DRC-II

Work Order: C190918

Analytical Sequence: 1910120 Total Recoverable

Concentration Units: ug/kg dry wt

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Copper	-0.02	1	2	3	4	NA	1909209-BLK2	100.00
		-0.02	0.01	-0.02		NA	0.21	
		5	6	7	8			
	-0.02	1	2	3	4	NA	1909208-BLK2	100.00
		-0.02	0.01	-0.02		NA	0.07	
		5	6	7	8			
Arsenic	0.05	1	2	3	4	NA	1909209-BLK2	200.00
		0.03	-0.04	0.05		NA	0.08	
		5	6	7	8			
	0.05	1	2	3	4	NA	1909208-BLK2	200.00
		0.03	-0.04	0.05		NA	-0.61	
		5	6	7	8			
Selenium	0.04	1	2	3	4	NA	1909209-BLK2	200.00
		-0.03	0.02	0.26		NA	0.01	
		5	6	7	8			
	0.04	1	2	3	4	NA	1909208-BLK2	200.00
		-0.03	0.02	0.26		NA	0.14	
		5	6	7	8			
Molybdenum	0.01	1	2	3	4	NA	1909208-BLK2	100.00
		0.07	0.05	0.05		NA	0.14	
		5	6	7	8			
	0.01	1	2	3	4	NA	1909209-BLK2	100.00
		0.07	0.05	0.05		NA	0.19	
		5	6	7	8			

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

TechLaw Inc., ESAT Region 8
INORGANIC ANALYSES DATA SHEET
Initial and Continuing Calibration Blanks

Analytical Method: EPA 200.2 / 200.8Analysis Name: ICPMS Tot. Rec. MetalsInstrument: ICPMS-PE DRC-IIWork Order: C190918Analytical Sequence: 1910120 **Total Recoverable**Concentration Units: ug/kg dry wt

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Silver	0.00	1	2	3	4	NA	1909209-BLK2	100.00
		0.01	0.01	0.01		NA	0.02	
		5	6	7	8			
	0.00	1	2	3	4	NA	1909208-BLK2	100.00
		0.01	0.01	0.01		NA	0.37	
		5	6	7	8			
Cadmium	0.01	1	2	3	4	NA	1909209-BLK2	20.00
		0.00	0.02	0.01		NA	0.03	
		5	6	7	8			
	0.01	1	2	3	4	NA	1909208-BLK2	40.00
		0.00	0.02	0.01		NA	0.30	
		5	6	7	8			
Antimony	0.07	1	2	3	4	NA	1909208-BLK2	100.00
		0.14	0.13	0.15		NA	0.74	
		5	6	7	8			
	0.07	1	2	3	4	NA	1909209-BLK2	100.00
		0.14	0.13	0.15		NA	0.45	
		5	6	7	8			
Barium	-0.01	1	2	3	4	NA	1909208-BLK2	100.00
		0.00	-0.01	0.00		NA	0.03	
		5	6	7	8			
	-0.01	1	2	3	4	NA	1909209-BLK2	100.00
		0.00	-0.01	0.00		NA	0.03	
		5	6	7	8			

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

TechLaw Inc., ESAT Region 8
INORGANIC ANALYSES DATA SHEET
Initial and Continuing Calibration Blanks

Analytical Method: EPA 200.2 / 200.8Analysis Name: ICPMS Tot. Rec. MetalsInstrument: ICPMS-PE DRC-IIWork Order: C190918Analytical Sequence: 1910120 **Total Recoverable**Concentration Units: ug/kg dry wt

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Thallium	0.00	1	2	3	4	NA	1909208-BLK2	200.00
		0.01	0.01	0.01		NA	0.01	
		5	6	7	8			
	0.00	1	2	3	4	NA	1909209-BLK2	200.00
		0.01	0.01	0.01		NA	0.00	
		5	6	7	8			
Lead	-0.01	1	2	3	4	NA	1909208-BLK2	20.00
		0.09	0.04	0.01		NA	4.06	
		5	6	7	8			
	-0.01	1	2	3	4	NA	1909209-BLK2	20.00
		0.09	0.04	0.01		NA	1.30	
		5	6	7	8			
Uranium	0.00	1	2	3	4	NA	1909209-BLK2	20.00
		0.00	0.00	0.00		NA	0.00	
		5	6	7	8			
	0.00	1	2	3	4	NA	1909208-BLK2	20.00
		0.00	0.00	0.00		NA	0.00	
		5	6	7	8			

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

TechLaw, Inc. - ESAT Region 8												
Initial and Continuing Calibration Verification Results												
NIC MA-3000			Method: 7473			Analysis Name: TM_Mercury 7473						
Sequence: 1909191			Work Order: C190918			Units: mg/kg dry wt						
Total Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Mercury	100	103.6	103.6	1			2			3		
				100	103.2	103.2	100	104.0	104.0	100	107.4	107.4
				4			5			6		
				100	105.1	105.1	100	99.83	99.8			
				7			8			9		

TDF #: A-223

TechLaw, Inc. - ESAT Region 8												
Initial and Continuing Calibration Verification Results												
ICPOE - PE Optima			Method: EPA 200.2/200.7				Analysis Name: ICPOE Tot. Rec. Metals					
Sequence: 1910065			Work Order: C190918				Units: mg/kg dry wt					
Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Aluminum	12500	12459	99.7	1			2			3		
				12500	12451	99.6	12500	12496	100.0	12500	12391	99.1
				4			5			6		
				12500	12457	99.7	12500	12484	99.9	12500	12351	98.8
				7			8			9		
Beryllium	500	504.37	100.9	1			2			3		
				500	514.27	102.9	500	508.24	101.6	500	509.68	101.9
				4			5			6		
				500	506.47	101.3	500	508.17	101.6	500	509.77	102.0
				7			8			9		
Calcium	12500	12695	101.6	1			2			3		
				12500	12674	101.4	12500	12802	102.4	12500	12715	101.7
				4			5			6		
				12500	12705	101.6	12500	12597	100.8	12500	12367	98.9
				7			8			9		
Iron	12500	12574	100.6	1			2			3		
				12500	12521	100.2	12500	12593	100.7	12500	12422	99.4
				4			5			6		
				12500	11853	94.8	12500	12321	98.6	12500	12041	96.3
				7			8			9		
Magnesium	12500	12601	100.8	1			2			3		
				12500	12497	100.0	12500	12540	100.3	12500	12431	99.4
				4			5			6		
				12500	12476	99.8	12500	12397	99.2	12500	12197	97.6
				7			8			9		
Manganese	1000	1050.9	105.1	1			2			3		
				1000	1063.4	106.3	1000	1049.4	104.9	1000	1056.3	105.6
				4			5			6		
				1000	1049.0	104.9	1000	1045.3	104.5	1000	1038.9	103.9
				7			8			9		

TDF #: A-223

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima

Method: EPA 200.2/200.7

Analysis Name: ICPOE Tot. Rec. Metals

Sequence: 1910065

Work Order: C190918

Units: mg/kg dry wt

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Potassium	25000	25174	100.7	1			2			3		
				25000	24507	98.0	25000	25477	101.9	25000	25392	101.6
				4			5			6		
				25000	25609	102.4	25000	25625	102.5	25000	25230	100.9
				7			8			9		
Sodium	12500	12574	100.6	1			2			3		
				12500	12365	98.9	12500	12290	98.3	12500	12113	96.9
				4			5			6		
				12500	12079	96.6	12500	12027	96.2	12500	11857	94.9
				7			8			9		
Zinc	2500	2588.3	103.5	1			2			3		
				2500	2595.2	103.8	2500	2549.0	102.0	2500	2562.7	102.5
				4			5			6		
				2500	2522.0	100.9	2500	2524.3	101.0	2500	2508.2	100.3
				7			8			9		

TDF #: A-223

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II

Method: EPA 200.2 / 200.8

Analysis Name: ICPMS Tot. Rec. Metals

Sequence: 1910119

Work Order: C190918

Units: ug/kg dry wt

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Antimony	50.0	48.9	97.8		1			2			3	
				50.0	47.8	95.6	50.0	47.5	95.0	50.0	47.0	94.0
					4			5			6	
					7			8			9	
Arsenic	50.0	52.3	104.6		1			2			3	
				50.0	51.1	102.2	50.0	51.6	103.2	50.0	51.8	103.6
					4			5			6	
					7			8			9	
Barium	50.0	49.7	99.4		1			2			3	
				50.0	50.3	100.6	50.0	47.9	95.8	50.0	47.0	94.0
					4			5			6	
					7			8			9	
Cadmium	50.0	51.7	103.4		1			2			3	
				50.0	51.3	102.6	50.0	51.5	103.0	50.0	51.8	103.6
					4			5			6	
					7			8			9	
Chromium	50.0	49.0	98.0		1			2			3	
				50.0	50.7	101.4	50.0	49.1	98.2	50.0	49.4	98.8
					4			5			6	
					7			8			9	
Cobalt	50.0	49.5	99.0		1			2			3	
				50.0	50.7	101.4	50.0	50.2	100.4	50.0	50.5	101.0
					4			5			6	
					7			8			9	

TDF #: A-223

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II

Method: EPA 200.2 / 200.8

Analysis Name: ICPMS Tot. Rec. Metals

Sequence: 1910119

Work Order: C190918

Units: ug/kg dry wt

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Copper	50.0	50.4	100.8		1			2			3	
				50.0	51.4	102.8	50.0	50.6	101.2	50.0	50.8	101.6
					4			5			6	
					7			8			9	
Lead	50.0	49.9	99.8		1			2			3	
				50.0	50.7	101.4	50.0	50.7	101.4	50.0	52.0	104.0
					4			5			6	
					7			8			9	
Molybdenum	50.0	49.2	98.4		1			2			3	
				50.0	48.2	96.4	50.0	47.5	95.0	50.0	46.0	92.0
					4			5			6	
					7			8			9	
Nickel	50.0	50.7	101.4		1			2			3	
				50.0	51.3	102.6	50.0	50.3	100.6	50.0	50.2	100.4
					4			5			6	
					7			8			9	
Selenium	50.0	55.5	111.0		1			2			3	
				50.0	55.6	111.2	50.0	55.1	110.2	50.0	58.3	116.6
					4			5			6	
					7			8			9	
Silver	50.0	50.0	100.0		1			2			3	
				50.0	49.8	99.6	50.0	49.5	99.0	50.0	48.7	97.4
					4			5			6	
					7			8			9	

TDF #: A-223

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II

Method: EPA 200.2 / 200.8

Analysis Name: ICPMS Tot. Rec. Metals

Sequence: 1910119

Work Order: C190918

Units: ug/kg dry wt

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Thallium	50.0	49.8	99.6	1			2			3		
				50.0	49.7	99.4	50.0	50.5	101.0	50.0	51.9	103.8
				4			5			6		
				7			8			9		
Uranium	50.0	48.4	96.8	1			2			3		
				50.0	48.3	96.6	50.0	47.6	95.2	50.0	46.5	93.0
				4			5			6		
				7			8			9		
Vanadium	50.0	49.4	98.8	1			2			3		
				50.0	50.4	100.8	50.0	49.1	98.2	50.0	49.7	99.4
				4			5			6		
				7			8			9		

TDF #: A-223

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II

Method: EPA 200.2 / 200.8

Analysis Name: ICPMS Tot. Rec. Metals

Sequence: 1910120

Work Order: C190918

Units: ug/kg dry wt

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Antimony	50.0	48.2	96.4		1			2			3	
				50.0	47.2	94.4	50.0	47.7	95.4	50.0	47.6	95.2
					4			5			6	
					7			8			9	
Arsenic	50.0	49.8	99.6		1			2			3	
				50.0	49.2	98.4	50.0	50.2	100.4	50.0	49.7	99.4
					4			5			6	
					7			8			9	
Barium	50.0	47.6	95.2		1			2			3	
				50.0	46.9	93.8	50.0	46.6	93.2	50.0	47.3	94.6
					4			5			6	
					7			8			9	
Cadmium	50.0	49.7	99.4		1			2			3	
				50.0	50.1	100.2	50.0	49.6	99.2	50.0	49.5	99.0
					4			5			6	
					7			8			9	
Chromium	50.0	48.3	96.6		1			2			3	
				50.0	46.9	93.8	50.0	48.5	97.0	50.0	48.1	96.2
					4			5			6	
					7			8			9	
Cobalt	50.0	48.5	97.0		1			2			3	
				50.0	46.5	93.0	50.0	47.4	94.8	50.0	47.4	94.8
					4			5			6	
					7			8			9	

TDF #: A-223

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II

Method: EPA 200.2 / 200.8

Analysis Name: ICPMS Tot. Rec. Metals

Sequence: 1910120

Work Order: C190918

Units: ug/kg dry wt

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Copper	50.0	49.0	98.0		1			2			3	
				50.0	46.9	93.8	50.0	48.3	96.6	50.0	46.8	93.6
					4			5			6	
					7			8			9	
Lead	50.0	48.5	97.0		1			2			3	
				50.0	49.4	98.8	50.0	51.2	102.4	50.0	50.9	101.8
					4			5			6	
					7			8			9	
Molybdenum	50.0	47.7	95.4		1			2			3	
				50.0	46.5	93.0	50.0	46.3	92.6	50.0	47.1	94.2
					4			5			6	
					7			8			9	
Nickel	50.0	47.8	95.6		1			2			3	
				50.0	46.1	92.2	50.0	47.6	95.2	50.0	46.9	93.8
					4			5			6	
					7			8			9	
Selenium	50.0	53.3	106.6		1			2			3	
				50.0	53.7	107.4	50.0	56.1	112.2	50.0	53.2	106.4
					4			5			6	
					7			8			9	
Silver	50.0	48.1	96.2		1			2			3	
				50.0	47.9	95.8	50.0	48.4	96.8	50.0	48.2	96.4
					4			5			6	
					7			8			9	

TDF #: A-223

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II

Method: EPA 200.2 / 200.8

Analysis Name: ICPMS Tot. Rec. Metals

Sequence: 1910120

Work Order: C190918

Units: ug/kg dry wt

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Thallium	50.0	47.9	95.8		1			2			3	
				50.0	49.0	98.0	50.0	50.7	101.4	50.0	50.9	101.8
					4			5			6	
					7			8			9	
Uranium	50.0	47.9	95.8		1			2			3	
				50.0	48.1	96.2	50.0	50.4	100.8	50.0	50.3	100.6
					4			5			6	
					7			8			9	
Vanadium	50.0	47.3	94.6		1			2			3	
				50.0	47.0	94.0	50.0	47.6	95.2	50.0	47.8	95.6
					4			5			6	
					7			8			9	

TDF #: A-223

TechLaw, Inc. - ESAT Region 8
ICP Interference Check Sample
ICPMS-PE DRC-II

<u>Analyte</u>	<u>Check Sample</u>	<u>Result*</u>	<u>Units</u>	<u>True</u>	<u>%R</u>	<u>PQL</u>
Sequence: 1910119	Analysis: ICPMS Tot. Rec. Metals					
Antimony	IFA1	0.0	ug/L			1.0
	IFB1	0.1	ug/L			1.0
Arsenic	IFA1	0.0	ug/L			2.0
	IFB1	19.8	ug/L	20	99	2.0
Barium	IFA1	0.1	ug/L			1.0
	IFB1	0.1	ug/L			1.0
Cadmium	IFA1	0.1	ug/L			0.2
	IFB1	20.4	ug/L	20	102	0.2
Chromium	IFA1	0.1	ug/L			2.0
	IFB1	20.1	ug/L	20	100	2.0
Cobalt	IFA1	0.0	ug/L			0.2
	IFB1	20.7	ug/L	20	103	0.2
Copper	IFA1	0.6	ug/L			1.0
	IFB1	20.9	ug/L	20	104	1.0
Lead	IFA1	0.0	ug/L			0.2
	IFB1	0.0	ug/L			0.2
Molybdenum	IFA1	194.3	ug/L	200	97	1.0
	IFB1	197.6	ug/L	200	99	1.0
Nickel	IFA1	-0.5	ug/L			1.0
	IFB1	19.1	ug/L	20	95	1.0
Selenium	IFA1	0.1	ug/L			2.0
	IFB1	-0.2	ug/L			2.0
Silver	IFA1	0.0	ug/L			1.0
	IFB1	20.0	ug/L	20	100	1.0
Thallium	IFA1	0.0	ug/L			2.0
	IFB1	0.0	ug/L			2.0
Uranium	IFA1	0.0	ug/L			0.2
	IFB1	0.0	ug/L			0.2
Vanadium	IFA1	0.0	ug/L			3.0
	IFB1	-0.4	ug/L			3.0

*Criteria = 80-120%R of True Value or +/- PQL

See raw data for complete analyte list and results.

TDF #: A-223

TechLaw, Inc. - ESAT Region 8
ICP Interference Check Sample
ICPMS-PE DRC-II

<u>Analyte</u>	<u>Check Sample</u>	<u>Result*</u>	<u>Units</u>	<u>True</u>	<u>%R</u>	<u>PQL</u>
Sequence: 1910120	Analysis: ICPMS Tot. Rec. Metals					
Antimony	IFA1	0.1	ug/L			1.0
	IFB1	0.1	ug/L			1.0
Arsenic	IFA1	-0.1	ug/L			2.0
	IFB1	19.5	ug/L	20	98	2.0
Barium	IFA1	0.1	ug/L			1.0
	IFB1	0.1	ug/L			1.0
Cadmium	IFA1	0.1	ug/L			0.2
	IFB1	20.5	ug/L	20	102	0.2
Chromium	IFA1	0.3	ug/L			2.0
	IFB1	20.1	ug/L	20	101	2.0
Cobalt	IFA1	0.0	ug/L			0.2
	IFB1	20.2	ug/L	20	101	0.2
Copper	IFA1	0.7	ug/L			1.0
	IFB1	20.6	ug/L	20	103	1.0
Lead	IFA1	0.0	ug/L			0.2
	IFB1	0.0	ug/L			0.2
Molybdenum	IFA1	195.4	ug/L	200	98	1.0
	IFB1	197.5	ug/L	200	99	1.0
Nickel	IFA1	-0.4	ug/L			1.0
	IFB1	18.7	ug/L	20	94	1.0
Selenium	IFA1	0.0	ug/L			2.0
	IFB1	0.3	ug/L			2.0
Silver	IFA1	0.0	ug/L			1.0
	IFB1	19.9	ug/L	20	99	1.0
Thallium	IFA1	0.0	ug/L			2.0
	IFB1	0.0	ug/L			2.0
Uranium	IFA1	0.0	ug/L			0.2
	IFB1	0.0	ug/L			0.2
Vanadium	IFA1	0.0	ug/L			3.0
	IFB1	-0.1	ug/L			3.0

*Criteria = 80-120%R of True Value or +/- PQL

See raw data for complete analyte list and results.

TDF #: A-223

TechLaw, Inc. - ESAT Region 8

ICP Interference Check Sample

ICPOE - PE Optima

<u>Analyte</u>	<u>Check Sample</u>	<u>Result*</u>	<u>Units</u>	<u>True</u>	<u>%R</u>	<u>PQL</u>
Sequence: 1910065	Analysis: ICPOE Tot. Rec. Metals					
Aluminum	IFA1	59,683.8	ug/L	60,000	99	50.0
	IFB1	65,745.9	ug/L	60,000	110	50.0
Beryllium	IFA1	0.9	ug/L			5.00
	IFB1	106.0	ug/L	100	106	5.00
Calcium	IFA1	293,255.6	ug/L	300,000	98	250
	IFB1	312,147.8	ug/L	300,000	104	250
Iron	IFA1	220,856.6	ug/L	250,000	88	250
	IFB1	235,922.4	ug/L	250,000	94	250
Magnesium	IFA1	132,807.8	ug/L	150,000	89	250
	IFB1	142,582.8	ug/L	150,000	95	250
Manganese	IFA1	2.7	ug/L			5.00
	IFB1	209.5	ug/L	200	105	5.00
Potassium	IFA1	-204.6	ug/L			1000
	IFB1	20,986.0	ug/L	20,000	105	1000
Sodium	IFA1	48,960.3	ug/L	50,000	98	1000
	IFB1	53,776.1	ug/L	50,000	108	1000
Zinc	IFA1	4.6	ug/L			20.0
	IFB1	292.8	ug/L	300	98	20.0

*Criteria = 80-120%R of True Value or +/- PQL

See raw data for complete analyte list and results.

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

TechLaw, Inc. - ESAT Region 8				
Detection Limit (PQL) Standard				
NIC MA-3000				
Metals (Total Recov) by EPA 200/7000 Series Methods				
Sequence: 1909191				
<u>Analyte</u>	<u>True</u>	<u>Found</u>	<u>%R</u>	<u>Units</u>
Mercury	10.0	9.54	95	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TDF #: A-223

TechLaw, Inc. - ESAT Region 8 Detection Limit (PQL) Standard ICPMS-PE DRC-II				
Metals (Total Recov) by EPA 200/7000 Series Methods				
Sequence: 1910119				
<u>Analyte</u>	<u>True</u>	<u>Found</u>	<u>%R</u>	<u>Units</u>
Antimony	1.00	0.9	94	ug/L
Arsenic	2.00	1.9	97	ug/L
Barium	10.0	9.7	97	ug/L
Cadmium	0.200	0.2	106	ug/L
Chromium	2.00	1.9	94	ug/L
Cobalt	0.200	0.2	118	ug/L
Copper	1.00	1.1	110	ug/L
Lead	0.200	0.2	108	ug/L
Molybdenum	1.00	0.9	94	ug/L
Nickel	1.00	1.0	96	ug/L
Selenium	2.00	2.0	102	ug/L
Silver	1.00	0.9	94	ug/L
Thallium	1.00	1.0	95	ug/L
Uranium	0.200	0.2	97	ug/L
Vanadium	2.00	1.9	95	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TDF #: A-223

TechLaw, Inc. - ESAT Region 8 Detection Limit (PQL) Standard ICPMS-PE DRC-II				
Metals (Total Recov) by EPA 200/7000 Series Methods				
Sequence: 1910120				
<u>Analyte</u>	<u>True</u>	<u>Found</u>	<u>%R</u>	<u>Units</u>
Antimony	1.00	1.1	105	ug/L
Arsenic	2.00	1.9	93	ug/L
Barium	10.0	9.5	95	ug/L
Cadmium	0.200	0.2	107	ug/L
Chromium	2.00	1.9	97	ug/L
Cobalt	0.200	0.2	108	ug/L
Copper	1.00	1.0	105	ug/L
Lead	0.200	0.2	97	ug/L
Molybdenum	1.00	1.0	102	ug/L
Nickel	1.00	1.0	96	ug/L
Selenium	2.00	1.9	96	ug/L
Silver	1.00	0.9	94	ug/L
Thallium	1.00	0.9	94	ug/L
Uranium	0.200	0.2	99	ug/L
Vanadium	2.00	1.9	95	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TDF #: A-223

TechLaw, Inc. - ESAT Region 8 Detection Limit (PQL) Standard ICPOE - PE Optima				
Metals (Total Recov) by EPA 200/7000 Series Methods Sequence: 1910065				
<u>Analyte</u>	<u>True</u>	<u>Found</u>	<u>%R</u>	<u>Units</u>
Aluminum	100	94.650	95	ug/L
Beryllium	5.00	5.0747	101	ug/L
Calcium	250	238.42	95	ug/L
Iron	100	96.415	96	ug/L
Magnesium	1000	1005.8	101	ug/L
Manganese	10.0	11.495	115	ug/L
Potassium	1000	1068.8	107	ug/L
Sodium	1000	1014.3	101	ug/L
Zinc	50.0	54.661	109	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TDF #: A-223

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 7473

Total

Sequence ID#: 1909191

Instrument ID #: NIC MA-3000

Solid (dry wt basis)

LSR #: A-223

Analysis ID	Sample Name	Analysis Date	Analysis Time
1909191-ICV1	Initial Cal Check	10/02/19	12:17
1909191-ICB1	Initial Cal Blank	10/02/19	12:17
1909191-CRL1	Instrument RL Check	10/02/19	12:17
1909190-BLK1	Blank	10/02/19	12:17
1909190-SRM1	Reference	10/02/19	12:17
C190918-01	ABR-SO-BKG-01	10/02/19	12:17
1909190-DUP1	Duplicate	10/02/19	12:17
1909190-MS1	Matrix Spike	10/02/19	12:17
1909190-MSD1	Matrix Spike Dup	10/02/19	12:17
C190918-02	ABR-SO-MP01-01	10/02/19	12:17
C190918-03	ABR-SO-MP01-01	10/02/19	12:17
1909191-CCV1	Calibration Check	10/02/19	12:17
1909191-CCB1	Calibration Blank	10/02/19	12:17
C190918-04	ABR-SO-MP01-02	10/02/19	12:17
C190918-05	ABR-SO-MP01-03	10/02/19	12:17
C190918-06	ABR-SO-MP01-04	10/02/19	12:17
C190918-07	ABR-SO-MP01-05	10/02/19	12:17
C190918-08	COB-SO-BKG-01	10/02/19	12:17
C190918-09	COB-SO-MP01-01	10/02/19	12:17
C190918-10	EGM-SO-BKG-01	10/02/19	12:17
C190918-11	EGM-SO-MP01-01	10/02/19	12:17
C190918-12	EGM-SO-MP01-01	10/02/19	12:17
C190918-13	IRN-SO-BKG-01	10/02/19	12:17
1909191-CCV2	Calibration Check	10/02/19	12:17
1909191-CCB2	Calibration Blank	10/02/19	12:17
C190918-14	IRN-SO-MP01-01	10/02/19	12:17
C190918-15	IRN-SO-MP01-01	10/02/19	12:17
C190918-16	IRN-SO-MP01-02	10/02/19	12:17
C190918-17	IRN-SO-MP01-03	10/02/19	12:17
C190918-18	IRN-SO-MP01-04	10/02/19	12:17
C190918-19	IRN-SO-MP01-05	10/02/19	12:17
1909190-SRM2	Reference	10/02/19	12:17
1909190-BLK2	Blank	10/02/19	12:17
C190918-20	IRN-SO-MP01-06	10/02/19	12:17
1909190-DUP2	Duplicate	10/02/19	12:17
1909191-CCV3	Calibration Check	10/02/19	12:17
1909191-CCB3	Calibration Blank	10/02/19	12:17
1909190-MS2	Matrix Spike	10/02/19	12:17
1909190-MSD2	Matrix Spike Dup	10/02/19	12:17

Project Name: Tronox Mining Sites_Soil_SEP_2019_A223

Certificate of Analysis

TDF #: A-223

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 7473

Total

Sequence ID#: 1909191

Instrument ID #: NIC MA-3000

Solid (dry wt basis)

LSR #: A-223

Analysis ID	Sample Name	Analysis Date	Analysis Time
C190918-21	IRN-SO-MP02-01	10/02/19	12:17
C190918-22	UNK02-SO-MP01-01	10/02/19	12:17
C190918-23	UNK02-SO-MP01-01	10/02/19	12:17
C190918-24	UNK06-SO-BKG-01	10/02/19	12:17
C190918-25	UNK06-SO-MP01-01	10/02/19	12:17
C190918-26	UNK09-SO-BKG-01	10/02/19	12:17
C190918-27	UNK09-SO-BKG-01	10/02/19	12:17
C190918-28	UNK09-SO-MP01-01	10/02/19	12:17
1909191-CCV4	Calibration Check	10/02/19	12:17
1909191-CCB4	Calibration Blank	10/02/19	12:17
C190918-29	UNK09-SO-MP01-01	10/02/19	12:17
C190918-30	UNK11-SO-BKG-01	10/02/19	12:17
C190918-31	UNK11-SO-MP01-01	10/02/19	12:17
C190918-32	UNK11-SO-MP01-01	10/02/19	12:17
C190918-33	UNK14-SO-BKG-01	10/02/19	12:17
C190918-34	UNK14-SO-MP01-01	10/02/19	12:17
1909191-CCV5	Calibration Check	10/02/19	12:17
1909191-CCB5	Calibration Blank	10/02/19	12:17

TDF #: A-223

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 200.2/200.7

Total Recoverable

Sequence ID#: 1910065

Instrument ID #: ICPOE - PE Optima

Solid (dry wt basis)

LSR #: A-223

Analysis ID	Sample Name	Analysis Date	Analysis Time
1910065-ICV1	Initial Cal Check	10/08/19	09:30
1910065-SCV1	Secondary Cal Check	10/08/19	09:35
1910065-ICB1	Initial Cal Blank	10/08/19	09:38
1910065-CRL1	Instrument RL Check	10/08/19	09:41
1910065-IFA1	Interference Check A	10/08/19	09:45
1910065-IFB1	Interference Check B	10/08/19	09:49
1909208-BLK1	Blank	10/08/19	09:53
1909208-SRM1	Reference	10/08/19	09:56
C190918-01	ABR-SO-BKG-01	10/08/19	10:00
1909208-DUP1	Duplicate	10/08/19	10:03
1910065-SRD1	Serial Dilution	10/08/19	10:06
1909208-MS1	Matrix Spike	10/08/19	10:09
C190918-02	ABR-SO-MP01-01	10/08/19	10:12
1909208-MS3	Matrix Spike	10/08/19	10:15
C190918-03	ABR-SO-MP01-01	10/08/19	10:18
1910065-CCV1	Calibration Check	10/08/19	10:25
1910065-CCB1	Calibration Blank	10/08/19	10:28
C190918-04	ABR-SO-MP01-02	10/08/19	10:31
C190918-05	ABR-SO-MP01-03	10/08/19	10:34
C190918-06	ABR-SO-MP01-04	10/08/19	10:39
C190918-07	ABR-SO-MP01-05	10/08/19	10:43
C190918-08	COB-SO-BKG-01	10/08/19	10:46
C190918-09	COB-SO-MP01-01	10/08/19	10:49
C190918-10	EGM-SO-BKG-01	10/08/19	10:52
C190918-11	EGM-SO-MP01-01	10/08/19	10:55
C190918-12	EGM-SO-MP01-01	10/08/19	10:58
1910065-CCV2	Calibration Check	10/08/19	11:04
1910065-CCB2	Calibration Blank	10/08/19	11:07
C190918-13	IRN-SO-BKG-01	10/08/19	11:10
C190918-14	IRN-SO-MP01-01	10/08/19	11:13
C190918-15	IRN-SO-MP01-01	10/08/19	11:18
C190918-16	IRN-SO-MP01-02	10/08/19	11:22
C190918-17	IRN-SO-MP01-03	10/08/19	11:25
1910065-CCV3	Calibration Check	10/08/19	11:32
1910065-CCB3	Calibration Blank	10/08/19	11:35
1909209-BLK1	Blank	10/08/19	11:43
1909209-SRM1	Reference	10/08/19	11:46
C190918-18	IRN-SO-MP01-04	10/08/19	11:49
1909209-DUP1	Duplicate	10/08/19	11:52

TDF #: A-223

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 200.2/200.7

Total Recoverable

Sequence ID#: 1910065

Instrument ID #: ICPOE - PE Optima

Solid (dry wt basis)

LSR #: A-223

Analysis ID	Sample Name	Analysis Date	Analysis Time
1910065-SRD2	Serial Dilution	10/08/19	11:55
1909209-MS1	Matrix Spike	10/08/19	11:58
C190918-19	IRN-SO-MP01-05	10/08/19	12:01
1909209-MS3	Matrix Spike	10/08/19	12:05
C190918-20	IRN-SO-MP01-06	10/08/19	12:08
1910065-CCV4	Calibration Check	10/08/19	12:14
1910065-CCB4	Calibration Blank	10/08/19	12:17
C190918-21	IRN-SO-MP02-01	10/08/19	12:20
C190918-22	UNK02-SO-MP01-01	10/08/19	12:24
C190918-23	UNK02-SO-MP01-01	10/08/19	12:28
C190918-24	UNK06-SO-BKG-01	10/08/19	12:31
C190918-25	UNK06-SO-MP01-01	10/08/19	12:34
C190918-26	UNK09-SO-BKG-01	10/08/19	12:38
C190918-27	UNK09-SO-BKG-01	10/08/19	12:41
C190918-28	UNK09-SO-MP01-01	10/08/19	12:44
C190918-29	UNK09-SO-MP01-01	10/08/19	12:47
1910065-CCV5	Calibration Check	10/08/19	12:53
1910065-CCB5	Calibration Blank	10/08/19	12:57
C190918-30	UNK11-SO-BKG-01	10/08/19	13:00
C190918-31	UNK11-SO-MP01-01	10/08/19	13:03
C190918-32	UNK11-SO-MP01-01	10/08/19	13:06
C190918-33	UNK14-SO-BKG-01	10/08/19	13:09
C190918-34	UNK14-SO-MP01-01	10/08/19	13:13
1910065-CCV6	Calibration Check	10/08/19	13:19
1910065-CCB6	Calibration Blank	10/08/19	13:22

TDF #: A-223

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 200.2 / 200.8

Total Recoverable

Sequence ID#: 1910119

Instrument ID #: ICPMS-PE DRC-II

Solid (dry wt basis)

LSR #: A-223

Analysis ID	Sample Name	Analysis Date	Analysis Time
1909208-BLK2	Blank	09/30/19	12:43
C190918-01	ABR-SO-BKG-01	09/30/19	12:43
1909208-DUP2	Duplicate	09/30/19	12:43
1909208-SRM2	Reference	09/30/19	12:43
1909208-MS2	Matrix Spike	09/30/19	12:43
C190918-02	ABR-SO-MP01-01	09/30/19	12:43
1909208-MS4	Matrix Spike	09/30/19	12:43
C190918-03	ABR-SO-MP01-01	09/30/19	12:43
C190918-04	ABR-SO-MP01-02	09/30/19	12:43
C190918-05	ABR-SO-MP01-03	09/30/19	12:43
C190918-06	ABR-SO-MP01-04	09/30/19	12:43
C190918-07	ABR-SO-MP01-05	09/30/19	12:43
C190918-08	COB-SO-BKG-01	09/30/19	12:43
C190918-09	COB-SO-MP01-01	09/30/19	12:43
C190918-10	EGM-SO-BKG-01	09/30/19	12:43
C190918-11	EGM-SO-MP01-01	09/30/19	12:43
C190918-12	EGM-SO-MP01-01	09/30/19	12:43
C190918-13	IRN-SO-BKG-01	09/30/19	12:43
C190918-14	IRN-SO-MP01-01	09/30/19	12:43
C190918-15	IRN-SO-MP01-01	09/30/19	12:43
C190918-16	IRN-SO-MP01-02	09/30/19	12:43
C190918-17	IRN-SO-MP01-03	09/30/19	12:43
1910119-ICV1	Initial Cal Check	10/15/19	14:08
1910119-SCV1	Secondary Cal Check	10/15/19	14:08
1910119-ICB1	Initial Cal Blank	10/15/19	14:08
1910119-CRL1	Instrument RL Check	10/15/19	14:08
1910119-IFA1	Interference Check A	10/15/19	14:08
1910119-IFB1	Interference Check B	10/15/19	14:08
1910119-SRD2	Serial Dilution	10/15/19	14:08
1910119-CCV1	Calibration Check	10/15/19	14:08
1910119-CCB1	Calibration Blank	10/15/19	14:08
1910119-CCV2	Calibration Check	10/15/19	14:08
1910119-CCB2	Calibration Blank	10/15/19	14:08
1910119-CCV3	Calibration Check	10/15/19	14:08
1910119-CCB3	Calibration Blank	10/15/19	14:08

TDF #: A-223

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 200.2 / 200.8

Total Recoverable

Sequence ID#: 1910120

Instrument ID #: ICPMS-PE DRC-II

Solid (dry wt basis)

LSR #: A-223

Analysis ID	Sample Name	Analysis Date	Analysis Time
1909209-BLK2	Blank	09/30/19	12:45
C190918-18	IRN-SO-MP01-04	09/30/19	12:45
1909209-DUP2	Duplicate	09/30/19	12:45
1909209-SRM2	Reference	09/30/19	12:45
1909209-MS2	Matrix Spike	09/30/19	12:45
C190918-19	IRN-SO-MP01-05	09/30/19	12:45
1909209-MS4	Matrix Spike	09/30/19	12:45
C190918-20	IRN-SO-MP01-06	09/30/19	12:45
C190918-21	IRN-SO-MP02-01	09/30/19	12:45
C190918-22	UNK02-SO-MP01-01	09/30/19	12:45
C190918-23	UNK02-SO-MP01-01	09/30/19	12:45
C190918-24	UNK06-SO-BKG-01	09/30/19	12:45
C190918-25	UNK06-SO-MP01-01	09/30/19	12:45
C190918-26	UNK09-SO-BKG-01	09/30/19	12:45
C190918-27	UNK09-SO-BKG-01	09/30/19	12:45
C190918-28	UNK09-SO-MP01-01	09/30/19	12:45
C190918-29	UNK09-SO-MP01-01	09/30/19	12:45
C190918-30	UNK11-SO-BKG-01	09/30/19	12:45
C190918-31	UNK11-SO-MP01-01	09/30/19	12:45
C190918-32	UNK11-SO-MP01-01	09/30/19	12:45
C190918-33	UNK14-SO-BKG-01	09/30/19	12:45
C190918-34	UNK14-SO-MP01-01	09/30/19	12:45
1910120-ICV1	Initial Cal Check	10/15/19	14:18
1910120-SCV1	Secondary Cal Check	10/15/19	14:18
1910120-ICB1	Initial Cal Blank	10/15/19	14:18
1910120-CRL1	Instrument RL Check	10/15/19	14:18
1910120-IFA1	Interference Check A	10/15/19	14:18
1910120-IFB1	Interference Check B	10/15/19	14:18
1910120-SRD2	Serial Dilution	10/15/19	14:18
1910120-CCV1	Calibration Check	10/15/19	14:18
1910120-CCB1	Calibration Blank	10/15/19	14:18
1910120-CCV2	Calibration Check	10/15/19	14:18
1910120-CCB2	Calibration Blank	10/15/19	14:18
1910120-CCV3	Calibration Check	10/15/19	14:18
1910120-CCB3	Calibration Blank	10/15/19	14:18

US EPA CLP Chain-of-Custody

Sample #	Tag	Location	Sub Location	Sample Type ¹	Collection ²	Matrix ³	Analyses ⁴	Preservation ⁵	Sample Date	Sample Time	Remarks	Sampler
	a	ABR-SO-MP01-01	Auburn Mine	Field Sample	Composite	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	13:17		RM
	b	ABR-SO-MP01-01	Auburn Mine	Field Sample	Composite	Soil	CLP - SPLP Metals	Cool to 4C	9/18/2019	13:17		RM
	a	ABR-SO-MP01-01	Auburn Mine	Field Duplicate	Composite	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	13:17		RM
	b	ABR-SO-MP01-01	Auburn Mine	Field Duplicate	Composite	Soil	CLP - SPLP Metals	Cool to 4C	9/18/2019	13:17		RM
	a	COB-SO-BKG-01	Unknown Mine #15	Field Sample	Composite	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	17:03		KB
	a	UNK11-SO-BKG-01	Unknown Mine #11	Field Sample	Composite	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	11:40		RM
	a	EGM-SO-BKG-01	English Maid Mne	Field Sample	Composite	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	16:10		BB
	a	UNK06-SO-BKG-01	Unknown Mine #6	Field Sample	Composite	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	14:57		MC
	a	UNK06-SO-MP01-01	Unknown Mine #6	Field Sample	Composite	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	14:52		BB
	b	UNK06-SO-MP01-01	Unknown Mine #6	Field Sample	Composite	Soil	CLP - SPLP Metals	Cool to 4C	9/18/2019	14:52		BB
	a	IRN-SO-BKG-01	Irene Mine	Field Sample	Composite	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	12:19		BB
	a	IRN-SO-MP01-06	Irene Mine	Field Sample	Grab	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	12:13		BB
	a	IRN-SO-MP01-05	Irene Mine	Field Sample	Grab	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	12:10		BB
	a	IRN-SO-MP01-04	Irene Mine	Field Sample	Grab	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	12:06		BB
	a	IRN-SO-MP01-03	Irene Mine	Field Sample	Grab	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	12:03		BB
	a	IRN-SO-MP01-02	Irene Mine	Field Sample	Grab	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	11:58		BS
	a	IRN-SO-MP01-01	Irene Mine	Field Sample	Composite	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	11:21		BS
	b	IRN-SO-MP01-01	Irene Mine	Field Sample	Composite	Soil	CLP - SPLP Metals	Cool to 4C	9/18/2019	11:21		BS
	a	IRN-SO-MP01-01	Irene Mine	Field Duplicate	Composite	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	11:21		BS
	b	IRN-SO-MP01-01	Irene Mine	Field Duplicate	Composite	Soil	CLP - SPLP Metals	Cool to 4C	9/18/2019	11:21		BS
	a	IRN-SO-MP02-01	Irene Mine	Field Sample	Composite	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	11:45		BB
	a	UNK14-SO-BKG-01	Unknown Mine #14	Field Sample	Composite	Soil	TRM_Hg_Soil	Cool to 4C	9/19/2019	12:15		BB
	a	UNK14-SO-MP01-01	Unknown Mine #14	Field Sample	Composite	Soil	TRM_Hg_Soil	Cool to 4C	9/19/2019	12:06		BB
	b	UNK14-SO-MP01-01	Unknown Mine #14	Field Sample	Composite	Soil	CLP - SPLP Metals	Cool to 4C	9/19/2019	12:06		BB
	a	ABR-SO-MP01-02	Auburn Mine	Field Sample	Grab	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	15:10		RM
	a	ABR-SO-MP01-03	Auburn Mine	Field Sample	Grab	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	15:16		MAM
	a	ABR-SO-MP01-04	Auburn Mine	Field Sample	Grab	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	15:29		RM
	a	ABR-SO-MP01-05	Auburn Mine	Field Sample	Grab	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	15:24		MAM
	a	ABR-SO-BKG-01	Auburn Mine	Field Sample	Composite	Soil	TRM_Hg_Soil	Cool to 4C	9/18/2019	15:34		MAM

Relinquished by	Date/Time	Received by	Date/Time
M. Carney / <i>[Signature]</i>	9.20.2019 @ 17:55	Johman ESAT	9/20/19 17:55

**US EPA CLP
Chain-of-Custody**

Relinquished by	Date/Time	Received by	Date/Time
M. Carney / <i>[Signature]</i>	9.20.2019 @ 17:55	<i>[Signature]</i> ESKJ	9/20/19 17:55



Sample Receipt Form - TLF-51.03

Project: TRONOX Mining Sites TDF #: A-223
Date Received: 9/20/19 Time Received: 17:55 By: J. Lohman

1	Airbill/shipping documents present?	<u>Drop Off</u>	Yes	No
2	Custody seals on shipping containers present and intact?	<u>None</u>	Yes	No
3	Chain of Custody (COC) present?		<u>Yes</u>	No
4	COC and sample container information agree?		<u>Yes</u>	No
5	Analyses listed on COC conform with analyses listed on TDF?		<u>Yes</u>	No
6	Aqueous samples preserved correctly, if required?	<u>N/A</u>	Yes	No
7	Samples received within holding times for requested analyses?		<u>Yes</u>	No
8	Sufficient sample volume for requested analyses?		<u>Yes</u>	No
9	Sample containers intact and not leaking?		<u>Yes</u>	No
10	Sample containers appropriate for requested analyses?		<u>Yes</u>	No
11	Samples shipped on ice?		<u>Yes</u>	No
12	Cooler temperature(s) ≤ 6.0 °C?	N/A	<u>Yes</u>	No

Thermometer Used: ESAT002 Correction Factor(°C): 0.0

Cooler #: 1 2 3 4 5

Uncorrected Temperature (°C): 1.1 1.4 _____

pH Strip Lot #: HC987803

N/A

Preservation Name and Lot #: _____

N/A

Comments and Additional Information: _____

Client notified of anomalies, if necessary?	N/A	Yes	No
Anomalies noted in case narrative and data qualified, if necessary ?	N/A	Yes	No
Sampler notified of sample receipt?	N/A	Yes	No
Analytical team notified?	N/A	Yes	No

C190918

ESAT Technical Direction Form

Contract No. EPW13028

EPA Region 8

Site ID: 0800
TDF ID: A-223

Date Issued: 9/5/2019
Date Updated:

Date Closed:
Closed By:

Name: USFS Tronox 2019 Analytical Support *Sept.*

Details: The Contractor shall analyze and process several water and soil pre-CERCLA screening samples collected from several areas associated with the Tronox Mining sites. The samples are expected to be collected in mid-September 2019. The water samples (~15) will be analyzed for total recoverable and dissolved metals (including hardness) along with alkalinity, anions, and mercury** (total and dissolved), as indicated in the Analytical Information Section and on the applicable COCs. The soil samples (~20) will be analyzed for total metals and mercury using the same metals analyte list reported for the waters.

Additionally, approximately 5 soil samples will be sent to the CLP for SPLP analysis. The CLP Case number assigned to this project is 48473. The CLP Laboratory Assignment will be provided by SMO or Don Goodrich one to two weeks before the start of the shipping period associated with the CLP Case.

**Note: Dissolved Hg is only required for samples in which Hg was detected in the total analysis.

Site RPM is Jean Wyatt.

TO02/Subtask 02b: Inorganic Chemistry

Analytical Information:

MATRIX

☒ Water ☒ Soils ☐ Vegetation ☐ Biota

WET CHEM

☐ TSS ☐ TDS ☐ DOC ☒ Alk ☒ Chloride ☒ Sulfate ☒ Fluoride ☒ Nitrate ☒ Nitrite
Other Report as combined NO₂-NO₃

METALS

☒ Dissolved ☒ Total Recoverable ☐ Total ☒ Hardness (Calc)

200.7: ☐ Ag ☒ Al ☐ As ☐ Ba ☒ Be ☐ B ☒ Ca ☐ Cd ☐ Co ☐ Cr ☐ Cu ☒ Fe ☒ K ☒ Mg
☒ Mn ☐ Mo ☒ Na ☐ Ni ☐ Pb ☐ Sb ☐ Se ☐ Sr ☐ Ti ☐ Tl ☐ V ☒ Zn ☐ SiO₂
200.8: ☒ Ag ☐ Al ☒ As ☒ Ba ☒ Be ☒ Cd ☒ Co ☒ Cr ☒ Cu ☒ Mn ☒ Mo ☒ Ni ☒ Pb ☒ Sb
☒ Se ☐ Th ☒ Tl ☒ U ☒ V ☒ Zn

7470/7471/7473: ☒ Hg

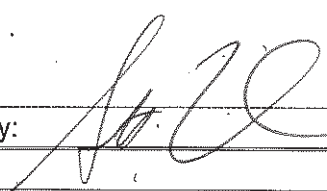

FIBERS

☐ PLM ☐ TBM

Deliverables:

ID	Description	Due Date	Submission Date
1	Provide final deliverable package to Task Monitor no later than 45 days after delivery of final sample(s)		

*Sc
10/03/19*

TLF-07.01	SOP: QAQ-04.00	Eff. Date: 1/17/2007
ESAT Region 8 Final Report Review Form		
LIMS: C190918	Project: Tronox Mining soil Sept 2019	
TDF: A-223	Due Date: 11/04/19	
QA/QC Review – Level III		
Compare TDF to performed analysis / Ensure all analyses are complete	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Review each Analytical Data Review form noting discrepancies for narrative	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Examine each analytical sequence in LIMS using Data Entry Review application	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Generate draft report, print QC section	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Confirm presence of each analytical batch, QC samples	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Examine analytical results (Form I) for accuracy and completeness	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Check spike recoveries of LCSs, matrix spikes and post-digestion spikes	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Verify serial dilution %D and duplicate RPD for each metals batch	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
<i>Narrative Comments</i>		
		
Review By:	Date: 10/21/19	
ESAT Management Review – Level IV		
All analytical data and deliverable review forms present and complete	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
COC copy, received temp. noted, preservatives noted, signature present, holding times met	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Copy of TDF present, Analytical requirements met	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Case narrative checked for spelling, grammar, technical content and completeness	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
10% Validation of raw data to reported data on Form Ones	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Standard Traceability COAs and ICP / ICP-MS MDL forms present	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Final Report cover letter including DCN present	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Deficiencies noted requiring correction before delivery to EPA Project Officer	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
<i>Manager Review Comments</i>		
		
Review By:	Date: 11/6/2019	
Corrections By:	Date:	



TechLaw, Inc.
Environmental Services Assistance Team
16194 W. 45th Drive, Golden, CO 80403
303-312-7721

Contract: EP-W-13-028

Certificates of Analysis

Valid through January 2020

Perkin Elmer Optima ICP-OE

Perkin Elmer DRC IIe ICP-MS

NIPPON NIC MA-3

Perkin Elmer FIMS 100

- Initial Calibration Verification (ICV) Standards
- Laboratory Check Standards (LCS)
- Matrix Spike Solutions
- Interference Check (ICSA / AB) Standards

Certificate of Analysis



ULTRAGrade™ Solution
Aluminum ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-013
Lot Number: CM-1795
Lot Issue Date: 04/13/2015
Expiration Date: 05/31/2022

Starting Material: aluminum nitrate nonahydrate
Starting Material Purity: 99.999%
Starting Material Lot #: RM07806
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Al: 26.98

Certified Value: 1001 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3101a

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

s	Al			*	Ga	<0.005	D	n	Nb			n	S		
*	Sb	<0.005	ND	n	Ge			n	Os			n	Ta		
*	As	<0.005	ND	n	Au			*	Pd	<0.005	ND	n	Te		
*	Ba	<0.005	ND	n	Hf			*	P	<0.005	ND	n	Tb		
*	Be	<0.005	ND	n	Ho			*	Pt	<0.005	ND	n	Ti	<0.005	ND
*	Bi	<0.005	ND	*	In	<0.005	ND	*	K	<0.005	ND	n	Th		
*	B	<0.005	ND	n	Ir			n	Pr			n	Tm		
*	Cd	<0.005	ND	*	Fe	<0.005	D	n	Re			*	Sn	<0.005	ND
*	Ca	<0.005	ND	*	La	<0.005	ND	n	Rh			*	Ti	<0.005	ND
n	Ce			*	Pb	<0.005	ND	n	Rb			n	W		
n	Cs			*	Li	<0.005	ND	n	Ru			n	U	<0.005	ND
*	Cr	<0.005	ND	n	Lu			n	Sm			n	V		
*	Co	<0.005	ND	*	Mg	<0.005	ND	n	Sc			n	Yb		
*	Cu	<0.005	ND	*	Mn	<0.005	ND	*	Se	<0.005	ND	n	Y		
n	Dy			*	Hg	<0.005	ND	*	Si	<0.005	ND	n	Zn	<0.005	ND
*	Er	<0.005	ND	*	Mo	<0.005	ND	*	Ag	<0.005	ND	n	Zr		
*	Eu	<0.005	ND	n	Nd			*	Na	<0.010	D				
*	Gd	<0.005	ND	*	Ni	<0.005	ND	*	Sr	<0.005	ND				

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0150 g/mL



ISO 9001 Registered Quality System - TUV USA


 William J. Leary
 Quality Assurance Manager

Certificate of Analysis



ULTRAGrade™ Solution
Antimony ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-051
Lot Number: CM-3845
Lot Issue Date: 07/17/2015
Expiration Date: 08/31/2022

Starting Material: Antimony Metal
Starting Material Purity: 99.999%
Starting Material Lot #: RM09527
Matrix: 2% nitric acid, with trace tartaric acid in low TOC water (< 50 ppb)
Atomic Weight Sb: 121.87

Certified Value: 1000 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3102a

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al <0.005 ND	* Ga <0.005 ND	* Nb <0.050 ND	n S
* Sb <0.005 ND	* Ge <0.005 ND	* Os <0.050 ND	* Ta <0.010 ND
* As <0.005 D	* Au <0.005 ND	* Pd <0.005 ND	* Te <0.005 ND
* Ba <0.005 ND	* Hf <0.005 ND	n P	* Tb <0.005 ND
* Be <0.005 ND	* Ho <0.005 ND	* Pt <0.005 ND	* Tl <0.005 ND
* Bi <0.005 ND	* In <0.005 ND	* K <0.005 ND	* Th <0.005 ND
* B <0.005 ND	* Ir <0.005 ND	* Pr <0.005 ND	* Tm <0.005 ND
* Cd <0.005 ND	* Fe <0.005 D	* Re <0.005 ND	* Sn <0.005 ND
* Ca <0.005 ND	* La <0.005 ND	* Rh <0.005 ND	* Ti <0.005 ND
* Ce <0.005 ND	* Pb <0.005 D	* Rb <0.005 ND	* W <0.005 ND
* Cs <0.005 ND	* Li <0.005 ND	* Ru <0.005 ND	* U <0.005 ND
* Cr <0.005 ND	* Lu <0.005 ND	* Sm <0.005 ND	* V <0.005 ND
* Co <0.005 ND	* Mg <0.005 ND	* Sc <0.005 ND	* Yb <0.005 ND
* Cu <0.005 D	* Mn <0.005 ND	* Se <0.005 ND	* Y <0.005 ND
* Dy <0.005 ND	* Hg <0.005 ND	* Si <0.500 ND	* Zn <0.005 ND
* Er <0.005 ND	* Mo <0.005 ND	* Ag <0.005 ND	* Zr <0.005 ND
* Eu <0.005 ND	* Nd <0.005 ND	* Na <0.005 D	
* Gd <0.005 ND	* Ni <0.005 D	* Sr <0.005 ND	

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0150 g/mL



ISO 9001 Registered Quality System - TUV USA


 William J. Lee
 Quality Assurance Manager

Certificate of Analysis



ULTRAGrade™ Solution
Barium ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-056
Lot Number: CM-2389
Lot Issue Date: 05/07/2015
Expiration Date: 06/30/2022

Starting Material: barium nitrate
 Starting Material Purity: 99.9995%
 Starting Material Lot #: RM07892
 Matrix: 2% nitric acid in low TOC water (< 50 ppb)
 Atomic Weight Ba: 137.36

Certified Value: 1000 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3104a

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

*	Al	<0.005	ND	*	Ga	<0.005	ND	n	Nb		n	S		
*	Sb	<0.005	ND	n	Ge			n	Os		n	Ta		
*	As	<0.005	ND	n	Au			*	Pd	<0.005	ND	Te		
s	Ba			n	Hf			*	P	<0.005	ND	Tb		
*	Be	<0.005	ND	n	Ho			*	Pt	<0.005	ND	Tl	<0.005	ND
*	Bi	<0.005	ND	*	In	<0.005	ND	*	K	<0.005	ND	Th		
*	B	<0.005	ND	n	Ir			n	Pr			Tm		
*	Cd	<0.005	ND	*	Fe	<0.005	ND	n	Re			Sn	<0.005	ND
*	Ca	<0.005	ND	*	La	<0.005	ND	n	Rh			Ti	<0.005	ND
p	Ce			*	Pb	<0.005	ND	n	Rb			W		
*	Cs			*	Li	<0.005	ND	n	Ru			U		
*	Cr	<0.005	ND	n	Lu			n	Sm			V	<0.005	ND
*	Co	<0.005	ND	*	Mg	<0.005	ND	n	Sc			Yb		
*	Cu	<0.005	ND	*	Mn	<0.005	ND	*	Se	<0.005	ND	Y		
n	Dy			*	Hg	<0.005	ND	*	Si	<0.005	ND	Zn	<0.005	ND
*	Er	<0.005	ND	*	Mo	<0.005	ND	*	Ag	<0.005	ND	Zr		
*	Eu	<0.005	ND	n	Nd			*	Na	<0.005	ND			
*	Gd	<0.005	ND	*	Ni	<0.005	ND	*	Sr	<0.005	D			

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 19.99°C ± 0.05°C): 1.0101 g/mL



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ULTRAGrade™ Solution
Beryllium ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-004
Lot Number: CM-0061
Lot Issue Date: 01/08/2015
Expiration Date: 02/28/2022

Starting Material: Beryllium acetate
Starting Material Purity: 99.999%
Starting Material Lot #: RM07400
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Be: 9.01

Certified Value: 1002 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3105a

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

*	Al	<0.005	ND	*	Ga	<0.005	ND	n	Nb		n	S		
*	Sb	<0.005	ND	n	Ge			n	Os		n	Ta		
*	As	<0.005	ND	n	Au			n	Pd	<0.005	ND	Te		
*	Ba	<0.005	ND	n	Hf			*	P	<0.005	ND	Tb		
s	Be			n	Ho			*	Pt	<0.005	ND	Tl	<0.005	ND
*	Bi	<0.005	ND	*	In	<0.005	ND	*	K	<0.005	ND	Th		
*	B	<0.005	ND	n	Ir			n	Pr			Tm		
*	Cd	<0.005	ND	*	Fe	<0.005	D	n	Re			Sn	<0.005	ND
*	Ca	<0.005	D	*	La	<0.005	ND	n	Rh			Ti	<0.005	ND
n	Ce			*	Pb	<0.005	ND	n	Rb			U		
*	Cs			n	Li	<0.005	ND	n	Ru			V	<0.005	ND
*	Cr	<0.005	ND	n	Lu			n	Sm			Y		
*	Co	<0.005	ND	*	Mg	<0.005	ND	n	Sc			Yb		
*	Cu	<0.005	ND	*	Mn	<0.005	ND	*	Se	<0.005	ND	Zn	<0.005	ND
n	Dy			*	Hg	<0.005	ND	*	Si	<0.005	D	Zr		
*	Er	<0.005	ND	*	Mo	<0.005	ND	*	Ag	<0.005	ND			
*	Eu	<0.005	ND	n	Nd			*	Na	<0.005	ND			
*	Gd	<0.005	ND	*	Ni	<0.005	ND	*	Sr	<0.005	ND			

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0147 g/mL



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ULTRAGrade™ Solution
Cadmium ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-048
Lot Number: CL-2608
Lot Issue Date: 07/09/2014
Expiration Date: 08/31/2021

Starting Material: cadmium nitrate tetrahydrate
 Starting Material Purity: 99.9999%
 Starting Material Lot #: RM07888
 Matrix: 2% nitric acid in low TOC water (< 50 ppb)
 Atomic Weight Cd: 112.4

Certified Value: 1001 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3108

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al <0.005 ND	* Ga <0.005 ND	n Nb	n S
* Sb <0.005 ND	n Ge	n Os	n Ta
* As <0.005 ND	n Au	* Pd <0.005 ND	n Te
* Ba <0.005 ND	n Hf	* P <0.005 ND	n Tb
* Be <0.005 ND	n Ho	* Pt <0.005 ND	n Tl <0.005 ND
* Bi <0.005 ND	* In <0.005 ND	* K <0.005 ND	n Th
* B <0.005 ND	n Ir	n Pr	n Tm
s Cd	* Fe <0.005 ND	n Re	* Sn <0.005 ND
n Ca <0.005 ND	* La <0.005 ND	n Rh	* Ti <0.005 ND
n Ce	* Pb <0.005 ND	n Rb	n W
n Cs	* Li <0.005 ND	n Ru	n U
* Cr <0.005 ND	n Lu	n Sm	* V <0.005 ND
* Co <0.005 ND	* Mg <0.005 ND	n Sc	n Yb
* Cu <0.005 ND	* Mn <0.005 ND	* Se <0.005 ND	n Y
n Dy	* Hg <0.005 ND	* Si <0.005 ND	* Zn <0.005 ND
* Er <0.005 ND	* Mo <0.005 ND	* Ag <0.005 ND	n Zr
* Eu <0.005 ND	n Nd	* Na <0.005 ND	
* Gd <0.005 ND	* Ni <0.005 ND	* Sr <0.005 ND	

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0102 g/mL



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 William J. Leary
 Quality Assurance Manager

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ULTRAGrade™ Solution
Calcium ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-020
Lot Number: CL-3294
Lot Issue Date: 08/19/2014
Expiration Date: 09/30/2021

Starting Material: Calcium carbonate
Starting Material Purity: 99.999%
Starting Material Lot #: RM07809
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Ca: 40.08

Certified Value: 1000 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3109a

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

*	Al	<0.005	ND	*	Ga	<0.005	ND	n	Nb		n	S		
*	Sb	<0.005	ND	n	Ge			n	Os		n	Ta		
*	As	<0.005	ND	n	Au			*	Pd	<0.005	ND	Te		
*	Ba	<0.005	ND	n	Hf			*	P	<0.005	ND	Tb		
*	Be	<0.005	ND	n	Ho			*	Pt	<0.005	ND	Tl	<0.005	ND
*	Bi	<0.005	ND	*	In	<0.005	ND	*	K	<0.005	ND	Th		
*	B	<0.005	ND	n	Ir			*	Pr			Tm		
*	Cd	<0.005	ND	*	Fe	<0.005	ND	n	Re			Sn	<0.005	ND
s	Ca			*	La	<0.005	ND	n	Rh			Ti	<0.005	ND
n	Ce			*	Pb	<0.005	ND	n	Rb			W		
n	Cs			*	Li	<0.005	ND	n	Ru			U		
*	Cr	<0.005	ND	n	Lu			n	Sm			V		
*	Co	<0.005	ND	*	Mg	<0.005	D	n	Sc			Yb		
*	Cu	<0.005	ND	*	Mn	<0.005	ND	*	Se	<0.005	ND	Y		
n	Dy			*	Hg	<0.005	ND	*	Si	<0.005	ND	Zn	<0.005	ND
*	Er	<0.005	ND	*	Mo	<0.005	ND	*	Ag	<0.005	ND	Zr		
*	Eu	<0.005	ND	n	Nd			*	Na	<0.005	D			
*	Gd	<0.005	ND	*	Ni	<0.005	ND	*	Sr	<0.005	D			

* - element checked for
ND - not detected

I - spectral interference
D - detected

n - not checked for
s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0099 g/mL



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William J. Leary
Quality Assurance Manager

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ULTRAgrade™ Solution
Chromium ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-024
Lot Number: R01377
Job Number: J00017468
Lot Issue Date: 12/24/2013
Expiration Date: 01/31/2021

Starting Material: chromium(III) nitrate nonahydrate
Starting Material Purity: 99.996%
Starting Material Lot #: BH01385
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Cr: 52.00

Certified Value: 1000 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3112a

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAgrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al	<0.005	ND	* Ga	<0.005	ND	n Nb		n S	
* Sb	<0.005	ND	n Ge			n Os		n Ta	
* As	<0.005	ND	n Au			* Pd	<0.005	ND	n Te
* Ba	<0.005	ND	n Hf			* P	<0.005	ND	n Tb
* Be	<0.005	ND	n Ho			* Pt	<0.005	ND	* Tl
* Bi	<0.005	ND	* In	<0.005	ND	* K	<0.005	ND	n Th
* B	<0.005	ND	n Ir			n Pr			n Tm
* Cd	<0.005	ND	* Fe	<0.300	D	n Re			* Sn
* Ca	<0.005	D	* La	<0.005	ND	n Rh			* Ti
n Ce			* Pb	<0.005	ND	n Rb			n W
n Cs			* Li	<0.005	ND	n Ru			n U
s Cr			n Lu			n Sm			* V
* Co	<0.005	ND	* Mg	<0.005	ND	n Sc			n Yb
* Cu	<0.005	ND	* Mn	<0.005	ND	* Se	<0.005	ND	n Y
n Dy			* Hg	<0.005	ND	* Si	<0.005	ND	* Zn
* Er	<0.005	ND	* Mo	<0.005	ND	* Ag	<0.005	ND	n Zr
* Eu	<0.005	ND	n Nd			* Na	<0.005	D	
* Gd	<0.005	ND	* Ni	<0.005	ND	* Sr	<0.005	ND	

* - element checked for
ND - not detected

I - spectral interference
D - detected

n - not checked for
s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0124 g/mL



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William J. Leary
Quality Assurance Manager

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ULTRAGrade™ Solution
Cobalt ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-027
Lot Number: T00692
Job Number: J00018405
Lot Issue Date: 06/17/2014
Expiration Date: 07/31/2021

Starting Material: cobalt nitrate hexahydrate
Starting Material Purity: 99.999%
Starting Material Lot #: BH02547
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Co: 58.93

Certified Value: 1001 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3113

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al	<0.005	ND	* Ga	<0.005	ND	n Nb		n S			
* Sb	<0.005	ND	n Ge			n Os		n Ta			
* As	<0.005	ND	n Au			* Pd	<0.005	ND	n Te		
* Ba	<0.005	ND	n Hf			* P	<0.005	ND	n Tb		
* Be	<0.005	ND	n Ho			* Pt	<0.005	ND	n Tl	<0.005	ND
* Bi	<0.005	ND	n In	<0.005	ND	* K	<0.005	ND	n Th		
* B	<0.005	ND	n Ir			n Pr			n Tm		
* Cd	<0.005	ND	* Fe	<0.005	D	n Re			* Sn	<0.005	ND
* Ca	<0.005	ND	* La	<0.005	ND	n Rh			* Ti	<0.005	ND
n Ce			* Pb	<0.005	ND	n Rb			n W		
n Cs			* Li	<0.005	ND	n Ru			n U	<0.005	ND
* Cr	<0.005	ND	n Lu			n Sm			n V		
s Co			* Mg	<0.005	ND	n Sc			n Yb		
* Cu	<0.005	ND	* Mn	<0.005	ND	* Se	<0.005	ND	n Y		
n Dy			* Hg	<0.005	ND	* Si	<0.005	ND	* Zn	<0.005	ND
* Er	<0.005	ND	* Mo	<0.005	ND	* Ag	<0.005	ND	n Zr		
* Eu	<0.005	ND	n Nd			* Na	<0.005	ND			
* Gd	<0.005	ND	* Ni	<0.008	D	* Sr	<0.005	ND			

* - element checked for
 ND - not detected

I - spectral interference
 D - detected


n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0113 g/mL



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 William J. Lear
 Quality Assurance Manager

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ULTRAGrade™ Solution
Copper ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-029
Lot Number: T00620
Job Number: J00018310
Lot Issue Date: 05/28/2014
Expiration Date: 06/30/2021

Starting Material: copper (II) nitrate hydrate
Starting Material Purity: 99.999%
Starting Material Lot #: BH02515
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Cu: 63.54

Certified Value: 1002 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3114

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCCL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

*	Al	<0.005	ND	*	Ga	<0.005	ND	n	Nb		n	S		
*	Sb	<0.005	ND	n	Ge			n	Os		n	Ta		
*	As	<0.005	ND	n	Au			*	Pd	<0.005	ND	Te		
*	Ba	<0.005	ND	n	Hf			*	P	<0.005	ND	Tb		
*	Be	<0.005	ND	n	Ho			*	Pt	<0.005	ND	Tl	<0.005	ND
*	Bi	<0.005	ND	*	In	<0.005	ND	*	K	<0.005	ND	Th		
*	B	<0.005	ND	n	Ir			n	Pr			Tm		
*	Cd	<0.005	ND	*	Fe	<0.005	ND	n	Re			Sn	<0.005	ND
*	Ca	<0.005	ND	*	La	<0.005	ND	n	Rh			Ti	<0.005	ND
n	Ce			*	Pb	<0.005	ND	n	Rb			W		
n	Cs			*	Li	<0.005	ND	n	Ru			U		
*	Cr	<0.005	ND	n	Lu			n	Sm			V	<0.005	ND
*	Co	<0.005	ND	*	Mg	<0.005	ND	n	Sc	<0.005	ND	Yb		
s	Cu			*	Mn	<0.005	ND	*	Se	<0.005	ND	Y		
n	Dy			*	Hg	<0.005	ND	*	Si	<0.005	ND	Zn	<0.005	ND
*	Er	<0.005	ND	*	Mo	<0.005	ND	*	Ag	<0.005	ND	Zr		
*	Eu	<0.005	ND	n	Nd			*	Na	<0.005	ND			
*	Gd	<0.005	ND	*	Ni	<0.005	ND	*	Sr	<0.005	ND			

* - element checked for
 ND - not detected

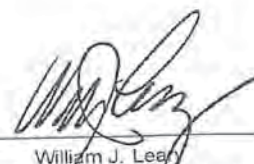
I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0108 g/mL



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 William J. Lean
 Quality Assurance Manager

Certificate of Analysis



ULTRAGrade™ Solution
Gadolinium ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-064
Lot Number: CM-0286
Lot Issue Date: 01/22/2015
Expiration Date: 02/28/2022

Starting Material: gadolinium oxide
 Starting Material Purity: 99.999%
 Starting Material Lot #: RM09365
 Matrix: 1% nitric acid in low TOC water (< 50 ppb)
 Atomic Weight Gd: 157.25

Certified Value: 1000 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3118a

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

*	Al	<0.005	ND	*	Ga	<0.005	ND	n	Nb		n	S		
*	Sb	<0.005	ND	n	Ge			n	Os		n	Ta		
*	As	<0.005	ND	n	Au			*	Pd	<0.005	ND	Te		
*	Ba	<0.005	ND	n	Hf	<0.005	ND	*	P	<0.005	ND	Tb		
*	Be	<0.005	ND	n	Ho			*	Pt	<0.005	ND	Tl	<0.005	ND
*	Bi	<0.005	ND	*	In	<0.005	ND	*	K	<0.005	ND	Th		
*	B	<0.005	ND	n	Ir			n	Pr			Tm		
*	Cd	<0.005	ND	*	Fe	<0.005	ND	n	Re			Sn	<0.005	ND
*	Ca	<0.005	ND	*	La	<0.005	ND	n	Rh			Ti	<0.005	ND
n	Ce			*	Pb	<0.005	ND	n	Rb			W		
n	Cs			*	Li	<0.005	ND	n	Ru			U		
*	Cr	<0.005	ND	n	Lu			n	Sm			V	<0.005	ND
*	Co	<0.005	ND	*	Mg	<0.005	ND	n	Sc			Yb		
*	Cu	<0.005	ND	*	Mn	<0.005	ND	*	Se	<0.005	ND	Y		
n	Dy			*	Hg	<0.005	ND	*	Si	<0.005	ND	Zn	<0.005	ND
*	Er	<0.005	ND	*	Mo	<0.005	ND	*	Ag	<0.005	ND	Zr		
*	Eu	<0.005	ND	n	Nd			*	Na	<0.005	ND			
s	Gd			*	Ni	<0.005	ND	*	Sr	<0.005	ND			

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 19.99°C ± 0.05°C): 1.0068 g/mL



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 Quality Assurance Manager

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ULTRAgrade™ Solution
Iron ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-026
Lot Number: T00694
Job Number: J00018404
Lot Issue Date: 06/17/2014
Expiration Date: 07/31/2021

Starting Material: iron (III) nitrate
Starting Material Purity: 99.9999%
Starting Material Lot #: BH02686
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Fe: 55.85

Certified Value: 1001 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3126a

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAgrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al <0.005 ND	* Ga <0.005 ND	n Nb	n S
* Sb <0.005 ND	n Ge	n Os	n Ta
* As <0.005 ND	n Au	* Pd <0.005 ND	n Te
* Ba <0.005 ND	n Hf	* P <0.005 ND	n Tb
* Be <0.005 ND	n Ho	* Pt <0.005 ND	* Tl <0.005 ND
* Bi <0.005 ND	* In <0.005 ND	* K <0.005 ND	n Th
* B <0.005 ND	n Ir	n Pr	n Tm
* Cd <0.005 ND	s Fe	n Re	* Sn <0.005 ND
* Ca <0.005 D	* La <0.005 ND	n Rh	* Ti <0.005 ND
n Ce	* Pb <0.005 ND	n Rb	n W
n Cs	* Li <0.005 ND	n Ru	n U
* Cr <0.005 ND	n Lu	n Sm	* V <0.005 ND
* Co <0.005 ND	* Mg <0.005 ND	n Sc	n Yb
* Cu <0.005 ND	* Mn <0.005 ND	* Se <0.005 ND	n Y
n Dy	* Hg <0.005 ND	* Si <0.005 ND	* Zn <0.005 ND
* Er <0.005 ND	* Mo <0.005 ND	* Ag <0.005 ND	n Zr
* Eu <0.005 ND	n Nd	* Na <0.005 ND	
* Gd <0.005 ND	n Ni <0.005 ND	* Sr <0.005 ND	

* - element checked for
ND - not detected

I - spectral interference
D - detected

n - not checked for
s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0123 g/mL



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ULTRAgrade™ Solution
Lithium ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-003
Lot Number: CM-3894
Lot Issue Date: 07/17/2015
Expiration Date: 08/31/2022

Starting Material: lithium carbonate
Starting Material Purity: 99.9999%
Starting Material Lot #: RM07634
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Li: 6.94

Certified Value: 1002 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3129a

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAgrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

*	Al	<0.005	ND	*	Ga	<0.005	ND	n	Nb		n	S		
*	Sb	<0.005	ND	n	Ge			n	Os		n	Ta		
*	As	<0.005	ND	n	Au			*	Pd	<0.005	ND	Te		
*	Ba	<0.005	ND	n	Hf			*	P	<0.005	ND	Tb		
*	Be	<0.005	ND	n	Ho			*	Pt	<0.005	ND	Tl	<0.005	ND
*	Bi	<0.005	ND	*	In	<0.005	ND	*	K	<0.005	ND	Th		
*	B	<0.005	ND	n	Ir			n	Pr		n	Tm		
*	Cd	<0.005	ND	*	Fe	<0.005	D	n	Re		*	Sn	<0.005	ND
*	Ca	<0.005	ND	*	La	<0.005	ND	n	Rh		*	Ti	<0.005	ND
	Ce			*	Pb	<0.005	ND	n	Rb		n	W		
	Cs			s	Li			n	Ru		n	U		
	Cr	<0.005	ND	n	Lu			n	Sm		*	V	<0.005	ND
	Co	<0.005	ND	*	Mg	<0.005	ND	n	Sc		n	Yb		
	Cu	<0.005	ND	*	Mn	<0.005	ND	*	Se	<0.005	ND	Y		
	Dy			*	Hg	<0.005	ND	*	Si	<0.005	ND	Zn	<0.005	ND
	Er	<0.005	ND	*	Mo	<0.005	ND	*	Ag	<0.005	ND	Zr		
	Eu	<0.005	ND	n	Nd			*	Na	<0.005	ND			
	Gd	<0.005	ND	*	Ni	<0.005	ND	*	Sr	<0.005	ND			

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0097 g/mL




 William J. Leary
 Quality Assurance Manager

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ULTRAGrade™ Solution
Magnesium ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-012
Lot Number: CM-1228
Lot Issue Date: 03/24/2015
Expiration Date: 04/30/2022

Starting Material: magnesium nitrate hexahydrate
 Starting Material Purity: 99.999%
 Starting Material Lot #: RM07690
 Matrix: 2% nitric acid in low TOC water (< 50 ppb)
 Atomic Weight Mg: 24.31

Certified Value: 1001 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3131a

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al <0.005 ND	* Ga <0.005 ND	n Nb	n S
* Sb <0.005 ND	n Ge	n Os	n Ta
* As <0.005 ND	n Au	* Pd <0.005 ND	n Te
* Ba <0.005 ND	n Hf	* P <0.005 ND	n Tb
* Be <0.005 ND	n Ho	* Pt <0.005 ND	* Tl <0.005 ND
* Bi <0.005 ND	* In <0.005 ND	* K <0.005 ND	n Th
* B <0.005 ND	n Ir	n Pr	n Tm
* Cd <0.005 ND	* Fe <0.005 D	n Re	* Sn <0.005 ND
* Ca <0.005 D	* La <0.005 ND	n Rh	* Ti <0.005 ND
n Ce	* Pb <0.005 ND	n Rb	n W
n Cs	* Li <0.005 ND	n Ru	n U
* Cr <0.005 ND	n Lu	n Sm	* V <0.005 ND
* Co <0.005 ND	s Mg	n Sc	n Yb
* Cu <0.005 ND	* Mn <0.005 ND	* Se <0.005 ND	n Y
n Dy	* Hg <0.005 ND	* Si <0.005 ND	* Zn <0.005 ND
* Er <0.005 ND	* Mo <0.005 ND	* Ag <0.005 ND	n Zr
* Eu <0.005 ND	n Nd	* Na <0.005 ND	
* Gd <0.005 ND	* Ni <0.005 ND	* Sr <0.005 ND	

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0131 g/mL



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 Quality Assurance Manager

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ULTRAgrade™ Solution
Manganese ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-025
Lot Number: CL-3978
Lot Issue Date: 10/07/2014
Expiration Date: 11/30/2021

Starting Material: manganese nitrate tetrahydrate
Starting Material Purity: 99.999%
Starting Material Lot #: RM09480
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Mn: 54.94

Certified Value: 1001 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3132

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAgrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al <0.005 D	* Ga <0.005 ND	n Nb	n S
* Sb <0.005 ND	n Ge	n Os	n Ta
* As <0.005 ND	n Au	* Pd <0.005 ND	n Te
* Ba <0.005 ND	n Hf	* P <0.005 ND	n Tb
* Be <0.005 ND	n Ho	* Pt <0.005 ND	* Tl <0.005 ND
* Bi <0.005 ND	* In <0.005 ND	* K <0.005 ND	n Th
* B <0.005 ND	n Ir	n Pr	n Tm
* Cd <0.005 ND	* Fe <0.005 D	n Re	* Sn <0.005 ND
* Ca <0.005 D	* La <0.005 ND	n Rh	* Ti <0.005 ND
p Ce	* Pb <0.005 ND	n Rb	n W
p Cs	* Li <0.005 ND	n Ru	n U
* Cr <0.005 ND	n Lu	n Sm	* V <0.005 ND
* Co <0.005 ND	* Mg <0.005 D	n Sc	n Yb
* Cu <0.005 ND	s Mn	* Se <0.005 ND	n Y
p Dy	* Hg <0.005 ND	* Si <0.005 ND	* Zn <0.005 ND
* Er <0.005 ND	* Mo <0.005 ND	* Ag <0.005 ND	n Zr
* Eu <0.005 ND	n Nd	* Na <0.005 ND	
* Gd <0.005 ND	* Ni <0.005 ND	* Sr <0.005 ND	

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0112 g/mL



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ULTRAGrade™ Solution
Mercury ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-080
Lot Number: T00602
Job Number: J00018291
Lot Issue Date: 05/23/2014
Expiration Date: 06/30/2021

Starting Material: mercuric nitrate (*light sensitive*)
Starting Material Purity: 99.999%
Starting Material Lot #: NT00079
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Hg: 200.61

Certified Value: 1001 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3133

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

*	Al	<0.005	ND	*	Ga	<0.005	ND	n	Nb		n	S		
*	Sb	<0.005	ND	n	Ge			n	Os		n	Ta		
*	As	<0.005	ND	n	Au			*	Pd	<0.005	ND	Te		
*	Ba	<0.005	ND	n	Hf			*	P	<0.005	ND	Tb		
*	Be	<0.005	ND	n	Ho			*	Pt	<0.005	ND	Tl	<0.005	ND
*	Bi	<0.005	ND	*	In	<0.005	ND	*	K	<0.005	ND	Th		
*	B	<0.005	ND	n	Ir			n	Pr		n	Tm		
*	Cd	<0.005	ND	*	Fe	<0.005	ND	n	Re		*	Sn	<0.005	ND
*	Ca	<0.005	ND	*	La	<0.005	ND	n	Rh		*	Ti	<0.005	ND
	Ce			*	Pb	<0.005	ND	n	Rb		n	W		
	Cs			n	Li	<0.005	ND	n	Ru		n	U		
	Cr	<0.005	ND	n	Lu			n	Sm		*	V	<0.005	ND
	Co	<0.005	ND	*	Mg	<0.005	ND	n	Sc		n	Yb		
	Cu	<0.005	ND	*	Mn	<0.005	ND	*	Se	<0.005	ND	Y		
	Dy			s	Hg			*	Si	<0.005	ND	Zn	<0.005	ND
	Er	<0.005	ND	*	Mo	<0.005	ND	*	Ag	<0.005	ND	Zr		
	Eu	<0.005	ND	n	Nd			*	Na	<0.005	ND			
	Gd	<0.005	ND	*	Ni	<0.005	D	*	Sr	<0.005	ND			

* - element checked for
 ND - not detected

I - spectral interference
 D - detected


n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0100 g/mL



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ULTRAGrade™ Solution
Molybdenum ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-042
Lot Number: CL-4904
Lot Issue Date: 12/04/2014
Expiration Date: 01/31/2022

Starting Material: molybdenum (VI) oxide
Starting Material Purity: 99.998%
Starting Material Lot #: RM07695
Matrix: 2% ammonium hydroxide in low TOC water (< 50 ppb)
Atomic Weight Mo: 95.94

Certified Value: 1001 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3134

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al	<0.005	ND	* Ga	<0.005	ND	n Nb		n S	
* Sb	<0.005	ND	n Ge			n Os		n Ta	
* As	<0.005	ND	n Au			* Pd	<0.005	n Te	
* Ba	<0.005	ND	* Hf	<0.005	ND	* P	<0.005	n Tb	
* Be	<0.005	ND	n Ho			* Pt	<0.005	n Tl	<0.005 ND
* Bi	<0.005	ND	* In	<0.005	ND	* K	<0.005	n Th	
* B	<0.005	ND	n Ir			n Pr		n Tm	
* Cd	<0.005	ND	* Fe	<0.005	ND	n Re		* Sn	<0.005 ND
* Ca	<0.005	ND	* La	<0.005	ND	n Rh		* Ti	<0.005 ND
n Ce			* Pb	<0.005	ND	n Rb		n W	
n Cs			* Li	<0.005	ND	n Ru		n U	
* Cr	<0.005	ND	n Lu			n Sm		* V	<0.005 ND
* Co	<0.005	ND	* Mg	<0.005	ND	n Sc		n Yb	
* Cu	<0.005	ND	* Mn	<0.005	ND	* Se	<0.005	n Y	
n Dy			* Hg	<0.005	ND	* Si	<0.005	* Zn	<0.005 D
* Er	<0.005	ND	s Mo			* Ag	<0.005	* Zr	<0.005 ND
* Eu	<0.005	ND	n Nd			* Na	<0.005		
* Gd	<0.005	ND	* Ni	<0.005	ND	* Sr	<0.005		

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 0.9980 g/mL



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 Quality Assurance Manager

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ULTRAGrade™ Solution
Nickel ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-028
Lot Number: CL-4110
Lot Issue Date: 10/16/2014
Expiration Date: 11/30/2021

Starting Material: nickel nitrate hexahydrate
 Starting Material Purity: 99.999%
 Starting Material Lot #: RM07862
 Matrix: 2% nitric acid in low TOC water (< 50 ppb)
 Atomic Weight Ni: 58.69

Certified Value: 1001 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3136

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al	<0.005	ND	* Ga	<0.005	ND	n Nb		n S	
* Sb	<0.005	ND	n Ge			n Os		n Ta	
* As	<0.005	ND	n Au			* Pd	<0.005	ND	Te
* Ba	<0.005	ND	n Hf			* P	<0.005	ND	Tb
* Be	<0.005	ND	n Ho			* Pt	<0.005	ND	TI
* Bi	<0.005	ND	n In	<0.005	ND	* K	<0.005	ND	Th
* B	<0.005	ND	n Ir			n Pr			Tm
* Cd	<0.005	ND	* Fe	<0.005	D	n Re			* Sn
* Ca	<0.005	ND	* La	<0.005	ND	n Rh			* Ti
n Ce			* Pb	<0.005	ND	n Rb			W
n Cs			* Li	<0.005	ND	n Ru			U
* Cr	<0.005	ND	n Lu			n Sm			* V
* Co	<0.005	ND	* Mg	<0.005	ND	n Sc			n Yb
* Cu	<0.005	ND	* Mn	<0.005	ND	* Se	<0.005	ND	n Y
n Dy			* Hg	<0.005	ND	* Si	<0.005	ND	* Zn
* Er	<0.005	ND	* Mo	<0.005	ND	* Ag	<0.005	ND	n Zr
* Eu	<0.005	ND	n Nd			* Na	<0.005	ND	
* Gd	<0.005	ND	s Ni			* Sr	<0.005	ND	

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0112 g/mL



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 William J. Leary
 Quality Assurance Manager

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ULTRAGrade™ Solution
Potassium ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-019
Lot Number: CL-4332
Lot Issue Date: 10/28/2014
Expiration Date: 11/30/2021

Starting Material: potassium nitrate
Starting Material Purity: 99.999%
Starting Material Lot #: RM07425
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight K: 39.10

Certified Value: 1002 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3141a

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al <0.005 ND	* Ga <0.005 ND	n Nb	n S
* Sb <0.005 ND	n Ge	n Os	n Ta
* As <0.005 ND	n Au	* Pd <0.005 ND	n Te
* Ba <0.005 ND	n Hf	* P <0.005 ND	n Tb
* Be <0.005 ND	n Ho	* Pt <0.005 ND	* Tl <0.005 ND
* Bi <0.005 ND	* In <0.005 ND	s K	n Th
* B <0.005 ND	n Ir	n Pr	n Tm
* Cd <0.005 ND	* Fe <0.005 D	n Re	* Sn <0.005 ND
* Ca <0.005 D	* La <0.005 ND	n Rh	* Ti <0.005 ND
n Ce	* Pb <0.005 ND	n Rb	n W
n Cs	* Li <0.005 ND	n Ru	n U
* Cr <0.005 ND	n Lu	n Sm	n V
* Co <0.005 ND	* Mg <0.005 ND	n Sc	n Yb
* Cu <0.005 ND	* Mn <0.005 ND	* Se <0.005 ND	n Y
n Dy	* Hg <0.005 ND	* Si <0.005 ND	* Zn <0.005 ND
* Er <0.005 ND	* Mo <0.005 ND	* Ag <0.005 ND	n Zr
* Eu <0.005 ND	n Nd	* Na <0.005 D	
* Gd <0.005 ND	* Ni <0.005 ND	* Sr <0.005 ND	

* - element checked for
ND - not detected

I - spectral interference
D - detected

n - not checked for
s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0101 g/mL



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William J. Lean
Quality Assurance Manager

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ULTRAgrade™ Solution
Selenium ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-034
Lot Number: CM-4087
Lot Issue Date: 07/30/2015
Expiration Date: 08/31/2022

Starting Material: selenium dioxide
Starting Material Purity: 99.999%
Starting Material Lot #: RM10651
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Se: 78.96

Certified Value: 1001 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3149

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAgrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCCL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al	<0.005	ND	* Ga	<0.005	ND	n Nb		n S
* Sb	<0.005	ND	n Ge			n Os		n Ta
* As	<0.005	ND	n Au			* Pd	<0.005	ND
* Ba	<0.005	D	n Hf			* P	<0.005	ND
* Be	<0.005	ND	n Ho			* Pt	<0.005	ND
* Bi	<0.005	ND	* In	<0.005	ND	* K	<0.005	ND
* B	<0.005	D	n Ir			n Pr		n Th
* Cd	<0.005	ND	* Fe	<0.005	D	n Re		n Tm
* Ca	<0.005	D	n La	<0.005	ND	n Rh		* Sn
n Ce			* Pb	<0.005	ND	n Rb		* Ti
n Cs			* Li	<0.005	ND	n Ru		n W
* Cr	<0.005	D	n Lu			n Sm		n U
* Co	<0.005	ND	* Mg	<0.005	ND	n Sc		* V
* Cu	<0.005	ND	* Mn	<0.005	ND	s Se		n Yb
n Dy			* Hg	<0.005	ND	* Si	<0.005	ND
* Er	<0.005	ND	* Mo	<0.005	ND	* Ag	<0.005	ND
* Eu	<0.005	ND	n Nd			* Na	<0.005	D
* Gd	<0.005	ND	* Ni	<0.005	D	* Sr	<0.005	ND
								n Zn
								n Zr

* - element checked for
ND - not detected

I - spectral interference
D - detected

n - not checked for
s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0098 g/mL



ISO 9001 Registered Quality System - TUV USA


William J. Leary
Quality Assurance Manager

Certificate of Analysis



ULTRAGrade™ Solution
Silicon ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-014
Lot Number: T00477
Job Number: J00018110
Lot Issue Date: 04/24/2014
Expiration Date: 05/31/2021

Starting Material: ammonium hexafluorosilicate
Starting Material Purity: 99.999%
Starting Material Lot #: BH01549
Matrix: 2% nitric acid, with trace HF, in low TOC water (< 50 ppb)
Atomic Weight Si: 28.09

Certified Value: 1000 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3150

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

*	Al	<0.005	ND	*	Ga	<0.005	ND	n	Nb		n	S			
*	Sb	<0.005	ND	n	Ge			n	Os		n	Ta			
*	As	<0.005	ND	n	Au			*	Pd	<0.005	ND	n	Te		
*	Ba	<0.005	ND	n	Hf			*	P	<0.005	ND	n	Tb		
*	Be	<0.005	ND	n	Ho			*	Pt	<0.005	ND	*	Tl	<0.005	ND
*	Bi	<0.005	ND	*	In	<0.005	ND	*	K	<0.005	ND	n	Th		
*	B	<0.005	ND	n	Ir			n	Pr			n	Tm		
*	Cd	<0.005	ND	*	Fe	<0.005	ND	n	Re			*	Sn	<0.005	ND
*	Ca	<0.005	ND	*	La	<0.005	ND	n	Rh			*	Ti	<0.005	ND
n	Ce			*	Pb	<0.005	ND	n	Rb			n	W		
n	Cs			*	Li	<0.005	ND	n	Ru			n	U		
*	Cr	<0.005	ND	n	Lu			n	Sm			*	V	<0.005	ND
*	Co	<0.005	ND	*	Mg	<0.005	ND	n	Sc			n	Yb		
*	Cu	<0.005	ND	*	Mn	<0.005	ND	*	Se	<0.005	ND	n	Y		
n	Dy			*	Hg	<0.005	ND	s	Si			*	Zn	<0.005	ND
*	Er	<0.005	ND	*	Mo	<0.005	ND	*	Ag	<0.005	ND	n	Zr		
*	Eu	<0.005	ND	n	Nd			*	Na	<0.005	ND				
*	Gd	<0.005	ND	*	Ni	<0.005	ND	*	Sr	<0.005	ND				

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0122 g/mL



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 Quality Assurance Manager

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ULTRAgrade™ Solution
Silver ICP Standard
1000 µg/mL

Catalog Number: ICP-047
Lot Number: CM-1594
Lot Issue Date: 04/06/2015
Expiration Date: 05/31/2022

Starting Material: Silver Nitrate (* light sensitive)
Starting Material Purity: 99.9999%
Starting Material Lot No.: RM07883
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Ag: 107.88

Certified Value: 1002 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentrations were verified by our ISO 17025 accredited laboratory to be within ± 2.5%, when compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP-MS) vs. NIST SRM 3151

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware and clean bottles in the manufacture of ULTRAgrade standards. Balances used in the manufacture of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al <0.005 ND	* Ga <0.005 ND	n Nb	* S <0.005 ND
* Sb <0.005 ND	n Ge	n Os	n Ta
* As <0.005 ND	n Au	* Pd <0.005 ND	n Te
* Ba <0.005 ND	n Hf	* P <0.005 ND	n Tb
* Be <0.005 ND	n Ho	* Pt <0.005 ND	* Tl <0.005 ND
* Bi <0.005 ND	* In <0.005 ND	* K <0.005 ND	n Th
* B <0.005 ND	n Ir	n Pr	n Tm
* Cd <0.005 ND	* Fe <0.005 ND	n Re	* Sn <0.005 ND
* Ca <0.005 ND	* La <0.005 ND	n Rh	* Ti <0.005 ND
n Ce	* Pb <0.005 ND	n Rb	n W
n Cs	* Li <0.005 ND	n Ru	n U
* Cr <0.005 ND	n Lu	n Sm	* V <0.005 ND
* Co <0.005 ND	* Mg <0.005 ND	n Sc	n Yb
* Cu <0.005 ND	* Mn <0.005 ND	* Se <0.005 ND	n Y
n Dy	* Hg <0.005 ND	* Si <0.005 ND	* Zn <0.005 ND
* Er <0.005 ND	* Mo <0.005 ND	s Ag <0.005 ND	n Zr
* Eu <0.005 ND	n Nd	* Na <0.005 ND	
* Gd <0.005 ND	* Ni <0.005 ND	* Sr <0.005 ND	

* - element checked for
 ND - not detected

i - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0103 g/mL



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 William J. Lea
 Quality Assurance Manager

Certificate of Analysis



ULTRAgrade™ Solution
Sodium ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-011
Lot Number: R01359
Job Number: J00017410
Lot Issue Date: 12/19/2013
Expiration Date: 01/31/2021

Starting Material: sodium nitrate
Starting Material Purity: 99.999%
Starting Material Lot #: BH02507
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Na: 22.99

Certified Value: 1001 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3152a
ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAgrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al	<0.005	ND	* Ga	<0.005	ND	n Nb		n S
* Sb	<0.005	ND	n Ge			n Os		n Ta
* As	<0.005	ND	n Au			* Pd	<0.005	ND
* Ba	<0.005	ND	n Hf			* P	<0.005	ND
* Be	<0.005	ND	n Ho			* Pt	<0.005	ND
* Bi	<0.005	ND	n In	<0.005	ND	* K	<0.005	D
* B	<0.005	ND	n Ir			n Pr		
* Cd	<0.005	ND	* Fe	<0.005	ND	n Re		
* Ca	<0.005	D	* La	<0.005	ND	n Rh		
n Ce			* Pb	<0.005	ND	n Rb		
n Cs			* Li	<0.005	ND	n Ru		
* Cr	<0.005	ND	n Lu			n Sm		
* Co	<0.005	ND	* Mg	<0.005	ND	n Sc		
* Cu	<0.005	ND	* Mn	<0.005	ND	* Se	<0.005	ND
n Dy			* Hg	<0.005	ND	* Si	<0.005	ND
* Er	<0.005	ND	* Mo	<0.005	ND	* Ag	<0.005	ND
* Eu	<0.005	ND	n Nd			s Na		
* Gd	<0.005	ND	* Ni	<0.005	ND	* Sr	<0.005	ND
								n Zr
								n Yb
								n Tm
								n Th
								n Ti
								n Sn
								n Sb
								n Te
								n Ta
								n S

* - element checked for
ND - not detected

I - spectral interference
D - detected

n - not checked for
s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0111 g/mL



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Quality Assurance Manager

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ULTRAGrade™ Solution
Thallium ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-081
Lot Number: CM-1100
Lot Issue Date: 03/13/2015
Expiration Date: 04/30/2022

Starting Material: thallium (I) nitrate
Starting Material Purity: 99.999%
Starting Material Lot #: RM07900
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Tl: 204.4

Certified Value: 1002 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3158

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al <0.005 ND	* Ga <0.005 ND	n Nb	n S
* Sb <0.005 ND	n Ge	n Os	n Ta
* As <0.005 ND	n Au	* Pd <0.005 ND	n Te
* Ba <0.005 ND	n Hf	* P <0.005 ND	n Tb
* Be <0.005 ND	n Ho	* Pt <0.005 ND	s Tl
* Bi <0.005 ND	* In <0.005 ND	* K <0.005 ND	n Th
* B <0.005 ND	n Ir	n Pr	n Tm
* Cd <0.005 ND	* Fe <0.005 ND	n Re	* Sn <0.005 ND
* Ca <0.005 ND	* La <0.005 ND	n Rh	* Ti <0.005 ND
n Ce	* Pb <0.005 D	n Rb	n W
n Cs	* Li <0.005 ND	n Ru	n U
* Cr <0.005 ND	n Lu	n Sm	* V <0.005 ND
* Co <0.005 ND	* Mg <0.005 ND	n Sc	n Yb
* Cu <0.005 ND	* Mn <0.005 ND	* Se <0.005 ND	n Y
n Dy	* Hg <0.005 ND	* Si <0.005 ND	* Zn <0.005 ND
* Er <0.005 ND	* Mo <0.005 ND	* Ag <0.005 ND	n Zr
* Eu <0.005 ND	n Nd	* Na <0.005 ND	
* Gd <0.005 ND	* Ni <0.005 ND	* Sr <0.005 ND	

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 19.99°C ± 0.05°C): 1.0101 g/mL



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ULTRAGrade™ Solution
Tin ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-050
Lot Number: T00338
Job Number: J00017859
Lot Issue Date: 03/26/2014
Expiration Date: 04/30/2021

Starting Material: ammonium hexafluorostannate
Starting Material Purity: 99.999%
Starting Material Lot #: BH02860
Matrix: 2% nitric acid, with trace hydrofluoric acid, in low TOC water (< 50 ppb)
Atomic Weight Sn: 118.70

Certified Value: 1001 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3161a

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

*	Al	<0.005	ND	*	Ga	<0.005	ND	n	Nb		n	S			
*	Sb	<0.005	ND	n	Ge			n	Os		n	Ta			
*	As	<0.005	ND	n	Au			*	Pd	<0.005	ND	n	Te		
*	Ba	<0.005	ND	n	Hf			*	P	<0.005	ND	n	Tb		
*	Be	<0.005	ND	n	Ho			*	Pt	<0.005	ND	n	Tl	<0.005	ND
*	Bi	<0.005	ND	*	In	<0.005	ND	*	K	<0.005	ND	n	Th		
*	B	<0.005	ND	n	Ir			n	Pr			n	Tm		
*	Cd	<0.005	ND	*	Fe	<0.005	ND	n	Re			s	Sn		
*	Ca	<0.005	ND	*	La	<0.005	ND	n	Rh			*	Ti	<0.005	ND
n	Ce			*	Pb	<0.005	ND	n	Rb			n	W		
n	Cs			*	Li	<0.005	ND	n	Ru			n	U		
*	Cr	<0.005	ND	n	Lu			n	Sm			*	V	<0.005	ND
*	Co	<0.005	ND	*	Mg	<0.005	ND	n	Sc			n	Yb		
*	Cu	<0.005	ND	*	Mn	<0.005	ND	*	Se	<0.005	ND	n	Y		
n	Dy			*	Hg	<0.005	ND	*	Si	<0.005	ND	*	Zn	<0.005	ND
*	Er	<0.005	ND	*	Mo	<0.005	ND	*	Ag	<0.005	ND	n	Zr		
*	Eu	<0.005	ND	n	Nd			*	Na	<0.005	ND				
*	Gd	<0.005	ND	*	Ni	<0.005	D	*	Sr	<0.005	ND				

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0102 g/mL



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ULTRAGrade™ Solution
Titanium ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-022
Lot Number: T00684
Job Number: J00018395
Lot Issue Date: 06/09/2014
Expiration Date: 07/31/2021

Starting Material: ammonium hexafluorotitanate (IV)
Starting Material Purity: 99.998%
Starting Material Lot #: BH01796
Matrix: 2% nitric acid, with trace hydrofluoric acid, in low TOC water (< 50 ppb)
Atomic Weight Ti: 47.90

Certified Value: 1002 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3162a

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al	<0.005	ND	* Ga	<0.005	ND	n Nb		n S
* Sb	<0.005	ND	n Ge			n Os		n Ta
* As	<0.005	ND	n Au			* Pd	<0.005	n Te
* Ba	<0.005	ND	n Hf			* P	<0.005	n Tb
* Be	<0.005	ND	n Ho			* Pt	<0.005	* Tl
* Bi	<0.005	ND	* In	<0.005	ND	* K	<0.005	n Th
* B	<0.005	ND	n Ir			n Pr		n Tm
* Cd	<0.005	ND	* Fe	<0.005	ND	n Re		* Sn
* Ca	<0.005	ND	* La	<0.005	ND	n Rh		n Ti
n Ce			* Pb	<0.005	ND	n Rb		n W
n Cs			* Li	<0.005	ND	n Ru		n U
* Cr	<0.005	ND	n Lu			n Sm		* V
* Co	<0.005	ND	* Mg	<0.005	ND	n Sc		n Yb
* Cu	<0.005	ND	* Mn	<0.005	ND	* Se	<0.005	n Y
n Dy			* Hg	<0.005	ND	* Si	<0.005	n Zn
* Er	<0.005	ND	* Mo	<0.005	D	* Ag	<0.005	n Zr
* Eu	<0.005	ND	n Nd			* Na	<0.005	
* Gd	<0.005	ND	* Ni	<0.005	ND	* Sr	<0.005	

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0113 g/mL



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 William J. Leary
 Quality Assurance Manager

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ULTRAGrade™ Solution
Uranium ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-092
Lot Number: CL-4911
Lot Issue Date: 12/09/2014
Expiration Date: 01/31/2022

Starting Material: Uranium dioxide
Starting Material Purity: 99.99%
Starting Material Lot #: RM09728
Matrix: 4% nitric acid in low TOC water (< 50 ppb)
Atomic Weight U: 238.0

Certified Value: 1000 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. second source

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al <0.005 ND	* Ga <0.005 ND	n Nb	n S
* Sb <0.005 ND	n Ge	n Os	n Ta
* As <0.005 ND	n Au	* Pd <0.005 ND	n Te
* Ba <0.005 ND	n Hf	* P <0.005 ND	n Tb
* Be <0.005 ND	n Ho	* Pt <0.005 ND	* Tl <0.005 ND
* Bi <0.005 ND	* In <0.005 ND	* K <0.005 ND	n Th
* B <0.005 ND	n Ir	n Pr	n Tm
* Cd <0.005 ND	* Fe <0.005 ND	n Re	* Sn <0.005 ND
* Ca <0.005 ND	* La <0.005 ND	n Rh	* Ti <0.005 ND
n Ce	* Pb <0.005 ND	n Rb	n W
n Cs	* Li <0.005 ND	n Ru	s U
* Cr <0.005 ND	n Lu	n Sm	n V
* Co <0.005 ND	* Mg <0.005 ND	n Sc	n Yb
* Cu <0.005 ND	* Mn <0.005 ND	* Se <0.005 ND	n Y
n Dy	* Hg <0.005 ND	* Si <0.005 ND	* Zn <0.005 ND
* Er <0.005 ND	* Mo <0.005 ND	* Ag <0.005 ND	n Zr
* Eu <0.005 ND	n Nd	* Na <0.005 ND	
* Gd <0.005 ND	* Ni <0.030 D	* Sr <0.005 ND	

* - element checked for
 ND - not detected

I - spectral interference
 D - detected


n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0220 g/mL



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 Quality Assurance Manager

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ULTRAgrade™ Solution
Vanadium ICP / ICP-MS Standard
1000 µg/mL

Catalog Number: ICP-023
Lot Number: CM-5443
Lot Issue Date: 10/21/2015
Expiration Date: 11/30/2022

Starting Material: ammonium metavanadate (* *light sensitive*)
Starting Material Purity: 99.999%
Starting Material Lot #: RM07842
Matrix: 5% nitric acid, 1% hydrofluoric acid in low TOC water (< 50 ppb)
Atomic Weight V: 50.94

Certified Value: 1001 ± 2 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3165

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAgrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al <0.005 ND	* Ga <0.005 ND	n Nb	n S
* Sb <0.005 ND	* Ge <0.005 ND	n Os	n Ta
* As <0.005 ND	n Au	* Pd <0.005 ND	n Te
* Ba <0.005 D	n Hf	* P <0.005 ND	n Tb
* Be <0.005 ND	n Ho	* Pt <0.005 ND	* Tl <0.005 ND
* Bi <0.005 ND	* In <0.005 ND	* K <0.005 ND	n Th
* B <0.005 ND	n Ir	n Pr	n Tm
* Cd <0.005 ND	* Fe <0.005 ND	* Re <0.005 ND	* Sn <0.005 D
* Ca <0.005 ND	* La <0.005 ND	n Rh	* Ti <0.005 ND
n Ce	* Pb <0.005 ND	n Rb	n W
n Cs	* Li <0.005 ND	n Ru	n U
* Cr <0.005 D	n Lu	n Sm	s V
* Co <0.005 ND	* Mg <0.005 ND	n Sc	n Yb
* Cu <0.005 ND	* Mn <0.005 ND	* Se <0.005 ND	n Y
n Dy	* Hg <0.005 ND	* Si <0.005 ND	* Zn <0.005 ND
* Er <0.005 ND	* Mo <0.005 ND	* Ag <0.005 ND	n Zr
* Eu <0.005 ND	n Nd	* Na <0.005 D	
* Gd <0.005 ND	* Ni <0.005 ND	* Sr <0.005 ND	

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 19.99°C ± 0.05°C): 1.0280 g/mL

Certificate of Analysis



ULTRAGrade™ Solution
Aluminum ICP / ICP-MS Standard
10000 µg/mL

Catalog Number: ICP-113
Lot Number: CM-1334
Lot Issue Date: 03/23/2015
Expiration Date: 04/30/2022

Starting Material: aluminum nitrate nonahydrate
Starting Material Purity: 99.999%
Starting Material Lot #: RM07806
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Al: 26.98

Certified Value: 10013 ± 20 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3101a

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

s	Al		*	Ga	<0.005	D	n	Nb		n	S
*	Sb	<0.005	ND	n	Ge		n	Os		n	Ta
*	As	<0.005	ND	n	Au		*	Pd	<0.005	ND	Te
*	Ba	<0.005	ND	n	Hf		*	P	<0.005	ND	Tb
*	Be	<0.005	ND	n	Ho		*	Pt	<0.005	ND	Tl
*	Bi	<0.005	ND	*	In	<0.005	ND	*	K	<0.005	ND
*	B	<0.005	ND	n	Ir		n	Pr		n	Th
*	Cd	<0.005	ND	*	Fe	<0.005	D	n	Re		Tm
*	Ca	<0.005	ND	*	La	<0.005	ND	n	Rh		Sn
p	Ce			*	Pb	<0.005	ND	n	Rb		Ti
p	Cs			*	Li	<0.005	ND	n	Ru		W
*	Cr	<0.005	ND	n	Lu		n	Sm		n	U
*	Co	<0.005	ND	*	Mg	<0.005	ND	n	Sc		V
*	Cu	<0.005	ND	*	Mn	<0.005	ND	*	Se	<0.005	ND
p	Dy			*	Hg	<0.005	ND	*	Si	<0.005	ND
*	Er	<0.005	ND	*	Mo	<0.005	ND	*	Ag	<0.005	ND
*	Eu	<0.005	ND	n	Nd		n	*	Na	<0.005	D
*	Gd	<0.005	ND	*	Ni	<0.005	ND	*	Sr	<0.005	ND
										n	Zr

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0682 g/mL



ISO 17025:2005
 Accredited
 A2LA
 Cert. No. 0851.D1

ISO 9001:2000
 Registered
 TUV USA, Inc.
 Cert. No. 06-1004


 William J. Lean
 Quality Assurance Manager

Certificate of Analysis

CALCIUM ICP STANDARD

0009897

Received
6/3/14



ULTRAGrade™ Solution
Calcium ICP Standard
10000 µg/mL

Catalog Number: ICP-120
Lot Number: T00315
Job Number: J00017905
Lot Issue Date: 03/24/2014
Expiration Date: 04/30/2021

Starting Material: calcium carbonate
Starting Material Purity: 99.999%
Starting Material Lot No.: BH02733
Matrix: 5% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Ca: 40.08

Certified Value: 10013 ± 20 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP-MS) vs. NIST SRM 3109a
ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

*	Al	<0.005	ND	*	Ga	<0.005	ND	n	Nb		n	S		
*	Sb	<0.005	ND	n	Ge			n	Os		n	Ta		
*	As	<0.005	ND	n	Au			*	Pd	<0.005	ND	Te		
*	Ba	<0.005	ND	n	Hf			*	P	<0.005	ND	Tb		
*	Be	<0.005	ND	n	Ho			*	Pt	<0.005	ND	Tl	<0.005	ND
*	Bi	<0.005	ND	*	In	<0.005	ND	*	K	<0.005	ND	Th		
*	B	<0.005	ND	n	Ir			n	Pr		n	Tm		
s	Cd	<0.005	ND	*	Fe	<0.005	ND	n	Re		*	Sn	<0.005	ND
n	Ca			*	La	<0.005	ND	n	Rh		*	Ti	<0.005	ND
n	Ce			*	Pb	<0.005	ND	n	Rb		n	W		
n	Cs			*	Li	<0.005	ND	n	Ru		n	U		
*	Cr	<0.005	ND	n	Lu			n	Sm		*	V	<0.005	ND
*	Co	<0.005	ND	*	Mg	<0.040	D	n	Sc		n	Yb		
*	Cu	<0.005	ND	*	Mn	<0.005	ND	*	Se	<0.005	ND	Y		
n	Dy			*	Hg	<0.005	ND	*	Si	<0.005	ND	Zn	<0.005	ND
*	Er	<0.005	ND	n	Mo	<0.005	ND	*	Ag	<0.005	ND	Zr		
*	Eu	<0.005	ND	*	Nd			*	Na	<0.010	D			
*	Gd	<0.005	ND	*	Ni	<0.005	ND	*	Sr	<0.010	D			

* - element checked for
ND - not detected

i - spectral interference
D - detected

n - not checked for
s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05): 1.0378 g/mL



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ISO 9001:2000
Registered
TUV USA, Inc.
Cert. No. 06-1004


William J. Leary
Quality Assurance Manager

Certificate of Analysis



IRON ICP STANDARD

0009898

Received
6/3/14

ULTRAGrade™ Solution
Iron ICP Standard
10000 µg/mL

Catalog Number: ICP-126
Lot Number: R00990
Job Number: J00016995
Lot Issue Date: 09/18/2013
Expiration Date: 10/31/2020

Starting Material: Iron (III) Nitrate
Starting Material Purity: 99.999%
Starting Material Lot No.: BH01780
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Fe: 55.85

Certified Value: 10001 ± 20 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using USP CRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP-MS) vs. NIST SRM 3126a

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAGrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al <0.005 D	* Ga <0.005 D	n Nb	n S
* Sb <0.005 ND	n Ge	n Os	n Ta
* As <0.005 ND	n Au	* Pd <0.005 ND	n Te
* Ba <0.005 D	n Hf	* P <0.005 ND	n Tb
* Be <0.005 ND	n Ho	* Pt <0.005 ND	* Tl <0.005 ND
* Bi <0.005 ND	* In <0.005 D	* K <0.005 ND	n Th
* B <0.005 ND	n Ir	n Pr	n Tm
* Cd <0.005 D	s Fe	n Re	* Sn <0.005 ND
* Ca <0.010 D	* La <0.005 ND	n Rh	* Ti <0.005 ND
n Ce	* Pb <0.005 ND	n Rb	n W
n Cs	* Li <0.005 ND	n Ru	n U
* Cr <0.005 D	n Lu	n Sm	* V <0.005 D
* Co <0.005 ND	* Mg <0.005 D	n Sc	n Yb
* Cu <0.005 D	* Mn <0.005 D	* Se <0.005 ND	n Y
n Dy	* Hg <0.005 ND	* Si <0.005 ND	* Zn <0.005 D
* Er <0.005 ND	* Mo <0.005 ND	* Ag <0.005 ND	n Zr
* Eu <0.005 ND	n Nd	* Na <0.005 D	
* Gd <0.005 ND	* Ni <0.005 D	* Sr <0.005 D	

* - element checked for
ND - not detected

i - spectral interference
D - detected

n - not checked for
s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0422 g/mL



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TUV USA, Inc.
Cert. No. 06-1004


William J. Leary
Quality Assurance Manager

Certificate of Analysis



ULTRAgrade™ Solution
Magnesium ICP / ICP-MS Standard
10000 µg/mL

Catalog Number: ICP-112
Lot Number: CM-4445
Lot Issue Date: 08/19/2015
Expiration Date: 09/30/2022

Starting Material: magnesium nitrate hexahydrate
Starting Material Purity: 99.999%
Starting Material Lot #: RM07690
Matrix: 2% nitric acid in low TOC water (< 50 ppb)
Atomic Weight Mg: 24.31

Certified Value: 10015 ± 20 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3131a

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAgrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al <0.005 ND	* Ga <0.005 ND	n Nb	n S
* Sb <0.005 ND	n Ge	n Os	n Ta
* As <0.005 ND	n Au	* Pd <0.005 ND	n Te
* Ba <0.005 ND	n Hf	* P <0.005 ND	n Tb
* Be <0.005 ND	n Ho	* Pt <0.005 ND	* Ti <0.005 ND
* Bi <0.005 ND	* In <0.005 ND	* K <0.005 ND	n Th
* B <0.005 ND	n Ir	n Pr	n Tm
* Cd <0.005 ND	* Fe <0.005 D	n Re	* Sn <0.005 ND
* Ca <0.005 D	* La <0.005 ND	n Rh	* Ti <0.005 ND
n Ce	* Pb <0.005 ND	n Rb	n W
n Cs	* Li <0.005 ND	n Ru	n U
* Cr <0.005 ND	n Lu	n Sm	* V <0.005 ND
* Co <0.005 ND	s Mg	n Sc	n Yb
* Cu <0.005 ND	* Mn <0.005 ND	* Se <0.005 ND	n Y
n Dy	* Hg <0.005 ND	* Si <0.005 ND	* Zn <0.005 ND
* Er <0.005 ND	* Mo <0.005 ND	* Ag <0.005 ND	n Zr
* Eu <0.005 ND	n Nd	* Na <0.005 ND	
* Gd <0.005 ND	s Ni	* Sr <0.005 ND	

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0537 g/mL

Certificate of Analysis



ULTRAgrade™ Solution
Sodium ICP / ICP-MS Standard
10000 µg/mL

Catalog Number: ICP-111
Lot Number: CM-3431
Lot Issue Date: 06/25/2015
Expiration Date: 07/31/2022

Starting Material: sodium nitrate
 Starting Material Purity: 99.999%
 Starting Material Lot #: RM07801
 Matrix: 2% nitric acid in low TOC water (< 50 ppb)
 Atomic Weight Na: 22.99

Certified Value: 10016 ± 20 µg/mL

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentration(s) were prepared and verified by an ISO Guide 34 / ISO 17025 accredited laboratory, and compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Classical Wet Assay Method: Theoretical, based on gravimetric measurements

Confirmation by Inductively Coupled Plasma Spectroscopy (ICP / ICP/MS) vs. NIST SRM 3152a

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAgrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Trace Metallic Impurities in Solution Standard in µg/mL:

* Al <0.005 ND	* Ga <0.005 ND	n Nb	n S
* Sb <0.005 ND	n Ge	n Os	n Ta
* As <0.005 ND	n Au	* Pd <0.005 ND	n Te
* Ba <0.005 ND	n Hf	* P <0.005 ND	n Tb
* Be <0.005 ND	n Ho	* Pt <0.005 ND	* Tl <0.005 ND
* Bi <0.005 ND	* In <0.005 ND	* K <0.005 D	n Th
* B <0.005 ND	n Ir	n Pr	n Tm
* Cd <0.005 ND	* Fe <0.005 ND	n Re	* Sn <0.005 ND
* Ca <0.005 D	* La <0.005 ND	n Rh	* Ti <0.005 ND
n Ce	* Pb <0.005 ND	n Rb	n W
n Cs	* Li <0.005 ND	n Ru	n U
* Cr <0.005 ND	n Lu	n Sm	* V <0.005 ND
* Co <0.005 ND	* Mg <0.005 D	n Sc	n Yb
* Cu <0.005 ND	* Mn <0.005 ND	* Se <0.005 ND	n Y
n Dy	* Hg <0.005 ND	* Si <0.005 ND	* Zn <0.005 ND
* Er <0.005 ND	* Mo <0.005 ND	* Ag <0.005 ND	n Zr
* Eu <0.005 ND	n Nd	s Na	
* Gd <0.005 ND	* Ni <0.005 ND	* Sr <0.005 ND	

* - element checked for
 ND - not detected

I - spectral interference
 D - detected

n - not checked for
 s - solution standard element

Density of Solution (measured at 20.00°C ± 0.05°C): 1.0328 g/mL

▪ Certificate of Analysis ▪

Product: Metals in Soil
Catalog Number: 540
Lot No. D094-540
Certificate Issue Date: September 12, 2016
Expiration Date: March 31, 2020
Revision Number: Original

CERTIFICATION

Parameter	Total Concentration ⁶	Certified Value ¹	Uncertainty ²	QC Performance Acceptance Limits ³	PT Performance Acceptance Limits ⁴
	mg/kg	mg/kg	%	mg/kg	mg/kg
Aluminum	59900	8090	4.40	4030 - 12100	3200 - 13000
Antimony	215	99.3	5.05	D.L. - 206	21.4 - 255
Arsenic	115	100	6.62	80.9 - 120	69.6 - 131
Barium	848	217	2.44	177 - 257	160 - 278
Beryllium	169	147	5.75	120 - 175	111 - 185
Boron	111	85.2	7.76	60.5 - 110	51.1 - 128
Cadmium	99.8	83.7	5.42	68.0 - 99.5	61.3 - 110
Calcium	13000	6010	2.43	4860 - 7150	4430 - 7590
Chromium	152	107	6.22	82.9 - 130	74.3 - 144
Cobalt	147	123	5.38	101 - 145	91.4 - 160
Copper	192	166	10.5	134 - 197	125 - 213
Iron	29800	14600	8.76	6580 - 22600	5270 - 23900
Lead	113	88.4	11.6	71.8 - 105	61.8 - 115
Magnesium	4990	2930	3.27	2190 - 3670	1930 - 3940
Manganese	545	311	4.84	249 - 373	233 - 390
Mercury	2.76	2.90	3.80	2.13 - 3.68	1.47 - 4.33
Molybdenum	66.5	54.1	5.49	41.8 - 66.3	36.2 - 71.9
Nickel	63.5	49.8	10.9	40.3 - 59.2	34.4 - 67.3
Potassium	29700	2620	1.44	1810 - 3430	1600 - 3640
Selenium	106	87.7	6.27	66.7 - 109	56.2 - 119
Silver	47.1	41.4	6.39	30.5 - 52.2	27.3 - 55.4
Sodium	13800	252	7.76	174 - 331	82.9 - 422
Strontium	239	58.8	9.01	47.0 - 70.6	41.0 - 76.6

ISO/IEC GUIDE 34:2009

ISO/IEC 17025:2005



▪ Certificate of Analysis ▪

Parameter	Total Concentration ⁶	Certified Value ¹	Uncertainty ²	QC Performance Acceptance Limits ³	PT Performance Acceptance Limits ⁴
	mg/kg	mg/kg	%	mg/kg	mg/kg
Thallium	68.9	58.1	6.26	45.1 - 71.2	37.1 - 79.2
Tin	185	154	4.81	116 - 192	92.3 - 215
Titanium	2440	370	4.01	110 - 630	77.5 - 663
Uranium	65.2	58.6	5.84	46.6 - 70.7	43.2 - 74.0
Vanadium	194	140	5.47	107 - 172	97.8 - 181
Zinc	180	145	10.9	119 - 171	98.2 - 192

ANALYTICAL VERIFICATION

Parameter	Certified Value ¹	Proficiency Testing Study			NIST Traceability	
		Mean	Recovery ⁵	n	SRM Number	Recovery
	mg/kg	mg/kg	%			%
Aluminum	8090	8090	80.1	146	-	-
Antimony	99.3	99.3	46.4	150	-	-
Arsenic	100	100	87.3	189	-	-
Barium	217	217	85.8	164	-	-
Beryllium	147	147	87.8	163	-	-
Boron	85.2	85.2	73.4	109	-	-
Cadmium	83.7	83.7	83.9	195	-	-
Calcium	6010	6010	88.6	132	-	-
Chromium	107	107	81.5	186	-	-
Cobalt	123	123	84.8	155	-	-
Copper	166	166	85.3	184	-	-
Iron	14600	14600	89.4	147	-	-
Lead	88.4	88.4	88.4	202	-	-
Magnesium	2930	2930	84.9	135	-	-
Manganese	311	311	88.2	157	-	-
Mercury	2.90	2.90	105	133	-	-
Molybdenum	54.1	54.1	82.7	157	-	-
Nickel	49.8	49.8	81.3	188	-	-

▪ Certificate of Analysis ▪

Parameter	Certified Value ¹	Proficiency Testing Study		n	NIST Traceability	
		Mean	Recovery ⁵		SRM Number	Recovery
	mg/kg	mg/kg	%			%
Potassium	2620	2620	85.9	136	-	-
Selenium	87.7	87.7	82.7	171	-	-
Silver	41.4	41.4	86.0	164	-	-
Sodium	252	252	84.1	122	-	-
Strontium	58.8	58.8	93.6	103	-	-
Thallium	58.1	58.1	82.9	158	-	-
Tin	154	154	84.0	117	-	-
Titanium	370	370	86.7	108	-	-
Uranium	58.6	58.6	96.6	26	-	-
Vanadium	140	140	86.2	157	-	-
Zinc	145	145	100	184	-	-

▪ Certificate of Analysis ▪

1. The **Certified Values** are equal to the mean recoveries for the parameters as determined in an interlaboratory round robin study based on all applicable digestion techniques reported in the study. The Certified Values are based on an "as received" basis, assuming 100% solids content. The certified values are monitored and purchasers will be notified of any significant changes resulting in recertification or withdrawal of this certified reference material during the period of validity of this certificate.
2. The **Uncertainty** is the total propagated uncertainty at the 95% confidence interval. The uncertainty is based on the preparation and internal analytical verification of the product by ERA, multiplied by a coverage factor. The uncertainty applies to the product as supplied and does not take into account any required or optional dilution and/or preparations the laboratory may perform while using this product.
3. The **QC Performance Acceptance Limits (QC PALs™)** are based on actual historical data collected in ERA's Proficiency Testing program. The QC PALs™ reflect any inherent biases in the methods used to establish the limits and closely approximate a 95% confidence interval of the performance that experienced laboratories should achieve using accepted environmental methods. Use the QC PALs™ to realistically evaluate your performance against your peers.
4. The **PT Performance Acceptance Limits (PT PALs™)** are calculated using the regression equations and fixed acceptance criteria specified in the NELAC proficiency testing requirements. Use the PT PALs™ when analyzing this QC standard alongside USEPA and NELAC compliant PT standards. Please note that many PT study acceptance limits are concentration dependent (some non-linearly) and, therefore, the acceptance limits of this QC standard and any PT standard may differ relative to their difference in concentrations.
5. The **PT Data/Traceability** data include the mean value, percent recovery and number of data points reported by the laboratories in our Proficiency Testing study compared to the Certified Values. In addition, where NIST Standard Reference Materials (SRMs) are available, each analyte has been analytically traced to the NIST SRM listed. This product is traceable to the lot numbers of its starting materials. All gravimetric and volumetric measurements related to its manufacture are traceable to NIST through an unbroken chain of comparisons.
Traceability Recovery (%) = $[(\% \text{ recovery certified standard})/(\% \text{ recovery NIST SRM})] \times 100$
The traceability data shown were compiled by analyzing the ERA standards or their associated stock solutions against the applicable NIST SRMs.
6. The **Total Concentrations** are equal to the background concentrations in the blank soil matrix (measured using neutron activation, XRF, and total acid digestion techniques), plus the amount of each analyte spiked onto the soil. For Trace Metals, the values listed are only "Theoretical Values" based upon the methodologies listed.
7. For additional information on this product such as intended use, instructions for use, level of homogeneity, and safety information, please refer to the provided Instruction Sheet

If you have any questions or need technical assistance, please call ERA technical assistance at 1-800-372-0122 or send an email to info@eraqc.com.

Certifying Officer

Brian Miller

Quality Officer

Patrick Larson



Certificate of Analysis



Mercury
AA Standard

Catalog Number: IAA-280
Lot Number: T00601
Job Number: J00018289
Lot Issue Date: 05/23/2014
Expiration Date: 06/30/2021

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system. The analyte concentrations were verified by our ISO 17025 accredited laboratory to be within $\pm 2.5\%$, when compared to calibration standards independently prepared using NIST SRM(s). The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Analyte	True Value	Analytical Method	NIST SRM
* mercury	1002 \pm 5 $\mu\text{g/mL}$	ICP / ICP-MS	3133

Matrix: 2% nitric acid in low TOC water (< 50 ppb)

** light sensitive*

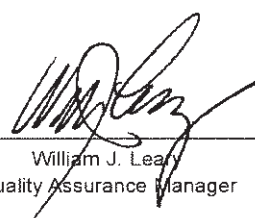
ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAgrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

-Density of Solution (measured at 20.00°C \pm 0.05°C): 1.0100 g/mL



ISO 17025:2005
Accredited
A2LA
Cert. No. 0851.01

ISO 9001:2000
Registered
TUV USA, Inc.
Cert. No. 06-1004



William J. Leary
Quality Assurance Manager



3733 Technology Drive
Cape Canaveral, FL 32910-5000
Inorganic Ventures, Inc.

CERTIFICATE OF ANALYSIS

QSR 1001-1001-1001-1001-1001
QSR 1001-1001-1001-1001-1001
QSR 1001-1001-1001-1001-1001

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO Guide 34, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).



2.0 PRODUCT DESCRIPTION

Product Code: Multi Analyte Custom Grade Solution
Catalog Number: QCP-QCS-2
Lot Number: M2-MEB662007
Matrix: 5% (v/v) HNO₃
tr. HF
Value / Analyte(s): 500 µg/mL ea:
Silica, Tin,
200 µg/mL ea:
Antimony,
100 µg/mL ea:
Molybdenum, Titanium

LFMS ID C 901011
Exp: 01/29/20

Second Source: Whenever possible, this solution was manufactured from a second set of concentrates in our manufacturing facility.

3.0 CERTIFIED VALUES AND UNCERTAINTIES

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
Antimony, Sb	200.0 ± 1.4 µg/mL	Molybdenum, Mo	100.0 ± 0.5 µg/mL
Silica, SiO ₂	500.0 ± 3.2 µg/mL	Tin, Sn	500.0 ± 1.8 µg/mL
Titanium, Ti	100.0 ± 0.6 µg/mL		

Density: 1.027 g/mL (measured at 20 ± 4 °C)

Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
Mo	ICP Assay	3134	130418
Sb	ICP Assay	3102A	061229
SiO ₂	ICP Assay	3150	130912
Sn	ICP Assay	3161a	070330
Sn	Calculated		See Sec. 4.2
Ti	ICP Assay	3162a	130925

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM by two independent methods Characterization of CRM by one method

Characterization of CRM/RM by Two Methods

Certified Value, $X_{\text{CRM/RM}}$, where two methods of characterization are used is the weighted mean of the two results:

$$X_{\text{CRM/RM}} = [(w_a)(X_a) + (w_b)(X_b)]$$

X_a = mean of Assay Method A with standard uncertainty $u_{\text{char a}}$

X_b = mean of Assay Method B with standard uncertainty $u_{\text{char b}}$

w_a and w_b = the weighing factors for each method calculated using the inverse square of the variance:

$$w_a = (1/u_{\text{char a}})^2 / ((1/u_{\text{char a}})^2 + (1/u_{\text{char b}})^2)$$

$$w_b = (1/u_{\text{char b}})^2 / ((1/u_{\text{char a}})^2 + (1/u_{\text{char b}})^2)$$

$$\text{CRM/RM Expanded Uncertainty (t)} = U_{\text{CRM/RM}} = k (u_{\text{char a\&b}}^2 + u_{\text{bb}}^2 + u_{\text{its}}^2 + u_{\text{ts}}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{\text{char a\&b}} = [(w_a)^2 (u_{\text{char a}})^2 + (w_b)^2 (u_{\text{char b}})^2]^{1/2}$ where $u_{\text{char a}}$ and $u_{\text{char b}}$ are the square root of the sum of the squares of errors from characterization which include instrument measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{its} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{\text{CRM/RM}}$, where one method of characterization is used is the mean of individual results:

$$X_{\text{CRM/RM}} = \text{mean of Assay Method A with standard uncertainty } u_{\text{char a}}$$

$$\text{CRM/RM Expanded Uncertainty (t)} = U_{\text{CRM/RM}} = k (u_{\text{char a}}^2 + u_{\text{bb}}^2 + u_{\text{its}}^2 + u_{\text{ts}}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{\text{char a}} = \text{square root of the sum of the squares of the errors from characterization which include instrumental measurement, density, NIST SRM uncertainty, weighing, and volume}$

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{its} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

N/A

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit www.inorganicventures.com/TCT

HF Note: This standard should not be prepared or stored in glass.

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 10CFR50 Appendix B - Nuclear Regulatory Commission

- Domestic Licensing of Production and Utilization Facilities

10.2 10CFR21 - Nuclear Regulatory Commission

- Reporting defects and Non-Compliance

10.3 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.4 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.5 ISO Guide 34 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

October 02, 2017

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **October 02, 2021**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Supervisor, Quality Control

Handwritten signature of Michael Booth in black ink.

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

Handwritten signature of Paul R. Gaines in black ink.



1000 Technology Circle
Chantilly, VA 20151 USA
Inorganic Ventures, Inc.

CERTIFICATE OF ANALYSIS

ISO 9001:2015 QSR - Manufacturing
ISO 17025:2017
Inorganic Ventures, Inc.

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO Guide 34, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).



2.0 PRODUCT DESCRIPTION

Product Code: Multi Analyte Custom Grade Solution

Catalog Number: QCP-QCS-1

Lot Number: M2-MEB663178

Matrix: 5% (v/v) HNO₃

Value / Analyte(s): 500 µg/mL ea:

Potassium,

Phosphorus,

Thallium,

200 µg/mL ea:

Mercury,

Lead,

Arsenic,

100 µg/mL ea:

Boron,

Barium,

Beryllium,

Calcium,

Cadmium,

Cerium,

Cobalt,

Chromium,

Copper,

Iron,

Selenium,

Strontium,

Lithium,

Magnesium,

Manganese,

Sodium,

Nickel,

Vanadium,

Zinc,

Aluminum,

25 µg/mL ea:

Silver

LSMS D C901010
Exp: 01/29/20

Second Source: Whenever possible, this solution was manufactured from a second set of concentrates in our manufacturing facility.

3.0 CERTIFIED VALUES AND UNCERTAINTIES

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
Aluminum, Al	100.0 ± 0.3 µg/mL	Arsenic, As	200.0 ± 1.7 µg/mL
Barium, Ba	100.0 ± 0.4 µg/mL	Beryllium, Be	100.0 ± 0.4 µg/mL
Boron, B	100.0 ± 0.6 µg/mL	Cadmium, Cd	100.0 ± 0.4 µg/mL
Calcium, Ca	100.0 ± 0.4 µg/mL	Cerium, Ce	100.0 ± 0.4 µg/mL
Chromium, Cr	100.0 ± 0.6 µg/mL	Cobalt, Co	100.0 ± 0.4 µg/mL
Copper, Cu	100.0 ± 0.4 µg/mL	Iron, Fe	100.0 ± 0.4 µg/mL
Lead, Pb	200.0 ± 0.9 µg/mL	Lithium, Li	100.0 ± 0.4 µg/mL
Magnesium, Mg	100.0 ± 0.4 µg/mL	Manganese, Mn	100.0 ± 0.4 µg/mL
Mercury, Hg	200.0 ± 0.9 µg/mL	Nickel, Ni	100.0 ± 0.4 µg/mL
Phosphorus, P	500.0 ± 2.1 µg/mL	Potassium, K	500.0 ± 1.8 µg/mL
Selenium, Se	100.0 ± 0.6 µg/mL	Silver, Ag	25.00 ± 0.10 µg/mL
Sodium, Na	100.0 ± 0.4 µg/mL	Strontium, Sr	100.0 ± 0.4 µg/mL
Thallium, Tl	500.0 ± 3.2 µg/mL	Vanadium, V	100.0 ± 0.4 µg/mL
Zinc, Zn	100.0 ± 0.4 µg/mL		

Density: 1.039 g/mL (measured at 20 ± 4 °C)

Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
Ag	ICP Assay	3151	992212
Ag	Volhard	999c	999c
Al	ICP Assay	3101a	140903
Al	EDTA	928	928
As	ICP Assay	3103a	100818
B	ICP Assay	3107	110830
Ba	ICP Assay	3104a	140909
Ba	Gravimetric		See Sec. 4.2
Be	ICP Assay	3105a	090514
Be	Calculated		See Sec. 4.2
Ca	ICP Assay	3109a	130213
Ca	EDTA	928	928
Cd	ICP Assay	3108	130116
Cd	EDTA	928	928
Ce	ICP Assay	3110	890602
Ce	EDTA	928	928
Co	ICP Assay	3113	000630 Co
Co	EDTA	928	928
Cr	ICP Assay	3112a	030730Cr3
Cu	ICP Assay	3114	121207
Cu	EDTA	928	928
Fe	ICP Assay	3126a	140812
Fe	EDTA	928	928
Hg	ICP Assay	3133	061204
Hg	EDTA	928	928
K	ICP Assay	3141a	140813
K	Gravimetric		See Sec. 4.2
Li	ICP Assay	3129a	100714
Li	EDTA	928	928
Mg	ICP Assay	3131a	140110
Mg	EDTA	928	928
Mn	ICP Assay	3132	050429
Mn	EDTA	928	928
Na	ICP Assay	3152a	120715
Na	Gravimetric		See Sec. 4.2
Ni	ICP Assay	3136	120619
Ni	EDTA	928	928
P	ICP Assay	3139a	060717
P	Acidimetric		traceable to 84L
Pb	ICP Assay	3128	101028
Pb	EDTA	928	928
Se	ICP Assay	3149	100901
Se	Calculated		See Sec. 4.2
Sr	EDTA	928	928
Sr	ICP Assay	3153a	990906
Tl	ICP Assay	3158	993012
V	EDTA	928	928
V	ICP Assay	3165	992706
Zn	ICP Assay	3168a	120629

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

Characterization of CRM by two independent methods Characterization of CRM by one method

Characterization of CRM/RM by Two Methods

Certified Value, $X_{\text{CRM/RM}}$, where two methods of characterization are used is the weighted mean of the two results:

$$X_{\text{CRM/RM}} = [(w_a)(X_a) + (w_b)(X_b)]$$

X_a = mean of Assay Method A with standard uncertainty $u_{\text{char a}}$

X_b = mean of Assay Method B with standard uncertainty $u_{\text{char b}}$

w_a and w_b = the weighting factors for each method calculated using the inverse square of the variance:

$$w_a = (1/u_{\text{char a}})^2 / ((1/u_{\text{char a}})^2 + (1/u_{\text{char b}})^2)$$

$$w_b = (1/u_{\text{char b}})^2 / ((1/u_{\text{char a}})^2 + (1/u_{\text{char b}})^2)$$

$$\text{CRM/RM Expanded Uncertainty } (\pm) = U_{\text{CRM/RM}} = k (u_{\text{char a\&b}}^2 + u_{\text{bb}}^2 + u_{\text{its}}^2 + u_{\text{ts}}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{\text{char a\&b}} = [(w_a)^2 (u_{\text{char a}})^2 + (w_b)^2 (u_{\text{char b}})^2]^{1/2}$ where $u_{\text{char a}}$ and $u_{\text{char b}}$ are the square root of the sum of the squares of errors from characterization which include instrument measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{its} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{\text{CRM/RM}}$, where one method of characterization is used is the mean of individual results:

$$X_{\text{CRM/RM}} = \text{mean of Assay Method A with standard uncertainty } u_{\text{char a}}$$

$$\text{CRM/RM Expanded Uncertainty } (\pm) = U_{\text{CRM/RM}} = k (u_{\text{char a}}^2 + u_{\text{bb}}^2 + u_{\text{its}}^2 + u_{\text{ts}}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{\text{char a}}$ = square root of the sum of the squares of the errors from characterization which include instrumental measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{its} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

N/A

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit www.inorganicventures.com/TCT

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 10CFR50 Appendix B - Nuclear Regulatory Commission

- Domestic Licensing of Production and Utilization Facilities

10.2 10CFR21 - Nuclear Regulatory Commission

- Reporting defects and Non-Compliance

10.3 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.4 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.5 ISO Guide 34 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

November 15, 2017

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **November 15, 2021**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS


Certificate Approved By:

Michael Booth
Supervisor, Quality Control



Certifying Officer:

Paul Gaines
CEO, Senior Technical Director





100 Technology Drive
Chandler, AZ 85226-1100
Inorganic Ventures, Inc.

CERTIFICATE OF ANALYSIS

100% Purity Guaranteed
Batch: 01/29/20
Inorganic Ventures, Inc.

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO Guide 34, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).



2.0 PRODUCT DESCRIPTION

Product Code: Multi Analyte Custom Grade Solution

Catalog Number: WW-LFS-1

Lot Number: M2-MEB663189

Matrix: 5% (v/v) HNO₃

Value / Analyte(s): 1 000 µg/mL ea:

Potassium,

600 µg/mL ea:

Phosphorus,

300 µg/mL ea:

Sodium,

Iron,

200 µg/mL ea:

Magnesium,

Aluminum,

Cerium,

Selenium,

Thallium,

100 µg/mL ea:

Lead,

Calcium,

80 µg/mL ea:

Arsenic,

70 µg/mL ea:

Mercury,

50 µg/mL ea:

Nickel,

40 µg/mL ea:

Chromium,

30 µg/mL ea:

Copper,

Boron,

Vanadium,

20 µg/mL ea:

Zinc,

Strontium,

Barium,

Beryllium,

Cadmium,

Cobalt,

Manganese,

Lithium,

7.5 µg/mL ea:

Silver

LIME TO C901005
Exp: 01/29/20

3.0 CERTIFIED VALUES AND UNCERTAINTIES

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
Aluminum, Al	200.0 ± 0.7 µg/mL	Arsenic, As	80.0 ± 0.7 µg/mL
Barium, Ba	20.00 ± 0.09 µg/mL	Beryllium, Be	20.00 ± 0.11 µg/mL
Boron, B	30.00 ± 0.18 µg/mL	Cadmium, Cd	20.00 ± 0.09 µg/mL
Calcium, Ca	100.0 ± 0.4 µg/mL	Cerium, Ce	200.0 ± 0.8 µg/mL
Chromium, Cr	40.00 ± 0.23 µg/mL	Cobalt, Co	20.00 ± 0.09 µg/mL
Copper, Cu	30.00 ± 0.12 µg/mL	Iron, Fe	300.0 ± 1.2 µg/mL
Lead, Pb	100.0 ± 0.4 µg/mL	Lithium, Li	20.00 ± 0.08 µg/mL
Magnesium, Mg	200.0 ± 0.8 µg/mL	Manganese, Mn	20.00 ± 0.08 µg/mL
Mercury, Hg	70.0 ± 0.3 µg/mL	Nickel, Ni	50.00 ± 0.21 µg/mL
Phosphorus, P	600.0 ± 2.6 µg/mL	Potassium, K	1 000 ± 4 µg/mL
Selenium, Se	200.0 ± 1.3 µg/mL	Silver, Ag	7.50 ± 0.03 µg/mL
Sodium, Na	300.0 ± 1.2 µg/mL	Strontium, Sr	20.01 ± 0.08 µg/mL
Thallium, Tl	200.0 ± 1.3 µg/mL	Vanadium, V	30.00 ± 0.13 µg/mL
Zinc, Zn	20.01 ± 0.09 µg/mL		

Density: 1.034 g/mL (measured at 20 ± 4 °C)

Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
Ag	ICP Assay	3151	992212
Ag	Volhard	999c	999c
Al	ICP Assay	3101a	140903
Al	EDTA	928	928
As	ICP Assay	3103a	100818
B	ICP Assay	3107	110830
Ba	ICP Assay	3104a	140909
Ba	Gravimetric		See Sec. 4.2
Be	ICP Assay	3105a	090514
Ca	ICP Assay	3109a	130213
Ca	EDTA	928	928
Cd	ICP Assay	3108	130116
Cd	EDTA	928	928
Ce	ICP Assay	3110	890602
Ce	EDTA	928	928
Co	ICP Assay	3113	000630 Co
Co	EDTA	928	928
Cr	ICP Assay	3112a	030730Cr3
Cu	ICP Assay	3114	121207
Cu	EDTA	928	928
Fe	ICP Assay	3126a	140812
Fe	EDTA	928	928
Hg	ICP Assay	3133	061204
Hg	EDTA	928	928
K	ICP Assay	3141a	140813
K	Gravimetric		See Sec. 4.2
Li	ICP Assay	3129a	100714
Li	EDTA	928	928
Mg	ICP Assay	3131a	050302
Mg	EDTA	928	928
Mn	ICP Assay	3132	050429
Mn	EDTA	928	928
Na	ICP Assay	3152a	120715
Na	Gravimetric		See Sec. 4.2
Ni	ICP Assay	3136	120619
Ni	EDTA	928	928
P	ICP Assay	3139a	060717
P	Acidimetric		traceable to 84L
Pb	ICP Assay	3128	101026
Pb	EDTA	928	928
Se	ICP Assay	3149	100901
Sr	EDTA	928	928
Sr	ICP Assay	3153a	990906
Tl	ICP Assay	3158	993012
V	EDTA	928	928
V	ICP Assay	3165	992706
Zn	ICP Assay	3168a	120629
Zn	EDTA	928	928

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

Characterization of CRM by two independent methods Characterization of CRM by one method

Characterization of CRM/RM by Two Methods

Certified Value, $X_{\text{CRM/RM}}$, where two methods of characterization are used is the weighted mean of the two results:

$$X_{\text{CRM/RM}} = [(w_a)(X_a) + (w_b)(X_b)]$$

X_a = mean of Assay Method A with standard uncertainty $u_{\text{char a}}$

X_b = mean of Assay Method B with standard uncertainty $u_{\text{char b}}$

w_a and w_b = the weighting factors for each method calculated using the inverse square of the variance:

$$w_a = (1/u_{\text{char a}})^2 / ((1/u_{\text{char a}})^2 + (1/u_{\text{char b}})^2)$$

$$w_b = (1/u_{\text{char b}})^2 / ((1/u_{\text{char a}})^2 + (1/u_{\text{char b}})^2)$$

$$\text{CRM/RM Expanded Uncertainty } (\pm) = U_{\text{CRM/RM}} = k (u_{\text{char a\&b}}^2 + u_{\text{bb}}^2 + u_{\text{its}}^2 + u_{\text{ts}}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{\text{char a\&b}} = [(w_a)^2 (u_{\text{char a}})^2 + (w_b)^2 (u_{\text{char b}})^2]^{1/2}$ where $u_{\text{char a}}$ and $u_{\text{char b}}$ are the square root of the sum of the squares of errors from characterization which include instrument measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{its} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{\text{CRM/RM}}$, where one method of characterization is used is the mean of individual results:

$$X_{\text{CRM/RM}} = \text{mean of Assay Method A with standard uncertainty } u_{\text{char a}}$$

$$\text{CRM/RM Expanded Uncertainty } (\pm) = U_{\text{CRM/RM}} = k (u_{\text{char a}}^2 + u_{\text{bb}}^2 + u_{\text{its}}^2 + u_{\text{ts}}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{\text{char a}}$ = square root of the sum of the squares of the errors from characterization which include instrumental measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{its} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

N/A

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit www.inorganicventures.com/TCT

Low Silver Note: This solution contains "LOW" levels of Silver. Please store this entire bottle inside a sealed glass jar.

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 10CFR50 Appendix B - Nuclear Regulatory Commission

- Domestic Licensing of Production and Utilization Facilities

10.2 10CFR21 - Nuclear Regulatory Commission

- Reporting defects and Non-Compliance

10.3 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.4 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.5 ISO Guide 34 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

November 14, 2017

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **November 14, 2021**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Supervisor, Quality Control

Handwritten signature of Michael Booth in black ink.

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

Handwritten signature of Paul R. Gaines in black ink.



1400 Piedmont Technology Center
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854-670-0000 • Fax 854-670-0001
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CERTIFICATE OF ANALYSIS

1400 Piedmont Technology Center
Columbia, South Carolina 29405-5000
854-670-0000 • Fax 854-670-0001
info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO Guide 34, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).



2.0 PRODUCT DESCRIPTION

Product Code: Multi Analyte Custom Grade Solution
Catalog Number: VW-LFS-2
Lot Number: N2-MEB667905
Matrix: 5% (v/v) HNO₃
tr. HF
Value / Analyte(s): 200 µg/mL ea:
Silica,
80 µg/mL ea:
Antimony,
70 µg/mL ea:
Tin,
40 µg/mL ea:
Molybdenum,
20 µg/mL ea:
Titanium

LIMS ID C901006
Exp: 01/29/20

3.0 CERTIFIED VALUES AND UNCERTAINTIES

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
Antimony, Sb	80.0 ± 0.5 µg/mL	Molybdenum, Mo	40.01 ± 0.20 µg/mL
Silica, SiO ₂	200.0 ± 1.3 µg/mL	Tin, Sn	70.0 ± 0.3 µg/mL
Titanium, Ti	20.00 ± 0.11 µg/mL		

Density: 1.023 g/mL (measured at 20 ± 4 °C)

Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
Mo	ICP Assay	3134	130418
Sb	ICP Assay	3102a	140911
SiO ₂	ICP Assay	3150	130912
Sn	ICP Assay	3161a	070330
Ti	ICP Assay	3162a	130925
Ti	Calculated		See Sec. 4.2

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM/RM by Two Methods

Certified Value, $X_{CRM/RM}$, where two methods of characterization are used is the weighted mean of the two results:

$$X_{CRM/RM} = [(w_a)(X_a) + (w_b)(X_b)]$$

X_a = mean of Assay Method A with standard uncertainty $u_{char a}$

X_b = mean of Assay Method B with standard uncertainty $u_{char b}$

w_a and w_b = the weighing factors for each method calculated using the inverse square of the variance:

$$w_a = (1/u_{char a})^2 / ((1/u_{char a})^2 + (1/u_{char b})^2)$$

$$w_b = (1/u_{char b})^2 / ((1/u_{char a})^2 + (1/u_{char b})^2)$$

$$CRM/RM \text{ Expanded Uncertainty } (\pm) = U_{CRM/RM} = k (u_{char a \& b}^2 + u_{bb}^2 + u_{lts}^2 + u_{ts}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{char a \& b} = [(w_a)^2 (u_{char a})^2 + (w_b)^2 (u_{char b})^2]^{1/2}$ where $u_{char a}$ and $u_{char b}$ are the square root of the sum of the squares of errors from characterization which include instrument measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$$X_{CRM/RM} = \text{mean of Assay Method A with standard uncertainty } u_{char a}$$

$$CRM/RM \text{ Expanded Uncertainty } (\pm) = U_{CRM/RM} = k (u_{char a}^2 + u_{bb}^2 + u_{lts}^2 + u_{ts}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{char a}$ = square root of the sum of the squares of the errors from characterization which include instrumental measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

N/A

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit www.inorganicventures.com/TCT

HF Note: This standard should not be prepared or stored in glass.

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO Guide 34 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

May 14, 2018

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- May 14, 2022

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Supervisor, Quality Control



Certifying Officer:

Paul Gaines
CEO, Senior Technical Director





3001 Lee Boulevard, Suite 100
Chantilly, VA 20151 USA
Phone: 703.545.3000
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www.inorganicventures.com

CERTIFICATE OF ANALYSIS

Lot: 2007ICS-3
Date: 01/29/20
www.inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO Guide 34, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).



2.0 PRODUCT DESCRIPTION

Product Code: Multi Analyte Custom Grade Solution

Catalog Number: 2007ICS-3

Lot Number: M2-MEB657406

Matrix: 7% (v/v) HNO₃

Value / Analyte(s): 20 000 µg/mL ea:

Potassium,

1 000 µg/mL ea:

Arsenic,

500 µg/mL ea:

Selenium,

300 µg/mL ea:

Silver,

Zinc,

Cobalt,

200 µg/mL ea:

Manganese,

100 µg/mL ea:

Beryllium

Lead,

Nickel,

Barium,

Chromium,

Thallium,

Vanadium,

Cadmium,

Copper,

LEAS ID 1961008
Exp: 01/29/20

3.0 CERTIFIED VALUES AND UNCERTAINTIES

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
Arsenic, As	998 ± 9 µg/mL	Barium, Ba	299.5 ± 1.2 µg/mL
Beryllium, Be	99.8 ± 0.6 µg/mL	Cadmium, Cd	299.5 ± 1.3 µg/mL
Chromium, Cr	299.5 ± 1.7 µg/mL	Cobalt, Co	299.5 ± 1.4 µg/mL
Copper, Cu	299.5 ± 1.2 µg/mL	Lead, Pb	998 ± 4 µg/mL
Manganese, Mn	199.7 ± 0.8 µg/mL	Nickel, Ni	299.5 ± 1.2 µg/mL
Potassium, K	19 970.0 ± 70.0 µg/mL	Selenium, Se	499.2 ± 3.1 µg/mL
Silver, Ag	299.5 ± 1.5 µg/mL	Thallium, Tl	998 ± 7 µg/mL
Vanadium, V	299.5 ± 1.3 µg/mL	Zinc, Zn	299.5 ± 1.2 µg/mL *

Certified Density: 1.088 g/mL (measured at 20 ± 1 °C)

Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
Ag	ICP Assay	3151	992212
Ag	Volhard	999b	999b
As	ICP Assay	3103a	100818
Ba	ICP Assay	3104a	070222
Ba	Gravimetric		See Sec. 4.2
Be	ICP Assay	3105a	090514
Cd	ICP Assay	3108	130116
Cd	EDTA	928	928
Co	ICP Assay	3113	000630 Co
Co	EDTA	928	928
Cr	ICP Assay	3112a	030730Cr3
Cu	ICP Assay	3114	121207
Cu	EDTA	928	928
K	ICP Assay	3141a	140813
K	Gravimetric		See Sec. 4.2
Mn	ICP Assay	3132	050429
Mn	EDTA	928	928
Ni	ICP Assay	3136	120619
Ni	EDTA	928	928
Pb	ICP Assay	3128	101026
Pb	EDTA	928	928
Se	ICP Assay	3149	100901
Tl	ICP Assay	3158	993012
V	EDTA	928	928
V	ICP Assay	3165	992706
Zn	ICP Assay	3168a	120629
Zn	EDTA	928	928

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

Characterization of CRM by two independent methods Characterization of CRM by one method

Characterization of CRM/RM by Two Methods

Certified Value, $X_{CRM/RM}$, where two methods of characterization are used is the weighted mean of the two results:

$$X_{CRM/RM} = [(w_a)(X_a) + (w_b)(X_b)]$$

X_a = mean of Assay Method A with standard uncertainty $u_{char a}$

X_b = mean of Assay Method B with standard uncertainty $u_{char b}$

w_a and w_b = the weighting factors for each method calculated using the inverse square of the variance:

$$w_a = (1/u_{char a})^2 / ((1/u_{char a})^2 + (1/u_{char b})^2)$$

$$w_b = (1/u_{char b})^2 / ((1/u_{char a})^2 + (1/u_{char b})^2)$$

$$CRM/RM \text{ Expanded Uncertainty } (\pm) = U_{CRM/RM} = k (u_{char a \& b}^2 + u_{bb}^2 + u_{lts}^2 + u_{ts}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{char a \& b} = [(w_a)^2 (u_{char a})^2 + (w_b)^2 (u_{char b})^2]^{1/2}$ where $u_{char a}$ and $u_{char b}$ are the square root of the sum of the squares of errors from characterization which include instrument measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$$X_{CRM/RM} = \text{mean of Assay Method A with standard uncertainty } u_{char a}$$

$$CRM/RM \text{ Expanded Uncertainty } (\pm) = U_{CRM/RM} = k (u_{char a}^2 + u_{bb}^2 + u_{lts}^2 + u_{ts}^2)^{1/2}$$

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$u_{char a}$ = square root of the sum of the squares of the errors from characterization which include instrumental measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

N/A

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag keep cap tightly sealed when not in use. Store and use at 20° ± 4° C. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit www.inorganicventures.com/TCT

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 10CFR50 Appendix B - Nuclear Regulatory Commission

- Domestic Licensing of Production and Utilization Facilities

10.2 10CFR21 - Nuclear Regulatory Commission

- Reporting defects and Non-Compliance

10.3 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

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- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.5 ISO Guide 34 "General Requirements for the Competence of Reference Material Producers"

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

April 12, 2017

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- April 12, 2021

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

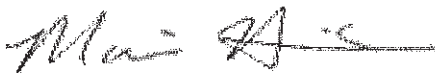
- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year from the date of removal from the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being handled and stored in accordance with the instructions given in Sec 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By:

Maurice Harris
Product Documentation Technician



Certificate Approved By:

Michael Booth
Supervisor, Quality Control



Certifying Officer:

Paul Gaines
CEO, Senior Technical Director





212 Technology Drive
Farmingdale, NY 11735 USA
info@inorganicventures.com

CERTIFICATE OF ANALYSIS

TEL: 800.662.6799 • FAX: 516.585.7000
WWW.INORGANICVENTURES.COM

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO Guide 34, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).



2.0 PRODUCT DESCRIPTION

Product Code: Multi Analyte Custom Grade Solution
Catalog Number: 2007ICS-1
Lot Number: N2-MEB665036
Matrix: 2% (v/v) HNO₃
0.3% (v/v) HF
Value / Analyte(s): 1 000 µg/mL ea:
Titanium,
500 µg/mL ea:
Boron,
300 µg/mL ea:
Molybdenum,
230 µg/mL ea:
Silicon

LIMS ID C901007
Exp: 01/29/20

3.0 CERTIFIED VALUES AND UNCERTAINTIES

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
Boron, B	500.1 ± 3.1 µg/mL	Molybdenum, Mo	300.1 ± 1.6 µg/mL
Silicon, Si	230.0 ± 1.5 µg/mL	Titanium, Ti	1 000 ± 6 µg/mL

Density: 1.015 g/mL (measured at 20 ± 4 °C)

Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
B	ICP Assay	3107	110830
Mo	ICP Assay	3134	130418
Si	ICP Assay	3150	130912
Ti	ICP Assay	3162a	130925

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM by two independent methods Characterization of CRM by one method

Characterization of CRM/RM by Two Methods

Certified Value, $X_{CRM/RM}$, where two methods of characterization are used is the weighted mean of the two results:

$$X_{CRM/RM} = [(w_a)(X_a) + (w_b)(X_b)]$$

X_a = mean of Assay Method A with standard uncertainty $u_{char a}$

X_b = mean of Assay Method B with standard uncertainty $u_{char b}$

w_a and w_b = the weighting factors for each method calculated using the inverse square of the variance:

$$w_a = (1/u_{char a})^2 / ((1/u_{char a})^2 + (1/u_{char b})^2)$$

$$w_b = (1/u_{char b})^2 / ((1/u_{char a})^2 + (1/u_{char b})^2)$$

$$CRM/RM \text{ Expanded Uncertainty } (z) = U_{CRM/RM} = k (u_{char a \& b}^2 + u_{bb}^2 + u_{lts}^2 + u_{ts}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{char a \& b} = [(w_a)^2 (u_{char a})^2 + (w_b)^2 (u_{char b})^2]^{1/2}$ where $u_{char a}$ and $u_{char b}$ are the square root of the sum of the squares of errors from characterization which include instrument measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$$X_{CRM/RM} = \text{mean of Assay Method A with standard uncertainty } u_{char a}$$

$$CRM/RM \text{ Expanded Uncertainty } (z) = U_{CRM/RM} = k (u_{char a}^2 + u_{bb}^2 + u_{lts}^2 + u_{ts}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{char a}$ = square root of the sum of the squares of the errors from characterization which include instrumental measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'In-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

N/A

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit www.inorganicventures.com/TCT

HF Note: This standard should not be prepared or stored in glass.

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 10CFR50 Appendix B - Nuclear Regulatory Commission

- Domestic Licensing of Production and Utilization Facilities

10.2 10CFR21 - Nuclear Regulatory Commission

- Reporting defects and Non-Compliance

10.3 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.4 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.5 ISO Guide 34 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; info@inorganicventures.com; inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

February 01, 2018

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **February 01, 2022**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

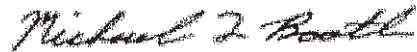
- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Supervisor, Quality Control

Handwritten signature of Michael Booth in cursive script.

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

Handwritten signature of Paul R. Gaines in cursive script.



999 Technology Drive
Chesapeake, VA 20763 USA
info@inorganicventures.com

CERTIFICATE OF ANALYSIS

Phone: 5669.6199 • Fax: 5669.6199
Email: info@inorganicventures.com

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO Guide 34, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).



2.0 PRODUCT DESCRIPTION

Product Code: Multi Analyte Custom Grade Solution
Catalog Number: 6020ICS-0A
Lot Number: N2-MEB671629
Matrix: 1% (v/v) HNO₃
Value / Analyte(s): 10 000 µg/mL ea:
Chloride,
2 000 µg/mL ea:
Carbon,
1 000 µg/mL ea:
Calcium, Aluminum,
Potassium, Magnesium,
Phosphorus, Sulfur,
20 µg/mL ea:
Titanium, Molybdenum

LIMS 2D C90/002
Exp: 01/29/20

3.0 CERTIFIED VALUES AND UNCERTAINTIES

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
Aluminum, Al	999 ± 3 µg/mL	Calcium, Ca	999 ± 4 µg/mL
Carbon, C	1 999 ± 4 µg/mL	Chloride, Cl	9 990.0 ± 60.0 µg/mL
Iron, Fe	999 ± 4 µg/mL	Magnesium, Mg	999 ± 4 µg/mL
Molybdenum, Mo	19.99 ± 0.10 µg/mL	Phosphorus, P	999 ± 5 µg/mL
Potassium, K	999 ± 4 µg/mL	Sodium, Na	999 ± 3 µg/mL
Sulfur, S	999 ± 4 µg/mL	Titanium, Ti	19.99 ± 0.12 µg/mL

Density: 1.032 g/mL (measured at 20 ± 4 °C)

Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
Al	ICP Assay	3101a	060502
Al	EDTA	928	928
C	Acidimetric	84L	84L
Ca	ICP Assay	3109a	130213
Ca	EDTA	928	928
Cl	Calculated		See Sec. 4.2
Fe	ICP Assay	3126a	140812
Fe	EDTA	928	928
K	ICP Assay	3141a	140813
K	Gravimetric		See Sec. 4.2
Mg	ICP Assay	3131a	140110
Mg	EDTA	928	928
Mo	ICP Assay	3134	130418
Na	ICP Assay	3152a	120715
Na	Gravimetric		See Sec. 4.2
P	ICP Assay	3139a	060717
P	Acidimetric	84L	84L
S	Acidimetric	84L	84L
S	ICP Assay	3154	892205
Ti	ICP Assay	3162a	130925

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

Characterization of CRM by two independent methods Characterization of CRM by one method

Characterization of CRM/RM by Two Methods

Certified Value, $X_{\text{CRM/RM}}$, where two methods of characterization are used is the weighted mean of the two results:

$$X_{\text{CRM/RM}} = [w_a (X_a) + (w_b) (X_b)]$$

X_a = mean of Assay Method A with standard uncertainty $u_{\text{char a}}$

X_b = mean of Assay Method B with standard uncertainty $u_{\text{char b}}$

w_a and w_b = the weighting factors for each method calculated using the inverse square of the variance:

$$w_a = (1/u_{\text{char a}})^2 / ((1/u_{\text{char a}})^2 + (1/u_{\text{char b}})^2)$$

$$w_b = (1/u_{\text{char b}})^2 / ((1/u_{\text{char a}})^2 + (1/u_{\text{char b}})^2)$$

$$\text{CRM/RM Expanded Uncertainty } (\pm) = U_{\text{CRM/RM}} = k (u_{\text{char a\&b}}^2 + u_{\text{bb}}^2 + u_{\text{ts}}^2 + u_{\text{ts}}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{\text{char a\&b}} = ((w_a)^2 (u_{\text{char a}})^2 + (w_b)^2 (u_{\text{char b}})^2)^{1/2}$ where $u_{\text{char a}}$ and $u_{\text{char b}}$ are the square root of the sum of the squares of errors from characterization which include instrument measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{ts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{\text{CRM/RM}}$, where one method of characterization is used is the mean of individual results:

$$X_{\text{CRM/RM}} = \text{mean of Assay Method A with standard uncertainty } u_{\text{char a}}$$

$$\text{CRM/RM Expanded Uncertainty } (\pm) = U_{\text{CRM/RM}} = k (u_{\text{char a}}^2 + u_{\text{bb}}^2 + u_{\text{ts}}^2 + u_{\text{ts}}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{\text{char a}}$ = square root of the sum of the squares of the errors from characterization which include instrumental measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{ts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M Ag < 0.000299	M Eu < 0.000099	s Na <	M Se < 0.002591	M Zn < 0.001895
s Al <	s Fe <	M Nb < 0.000099	n Si <	M Zr < 0.000299
O As < 0.020640	M Ga < 0.000099	M Nd < 0.000099	M Sm < 0.000099	
M Au < 0.000099	M Gd < 0.000099	M Ni < 0.009776	M Sn < 0.000598	
M B < 0.005786	M Ge < 0.000997	M Os < 0.000099	O Sr < 0.005263	
M Ba < 0.001396	M Hf < 0.000099	s P <	M Ta < 0.000399	
M Be < 0.000099	M Hg < 0.000199	M Pb < 0.000698	M Tb < 0.000099	
M Bi < 0.000399	M Ho < 0.000099	M Pd < 0.000099	M Te < 0.000798	
s Ca <	M In < 0.000099	M Pr < 0.000099	M Th < 0.000099	
O Cd < 0.000619	M Ir < 0.000099	M Pt < 0.000099	s Ti <	
M Ce < 0.000099	s K <	M Rb < 0.015563	M Tl < 0.000099	
M Co < 0.005786	M La < 0.000099	M Re < 0.003192	M Tm < 0.000099	
M Cr < 0.002394	O Li < 0.001651	M Rh < 0.000099	M U < 0.000099	
M Cs < 0.000698	M Lu < 0.000099	M Ru < 0.000199	M V < 0.001695	
O Cu < 0.015480	s Mg <	s S <	M W < 0.002194	
M Dy < 0.000099	O Mn < 0.002889	M Sb < 0.001496	M Y < 0.000099	
M Er < 0.000199	s Mo <	O Sc < 0.000516	M Yb < 0.000099	

M - Checked by ICP-MS O - Checked by ICP-OES I - Spectral Interference
n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit www.inorganicventures.com/TCT

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.3 ISO Guide 34 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

September 11, 2018

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **September 11, 2022**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

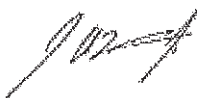
- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By:

James King Jr
Chemist, Technical Manager



Certificate Approved By:

Michael Booth
Supervisor, Quality Control

Michael J Booth

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

Paul R Gaines



3000 W. Broadway Blvd.
Tucson, AZ 85741 USA
info@inorganicventures.com

CERTIFICATE OF ANALYSIS

TEL: 520.609.6999 FAX: 520.609.9050
WWW.INORGANICVENTURES.COM

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO Guide 34, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories".

Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).



2.0 PRODUCT DESCRIPTION

Product Code: Multi Analyte Custom Grade Solution

Catalog Number: 6020ICS-0B

Lot Number: K2-MEB652938

Matrix: 3% (v/v) HNO₃

Value / Analyte(s): 2 µg/mL ea:

Silver,	Arsenic,	Cadmium,
Cobalt,	Chromium+3,	Copper,
Manganese,	Nickel,	Zinc

LIMS ID C901001
Exp: 01/29/20

3.0 CERTIFIED VALUES AND UNCERTAINTIES

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
Arsenic, As	2.000 ± 0.014 µg/mL	Cadmium, Cd	2.000 ± 0.012 µg/mL
Chromium+3, Cr3	2.000 ± 0.010 µg/mL	Cobalt, Co	2.000 ± 0.009 µg/mL
Copper, Cu	2.000 ± 0.012 µg/mL	Manganese, Mn	2.000 ± 0.010 µg/mL
Nickel, Ni	2.000 ± 0.012 µg/mL	Silver, Ag	2.000 ± 0.014 µg/mL
Zinc, Zn	2.000 ± 0.012 µg/mL		

Certified Density: 1.013 g/mL (measured at 20 ± 1 °C)

Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
Ag	ICP Assay	3151	992212
Ag	Volhard	999c	999c
As	ICP Assay	3103a	100818
Cd	ICP Assay	3108	130116
Cd	EDTA	928	928
Co	ICP Assay	3113	000630 Co
Co	EDTA	928	928
Cr3	ICP Assay	3112a	030730Cr3
Cr3	Calculated		See Sec. 4.2
Cu	ICP Assay	3114	121207
Cu	EDTA	928	928
Mn	ICP Assay	3132	050429
Mn	EDTA	928	928
Ni	ICP Assay	3136	120619
Ni	EDTA	928	928
Zn	ICP Assay	3168a	120629
Zn	EDTA	928	928

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

Characterization of CRM by two independent methods

Characterization of CRM/RM by Two Methods

Certified Value, $X_{CRM/RM}$, where two methods of characterization are used is the weighted mean of the two results:

$$X_{CRM/RM} = [(w_a)(X_a) + (w_b)(X_b)]$$

X_a = mean of Assay Method A with standard uncertainty $u_{char a}$

X_b = mean of Assay Method B with standard uncertainty $u_{char b}$

w_a and w_b = the weighting factors for each method calculated using the inverse square of the variance:

$$w_a = (1/u_{char a})^2 / ((1/u_{char a})^2 + (1/u_{char b})^2)$$

$$w_b = (1/u_{char b})^2 / ((1/u_{char a})^2 + (1/u_{char b})^2)$$

$$CRM/RM \text{ Expanded Uncertainty } (\pm) = U_{CRM/RM} = k (u_{char a \& b}^2 + u_{bb}^2 + u_{lts}^2 + u_{ts}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{char a \& b} = [(w_a)^2 (u_{char a})^2 + (w_b)^2 (u_{char b})^2]^{1/2}$ where $u_{char a}$ and $u_{char b}$ are the square root of the sum of the squares of errors from characterization which include instrument measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Characterization of CRM by one method

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$$X_{CRM/RM} = \text{mean of Assay Method A with standard uncertainty } u_{char a}$$

$$CRM/RM \text{ Expanded Uncertainty } (\pm) = U_{CRM/RM} = k (u_{char a}^2 + u_{bb}^2 + u_{lts}^2 + u_{ts}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{char a}$ = square root of the sum of the squares of the errors from characterization which include instrumental measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

N/A

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.
- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.
- After opening the sealed TCT bag keep cap tightly sealed when not in use. Store and use at 20° ± 4° C. Do not pipette from the container. Do not return removed aliquots to container.
- For more information, visit www.inorganicventures.com/TCT

Low Silver Note: This solution contains "LOW" levels of Silver. Please store this entire bottle inside a sealed glass jar.

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 10CFR50 Appendix B - Nuclear Regulatory Commission

- Domestic Licensing of Production and Utilization Facilities

10.2 10CFR21 - Nuclear Regulatory Commission

- Reporting defects and Non-Compliance

10.3 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.4 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.5 ISO Guide 34 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

October 31, 2016

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- October 31, 2020

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

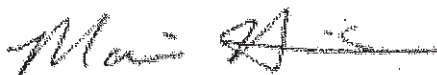
- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year from the date of removal from the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being handled and stored in accordance with the instructions given in Sec 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By:

Maurice Harris
Product Documentation Technician



Certificate Approved By:

Michael Booth
Supervisor, Quality Control



Certifying Officer:

Paul Gaines
CEO, Senior Technical Director





2005 Testline Technology
Charlottesville, VA 22902-4199
Inorganic Ventures, Inc.

CERTIFICATE OF ANALYSIS

Log # 93-229-0790 - 5/11/2010
Accredited by NIST
Inorganic Ventures, Inc.

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO Guide 34, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).



2.0 PRODUCT DESCRIPTION

Product Code: Multi Analyte Custom Grade Solution
Catalog Number: QCP-QCS-4
Lot Number: M2-MEB663298
Matrix: 7% (v/v) HNO₃
Value / Analyte(s): 5 µg/mL ea:
Mercury

LIMS ID C901003
Exp: 01/29/20

Second Source: Whenever possible, this solution was manufactured from a second set of concentrates in our manufacturing facility.

3.0 CERTIFIED VALUES AND UNCERTAINTIES

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
Mercury, Hg	5.000 ± 0.022 µg/mL		

Density: 1.034 g/mL (measured at 20 ± 4 °C)

Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
Hg	ICP Assay	3133	061204
Hg	EDTA	928	928

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM by two independent methods Characterization of CRM by one method

Characterization of CRM/RM by Two Methods

Certified Value, $X_{\text{CRM/RM}}$, where two methods of characterization are used is the weighted mean of the two results:

$$X_{\text{CRM/RM}} = \{ (w_a) (X_a) + (w_b) (X_b) \}$$

X_a = mean of Assay Method A with standard uncertainty $u_{\text{char a}}$

X_b = mean of Assay Method B with standard uncertainty $u_{\text{char b}}$

w_a and w_b = the weighting factors for each method calculated using the inverse square of the variance:

$$w_a = (1/u_{\text{char a}})^2 / \{ (1/u_{\text{char a}})^2 + (1/u_{\text{char b}})^2 \}$$

$$w_b = (1/u_{\text{char b}})^2 / \{ (1/u_{\text{char a}})^2 + (1/u_{\text{char b}})^2 \}$$

$$\text{CRM/RM Expanded Uncertainty } (\pm) = U_{\text{CRM/RM}} = k \{ u_{\text{char a\&b}}^2 + u_{\text{bb}}^2 + u_{\text{ts}}^2 + u_{\text{te}}^2 \}^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{\text{char a\&b}} = \{ (w_a)^2 (u_{\text{char a}})^2 + (w_b)^2 (u_{\text{char b}})^2 \}^{1/2}$ where $u_{\text{char a}}$ and $u_{\text{char b}}$ are the square root of the sum of the squares of errors from characterization which include instrument measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{ts} = long term stability standard uncertainty (storage)

u_{te} = transport stability standard uncertainty

Characterization of CRM/RM by One Method

Certified Value, $X_{\text{CRM/RM}}$, where one method of characterization is used is the mean of individual results:

$$X_{\text{CRM/RM}} = \text{mean of Assay Method A with standard uncertainty } u_{\text{char a}}$$

$$\text{CRM/RM Expanded Uncertainty } (\pm) = U_{\text{CRM/RM}} = k \{ u_{\text{char a}}^2 + u_{\text{bb}}^2 + u_{\text{ts}}^2 + u_{\text{te}}^2 \}^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{\text{char a}}$ = square root of the sum of the squares of the errors from characterization which include instrumental measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{ts} = long term stability standard uncertainty (storage)

u_{te} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

N/A

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit www.inorganicventures.com/TCT

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 10CFR50 Appendix B - Nuclear Regulatory Commission

- Domestic Licensing of Production and Utilization Facilities

10.2 10CFR21 - Nuclear Regulatory Commission

- Reporting defects and Non-Compliance

10.3 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.4 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.5 ISO Guide 34 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.669.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

November 17, 2017

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **November 17, 2021**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Michael Booth
Supervisor, Quality Control

Handwritten signature of Michael Z Booth in cursive script.

Certifying Officer:

Paul Gaines
CEO, Senior Technical Director

Handwritten signature of Paul R Gaines in cursive script.



QSR Certified Supply Chain
Certified to ISO 9001:2015
Inorganic Ventures, LLC

CERTIFICATE OF ANALYSIS

QSR-1034-2015-10-01
QSR-1034-2015-10-01
Inorganic Ventures, LLC

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO Guide 34, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (QSR Certificate Number QSR-1034).



2.0 PRODUCT DESCRIPTION

Product Code: Multi Analyte Custom Grade Solution

Catalog Number: QCP-QCS-3

Lot Number: M2-MEB663137

Matrix: 7% (v/v) HNO₃

Value / Analyte(s): 50 µg/mL ea:

Selenium,

10 µg/mL ea:

Thorium,

Vanadium,

Aluminum,

Beryllium,

Cobalt,

Iron,

Manganese,

Nickel,

Thallium,

Zinc,

Arsenic,

Calcium,

Chromium,

Potassium,

Molybdenum,

Lead,

Uranium,

Silver,

Barium,

Cadmium,

Copper,

Magnesium,

Sodium,

Antimony

Second Source: Whenever possible, this solution was manufactured from a second set of concentrates in our manufacturing facility.

3.0 CERTIFIED VALUES AND UNCERTAINTIES

LIMS ID C9 01004
Exp: 01/29/20

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
Aluminum, Al	10.01 ± 0.05 µg/mL	Antimony, Sb	10.01 ± 0.06 µg/mL
Arsenic, As	10.01 ± 0.09 µg/mL	Barium, Ba	10.01 ± 0.05 µg/mL
Beryllium, Be	10.01 ± 0.07 µg/mL	Cadmium, Cd	10.01 ± 0.05 µg/mL
Calcium, Ca	10.01 ± 0.05 µg/mL	Chromium, Cr	10.01 ± 0.07 µg/mL
Cobalt, Co	10.01 ± 0.06 µg/mL	Copper, Cu	10.01 ± 0.05 µg/mL
Iron, Fe	10.01 ± 0.04 µg/mL	Lead, Pb	10.01 ± 0.05 µg/mL
Magnesium, Mg	10.01 ± 0.05 µg/mL	Manganese, Mn	10.01 ± 0.05 µg/mL
Molybdenum, Mo	10.01 ± 0.04 µg/mL	Nickel, Ni	10.01 ± 0.05 µg/mL
Potassium, K	10.01 ± 0.05 µg/mL	Selenium, Se	50.04 ± 0.32 µg/mL
Silver, Ag	10.01 ± 0.04 µg/mL	Sodium, Na	10.01 ± 0.05 µg/mL
Thallium, Tl	10.01 ± 0.05 µg/mL	Thorium, Th	10.01 ± 0.05 µg/mL
Uranium, U	10.01 ± 0.06 µg/mL	Vanadium, V	10.01 ± 0.05 µg/mL
Zinc, Zn	10.01 ± 0.05 µg/mL		

Density: 1.037 g/mL (measured at 20 ± 4 °C)

Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
Ag	ICP Assay	3151	992212
Ag	Volhard	999c	999c
Al	ICP Assay	3101a	060502
Al	EDTA	928	928
As	ICP Assay	3103a	100818
Ba	ICP Assay	3104a	070222
Ba	Gravimetric		See Sec. 4.2
Be	ICP Assay	3105a	090514
Ca	ICP Assay	3109a	130213
Ca	EDTA	928	928
Cd	ICP Assay	3108	060531
Cd	EDTA	928	928
Co	ICP Assay	3113	000630 Co
Co	EDTA	928	928
Cr	ICP Assay	3112a	030730Cr3
Cu	ICP Assay	3114	121207
Cu	EDTA	928	928
Fe	ICP Assay	3126a	140812
Fe	EDTA	928	928
K	ICP Assay	3141a	140813
K	Gravimetric		See Sec. 4.2
Mg	ICP Assay	3131a	050302
Mg	EDTA	928	928
Mn	ICP Assay	3132	050429
Mn	EDTA	928	928
Mo	ICP Assay	3134	130418
Mo	Calculated		See Sec. 4.2
Na	ICP Assay	3152a	120715
Na	Gravimetric		See Sec. 4.2
Ni	ICP Assay	3136	120619
Ni	EDTA	928	928
Pb	ICP Assay	3128	101026
Pb	EDTA	928	928
Sb	ICP Assay	3102a	140911
Se	ICP Assay	3149	100901
Th	EDTA	928	928
Th	Calculated		See Sec. 4.2
Tl	ICP Assay	3158	993012
Tl	Calculated		See Sec. 4.2
U	ICP Assay	3164	080521
U	Calculated		See Sec. 4.2
V	EDTA	928	928
V	ICP Assay	3165	992706
Zn	ICP Assay	3168a	120629
Zn	EDTA	928	928

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

Characterization of CRM by two independent methods Characterization of CRM by one method

Characterization of CRM/RM by Two Methods

Certified Value, $X_{\text{CRM/RM}}$, where two methods of characterization are used is the weighted mean of the two results:

$$X_{\text{CRM/RM}} = [(w_a)(X_a) + (w_b)(X_b)]$$

X_a = mean of Assay Method A with standard uncertainty $u_{\text{char a}}$

X_b = mean of Assay Method B with standard uncertainty $u_{\text{char b}}$

w_a and w_b = the weighting factors for each method calculated using the Inverse square of the variance:

$$w_a = (1/u_{\text{char a}})^2 / ((1/u_{\text{char a}})^2 + (1/u_{\text{char b}})^2)$$

$$w_b = (1/u_{\text{char b}})^2 / ((1/u_{\text{char a}})^2 + (1/u_{\text{char b}})^2)$$

$$\text{CRM/RM Expanded Uncertainty } (\pm) = U_{\text{CRM/RM}} = k (u_{\text{char a\&b}}^2 + u_{\text{bb}}^2 + u_{\text{lte}}^2 + u_{\text{ts}}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{\text{char a\&b}} = [(w_a)^2 (u_{\text{char a}})^2 + (w_b)^2 (u_{\text{char b}})^2]^{1/2}$ where $u_{\text{char a}}$ and $u_{\text{char b}}$ are the square root of the sum of the squares of errors from characterization which include Instrument measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lte} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

Certified Abundance:

IV's Certified Abundance

<u>Isotope</u>	<u>Atom %</u>
Uranium 238U	99.7 ± 0.1
Uranium 235U	0.28 ± 0.05

Characterization of CRM/RM by One Method

Certified Value, $X_{\text{CRM/RM}}$, where one method of characterization is used is the mean of individual results:

$$X_{\text{CRM/RM}} = \text{mean of Assay Method A with standard uncertainty } u_{\text{char a}}$$

$$\text{CRM/RM Expanded Uncertainty } (\pm) = U_{\text{CRM/RM}} = k (u_{\text{char a}}^2 + u_{\text{bb}}^2 + u_{\text{lte}}^2 + u_{\text{ts}}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{\text{char a}} = \text{square root of the sum of the squares of the errors from characterization which include instrumental measurement, density, NIST SRM uncertainty, weighing, and volume}$

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lte} = long term stability standard uncertainty (storage)

u_{ts} = transport stability standard uncertainty

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

N/A

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit www.inorganicventures.com/TCT

Low Silver Note: This solution contains "LOW" levels of Silver. Please store this entire bottle inside a sealed glass jar.

Uranium Note: If uranium is present in this standard, it is natural abundance unless specified in Section 3

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 10CFR50 Appendix B - Nuclear Regulatory Commission

- Domestic Licensing of Production and Utilization Facilities

10.2 10CFR21 - Nuclear Regulatory Commission

- Reporting defects and Non-Compliance

10.3 ISO 9001 Quality Management System Registration

- QSR Certificate Number QSR-1034

10.4 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.5 ISO Guide 34 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

Inorganic Ventures, 300 Technology Drive, Christiansburg, Va. 24073, USA; Telephone: 800.869.6799; 540.585.3030, Fax: 540.585.3012; inorganicventures.com; info@inorganicventures.com

11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

November 10, 2017

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

11.2 Lot Expiration Date

- **November 10, 2021**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

11.3 Period of Validity

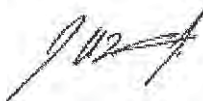
- Sealed TCT Bag Open Date: _____

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By:

James King Jr
Chemist, Technical Manager



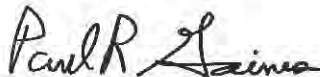
Certificate Approved By:

Michael Booth
Supervisor, Quality Control



Certifying Officer:

Paul Gaines
CEO, Senior Technical Director



C905002
Exp! 07/31/21

Reference Material

▪ Certificate of Analysis ▪

Product: Metals in Soil
Catalog Number: 540
Lot No. D100-540
Certificate Issue Date: December 14, 2017
Expiration Date: July 31, 2021
Revision Number: Original

Product use instructions are included as part of the certification packet and are paginated separately from this Certificate of Analysis. Please reference the product use instructions for catalog #540 revision 030512.

CERTIFICATION

Parameter	Certified Value ¹	Reference Value	Uncertainty ²	QC Performance Acceptance Limits ³	PT Performance Acceptance Limits ⁴
	mg/kg	mg/kg	%	mg/kg	mg/kg
Aluminum	10100	8720	0.150	4510 - 12900	4420 - 13000
Antimony	199	94.1	2.65	D.L. - 194	19.9 - 242
Arsenic	64.6	58.5	3.87	48.3 - 68.7	40.9 - 76.0
Barium	201	183	1.38	150 - 217	138 - 229
Beryllium	66.4	59.7	2.47	49.3 - 70.2	44.8 - 74.7
Boron	161	126	2.30	90.7 - 161	75.7 - 177
Cadmium	284	249	3.39	205 - 294	187 - 312
Calcium	5190	4600	0.292	3730 - 5470	3330 - 5870
Chromium	71.9	64.9	4.69	52.8 - 77.0	45.4 - 84.4
Cobalt	47.8	45.0	5.70	37.6 - 52.4	33.8 - 56.2
Copper	124	113	5.50	93.5 - 132	84.4 - 141
Iron	15000	13600	2.90	8000 - 19200	4610 - 22600
Lead	176	161	2.78	131 - 191	117 - 205
Magnesium	2570	2310	1.02	1750 - 2870	1430 - 3190
Manganese	232	219	3.28	179 - 260	158 - 281
Mercury	13.0	11.8	2.10	8.30 - 15.3	7.07 - 16.5
Molybdenum	88.3	76.2	3.43	60.6 - 91.8	53.0 - 99.5
Nickel	166	147	3.74	121 - 174	103 - 192
Potassium	2420	2030	4.39	1420 - 2640	1200 - 2860
Selenium	166	145	2.10	113 - 176	97.2 - 192
Silver	57.5	51.0	3.14	40.1 - 61.9	35.7 - 66.3
Sodium	2710	2430	2.02	1780 - 3070	1620 - 3230
Strontium	99.4	93.0	3.32	75.0 - 111	66.6 - 119
Thallium	216	188	3.63	150 - 225	134 - 241

▪ Certificate of Analysis ▪

Parameter	Certified Value ¹	Reference Value	Uncertainty ²	QC Performance Acceptance Limits ³	PT Performance Acceptance Limits ⁴
	mg/kg	mg/kg	%	mg/kg	mg/kg
Tin	166	139	2.80	107 - 172	82.8 - 196
Titanium	956	775	2.11	201 - 1350	350 - 1200
Uranium	60.0	53.5	1.96	39.2 - 67.7	33.3 - 73.6
Vanadium	139	125	3.25	97.9 - 152	87.7 - 162
Zinc	130	121	5.62	97.0 - 144	84.4 - 157

ANALYTICAL VERIFICATION

Parameter	Certified Value ¹	Proficiency Testing Study			NIST Traceability	
		Mean	Recovery ⁵	n	SRM Number	Recovery
	mg/kg	mg/kg	%			%
Aluminum	10100	8720	86.3	147	-	-
Antimony	199	94.1	47.3	147	-	-
Arsenic	64.6	58.5	90.5	184	-	-
Barium	201	183	91.2	159	-	-
Beryllium	66.4	59.7	90.0	158	-	-
Boron	161	126	78.3	103	-	-
Cadmium	284	249	87.8	188	-	-
Calcium	5190	4600	88.6	128	-	-
Chromium	71.9	64.9	90.3	176	-	-
Cobalt	47.8	45.0	94.1	145	-	-
Copper	124	113	90.8	180	-	-
Iron	15000	13600	90.5	138	-	-
Lead	176	161	91.4	194	-	-
Magnesium	2570	2310	89.9	131	-	-
Manganese	232	219	94.6	155	-	-
Mercury	13.0	11.8	90.7	119	-	-
Molybdenum	88.3	76.2	86.3	150	-	-
Nickel	166	147	88.8	184	-	-
Potassium	2420	2030	83.9	134	-	-
Selenium	166	145	87.2	171	-	-

▪ Certificate of Analysis ▪

Parameter	Certified Value ¹	Proficiency Testing Study		n	NIST Traceability	
		Mean	Recovery ⁵		SRM Number	Recovery
	mg/kg	mg/kg	%			%
Silver	57.5	51.0	88.7	156	-	-
Sodium	2710	2430	89.6	120	-	-
Strontium	99.4	93.0	93.5	86	-	-
Thallium	216	188	86.8	156	-	-
Tin	166	139	84.0	109	-	-
Titanium	956	775	81.0	99	-	-
Uranium	60.0	53.5	89.1	27	-	-
Vanadium	139	125	89.9	151	-	-
Zinc	130	121	92.8	177	-	-

1. The **Certified Values** are the actual "made-to" concentrations confirmed by ERA analytical verification. The certified values are monitored and purchasers will be notified of any significant changes resulting in recertification or withdrawal of this certified reference material during the period of validity of this certificate.

2. The **Uncertainty** is the total propagated uncertainty at the 95% confidence interval. The uncertainty is based on the preparation and internal analytical verification of the product by ERA, multiplied by a coverage factor. The uncertainty applies to the product as supplied and does not take into account any required or optional dilution and/or preparations the laboratory may perform while using this product.

3. The **QC Performance Acceptance Limits (QC PALs™)** are based on actual historical data collected in ERA's Proficiency Testing program. The QC PALs™ reflect any inherent biases in the methods used to establish the limits and closely approximate a 95% confidence interval of the performance that experienced laboratories should achieve using accepted environmental methods. Use the QC PALs™ to realistically evaluate your performance against your peers.

4. The **PT Performance Acceptance Limits (PT PALs™)** are calculated using the regression equations and fixed acceptance criteria specified in the NELAC proficiency testing requirements. Use the PT PALs™ when analyzing this QC standard alongside USEPA and NELAC compliant PT standards. Please note that many PT study acceptance limits are concentration dependent (some non-linearly) and, therefore, the acceptance limits of this QC standard and any PT standard may differ relative to their difference in concentrations.

5. The **PT Data/Traceability** data include the mean value, percent recovery and number of data points reported by the laboratories in our Proficiency Testing study compared to the Certified Values. In addition, where NIST Standard Reference Materials (SRMs) are available, each analyte has been analytically traced to the NIST SRM listed. This product is traceable to the lot numbers of its starting materials. All gravimetric and volumetric measurements related to its manufacture are traceable to NIST through an unbroken chain of comparisons.

Traceability Recovery (%) = [(% recovery certified standard)/(% recovery NIST SRM)]*100

The traceability data shown were compiled by analyzing the ERA standards or their associated stock solutions against the applicable NIST SRMs.

6. For additional information on this product such as intended use, instructions for use, level of homogeneity, and safety information, please refer to the provided Instruction Sheet

If you have any questions or need technical assistance, please call ERA technical assistance at 1-800-372-0122 or send an email to info@eraqc.com.

Certifying Officer

Brian Miller

Quality Officer

David Kilhefner

Brian Miller

David Kilhefner

ISO/IEC GUIDE 34:2009

ISO/IEC 17025:2005





National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 2710a

Montana I Soil

Highly Elevated Trace Element Concentrations

This Standard Reference Material (SRM) is intended primarily for use in the analysis of soils, sediments, or other materials of a similar matrix. One unit of SRM 2710a consists of 50 g of the dried, powdered soil, blended with lead oxide.

Certified Values: The certified concentrations for 22 elements, expressed as mass fractions [1] on a dry-mass basis, are provided in Table 1. Certified values are based on results obtained from critically evaluated independent analytical techniques. A NIST certified value is a value for which NIST has the highest confidence in its accuracy in that all known or suspected sources of bias have been investigated or taken into account [2].

Reference Values: The reference values for 13 constituents, expressed as mass fractions on a dry-mass basis, are provided in Table 2. Ten reference values are based on results obtained from a single NIST analytical method, and three are based on results from two NIST analytical methods. Reference values are non-certified values that are the best estimate of the true value; however, the values do not meet NIST criteria for certification and are provided with associated uncertainties that may not include all sources of uncertainty [2].

Information Values: The values for 13 elements are provided in Table 3 for information purposes only. These are non-certified values with no uncertainty assessed. The information values included in this certificate are based on results obtained from one NIST method.

Expiration of Certification: The certification of SRM 2710a is valid, within the measurement uncertainties specified, until **1 January 2019**, provided the SRM is handled in accordance with the instructions given in this certificate (see "Instructions for Use"). This certification is nullified if the SRM is damaged, contaminated, or otherwise modified.

Maintenance of SRM Certification: NIST will monitor this SRM over the period of its certification. If substantive technical changes occur that affect the certification before the expiration of this certificate, NIST will notify the purchaser. Registration (see attached sheet) will facilitate notification.

E.A. Mackey and R.R. Greenberg of the NIST Analytical Chemistry Division were responsible for coordination of the technical measurements leading to certification.

Statistical analyses were performed by J.H. Yen of the NIST Statistical Engineering Division.

Support aspects involved in the issuance of this SRM were coordinated through the NIST Measurement Services Division.

Stephen A. Wise, Chief
Analytical Chemistry Division

Gaithersburg, MD 20899
Certificate Issue Date: 7 April 2009

Robert L. Watters, Jr., Chief
Measurement Services Division

INSTRUCTIONS FOR USE

Sampling: The SRM should be thoroughly mixed by repeatedly inverting and rotating the bottle horizontally before removing a test portion for analysis. A minimum mass of 250 mg (dry mass - see *Instructions for Drying*) should be used for analytical determinations to be related to the mass fraction values in this Certificate of Analysis.

To obtain the certified values, sample preparation procedures should be designed to effect complete dissolution. If volatile elements (i.e., arsenic, mercury, selenium) will be determined, precautions should be taken in the dissolution of SRM 2710a to avoid volatilization losses.

Drying: To relate measurements to the certified, reference, and information values that are expressed on a dry-mass basis, users should determine a drying correction at the time of each analysis. The recommended drying procedure is oven drying for 2 h at 110 °C. Note that analytical determination of volatile elements (i.e., arsenic, mercury, selenium) should be determined on samples as received; separate samples should be dried as previously described to obtain a correction factor for moisture. Correction for moisture must be made to the data for volatile elements before comparing to the certified values. This procedure ensures that these elements are not lost during drying. The mass loss on drying for this material as bottled was approximately 2 %, but this value may change once the bottle is opened and the soil is exposed to air.

SOURCE, PREPARATION, AND ANALYSIS

Source and Preparation of Material¹: The U.S. Geological Survey (USGS), under contract to NIST, collected and processed the material for SRM 2710a. The original collection site used for SRM 2710 was no longer available due to remediation efforts by the Montana Department of Environmental Quality. An alternative nearby site, located within the flood plain of the Silver Bow Creek, was selected. The site is approximately five miles west of Butte, Montana. Soil for SRM 2710a was placed in 22 plastic-lined five-gallon buckets using a common garden spade. The buckets were sealed and transferred to the USGS using a commercial freight carrier. At the USGS, the SRM 2710a soil was dried at room temperature, disaggregated, and sieved to remove coarse material (≥ 2 mm). The resulting soil was ball-milled in 50 kg portions together with an amount of lead oxide sufficient to achieve a mass fraction of 0.55 % lead in the final product. The entire ball-milled batch of soil was transferred to a cross-flow V-blender for mixing. The blended soil was radiation sterilized prior to bottling. In the final preparation step the blended material was split into containers using a custom-designed spinning riffler, which was used to divide the material into smaller batches, and then used to apportion approximately 50 g into each pre-cleaned bottle.

Every 100th bottle was set aside for chemical analyses designed to assess material homogeneity using X-ray fluorescence spectrometry (XRF), inductively coupled plasma optical emission spectrometry (ICP-OES), and inductively coupled plasma mass spectrometry (ICP-MS) at the USGS. Homogeneity assessments were performed at NIST as well, and results indicated that additional processing was needed to achieve optimum homogeneity. The material from all bottles was combined, and then ground in batches between stainless steel plates for a time sufficient to produce a powder of which ≥ 95 %, by mass, passed through a 200 mesh (74 μm) sieve. The resulting powder was blended, and 50 g portions were dispensed into bottles using the spinning riffler. Results from additional analyses indicated material homogeneity was acceptable (see below).

Analysis: The homogeneity was assessed for selected elements in the bottled material using X-ray fluorescence spectrometry and instrumental neutron activation analysis (INAA). The estimated relative standard deviation for material inhomogeneity is <1 % and no component for inhomogeneity was included in the expanded uncertainties of the certified or reference values.

Analyses of this material were performed at NIST and at the USGS (Denver, CO). Results from NIST were used to provide the certified, reference, and information values shown in Tables 1, 2, and 3 respectively. Results from the USGS were used to confirm those values. The analytical techniques used for each element are listed in Table 4; the analysts are listed in Tables 5 and 6.

¹ Certain commercial equipment, instruments, or materials are identified in this certificate in order to specify adequately the experimental procedure. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.

Table 1. Certified Values^(a,b) (Dry-Mass Basis) for Selected Elements in SRM 2710a

Element	Mass Fraction (%)			Element	Mass Fraction (mg/kg)		
Aluminum	5.95	±	0.05	Antimony	52.5	±	1.6
Arsenic	0.154	±	0.010	Barium	792	±	36
Calcium	0.964	±	0.045	Cadmium	12.3	±	0.3
Copper	0.342	±	0.005	Cobalt	5.99	±	0.14
Iron	4.32	±	0.08	Lanthanum	30.6	±	1.2
Lead	0.552	±	0.003	Mercury	9.88	±	0.21
Magnesium	0.734	±	0.038	Strontium	255	±	7
Manganese	0.214	±	0.006	Uranium	9.11	±	0.30
Phosphorus	0.105	±	0.004				
Potassium	2.17	±	0.13				
Silicon	31.1	±	0.4				
Sodium	0.894	±	0.019				
Titanium	0.311	±	0.007				
Zinc	0.418	±	0.015				

^(a) Certified values for all elements except lead and mercury are the equally weighted means of results from two or three analytical methods. The uncertainty listed with each value is an expanded uncertainty about the mean. The expanded uncertainty is calculated as $U = ku_c$, where u_c is intended to represent, at the level of one standard deviation, the combined effect of between-method and within-method components of uncertainty, following the ISO Guide [3,4]. The coverage factor (k) is determined from the Student's t -distribution corresponding to the appropriate associated degrees of freedom and approximately 95 % confidence for each analyte.

^(b) The certified values for lead and mercury are each results from a single NIST method (see Table 4) for which a complete evaluation of all sources of uncertainty has been performed. The uncertainties for the certified values for these elements represent expanded uncertainties with a coverage factor of 2, with uncertainty components combined following the ISO Guide [4].

Table 2. Reference Values^(a,b,c) (Dry-Mass Basis) for Selected Elements in SRM 2710a

Element	Mass Fraction (mg/kg)	
Cesium	8.25 ±	0.11
Chromium	23 ±	6
Europium	0.82 ±	0.01
Gadolinium	3.0 ±	0.1
Lutetium	0.31 ±	0.01
Neodymium	22 ±	2
Nickel	8 ±	1
Rubidium	117 ±	3
Samarium	4.0 ±	0.2
Scandium	9.9 ±	0.1
Thallium	1.52 ±	0.02
Thorium	18.1 ±	0.3
Vanadium	82 ±	9

^(a) Reference values for all elements except chromium, nickel, samarium, and vanadium are based on results from one analytical method at NIST (see Table 4) and the uncertainties represent the expanded uncertainties, which include the combined Type A and Type B with a coverage factor of 2, following the ISO Guide [4].

^(b) Reference values for nickel and samarium are the equally weighted means of results from two analytical methods for nickel and two INAA experiments for samarium. The uncertainty listed with each value is an expanded uncertainty about the mean. The expanded uncertainty is calculated as $U = ku_c$, where u_c is intended to represent, at the level of one standard deviation, the combined effect of between-method and within-method components of uncertainty, following the ISO Guide [3,4]. The coverage factor (k) is determined from the Student's t -distribution corresponding to the appropriate associated degrees of freedom and approximately 95 % confidence for each analyte.

^(c) Reference values for chromium and vanadium are based on a weighted mean calculated based on the Dersimonian-Laird method [5], which incorporates an estimate of the between-method variance into the weights. The expanded uncertainty listed with these values is calculated as $U = ku_c$, where $k = 2$, and u_c is intended to represent, at the level of one standard deviation, the combined effect of between-method and within-method components of uncertainty.

Table 3. Information Values ^(a) (Dry-Mass Basis) for Selected Elements in SRM 2710a

Element	Mass Fraction (mg/kg)
Boron	20
Cerium	60
Dysprosium	3
Gold	0.2
Hafnium	7
Indium	7
Selenium	1
Silver	40
Tantalum	0.9
Terbium	0.5
Tungsten	190
Ytterbium	2
Zirconium	200

^(a) Information values are based on results from one analytical method at NIST

Table 4. NIST Methods Used for the Analysis of SRM 2710a

Element	Methods	Element	Methods
Ag	INAA	Na	INAA; XRF
Al	INAA; XRF	Nd	INAA
As	CCT-ICP-MS; INAA; XRF	Ni	ICP-MS; ICP-OES
Au	INAA	P	ICP-OES; XRF
B	PGAA	Pb	ID-ICP-MS
Ba	INAA; XRF	Rb	INAA
Ca	INAA; XRF	Sb	ICP-MS; INAA
Cd	ID-ICP-MS; PGAA	Sc	INAA
Ce	INAA	Se	CCT-ICP-MS
Co	INAA; ICP-OES	Si	PGAA; XRF
Cr	INAA; XRF	Sm	INAA ^(a)
Cs	INAA	Sr	ICP-OES; XRF
Cu	INAA; XRF	Ta	INAA
Dy	INAA	Tb	INAA
Eu	INAA	Th	INAA
Fe	INAA; PGAA; XRF	Ti	PGAA; XRF
Gd	PGAA	Tl	ICP-MS
Hf	INAA	U	ICP-MS; INAA
Hg	CV-ID-ICPMS	V	INAA; XRF
K	INAA; PGAA; XRF	W	INAA
La	INAA ^(a)	Yb	INAA
Lu	INAA	Zn	INAA; XRF
Mg	INAA; XRF	Zr	XRF
Mn	INAA; PGAA; XRF		

NIST Methods of Analysis

CCT-ICP-MS	Collision cell inductively coupled plasma mass spectrometry
CV-ID-ICP-MS	Cold vapor isotope dilution inductively coupled plasma mass spectrometry
ICP-MS	Inductively coupled plasma mass spectrometry
ICP-OES	Inductively coupled plasma optical emission spectrometry
ID-ICP-MS	Isotope dilution inductively coupled plasma mass spectrometry
INAA	Instrumental neutron activation analysis
PGAA	Prompt gamma-ray activation analysis
XRF	X-ray fluorescence spectrometry

USGS Methods of Analysis^(b)

WD-XRF-2	Wavelength dispersive X-ray fluorescence spectrometry at USGS
ICP-OES-2	Inductively coupled plasma optical emission spectrometry at USGS
ICP-MS-2	Inductively coupled plasma mass spectrometry at USGS

^(a)Two different INAA experiments, performed using different sub-samples and different analytical conditions, were used to provide certified and reference values for lanthanum and samarium, respectively.

^(b)USGS Methods of Analysis were used to confirm results from certification methods.

Table 5. Participating NIST Analysts:

S.J. Christopher	S.A. Rabb
R.D. Day	J.R. Sieber
S.E. Long	R.O. Spatz
E.A. Mackey	R.S. Popelka-Filcoff
A.F. Marlow	B.E. Tomlin
J.L. Molloy	L.J. Wood
K.E. Murphy	L.L. Yu
R.L. Paul	R. Zeisler

Table 6. Participating USGS Laboratory and Analysts

Laboratory	Analysts
U.S. Geological Survey Branch of Geochemistry Denver, CO, USA	M.G. Adams Z.A. Brown P.L. Lamothe J.E. Taggart S.A. Wilson

REFERENCES

- [1] Thompson, A.; Taylor, B.N.; *Guide for the Use of the International System of Units (SI)*, NIST Special Publication 811 (2008); available at <http://www.physics.nist.gov/Pubs/contents.html>.
- [2] May, W.E.; Gills, T.E.; Parris, R.; Beck, H, C.M.; Fassett, J.D.; Gettings, R.J.; Greenberg, R.R.; Guenther, F.R.; Kramer, G.; MacDonald, B.S.; Wise, S.A.; *Definitions of Terms and Modes Used at NIST for Value-Assignment of Reference Materials for Chemical Measurements*, NIST Special Publication 260-136 (1999); available at http://www.cstl.nist.gov/nist839/NIST_special_publications.htm.
- [3] Levenson, M.S.; Banks, D.L.; Eberhardt, K.R.; Gill, L.M.; Guthrie, W.F.; Liu, H.K.; Vangel, M.G.; Yen, J.H.; Zhang, N.F.; J. Res. NIST 105, pp. 571-579 (2000).
- [4] ISO; *Guide to the Expression of Uncertainty in Measurement*, ISBN 92-67-10188-9, 1st ed.; International Organization for Standardization: Geneva, Switzerland (1993); see also Taylor, B.N.; Kuyatt, C.E.; *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, NIST Technical Note 1297, U.S. Government Printing Office, Washington, DC (1994); available at <http://www.physics.nist.gov/Pubs/contents.html>.
- [5] DerSimonian, R.; Laird, N.; *Controlled Clinical Trials* 7, 177-188 (1986).

Users of this SRM should ensure that the certificate in their possession is current. This can be accomplished by contacting the SRM Program at: telephone (301) 975-2200; fax (301) 926-4751; e-mail srminfo@nist.gov; or via the Internet at <http://www.nist.gov/srm>.

Addendum to Certificate

Standard Reference Material® 2710a

Montana I Soil

Highly Elevated Trace Element Concentrations

Leachable Concentrations Determined Using USEPA Methods 200.7 and 3050B

The mass fraction values contained in the NIST Certificate of Analysis for SRM 2710a represent the total element content of the material. The measurement results used to provide the certified, reference or information values are obtained from methods that require complete sample decomposition, or from nondestructive analytical methods such as instrumental neutron activation analysis or prompt gamma-ray activation analysis. Where complete sample decomposition is required, it can be accomplished by digestion with mixed acids or by fusion. For mixed-acid decomposition, hydrofluoric acid must be included in the acid mixture used to totally decompose siliceous materials such as soils and sediments.

In its monitoring programs, the U.S. Environmental Protection Agency (USEPA) has established a number of leach methods for the preparation of soil samples for the determination of extractable elements. Six laboratories participated, five of which used USEPA Method 200.7; the remaining laboratory used USEPA SW-846 Method 3050B for preparation of soil samples. All elements were determined in leachates by inductively coupled plasma optical emission spectrometry. All laboratories provided individual results from duplicate portions, and these results were averaged together to provide one result for each element from each participating laboratory. Results rejected as outliers by the USEPA Contract Laboratory Program (CLP) officials were not included. Results are summarized in Table A1. The ranges of mass fraction values, median values (to two significant figures), and the number of results included for each are given for 23 elements. The percent recovery values based on the ratios of the median values to the total element content (from the certified, reference, or information values in the Certificate of Analysis) are listed in the last column of Table A1. **Note that the certified values provided as total mass fractions in the Certificate of Analysis are the best estimate of the true mass fraction values for this material.**

This USEPA CLP Study was coordinated by Clifton Jones, Quality Assurance and Technical Support Program (QATS), Shaw Environmental & Infrastructure Group, Las Vegas, NV, under the direction of John Nebelsick, USEPA, Analytical Services Branch. The participating laboratories are listed in Table A2.

Table A1. Results from Laboratories Participating in the EPA Contract Laboratory Program Study.

Element	n	Range (mg/kg)		Median (mg/kg)	Recovery (%)
Aluminum	6	8200	- 12000	10000	17
Antimony	6	5.0	- 12	9.6	18
Arsenic	6	1300	- 1600	1400	92
Barium	6	490	- 540	510	65
Beryllium	6	0.24	- 0.51	0.48	--
Cadmium	5	9.6	- 12	11	86
Calcium	6	1700	- 2000	1800	19
Chromium	6	9.2	- 11	10	41
Cobalt	6	2.8	- 5.2	3.8	64
Copper	6	3100	- 3500	3300	95
Iron	6	30000	- 36000	34000	79
Lead	6	4700	- 5800	5100	93
Magnesium	6	3200	- 3600	3500	48
Manganese	6	1500	- 1800	1700	77
Mercury	6	9.3	- 11.7	10	104
Nickel	5	4.8	- 6.1	5.5	69
Potassium	6	3800	- 4700	4100	19
Selenium	2	1.5	- 2.6	2.0	200
Silver	6	31	- 39	36	91
Sodium	6	550	- 650	590	7
Thallium	3	1.3	- 3.6	3.2	213
Vanadium	6	35	- 43	38	48
Zinc	6	3300	- 4400	3800	90

Table A2. List of CLP and non-CLP Participating Laboratories

A4 Scientific, Inc.
 Bonner Analytical Testing Co.
 Chem Tech Consulting Group
 Datachem Laboratories, Inc.
 Liberty Analytical Corporation
 SVL Analytical, Inc.

Appendix D
Volume Estimate Worksheets
Irene Mine

File name: irenewp1.ms4d

Volume: 835.74 yd³

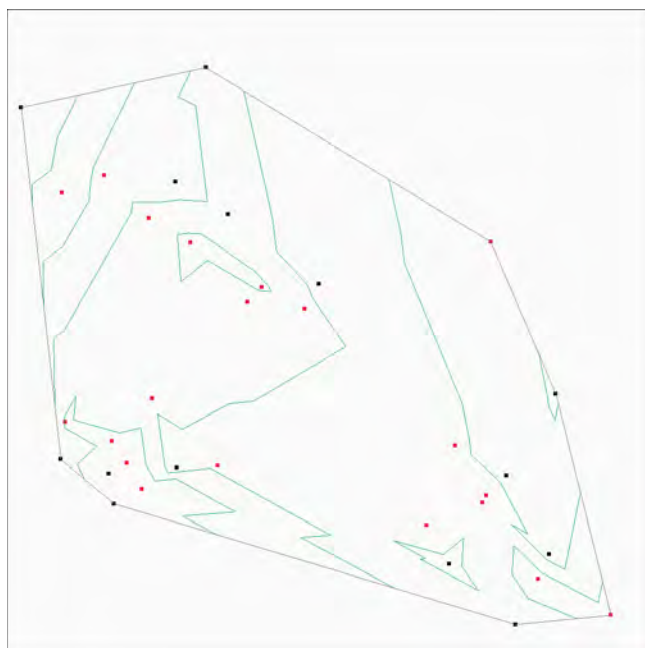
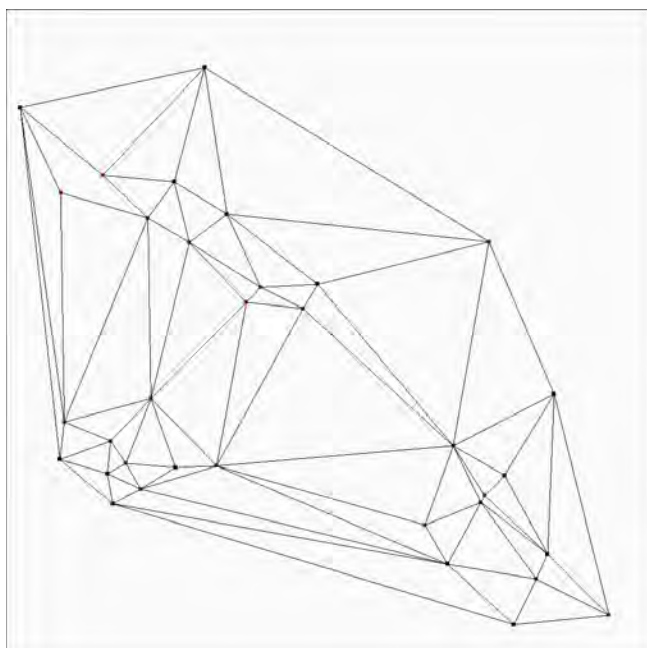
Weight: 0.00 pounds

Material type:

Method: Volume with Azimuth

Units: Feet

Note:



Point	X	Y	Z	Note
1	0.00	0.00	0.00	Origin
2	20.53	-17.79	-6.16	Base
3	2.20	-26.77	-5.51	Base
4	39.81	-35.72	2.60	Pile
5	9.11	-38.85	1.21	Pile
6	21.79	60.19	4.22	Base
7	10.86	-2.47	-1.67	Base
8	19.35	-19.83	-2.70	Base
9	41.80	13.42	6.92	Pile
10	26.56	-11.49	2.18	Pile
11	-42.51	29.99	-6.21	Traverse
12	-52.58	41.57	-9.50	Base
13	-35.20	39.67	-9.21	Base
14	-65.40	113.65	-8.88	Pile
15	-30.69	47.12	-5.09	Pile
16	-63.49	39.28	-7.25	Traverse
17	-70.06	59.98	-15.64	Base
18	-48.20	46.22	-15.01	Base
19	-58.51	68.73	-9.44	Pile
20	-84.43	54.66	-4.57	Traverse
21	-82.78	67.53	-9.93	Base
22	-74.67	78.57	-3.65	Pile
23	-105.80	66.85	3.86	Traverse
24	-109.49	75.22	3.81	Base
25	-96.55	80.61	-2.42	Base
26	-121.87	101.48	12.88	Pile
27	-104.65	16.21	-7.72	Traverse
28	-89.49	-7.86	-20.48	Base
29	-108.38	4.86	-14.37	Base
30	-95.18	-11.00	-19.82	Pile
31	-109.73	-6.70	-10.77	Pile
32	-85.47	1.12	-12.70	Traverse
33	-84.97	-15.73	-20.37	Base
34	-94.19	-0.97	-15.10	Base
35	-93.54	-20.22	-17.64	Pile
36	-68.36	5.01	-4.68	Traverse
37	-61.70	-8.65	-5.68	Base
38	-81.81	12.04	-8.35	Base
39	-74.31	-9.13	-2.92	Pile
40	-0.39	-25.12	-5.36	Traverse
41	58.66	-54.56	-9.70	Base
42	36.31	-43.33	-10.60	Base

Point	X	Y	Z	Note
43	29.50	-57.39	-2.59	Pile

APPENDIX E

Laboratory Analytical Results

July 21, 2020

Applied Intellect

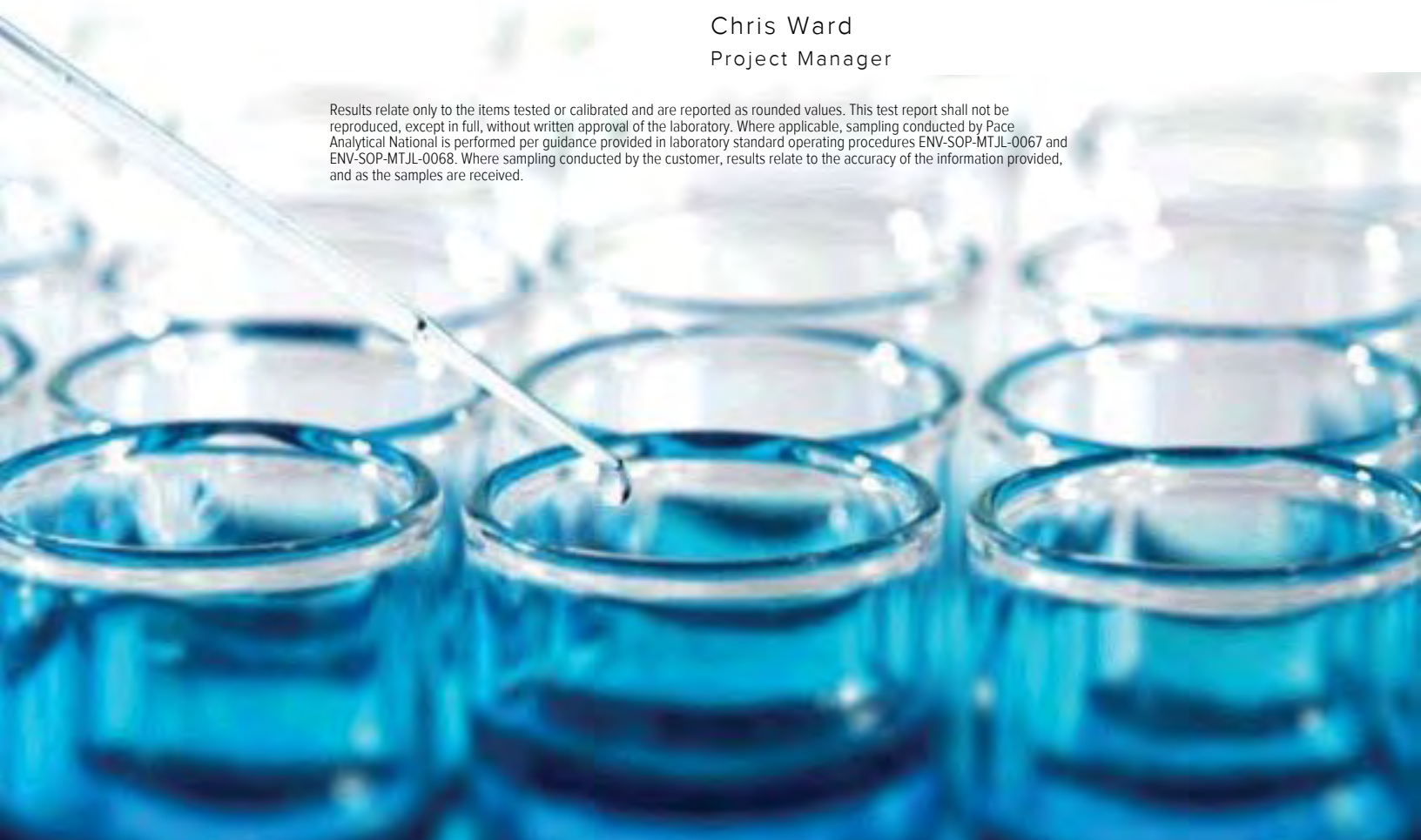
Sample Delivery Group: L1239884
Samples Received: 07/15/2020
Project Number: USFS GMV6 NF
Description: IRENE MINE
Site: IRENE MINE
Report To: Jeffrey Hart
2801 Youngfield St.
Suite 240
Golden, CO 80401

Entire Report Reviewed By:

Chris Ward

Chris Ward
Project Manager

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by Pace Analytical National is performed per guidance provided in laboratory standard operating procedures ENV-SOP-MTJL-0067 and ENV-SOP-MTJL-0068. Where sampling conducted by the customer, results relate to the accuracy of the information provided, and as the samples are received.





Cp: Cover Page	1	¹ Cp
Tc: Table of Contents	2	
Ss: Sample Summary	3	² Tc
Cn: Case Narrative	5	
Sr: Sample Results	6	³ Ss
IR-DA-SD-1 L1239884-01	6	
IR-DA-SD-2 L1239884-02	7	⁴ Cn
IR-DA-SWD-1 L1239884-03	8	⁵ Sr
IR-DA-SWR-1 L1239884-04	9	
IR-DA-SWD-2 L1239884-05	10	⁶ Qc
IR-DA-SWT-2 L1239884-06	11	
IR-SS-WP1-1 L1239884-07	12	⁷ Gl
IR-SS-WP1-1 L1239884-08	13	
IR-SS-WP1-2 L1239884-09	14	⁸ Al
IR-SS-WP2-1 L1239884-10	15	
IR-SS-WP2-1 L1239884-11	16	⁹ Sc
ER-TRONOX-7-8-2020 L1239884-12	17	
IR-SS-BKG-1 L1239884-13	18	
Qc: Quality Control Summary	19	
Mercury by Method 7470A	19	
Mercury by Method 7471A	22	
Metals (ICP) by Method 6010B	24	
Gl: Glossary of Terms	35	
Al: Accreditations & Locations	36	
Sc: Sample Chain of Custody	37	

SAMPLE SUMMARY

ONE LAB. NATIONWIDE.



IR-DA-SD-1 L1239884-01 Solid

				Collected by Jeff Hart	Collected date/time 07/08/20 15:45	Received date/time 07/15/20 08:30
Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Mercury by Method 7471A	WG1510525	1	07/16/20 20:44	07/17/20 13:22	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1511048	5	07/18/20 11:28	07/20/20 00:03	CCE	Mt. Juliet, TN

¹ Cp

² Tc

³ Ss

IR-DA-SD-2 L1239884-02 Solid

				Collected by Jeff Hart	Collected date/time 07/08/20 15:45	Received date/time 07/15/20 08:30
Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Mercury by Method 7471A	WG1510525	1	07/16/20 20:44	07/17/20 13:25	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1511048	5	07/18/20 11:28	07/20/20 00:06	CCE	Mt. Juliet, TN

⁴ Cn

⁵ Sr

⁶ Qc

IR-DA-SWD-1 L1239884-03 GW

				Collected by Jeff Hart	Collected date/time 07/08/20 15:30	Received date/time 07/15/20 08:30
Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Mercury by Method 7470A	WG1509757	1	07/16/20 19:00	07/17/20 09:38	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1510348	1	07/19/20 22:41	07/20/20 20:35	EL	Mt. Juliet, TN

⁷ Gl

⁸ Al

⁹ Sc

IR-DA-SWR-1 L1239884-04 GW

				Collected by Jeff Hart	Collected date/time 07/08/20 15:30	Received date/time 07/15/20 08:30
Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Mercury by Method 7470A	WG1509756	1	07/16/20 08:36	07/16/20 20:35	TCT	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1510357	1	07/20/20 00:27	07/21/20 07:20	CCE	Mt. Juliet, TN

IR-DA-SWD-2 L1239884-05 GW

				Collected by Jeff Hart	Collected date/time 07/08/20 15:30	Received date/time 07/15/20 08:30
Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Mercury by Method 7470A	WG1509757	1	07/16/20 19:00	07/17/20 09:40	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1510348	1	07/19/20 22:41	07/20/20 20:38	EL	Mt. Juliet, TN

IR-DA-SWT-2 L1239884-06 GW

				Collected by Jeff Hart	Collected date/time 07/08/20 15:30	Received date/time 07/15/20 08:30
Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Mercury by Method 7470A	WG1509756	1	07/16/20 08:36	07/16/20 20:37	TCT	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1510357	1	07/20/20 00:27	07/21/20 07:23	CCE	Mt. Juliet, TN

IR-SS-WP1-1 L1239884-07 GW

				Collected by Jeff Hart	Collected date/time 07/08/20 14:32	Received date/time 07/15/20 08:30
Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Preparation by Method 1312	WG1510103	1	07/16/20 11:36	07/16/20 11:36	TM	Mt. Juliet, TN
Mercury by Method 7470A	WG1510845	1	07/17/20 12:46	07/20/20 18:35	TCT	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1511061	1	07/17/20 22:08	07/18/20 11:13	EL	Mt. Juliet, TN

SAMPLE SUMMARY

ONE LAB. NATIONWIDE.



IR-SS-WP1-1 L1239884-08 Solid

				Collected by Jeff Hart	Collected date/time 07/08/20 14:32	Received date/time 07/15/20 08:30
Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Mercury by Method 7471A	WG1510525	1	07/16/20 20:44	07/17/20 13:33	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1511048	5	07/18/20 11:28	07/20/20 00:09	CCE	Mt. Juliet, TN

¹ Cp

² Tc

³ Ss

IR-SS-WP1-2 L1239884-09 Solid

				Collected by Jeff Hart	Collected date/time 07/08/20 12:00	Received date/time 07/15/20 08:30
Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Mercury by Method 7471A	WG1510525	1	07/16/20 20:44	07/17/20 12:46	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1511048	10	07/18/20 11:28	07/19/20 23:58	CCE	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1511048	5	07/18/20 11:28	07/20/20 00:00	CCE	Mt. Juliet, TN

⁴ Cn

⁵ Sr

⁶ Qc

IR-SS-WP2-1 L1239884-10 GW

				Collected by Jeff Hart	Collected date/time 07/08/20 16:20	Received date/time 07/15/20 08:30
Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Preparation by Method 1312	WG1510103	1	07/16/20 11:36	07/16/20 11:36	TM	Mt. Juliet, TN
Mercury by Method 7470A	WG1510845	1	07/17/20 12:46	07/20/20 18:43	TCT	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1511061	1	07/17/20 22:08	07/18/20 11:15	EL	Mt. Juliet, TN

⁷ Gl

⁸ Al

⁹ Sc

IR-SS-WP2-1 L1239884-11 Solid

				Collected by Jeff Hart	Collected date/time 07/08/20 16:20	Received date/time 07/15/20 08:30
Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Mercury by Method 7471A	WG1510525	1	07/16/20 20:44	07/17/20 13:35	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1511048	5	07/18/20 11:28	07/20/20 00:12	RDS	Mt. Juliet, TN

ER-TRONOX-7-8-2020 L1239884-12 GW

				Collected by Jeff Hart	Collected date/time 07/08/20 13:40	Received date/time 07/15/20 08:30
Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Mercury by Method 7470A	WG1509757	1	07/16/20 19:00	07/17/20 09:42	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1510348	1	07/19/20 22:41	07/20/20 20:41	EL	Mt. Juliet, TN

IR-SS-BKG-1 L1239884-13 Solid

				Collected by Jeff Hart	Collected date/time 07/08/20 15:25	Received date/time 07/15/20 08:30
Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Mercury by Method 7471A	WG1510875	1	07/17/20 13:14	07/20/20 11:09	ABL	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1511048	1	07/18/20 11:28	07/19/20 18:55	CCE	Mt. Juliet, TN



All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

Chris Ward
Project Manager

¹ Cp

² Tc

³ Ss

⁴ Cn

⁵ Sr

⁶ Qc

⁷ Gl

⁸ Al

⁹ Sc



Mercury by Method 7471A

Analyte	Result mg/kg	Qualifier	MDL mg/kg	RDL mg/kg	Dilution	Analysis date / time	Batch
Mercury	0.0304	J	0.0180	0.0400	1	07/17/2020 13:22	WG1510525

Metals (ICP) by Method 6010B

Analyte	Result mg/kg	Qualifier	MDL mg/kg	RDL mg/kg	Dilution	Analysis date / time	Batch
Aluminum	1340		41.0	100	5	07/20/2020 00:03	WG1511048
Antimony	5.97	J	2.50	10.0	5	07/20/2020 00:03	WG1511048
Arsenic	U		2.30	10.0	5	07/20/2020 00:03	WG1511048
Barium	12.6		1.20	2.50	5	07/20/2020 00:03	WG1511048
Beryllium	U		0.400	1.00	5	07/20/2020 00:03	WG1511048
Cadmium	U		0.405	2.50	5	07/20/2020 00:03	WG1511048
Calcium	U		150	500	5	07/20/2020 00:03	WG1511048
Chromium	U		1.25	5.00	5	07/20/2020 00:03	WG1511048
Cobalt	U		1.15	5.00	5	07/20/2020 00:03	WG1511048
Copper	73.0		2.53	10.0	5	07/20/2020 00:03	WG1511048
Iron	173000		25.0	50.0	5	07/20/2020 00:03	WG1511048
Lead	86.5		1.04	2.50	5	07/20/2020 00:03	WG1511048
Magnesium	104	J	102	500	5	07/20/2020 00:03	WG1511048
Manganese	11.0		1.22	5.00	5	07/20/2020 00:03	WG1511048
Nickel	U		2.45	10.0	5	07/20/2020 00:03	WG1511048
Potassium	155	J	104	250	5	07/20/2020 00:03	WG1511048
Selenium	5.16	J	3.08	10.0	5	07/20/2020 00:03	WG1511048
Silver	U		1.14	5.00	5	07/20/2020 00:03	WG1511048
Sodium	U		166	500	5	07/20/2020 00:03	WG1511048
Thallium	U		1.77	10.0	5	07/20/2020 00:03	WG1511048
Vanadium	6.95	J	3.44	10.0	5	07/20/2020 00:03	WG1511048
Zinc	70.1		4.70	25.0	5	07/20/2020 00:03	WG1511048

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc



Mercury by Method 7471A

Analyte	Result mg/kg	Qualifier	MDL mg/kg	RDL mg/kg	Dilution	Analysis date / time	Batch
Mercury	0.0208	J	0.0180	0.0400	1	07/17/2020 13:25	WG1510525

Metals (ICP) by Method 6010B

Analyte	Result mg/kg	Qualifier	MDL mg/kg	RDL mg/kg	Dilution	Analysis date / time	Batch
Aluminum	951		41.0	100	5	07/20/2020 00:06	WG1511048
Antimony	5.22	J	2.50	10.0	5	07/20/2020 00:06	WG1511048
Arsenic	U		2.30	10.0	5	07/20/2020 00:06	WG1511048
Barium	9.83		1.20	2.50	5	07/20/2020 00:06	WG1511048
Beryllium	U		0.400	1.00	5	07/20/2020 00:06	WG1511048
Cadmium	U		0.405	2.50	5	07/20/2020 00:06	WG1511048
Calcium	U		150	500	5	07/20/2020 00:06	WG1511048
Chromium	U		1.25	5.00	5	07/20/2020 00:06	WG1511048
Cobalt	U		1.15	5.00	5	07/20/2020 00:06	WG1511048
Copper	53.0		2.53	10.0	5	07/20/2020 00:06	WG1511048
Iron	139000		25.0	50.0	5	07/20/2020 00:06	WG1511048
Lead	78.7		1.04	2.50	5	07/20/2020 00:06	WG1511048
Magnesium	U		102	500	5	07/20/2020 00:06	WG1511048
Manganese	8.40		1.22	5.00	5	07/20/2020 00:06	WG1511048
Nickel	U		2.45	10.0	5	07/20/2020 00:06	WG1511048
Potassium	171	J	104	250	5	07/20/2020 00:06	WG1511048
Selenium	3.42	J	3.08	10.0	5	07/20/2020 00:06	WG1511048
Silver	U		1.14	5.00	5	07/20/2020 00:06	WG1511048
Sodium	U		166	500	5	07/20/2020 00:06	WG1511048
Thallium	U		1.77	10.0	5	07/20/2020 00:06	WG1511048
Vanadium	4.64	J	3.44	10.0	5	07/20/2020 00:06	WG1511048
Zinc	49.7		4.70	25.0	5	07/20/2020 00:06	WG1511048

¹ Cp² Tc³ Ss⁴ Cn⁵ Sr⁶ Qc⁷ Gl⁸ Al⁹ Sc



Mercury by Method 7470A

Analyte	Result mg/l	Qualifier	MDL mg/l	RDL mg/l	Dilution	Analysis date / time	Batch
Mercury,Dissolved	U		0.000100	0.000200	1	07/17/2020 09:38	WG1509757

Metals (ICP) by Method 6010B

Analyte	Result mg/l	Qualifier	MDL mg/l	RDL mg/l	Dilution	Analysis date / time	Batch
Aluminum,Dissolved	6.92		0.0704	0.200	1	07/20/2020 20:35	WG1510348
Antimony,Dissolved	0.00674	J	0.00430	0.0100	1	07/20/2020 20:35	WG1510348
Arsenic,Dissolved	U		0.00440	0.0100	1	07/20/2020 20:35	WG1510348
Barium,Dissolved	0.00806		0.000895	0.00500	1	07/20/2020 20:35	WG1510348
Beryllium,Dissolved	0.00131	J	0.000460	0.00200	1	07/20/2020 20:35	WG1510348
Cadmium,Dissolved	0.00896		0.000563	0.00200	1	07/20/2020 20:35	WG1510348
Calcium,Dissolved	56.8		0.389	1.00	1	07/20/2020 20:35	WG1510348
Chromium,Dissolved	U		0.00500	0.0100	1	07/20/2020 20:35	WG1510348
Cobalt,Dissolved	0.0349		0.000807	0.0100	1	07/20/2020 20:35	WG1510348
Copper,Dissolved	0.0987		0.00469	0.0100	1	07/20/2020 20:35	WG1510348
Iron,Dissolved	11.4		0.0458	0.100	1	07/20/2020 20:35	WG1510348
Lead,Dissolved	0.176		0.00295	0.00600	1	07/20/2020 20:35	WG1510348
Magnesium,Dissolved	11.5		0.111	1.00	1	07/20/2020 20:35	WG1510348
Manganese,Dissolved	1.56		0.00327	0.0100	1	07/20/2020 20:35	WG1510348
Nickel,Dissolved	0.0158		0.00298	0.0100	1	07/20/2020 20:35	WG1510348
Potassium,Dissolved	1.39	J	0.510	2.00	1	07/20/2020 20:35	WG1510348
Selenium,Dissolved	U		0.00735	0.0100	1	07/20/2020 20:35	WG1510348
Silver,Dissolved	U		0.00191	0.00500	1	07/20/2020 20:35	WG1510348
Sodium,Dissolved	6.99		1.40	3.00	1	07/20/2020 20:35	WG1510348
Thallium,Dissolved	U		0.00431	0.0100	1	07/20/2020 20:35	WG1510348
Vanadium,Dissolved	U		0.00634	0.0200	1	07/20/2020 20:35	WG1510348
Zinc,Dissolved	1.59		0.00916	0.0500	1	07/20/2020 20:35	WG1510348

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc



Mercury by Method 7470A

Analyte	Result mg/l	Qualifier	MDL mg/l	RDL mg/l	Dilution	Analysis date / time	Batch
Mercury	U		0.000100	0.000200	1	07/16/2020 20:35	WG1509756

Metals (ICP) by Method 6010B

Analyte	Result mg/l	Qualifier	MDL mg/l	RDL mg/l	Dilution	Analysis date / time	Batch
Aluminum	6.94		0.0704	0.200	1	07/21/2020 07:20	WG1510357
Antimony	U		0.00430	0.0100	1	07/21/2020 07:20	WG1510357
Arsenic	U		0.00440	0.0100	1	07/21/2020 07:20	WG1510357
Barium	0.00854		0.000895	0.00500	1	07/21/2020 07:20	WG1510357
Beryllium	0.00130	J	0.000460	0.00200	1	07/21/2020 07:20	WG1510357
Cadmium	0.00934		0.000563	0.00200	1	07/21/2020 07:20	WG1510357
Calcium	56.8		0.389	1.00	1	07/21/2020 07:20	WG1510357
Chromium	U		0.00500	0.0100	1	07/21/2020 07:20	WG1510357
Cobalt	0.0362		0.000807	0.0100	1	07/21/2020 07:20	WG1510357
Copper	0.108		0.00469	0.0100	1	07/21/2020 07:20	WG1510357
Iron	13.3		0.0458	0.100	1	07/21/2020 07:20	WG1510357
Lead	0.180		0.00295	0.00600	1	07/21/2020 07:20	WG1510357
Magnesium	12.0		0.111	1.00	1	07/21/2020 07:20	WG1510357
Manganese	1.58		0.00327	0.0100	1	07/21/2020 07:20	WG1510357
Nickel	0.0157		0.00298	0.0100	1	07/21/2020 07:20	WG1510357
Potassium	1.42	J	0.510	2.00	1	07/21/2020 07:20	WG1510357
Selenium	U		0.00735	0.0100	1	07/21/2020 07:20	WG1510357
Silver	U		0.00191	0.00500	1	07/21/2020 07:20	WG1510357
Sodium	7.02		1.40	3.00	1	07/21/2020 07:20	WG1510357
Thallium	U		0.00431	0.0100	1	07/21/2020 07:20	WG1510357
Vanadium	U		0.00634	0.0200	1	07/21/2020 07:20	WG1510357
Zinc	1.62		0.00916	0.0500	1	07/21/2020 07:20	WG1510357

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc



Mercury by Method 7470A

Analyte	Result mg/l	Qualifier	MDL mg/l	RDL mg/l	Dilution	Analysis date / time	Batch
Mercury,Dissolved	U		0.000100	0.000200	1	07/17/2020 09:40	WG1509757

Metals (ICP) by Method 6010B

Analyte	Result mg/l	Qualifier	MDL mg/l	RDL mg/l	Dilution	Analysis date / time	Batch
Aluminum,Dissolved	6.89		0.0704	0.200	1	07/20/2020 20:38	WG1510348
Antimony,Dissolved	U		0.00430	0.0100	1	07/20/2020 20:38	WG1510348
Arsenic,Dissolved	U		0.00440	0.0100	1	07/20/2020 20:38	WG1510348
Barium,Dissolved	0.00781		0.000895	0.00500	1	07/20/2020 20:38	WG1510348
Beryllium,Dissolved	0.00130	J	0.000460	0.00200	1	07/20/2020 20:38	WG1510348
Cadmium,Dissolved	0.00907		0.000563	0.00200	1	07/20/2020 20:38	WG1510348
Calcium,Dissolved	56.7		0.389	1.00	1	07/20/2020 20:38	WG1510348
Chromium,Dissolved	U		0.00500	0.0100	1	07/20/2020 20:38	WG1510348
Cobalt,Dissolved	0.0349		0.000807	0.0100	1	07/20/2020 20:38	WG1510348
Copper,Dissolved	0.100		0.00469	0.0100	1	07/20/2020 20:38	WG1510348
Iron,Dissolved	11.9		0.0458	0.100	1	07/20/2020 20:38	WG1510348
Lead,Dissolved	0.175		0.00295	0.00600	1	07/20/2020 20:38	WG1510348
Magnesium,Dissolved	11.5		0.111	1.00	1	07/20/2020 20:38	WG1510348
Manganese,Dissolved	1.54		0.00327	0.0100	1	07/20/2020 20:38	WG1510348
Nickel,Dissolved	0.0158		0.00298	0.0100	1	07/20/2020 20:38	WG1510348
Potassium,Dissolved	1.43	J	0.510	2.00	1	07/20/2020 20:38	WG1510348
Selenium,Dissolved	U		0.00735	0.0100	1	07/20/2020 20:38	WG1510348
Silver,Dissolved	U		0.00191	0.00500	1	07/20/2020 20:38	WG1510348
Sodium,Dissolved	7.00		1.40	3.00	1	07/20/2020 20:38	WG1510348
Thallium,Dissolved	U		0.00431	0.0100	1	07/20/2020 20:38	WG1510348
Vanadium,Dissolved	U		0.00634	0.0200	1	07/20/2020 20:38	WG1510348
Zinc,Dissolved	1.58		0.00916	0.0500	1	07/20/2020 20:38	WG1510348

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc



Mercury by Method 7470A

Analyte	Result mg/l	Qualifier	MDL mg/l	RDL mg/l	Dilution	Analysis date / time	Batch
Mercury	U		0.000100	0.000200	1	07/16/2020 20:37	WG1509756

Metals (ICP) by Method 6010B

Analyte	Result mg/l	Qualifier	MDL mg/l	RDL mg/l	Dilution	Analysis date / time	Batch
Aluminum	6.94		0.0704	0.200	1	07/21/2020 07:23	WG1510357
Antimony	U		0.00430	0.0100	1	07/21/2020 07:23	WG1510357
Arsenic	U		0.00440	0.0100	1	07/21/2020 07:23	WG1510357
Barium	0.00823		0.000895	0.00500	1	07/21/2020 07:23	WG1510357
Beryllium	0.00135	J	0.000460	0.00200	1	07/21/2020 07:23	WG1510357
Cadmium	0.00932		0.000563	0.00200	1	07/21/2020 07:23	WG1510357
Calcium	56.9		0.389	1.00	1	07/21/2020 07:23	WG1510357
Chromium	U		0.00500	0.0100	1	07/21/2020 07:23	WG1510357
Cobalt	0.0361		0.000807	0.0100	1	07/21/2020 07:23	WG1510357
Copper	0.109		0.00469	0.0100	1	07/21/2020 07:23	WG1510357
Iron	13.0		0.0458	0.100	1	07/21/2020 07:23	WG1510357
Lead	0.180		0.00295	0.00600	1	07/21/2020 07:23	WG1510357
Magnesium	12.0		0.111	1.00	1	07/21/2020 07:23	WG1510357
Manganese	1.57		0.00327	0.0100	1	07/21/2020 07:23	WG1510357
Nickel	0.0152		0.00298	0.0100	1	07/21/2020 07:23	WG1510357
Potassium	1.50	J	0.510	2.00	1	07/21/2020 07:23	WG1510357
Selenium	U		0.00735	0.0100	1	07/21/2020 07:23	WG1510357
Silver	U		0.00191	0.00500	1	07/21/2020 07:23	WG1510357
Sodium	7.02		1.40	3.00	1	07/21/2020 07:23	WG1510357
Thallium	U		0.00431	0.0100	1	07/21/2020 07:23	WG1510357
Vanadium	U		0.00634	0.0200	1	07/21/2020 07:23	WG1510357
Zinc	1.62		0.00916	0.0500	1	07/21/2020 07:23	WG1510357

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc



Preparation by Method 1312

Analyte	Result	Qualifier	Prep date / time	Batch
SPLP Extraction	-		7/16/2020 11:36:58 AM	WG1510103
Fluid	1		7/16/2020 11:36:58 AM	WG1510103
Final pH	3.39		7/16/2020 11:36:58 AM	WG1510103

Mercury by Method 7470A

Analyte	Result mg/l	Qualifier	MDL mg/l	RDL mg/l	Dilution	Analysis date / time	Batch
Mercury	U		0.000100	0.000200	1	07/20/2020 18:35	WG1510845

Metals (ICP) by Method 6010B

Analyte	Result mg/l	Qualifier	MDL mg/l	RDL mg/l	Dilution	Analysis date / time	Batch
Aluminum	0.210		0.0704	0.200	1	07/18/2020 11:13	WG1511061
Antimony	U		0.00430	0.0100	1	07/18/2020 11:13	WG1511061
Arsenic	U		0.00440	0.0100	1	07/18/2020 11:13	WG1511061
Barium	0.0472		0.000895	0.00500	1	07/18/2020 11:13	WG1511061
Beryllium	U		0.000460	0.00200	1	07/18/2020 11:13	WG1511061
Cadmium	0.00473		0.000563	0.00200	1	07/18/2020 11:13	WG1511061
Calcium	2.94		0.389	1.00	1	07/18/2020 11:13	WG1511061
Chromium	U		0.00500	0.0100	1	07/18/2020 11:13	WG1511061
Cobalt	0.000905	J	0.000807	0.0100	1	07/18/2020 11:13	WG1511061
Copper	0.130		0.00469	0.0100	1	07/18/2020 11:13	WG1511061
Iron	2.90		0.0458	0.100	1	07/18/2020 11:13	WG1511061
Lead	8.57		0.00295	0.00600	1	07/18/2020 11:13	WG1511061
Magnesium	0.519	J	0.111	1.00	1	07/18/2020 11:13	WG1511061
Manganese	0.0902		0.00327	0.0100	1	07/18/2020 11:13	WG1511061
Nickel	0.00364	J	0.00298	0.0100	1	07/18/2020 11:13	WG1511061
Potassium	2.72		0.510	2.00	1	07/18/2020 11:13	WG1511061
Selenium	U		0.00735	0.0100	1	07/18/2020 11:13	WG1511061
Silver	U		0.00191	0.00500	1	07/18/2020 11:13	WG1511061
Sodium	15.9		1.40	3.00	1	07/18/2020 11:13	WG1511061
Thallium	U		0.00431	0.0100	1	07/18/2020 11:13	WG1511061
Vanadium	U		0.00634	0.0200	1	07/18/2020 11:13	WG1511061
Zinc	1.65		0.00916	0.0500	1	07/18/2020 11:13	WG1511061

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc



Mercury by Method 7471A

Analyte	Result mg/kg	Qualifier	MDL mg/kg	RDL mg/kg	Dilution	Analysis date / time	Batch
Mercury	0.537		0.0180	0.0400	1	07/17/2020 13:33	WG1510525

Metals (ICP) by Method 6010B

Analyte	Result mg/kg	Qualifier	MDL mg/kg	RDL mg/kg	Dilution	Analysis date / time	Batch
Aluminum	2570		41.0	100	5	07/20/2020 00:09	WG1511048
Antimony	4.10	J	2.50	10.0	5	07/20/2020 00:09	WG1511048
Arsenic	12.2		2.30	10.0	5	07/20/2020 00:09	WG1511048
Barium	70.8		1.20	2.50	5	07/20/2020 00:09	WG1511048
Beryllium	U		0.400	1.00	5	07/20/2020 00:09	WG1511048
Cadmium	11.0		0.405	2.50	5	07/20/2020 00:09	WG1511048
Calcium	151	J	150	500	5	07/20/2020 00:09	WG1511048
Chromium	U		1.25	5.00	5	07/20/2020 00:09	WG1511048
Cobalt	1.70	J	1.15	5.00	5	07/20/2020 00:09	WG1511048
Copper	1670		2.53	10.0	5	07/20/2020 00:09	WG1511048
Iron	65600		25.0	50.0	5	07/20/2020 00:09	WG1511048
Lead	33400		1.04	2.50	5	07/20/2020 00:09	WG1511048
Magnesium	300	J	102	500	5	07/20/2020 00:09	WG1511048
Manganese	77.8		1.22	5.00	5	07/20/2020 00:09	WG1511048
Nickel	U		2.45	10.0	5	07/20/2020 00:09	WG1511048
Potassium	1610		104	250	5	07/20/2020 00:09	WG1511048
Selenium	9.63	J	3.08	10.0	5	07/20/2020 00:09	WG1511048
Silver	37.1		1.14	5.00	5	07/20/2020 00:09	WG1511048
Sodium	U		166	500	5	07/20/2020 00:09	WG1511048
Thallium	U		1.77	10.0	5	07/20/2020 00:09	WG1511048
Vanadium	6.00	J	3.44	10.0	5	07/20/2020 00:09	WG1511048
Zinc	3630		4.70	25.0	5	07/20/2020 00:09	WG1511048

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc



Mercury by Method 7471A

Analyte	Result mg/kg	Qualifier	MDL mg/kg	RDL mg/kg	Dilution	Analysis date / time	Batch
Mercury	0.538	<u>J6 O1</u>	0.0180	0.0400	1	07/17/2020 12:46	WG1510525

Metals (ICP) by Method 6010B

Analyte	Result mg/kg	Qualifier	MDL mg/kg	RDL mg/kg	Dilution	Analysis date / time	Batch
Aluminum	3360		41.0	100	5	07/20/2020 00:00	WG1511048
Antimony	U		2.50	10.0	5	07/20/2020 00:00	WG1511048
Arsenic	8.02	<u>J</u>	2.30	10.0	5	07/20/2020 00:00	WG1511048
Barium	72.4		1.20	2.50	5	07/20/2020 00:00	WG1511048
Beryllium	U		0.400	1.00	5	07/20/2020 00:00	WG1511048
Cadmium	32.7		0.405	2.50	5	07/20/2020 00:00	WG1511048
Calcium	167	<u>J</u>	150	500	5	07/20/2020 00:00	WG1511048
Chromium	U		1.25	5.00	5	07/20/2020 00:00	WG1511048
Cobalt	1.28	<u>J</u>	1.15	5.00	5	07/20/2020 00:00	WG1511048
Copper	831		2.53	10.0	5	07/20/2020 00:00	WG1511048
Iron	54800		25.0	50.0	5	07/20/2020 00:00	WG1511048
Lead	27000		1.04	2.50	5	07/20/2020 00:00	WG1511048
Magnesium	725		102	500	5	07/20/2020 00:00	WG1511048
Manganese	117		1.22	5.00	5	07/20/2020 00:00	WG1511048
Nickel	U		2.45	10.0	5	07/20/2020 00:00	WG1511048
Potassium	1560		104	250	5	07/20/2020 00:00	WG1511048
Selenium	8.72	<u>J</u>	3.08	10.0	5	07/20/2020 00:00	WG1511048
Silver	31.3		1.14	5.00	5	07/20/2020 00:00	WG1511048
Sodium	U		166	500	5	07/20/2020 00:00	WG1511048
Thallium	U		1.77	10.0	5	07/20/2020 00:00	WG1511048
Vanadium	9.10	<u>J</u>	3.44	10.0	5	07/20/2020 00:00	WG1511048
Zinc	9280		9.39	50.0	10	07/19/2020 23:58	WG1511048

¹ Cp² Tc³ Ss⁴ Cn⁵ Sr⁶ Qc⁷ Gl⁸ Al⁹ Sc



Preparation by Method 1312

Analyte	Result	Qualifier	Prep date / time	Batch
SPLP Extraction	-		7/16/2020 11:36:58 AM	WG1510103
Fluid	1		7/16/2020 11:36:58 AM	WG1510103
Final pH	3.33		7/16/2020 11:36:58 AM	WG1510103

Mercury by Method 7470A

Analyte	Result mg/l	Qualifier	MDL mg/l	RDL mg/l	Dilution	Analysis date / time	Batch
Mercury	U		0.000100	0.000200	1	07/20/2020 18:43	WG1510845

Metals (ICP) by Method 6010B

Analyte	Result mg/l	Qualifier	MDL mg/l	RDL mg/l	Dilution	Analysis date / time	Batch
Aluminum	0.273		0.0704	0.200	1	07/18/2020 11:15	WG1511061
Antimony	U		0.00430	0.0100	1	07/18/2020 11:15	WG1511061
Arsenic	U		0.00440	0.0100	1	07/18/2020 11:15	WG1511061
Barium	0.0726		0.000895	0.00500	1	07/18/2020 11:15	WG1511061
Beryllium	U		0.000460	0.00200	1	07/18/2020 11:15	WG1511061
Cadmium	0.00183	J	0.000563	0.00200	1	07/18/2020 11:15	WG1511061
Calcium	2.15		0.389	1.00	1	07/18/2020 11:15	WG1511061
Chromium	U		0.00500	0.0100	1	07/18/2020 11:15	WG1511061
Cobalt	U		0.000807	0.0100	1	07/18/2020 11:15	WG1511061
Copper	0.0768		0.00469	0.0100	1	07/18/2020 11:15	WG1511061
Iron	0.252		0.0458	0.100	1	07/18/2020 11:15	WG1511061
Lead	17.3		0.00295	0.00600	1	07/18/2020 11:15	WG1511061
Magnesium	0.555	J	0.111	1.00	1	07/18/2020 11:15	WG1511061
Manganese	0.0474		0.00327	0.0100	1	07/18/2020 11:15	WG1511061
Nickel	U		0.00298	0.0100	1	07/18/2020 11:15	WG1511061
Potassium	3.39		0.510	2.00	1	07/18/2020 11:15	WG1511061
Selenium	U		0.00735	0.0100	1	07/18/2020 11:15	WG1511061
Silver	U		0.00191	0.00500	1	07/18/2020 11:15	WG1511061
Sodium	3.61		1.40	3.00	1	07/18/2020 11:15	WG1511061
Thallium	U		0.00431	0.0100	1	07/18/2020 11:15	WG1511061
Vanadium	U		0.00634	0.0200	1	07/18/2020 11:15	WG1511061
Zinc	0.524		0.00916	0.0500	1	07/18/2020 11:15	WG1511061

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc



Mercury by Method 7471A

Analyte	Result	Qualifier	MDL	RDL	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Mercury	0.679		0.0180	0.0400	1	07/17/2020 13:35	WG1510525

Metals (ICP) by Method 6010B

Analyte	Result	Qualifier	MDL	RDL	Dilution	Analysis	Batch
	mg/kg		mg/kg	mg/kg		date / time	
Aluminum	1570		41.0	100	5	07/20/2020 00:12	WG1511048
Antimony	U		2.50	10.0	5	07/20/2020 00:12	WG1511048
Arsenic	19.2		2.30	10.0	5	07/20/2020 00:12	WG1511048
Barium	176		1.20	2.50	5	07/20/2020 00:12	WG1511048
Beryllium	U		0.400	1.00	5	07/20/2020 00:12	WG1511048
Cadmium	4.86		0.405	2.50	5	07/20/2020 00:12	WG1511048
Calcium	U		150	500	5	07/20/2020 00:12	WG1511048
Chromium	U		1.25	5.00	5	07/20/2020 00:12	WG1511048
Cobalt	U		1.15	5.00	5	07/20/2020 00:12	WG1511048
Copper	81.1		2.53	10.0	5	07/20/2020 00:12	WG1511048
Iron	18600		25.0	50.0	5	07/20/2020 00:12	WG1511048
Lead	13500		1.04	2.50	5	07/20/2020 00:12	WG1511048
Magnesium	174	J	102	500	5	07/20/2020 00:12	WG1511048
Manganese	66.6		1.22	5.00	5	07/20/2020 00:12	WG1511048
Nickel	U		2.45	10.0	5	07/20/2020 00:12	WG1511048
Potassium	1290		104	250	5	07/20/2020 00:12	WG1511048
Selenium	20.7		3.08	10.0	5	07/20/2020 00:12	WG1511048
Silver	46.7		1.14	5.00	5	07/20/2020 00:12	WG1511048
Sodium	U		166	500	5	07/20/2020 00:12	WG1511048
Thallium	U		1.77	10.0	5	07/20/2020 00:12	WG1511048
Vanadium	U		3.44	10.0	5	07/20/2020 00:12	WG1511048
Zinc	1180		4.70	25.0	5	07/20/2020 00:12	WG1511048

¹ Cp² Tc³ Ss⁴ Cn⁵ Sr⁶ Qc⁷ Gl⁸ Al⁹ Sc



Mercury by Method 7470A

Analyte	Result mg/l	Qualifier	MDL mg/l	RDL mg/l	Dilution	Analysis date / time	Batch
Mercury,Dissolved	U		0.000100	0.000200	1	07/17/2020 09:42	WG1509757

Metals (ICP) by Method 6010B

Analyte	Result mg/l	Qualifier	MDL mg/l	RDL mg/l	Dilution	Analysis date / time	Batch
Aluminum,Dissolved	U		0.0704	0.200	1	07/20/2020 20:41	WG1510348
Antimony,Dissolved	U		0.00430	0.0100	1	07/20/2020 20:41	WG1510348
Arsenic,Dissolved	U		0.00440	0.0100	1	07/20/2020 20:41	WG1510348
Barium,Dissolved	U		0.000895	0.00500	1	07/20/2020 20:41	WG1510348
Beryllium,Dissolved	U		0.000460	0.00200	1	07/20/2020 20:41	WG1510348
Cadmium,Dissolved	U		0.000563	0.00200	1	07/20/2020 20:41	WG1510348
Calcium,Dissolved	U		0.389	1.00	1	07/20/2020 20:41	WG1510348
Chromium,Dissolved	U		0.00500	0.0100	1	07/20/2020 20:41	WG1510348
Cobalt,Dissolved	U		0.000807	0.0100	1	07/20/2020 20:41	WG1510348
Copper,Dissolved	U		0.00469	0.0100	1	07/20/2020 20:41	WG1510348
Iron,Dissolved	U		0.0458	0.100	1	07/20/2020 20:41	WG1510348
Lead,Dissolved	U		0.00295	0.00600	1	07/20/2020 20:41	WG1510348
Magnesium,Dissolved	U		0.111	1.00	1	07/20/2020 20:41	WG1510348
Manganese,Dissolved	U		0.00327	0.0100	1	07/20/2020 20:41	WG1510348
Nickel,Dissolved	U		0.00298	0.0100	1	07/20/2020 20:41	WG1510348
Potassium,Dissolved	U		0.510	2.00	1	07/20/2020 20:41	WG1510348
Selenium,Dissolved	U		0.00735	0.0100	1	07/20/2020 20:41	WG1510348
Silver,Dissolved	U		0.00191	0.00500	1	07/20/2020 20:41	WG1510348
Sodium,Dissolved	U		1.40	3.00	1	07/20/2020 20:41	WG1510348
Thallium,Dissolved	U		0.00431	0.0100	1	07/20/2020 20:41	WG1510348
Vanadium,Dissolved	U		0.00634	0.0200	1	07/20/2020 20:41	WG1510348
Zinc,Dissolved	U		0.00916	0.0500	1	07/20/2020 20:41	WG1510348

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc



Mercury by Method 7471A

Analyte	Result mg/kg	Qualifier	MDL mg/kg	RDL mg/kg	Dilution	Analysis date / time	Batch
Mercury	0.0283	J	0.0180	0.0400	1	07/20/2020 11:09	WG1510875

¹ Cp² Tc³ Ss⁴ Cn⁵ Sr⁶ Qc⁷ Gl⁸ Al⁹ Sc

Metals (ICP) by Method 6010B

Analyte	Result mg/kg	Qualifier	MDL mg/kg	RDL mg/kg	Dilution	Analysis date / time	Batch
Aluminum	11700		8.20	20.0	1	07/19/2020 18:55	WG1511048
Antimony	1.64	J	0.500	2.00	1	07/19/2020 18:55	WG1511048
Arsenic	6.65		0.460	2.00	1	07/19/2020 18:55	WG1511048
Barium	130		0.240	0.500	1	07/19/2020 18:55	WG1511048
Beryllium	0.354		0.0800	0.200	1	07/19/2020 18:55	WG1511048
Cadmium	0.369	J	0.0810	0.500	1	07/19/2020 18:55	WG1511048
Calcium	2500		30.0	100	1	07/19/2020 18:55	WG1511048
Chromium	6.18		0.250	1.00	1	07/19/2020 18:55	WG1511048
Cobalt	3.76		0.230	1.00	1	07/19/2020 18:55	WG1511048
Copper	18.7		0.506	2.00	1	07/19/2020 18:55	WG1511048
Iron	42000		5.00	10.0	1	07/19/2020 18:55	WG1511048
Lead	261		0.208	0.500	1	07/19/2020 18:55	WG1511048
Magnesium	2970		20.5	100	1	07/19/2020 18:55	WG1511048
Manganese	247		0.245	1.00	1	07/19/2020 18:55	WG1511048
Nickel	3.76		0.490	2.00	1	07/19/2020 18:55	WG1511048
Potassium	1930		20.9	50.0	1	07/19/2020 18:55	WG1511048
Selenium	1.14	J	0.617	2.00	1	07/19/2020 18:55	WG1511048
Silver	0.411	J	0.228	1.00	1	07/19/2020 18:55	WG1511048
Sodium	83.3	J	33.2	100	1	07/19/2020 18:55	WG1511048
Thallium	U		0.354	2.00	1	07/19/2020 18:55	WG1511048
Vanadium	20.8		0.687	2.00	1	07/19/2020 18:55	WG1511048
Zinc	93.0		0.939	5.00	1	07/19/2020 18:55	WG1511048



Method Blank (MB)

(MB) R3550299-1 07/16/20 19:48

	MB Result	MB Qualifier	MB MDL	MB RDL
Analyte	mg/l		mg/l	mg/l
Mercury	U		0.000100	0.000200

Laboratory Control Sample (LCS)

(LCS) R3550299-2 07/16/20 19:50

	Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
Analyte	mg/l	mg/l	%	%	
Mercury	0.00300	0.00295	98.5	80.0-120	

L1239882-05 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1239882-05 07/16/20 19:52 • (MS) R3550299-3 07/16/20 19:54 • (MSD) R3550299-4 07/16/20 19:56

	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Analyte	mg/l	mg/l	mg/l	mg/l	%	%		%			%	%
Mercury	0.00300	U	0.00232	0.00277	77.5	92.2	1	75.0-125			17.4	20

L1239882-06 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1239882-06 07/16/20 19:58 • (MS) R3550299-5 07/16/20 20:04 • (MSD) R3550299-6 07/16/20 20:06

	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Analyte	mg/l	mg/l	mg/l	mg/l	%	%		%			%	%
Mercury	0.00300	U	0.00311	0.00288	104	96.1	1	75.0-125			7.72	20

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc



Method Blank (MB)

(MB) R3550452-1 07/17/20 09:11

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Mercury,Dissolved	U		0.000100	0.000200

Laboratory Control Sample (LCS)

(LCS) R3550452-2 07/17/20 09:13

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Mercury,Dissolved	0.00300	0.00305	102	80.0-120	

L1239858-07 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1239858-07 07/17/20 09:15 • (MS) R3550452-3 07/17/20 09:17 • (MSD) R3550452-4 07/17/20 09:19

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Mercury,Dissolved	0.00300	U	0.00323	0.00327	108	109	1	75.0-125			1.29	20

L1239886-13 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1239886-13 07/17/20 09:20 • (MS) R3550452-5 07/17/20 09:22 • (MSD) R3550452-6 07/17/20 09:24

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Mercury,Dissolved	0.00300	U	0.00327	0.00324	109	108	1	75.0-125			0.918	20

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc



Method Blank (MB)

(MB) R3551348-1 07/20/20 17:59

	MB Result	MB Qualifier	MB MDL	MB RDL
Analyte	mg/l		mg/l	mg/l
Mercury	U		0.000100	0.000200

Laboratory Control Sample (LCS)

(LCS) R3551348-2 07/20/20 18:01

	Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
Analyte	mg/l	mg/l	%	%	
Mercury	0.00300	0.00315	105	80.0-120	

L1239886-02 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1239886-02 07/20/20 18:03 • (MS) R3551348-3 07/20/20 18:05 • (MSD) R3551348-4 07/20/20 18:07

	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Analyte	mg/l	mg/l	mg/l	mg/l	%	%		%			%	%
Mercury	0.00300	U	0.00298	0.00217	99.3	72.4	1	75.0-125		J3 J6	31.4	20

L1239889-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1239889-01 07/20/20 18:09 • (MS) R3551348-5 07/20/20 18:11 • (MSD) R3551348-6 07/20/20 18:17

	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Analyte	mg/l	mg/l	mg/l	mg/l	%	%		%			%	%
Mercury	0.00300	0.00153	0.00200	0.00524	15.7	123	1	75.0-125	J6	J3	89.3	20

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc



Method Blank (MB)

(MB) R3550537-1 07/17/20 12:33

	MB Result	MB Qualifier	MB MDL	MB RDL
Analyte	mg/kg		mg/kg	mg/kg
Mercury	U		0.0180	0.0400

¹ Cp

² Tc

³ Ss

⁴ Cn

⁵ Sr

⁶ Qc

⁷ Gl

⁸ Al

⁹ Sc

Laboratory Control Sample (LCS)

(LCS) R3550537-2 07/17/20 12:36

	Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
Analyte	mg/kg	mg/kg	%	%	
Mercury	0.500	0.491	98.2	80.0-120	

L1239858-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1239858-03 07/17/20 12:38 • (MS) R3550537-3 07/17/20 12:41 • (MSD) R3550537-4 07/17/20 12:44

	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Analyte	mg/kg	mg/kg	mg/kg	mg/kg	%	%		%			%	%
Mercury	0.500	U	0.503	0.467	101	93.4	1	75.0-125			7.47	20

L1239884-09 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1239884-09 07/17/20 12:46 • (MS) R3550537-5 07/17/20 12:49 • (MSD) R3550537-6 07/17/20 12:51

	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Analyte	mg/kg	mg/kg	mg/kg	mg/kg	%	%		%			%	%
Mercury	0.500	0.538	0.832	1.00	58.8	92.3	1	75.0-125	J6		18.3	20



Method Blank (MB)

(MB) R3551201-1 07/20/20 10:40

	MB Result	MB Qualifier	MB MDL	MB RDL
Analyte	mg/kg		mg/kg	mg/kg
Mercury	U		0.0180	0.0400

Laboratory Control Sample (LCS)

(LCS) R3551201-2 07/20/20 10:43

	Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
Analyte	mg/kg	mg/kg	%	%	
Mercury	0.500	0.428	85.7	80.0-120	

L1239886-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1239886-01 07/20/20 10:45 • (MS) R3551201-3 07/20/20 10:47 • (MSD) R3551201-4 07/20/20 10:50

	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Analyte	mg/kg	mg/kg	mg/kg	mg/kg	%	%		%			%	%
Mercury	0.500	0.517	0.727	0.792	41.9	55.0	1	75.0-125	J6	J6	8.67	20

L1239886-06 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1239886-06 07/20/20 10:52 • (MS) R3551201-5 07/20/20 10:55 • (MSD) R3551201-6 07/20/20 10:57

	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Analyte	mg/kg	mg/kg	mg/kg	mg/kg	%	%		%			%	%
Mercury	0.500	0.0589	0.547	0.535	97.5	95.3	1	75.0-125			2.05	20

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc

Method Blank (MB)

(MB) R3551360-1 07/20/20 20:19

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Antimony,Dissolved	U		0.00430	0.0100
Arsenic,Dissolved	U		0.00440	0.0100
Barium,Dissolved	U		0.000895	0.00500
Beryllium,Dissolved	U		0.000460	0.00200
Cadmium,Dissolved	U		0.000563	0.00200
Calcium,Dissolved	U		0.389	1.00
Chromium,Dissolved	U		0.00500	0.0100
Cobalt,Dissolved	U		0.000807	0.0100
Copper,Dissolved	U		0.00469	0.0100
Iron,Dissolved	U		0.0458	0.100
Lead,Dissolved	U		0.00295	0.00600
Magnesium,Dissolved	U		0.111	1.00
Manganese,Dissolved	U		0.00327	0.0100
Nickel,Dissolved	U		0.00298	0.0100
Potassium,Dissolved	U		0.510	2.00
Selenium,Dissolved	U		0.00735	0.0100
Silver,Dissolved	U		0.00191	0.00500
Sodium,Dissolved	U		1.40	3.00
Thallium,Dissolved	U		0.00431	0.0100
Vanadium,Dissolved	U		0.00634	0.0200
Zinc,Dissolved	U		0.00916	0.0500

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Method Blank (MB)

(MB) R3551360-6 07/21/20 01:55

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Aluminum,Dissolved	U		0.0704	0.200

Laboratory Control Sample (LCS)

(LCS) R3551360-2 07/20/20 20:21

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Aluminum,Dissolved	10.0	9.60	96.0	80.0-120	
Antimony,Dissolved	1.00	0.924	92.4	80.0-120	
Arsenic,Dissolved	1.00	0.925	92.5	80.0-120	
Barium,Dissolved	1.00	0.981	98.1	80.0-120	
Beryllium,Dissolved	1.00	0.970	97.0	80.0-120	



Laboratory Control Sample (LCS)

(LCS) R3551360-2 07/20/20 20:21

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	<u>LCS Qualifier</u>
Cadmium,Dissolved	1.00	0.937	93.7	80.0-120	
Calcium,Dissolved	10.0	9.73	97.3	80.0-120	
Chromium,Dissolved	1.00	0.961	96.1	80.0-120	
Cobalt,Dissolved	1.00	0.984	98.4	80.0-120	
Copper,Dissolved	1.00	0.940	94.0	80.0-120	
Iron,Dissolved	10.0	9.62	96.2	80.0-120	
Lead,Dissolved	1.00	0.951	95.1	80.0-120	
Magnesium,Dissolved	10.0	9.42	94.2	80.0-120	
Manganese,Dissolved	1.00	0.947	94.7	80.0-120	
Nickel,Dissolved	1.00	0.974	97.4	80.0-120	
Potassium,Dissolved	10.0	9.11	91.1	80.0-120	
Selenium,Dissolved	1.00	0.972	97.2	80.0-120	
Silver,Dissolved	0.200	0.185	92.7	80.0-120	
Sodium,Dissolved	10.0	9.64	96.4	80.0-120	
Thallium,Dissolved	1.00	0.967	96.7	80.0-120	
Vanadium,Dissolved	1.00	0.968	96.8	80.0-120	
Zinc,Dissolved	1.00	0.955	95.5	80.0-120	

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc

L1239886-13 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1239886-13 07/20/20 20:24 • (MS) R3551360-4 07/20/20 20:30 • (MSD) R3551360-5 07/20/20 20:33

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	<u>MS Qualifier</u>	<u>MSD Qualifier</u>	RPD %	RPD Limits %
Aluminum,Dissolved	10.0	58.0	66.2	65.9	82.1	79.8	1	75.0-125			0.359	20
Antimony,Dissolved	1.00	0.0128	0.908	0.907	89.6	89.4	1	75.0-125			0.136	20
Arsenic,Dissolved	1.00	0.0171	0.937	0.937	92.0	92.0	1	75.0-125			0.0628	20
Barium,Dissolved	1.00	0.00161	0.934	0.930	93.2	92.9	1	75.0-125			0.361	20
Beryllium,Dissolved	1.00	0.0113	0.954	0.957	94.3	94.6	1	75.0-125			0.312	20
Cadmium,Dissolved	1.00	0.0788	1.01	1.00	92.6	92.5	1	75.0-125			0.107	20
Calcium,Dissolved	10.0	146	153	153	71.7	67.8	1	75.0-125	V	V	0.255	20
Chromium,Dissolved	1.00	0.0178	0.935	0.937	91.7	92.0	1	75.0-125			0.298	20
Cobalt,Dissolved	1.00	0.173	1.18	1.17	100	100	1	75.0-125			0.258	20
Copper,Dissolved	1.00	2.07	2.99	2.98	91.9	90.9	1	75.0-125			0.318	20
Iron,Dissolved	10.0	157	164	163	71.2	62.8	1	75.0-125	V	V	0.517	20
Lead,Dissolved	1.00	0.00513	0.946	0.946	94.1	94.0	1	75.0-125			0.0700	20
Magnesium,Dissolved	10.0	39.1	47.4	46.9	83.3	77.7	1	75.0-125			1.17	20
Manganese,Dissolved	1.00	21.8	22.0	22.2	28.6	44.2	1	75.0-125	E V	E V	0.703	20
Nickel,Dissolved	1.00	0.0849	1.08	1.08	99.5	99.3	1	75.0-125			0.171	20
Potassium,Dissolved	10.0	U	9.22	9.11	92.2	91.1	1	75.0-125			1.22	20



L1239886-13 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1239886-13 07/20/20 20:24 • (MS) R3551360-4 07/20/20 20:30 • (MSD) R3551360-5 07/20/20 20:33

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Selenium,Dissolved	1.00	0.0112	0.993	0.993	98.1	98.2	1	75.0-125			0.0587	20
Silver,Dissolved	0.200	0.00366	0.188	0.187	92.0	91.8	1	75.0-125			0.231	20
Sodium,Dissolved	10.0	2.05	11.7	11.6	96.2	95.8	1	75.0-125			0.323	20
Thallium,Dissolved	1.00	U	0.917	0.914	91.7	91.4	1	75.0-125			0.305	20
Vanadium,Dissolved	1.00	U	0.931	0.932	93.1	93.2	1	75.0-125			0.140	20
Zinc,Dissolved	1.00	15.4	16.1	16.1	71.6	67.1	1	75.0-125	V	V	0.278	20

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc

Method Blank (MB)

(MB) R3551587-1 07/21/20 06:20

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Aluminum	U		0.0704	0.200
Antimony	U		0.00430	0.0100
Arsenic	U		0.00440	0.0100
Barium	U		0.000895	0.00500
Beryllium	U		0.000460	0.00200
Cadmium	U		0.000563	0.00200
Calcium	U		0.389	1.00
Chromium	U		0.00500	0.0100
Cobalt	U		0.000807	0.0100
Copper	U		0.00469	0.0100
Iron	U		0.0458	0.100
Lead	U		0.00295	0.00600
Magnesium	U		0.111	1.00
Manganese	U		0.00327	0.0100
Nickel	U		0.00298	0.0100
Potassium	U		0.510	2.00
Selenium	U		0.00735	0.0100
Silver	U		0.00191	0.00500
Sodium	U		1.40	3.00
Thallium	U		0.00431	0.0100
Vanadium	U		0.00634	0.0200
Zinc	U		0.00916	0.0500

1

Cp

2

Tc

3

Ss

4

Cn

5

Sr

6

Qc

7

Gl

8

Al

9

Sc

Laboratory Control Sample (LCS)

(LCS) R3551587-7 07/21/20 11:27

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Aluminum	10.0	9.54	95.4	80.0-120	
Antimony	1.00	0.964	96.4	80.0-120	
Arsenic	1.00	0.964	96.4	80.0-120	
Barium	1.00	1.02	102	80.0-120	
Beryllium	1.00	0.977	97.7	80.0-120	
Cadmium	1.00	0.987	98.7	80.0-120	
Calcium	10.0	9.86	98.6	80.0-120	
Chromium	1.00	0.983	98.3	80.0-120	
Cobalt	1.00	0.996	99.6	80.0-120	
Copper	1.00	0.969	96.9	80.0-120	
Iron	10.0	9.68	96.8	80.0-120	



Laboratory Control Sample (LCS)

(LCS) R3551587-7 07/21/20 11:27

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	<u>LCS Qualifier</u>
Lead	1.00	0.972	97.2	80.0-120	
Magnesium	10.0	9.77	97.7	80.0-120	
Manganese	1.00	0.964	96.4	80.0-120	
Nickel	1.00	0.994	99.4	80.0-120	
Potassium	10.0	9.13	91.3	80.0-120	
Selenium	1.00	0.971	97.1	80.0-120	
Silver	0.200	0.186	92.9	80.0-120	
Sodium	10.0	9.76	97.6	80.0-120	
Thallium	1.00	0.977	97.7	80.0-120	
Vanadium	1.00	0.981	98.1	80.0-120	
Zinc	1.00	0.969	96.9	80.0-120	

L1239858-08 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1239858-08 07/21/20 06:26 • (MS) R3551587-3 07/21/20 06:31 • (MSD) R3551587-4 07/21/20 06:34

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	<u>MS Qualifier</u>	<u>MSD Qualifier</u>	RPD %	RPD Limits %
Aluminum	10.0	U	9.49	9.66	94.9	96.6	1	75.0-125			1.71	20
Antimony	1.00	U	0.991	0.984	99.1	98.4	1	75.0-125			0.648	20
Arsenic	1.00	U	0.991	1.01	99.1	101	1	75.0-125			1.57	20
Barium	1.00	0.00553	0.994	1.00	98.8	99.5	1	75.0-125			0.734	20
Beryllium	1.00	U	0.964	0.974	96.4	97.4	1	75.0-125			1.12	20
Cadmium	1.00	U	0.992	1.00	99.2	100	1	75.0-125			0.937	20
Calcium	10.0	382	386	386	45.3	38.5	1	75.0-125	V	V	0.176	20
Chromium	1.00	U	0.958	0.974	95.8	97.4	1	75.0-125			1.65	20
Cobalt	1.00	0.0107	1.01	1.02	100	101	1	75.0-125			0.974	20
Copper	1.00	U	0.976	0.986	97.6	98.6	1	75.0-125			1.05	20
Iron	10.0	7.60	16.8	18.1	92.4	105	1	75.0-125			7.05	20
Lead	1.00	U	0.965	0.968	96.5	96.8	1	75.0-125			0.241	20
Magnesium	10.0	10.5	19.7	19.8	92.3	93.3	1	75.0-125			0.499	20
Manganese	1.00	1.44	2.35	2.36	91.9	92.4	1	75.0-125			0.225	20
Nickel	1.00	U	0.995	1.00	99.5	100	1	75.0-125			0.873	20
Potassium	10.0	1.15	10.5	10.7	93.5	95.1	1	75.0-125			1.47	20
Selenium	1.00	U	0.996	0.998	99.6	99.8	1	75.0-125			0.180	20
Silver	0.200	U	0.189	0.191	94.7	95.3	1	75.0-125			0.655	20
Sodium	10.0	8.32	18.1	18.2	97.6	99.2	1	75.0-125			0.847	20
Thallium	1.00	U	0.934	0.943	93.4	94.3	1	75.0-125			0.928	20
Vanadium	1.00	U	0.967	0.981	96.7	98.1	1	75.0-125			1.43	20
Zinc	1.00	0.0166	0.962	0.967	94.5	95.0	1	75.0-125			0.555	20

1

Cp

2

Tc

3

Ss

4

Cn

5

Sr

6

Qc

7

Gl

8

Al

9

Sc



L1239886-12 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1239886-12 07/21/20 06:36 • (MS) R3551587-5 07/21/20 06:39 • (MSD) R3551587-6 07/21/20 06:41

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Aluminum	10.0	58.5	66.0	66.3	75.0	78.5	1	75.0-125			0.534	20
Antimony	1.00	U	0.922	0.919	92.2	91.9	1	75.0-125			0.371	20
Arsenic	1.00	0.0321	0.950	0.954	91.8	92.2	1	75.0-125			0.423	20
Barium	1.00	0.0579	1.00	1.01	94.3	95.0	1	75.0-125			0.678	20
Beryllium	1.00	0.0116	0.969	0.962	95.7	95.1	1	75.0-125			0.705	20
Cadmium	1.00	0.0828	1.03	1.03	94.3	94.9	1	75.0-125			0.622	20
Calcium	10.0	148	154	154	59.4	59.3	1	75.0-125	V	V	0.0111	20
Chromium	1.00	0.0267	0.949	0.949	92.2	92.2	1	75.0-125			0.00838	20
Cobalt	1.00	0.176	1.16	1.17	98.5	99.3	1	75.0-125			0.681	20
Copper	1.00	2.16	3.09	3.09	92.8	92.7	1	75.0-125			0.0578	20
Iron	10.0	183	189	190	62.3	66.8	1	75.0-125	V	V	0.242	20
Lead	1.00	0.128	1.07	1.08	94.4	95.1	1	75.0-125			0.669	20
Magnesium	10.0	40.7	49.2	49.3	85.1	85.2	1	75.0-125			0.0101	20
Manganese	1.00	23.2	23.5	23.4	33.5	24.0	1	75.0-125	EV	EV	0.407	20
Nickel	1.00	0.0952	1.08	1.08	98.1	98.6	1	75.0-125			0.396	20
Potassium	10.0	1.20	10.2	10.3	90.5	90.5	1	75.0-125			0.0173	20
Selenium	1.00	U	0.947	0.941	94.7	94.1	1	75.0-125			0.732	20
Silver	0.200	0.00482	0.191	0.189	92.9	92.1	1	75.0-125			0.808	20
Sodium	10.0	2.21	11.8	11.8	96.2	96.1	1	75.0-125			0.0960	20
Thallium	1.00	U	0.910	0.920	91.0	92.0	1	75.0-125			1.08	20
Vanadium	1.00	0.0150	0.955	0.955	94.1	94.0	1	75.0-125			0.0858	20
Zinc	1.00	15.5	16.1	16.1	51.8	54.6	1	75.0-125	V	V	0.169	20

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc



Method Blank (MB)

(MB) R3550925-1 07/18/20 10:30

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Aluminum	U		0.0704	0.200
Antimony	U		0.00430	0.0100
Arsenic	U		0.00440	0.0100
Barium	U		0.000895	0.00500
Beryllium	U		0.000460	0.00200
Cadmium	U		0.000563	0.00200
Calcium	U		0.389	1.00
Chromium	U		0.00500	0.0100
Cobalt	U		0.000807	0.0100
Copper	U		0.00469	0.0100
Iron	U		0.0458	0.100
Lead	U		0.00295	0.00600
Magnesium	U		0.111	1.00
Manganese	U		0.00327	0.0100
Nickel	U		0.00298	0.0100
Potassium	U		0.510	2.00
Selenium	U		0.00735	0.0100
Silver	U		0.00191	0.00500
Sodium	U		1.40	3.00
Thallium	U		0.00431	0.0100
Vanadium	U		0.00634	0.0200
Zinc	U		0.00916	0.0500

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc

Laboratory Control Sample (LCS)

(LCS) R3550925-2 07/18/20 10:33

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Aluminum	10.0	9.61	96.1	80.0-120	
Antimony	1.00	0.955	95.5	80.0-120	
Arsenic	1.00	0.922	92.2	80.0-120	
Barium	1.00	0.989	98.9	80.0-120	
Beryllium	1.00	0.975	97.5	80.0-120	
Cadmium	1.00	0.955	95.5	80.0-120	
Calcium	10.0	10.3	103	80.0-120	
Chromium	1.00	0.917	91.7	80.0-120	
Cobalt	1.00	0.985	98.5	80.0-120	
Copper	1.00	0.997	99.7	80.0-120	
Iron	10.0	9.78	97.8	80.0-120	



Laboratory Control Sample (LCS)

(LCS) R3550925-2 07/18/20 10:33

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	<u>LCS Qualifier</u>
Lead	1.00	0.939	93.9	80.0-120	
Magnesium	10.0	10.2	102	80.0-120	
Manganese	1.00	0.904	90.4	80.0-120	
Nickel	1.00	0.964	96.4	80.0-120	
Potassium	10.0	9.54	95.4	80.0-120	
Selenium	1.00	0.941	94.1	80.0-120	
Silver	0.200	0.175	87.4	80.0-120	
Sodium	10.0	10.1	101	80.0-120	
Thallium	1.00	1.00	100	80.0-120	
Vanadium	1.00	0.992	99.2	80.0-120	
Zinc	1.00	0.947	94.7	80.0-120	

L1239886-02 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1239886-02 07/18/20 10:35 • (MS) R3550925-4 07/18/20 10:41 • (MSD) R3550925-5 07/18/20 10:43

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	<u>MS Qualifier</u>	<u>MSD Qualifier</u>	RPD %	RPD Limits %
Aluminum	10.0	0.124	10.1	10.0	100	99.1	1	75.0-125			1.13	20
Antimony	1.00	U	1.01	0.978	101	97.8	1	75.0-125			3.51	20
Arsenic	1.00	U	0.953	0.942	95.3	94.2	1	75.0-125			1.15	20
Barium	1.00	0.0545	1.07	1.05	101	99.9	1	75.0-125			1.19	20
Beryllium	1.00	U	1.01	0.995	101	99.5	1	75.0-125			1.72	20
Cadmium	1.00	U	0.989	0.971	98.9	97.1	1	75.0-125			1.83	20
Calcium	10.0	2.93	13.6	13.4	107	105	1	75.0-125			1.48	20
Chromium	1.00	U	0.932	0.918	93.2	91.8	1	75.0-125			1.45	20
Cobalt	1.00	U	1.02	0.999	102	99.9	1	75.0-125			1.62	20
Copper	1.00	0.0199	1.06	1.04	104	102	1	75.0-125			1.70	20
Iron	10.0	0.134	10.2	10.2	101	100	1	75.0-125			0.831	20
Lead	1.00	0.0359	1.02	1.00	98.2	96.4	1	75.0-125			1.79	20
Magnesium	10.0	0.616	11.3	11.0	106	104	1	75.0-125			2.06	20
Manganese	1.00	0.0412	0.969	0.956	92.8	91.5	1	75.0-125			1.33	20
Nickel	1.00	U	0.996	0.987	99.6	98.7	1	75.0-125			0.944	20
Potassium	10.0	0.787	10.4	10.3	96.2	95.6	1	75.0-125			0.577	20
Selenium	1.00	U	0.973	0.952	97.3	95.2	1	75.0-125			2.21	20
Silver	0.200	U	0.181	0.177	90.4	88.7	1	75.0-125			1.97	20
Sodium	10.0	8.79	19.0	18.7	102	99.6	1	75.0-125			1.43	20
Thallium	1.00	U	1.05	1.01	105	101	1	75.0-125			3.30	20
Vanadium	1.00	U	1.03	1.01	103	101	1	75.0-125			1.75	20
Zinc	1.00	0.0789	1.06	1.05	98.4	97.3	1	75.0-125			1.05	20

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Cp

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Tc

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Sr

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Qc

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Gl

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Method Blank (MB)

(MB) R3550964-1 07/19/20 18:03

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Aluminum	U		8.20	20.0
Antimony	U		0.500	2.00
Arsenic	U		0.460	2.00
Barium	U		0.240	0.500
Beryllium	U		0.0800	0.200
Cadmium	U		0.0810	0.500
Calcium	U		30.0	100
Chromium	U		0.250	1.00
Cobalt	U		0.230	1.00
Copper	U		0.506	2.00
Iron	U		5.00	10.0
Lead	U		0.208	0.500
Magnesium	U		20.5	100
Manganese	U		0.245	1.00
Nickel	U		0.490	2.00
Potassium	U		20.9	50.0
Selenium	U		0.617	2.00
Silver	U		0.228	1.00
Sodium	U		33.2	100
Thallium	U		0.354	2.00
Vanadium	U		0.687	2.00
Zinc	U		0.939	5.00

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Cp

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Laboratory Control Sample (LCS)

(LCS) R3550964-2 07/19/20 18:05

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
Aluminum	1000	943	94.3	80.0-120	
Antimony	100	92.7	92.7	80.0-120	
Arsenic	100	91.0	91.0	80.0-120	
Barium	100	96.6	96.6	80.0-120	
Beryllium	100	97.1	97.1	80.0-120	
Cadmium	100	92.5	92.5	80.0-120	
Calcium	1000	968	96.8	80.0-120	
Chromium	100	95.0	95.0	80.0-120	
Cobalt	100	98.0	98.0	80.0-120	
Copper	100	93.9	93.9	80.0-120	
Iron	1000	953	95.3	80.0-120	

Laboratory Control Sample (LCS)

(LCS) R3550964-2 07/19/20 18:05

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	<u>LCS Qualifier</u>
Lead	100	94.0	94.0	80.0-120	
Magnesium	1000	927	92.7	80.0-120	
Manganese	100	93.4	93.4	80.0-120	
Nickel	100	96.5	96.5	80.0-120	
Potassium	1000	905	90.5	80.0-120	
Selenium	100	91.0	91.0	80.0-120	
Silver	20.0	17.6	88.0	80.0-120	
Sodium	1000	968	96.8	80.0-120	
Thallium	100	93.0	93.0	80.0-120	
Vanadium	100	95.5	95.5	80.0-120	
Zinc	100	92.6	92.6	80.0-120	

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Cp

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Tc

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Ss

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Cn

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Sr

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Qc

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Gl

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Sc

L1239884-09 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1239884-09 07/19/20 18:09 • (MS) R3550964-5 07/19/20 18:18 • (MSD) R3550964-6 07/19/20 18:21

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	<u>MS Qualifier</u>	<u>MSD Qualifier</u>	RPD %	RPD Limits %
Aluminum	1000	3580	5820	5800	224	222	1	75.0-125	J5	J5	0.357	20
Antimony	100	3.22	60.9	64.0	57.7	60.8	1	75.0-125	J6	J6	4.98	20
Arsenic	100	9.60	99.3	102	89.7	92.5	1	75.0-125			2.78	20
Barium	100	75.1	213	188	137	113	1	75.0-125	J5		12.1	20
Beryllium	100	0.0999	95.2	97.8	95.1	97.7	1	75.0-125			2.62	20
Cadmium	100	34.4	113	109	78.8	74.6	1	75.0-125		J6	3.79	20
Calcium	1000	159	1110	1130	95.3	97.2	1	75.0-125			1.63	20
Chromium	100	U	93.2	95.2	93.2	95.2	1	75.0-125			2.15	20
Cobalt	100	1.61	99.6	103	97.9	102	1	75.0-125			3.65	20
Copper	100	833	795	886	0.000	53.2	1	75.0-125	V	V	10.8	20
Iron	1000	53300	54700	70200	138	1690	1	75.0-125	E V	E J3 V	24.8	20
Lead	100	26600	34600	31300	8050	4680	1	75.0-125	E V	E V	10.2	20
Magnesium	1000	713	1460	1470	74.7	75.6	1	75.0-125	J6		0.573	20
Manganese	100	120	183	183	63.3	63.0	1	75.0-125	J6	J6	0.138	20
Nickel	100	U	96.9	99.8	96.9	99.8	1	75.0-125			2.94	20
Potassium	1000	1700	2980	2870	128	117	1	75.0-125	J5		3.79	20
Selenium	100	10.9	105	108	93.9	97.6	1	75.0-125			3.49	20
Silver	20.0	33.0	53.5	52.2	103	96.1	1	75.0-125			2.49	20
Sodium	1000	96.1	1040	1070	94.5	97.8	1	75.0-125			3.09	20
Thallium	100	0.822	88.9	90.3	88.1	89.5	1	75.0-125			1.49	20
Vanadium	100	10.1	105	108	94.7	97.7	1	75.0-125			2.80	20
Zinc	100	7600	5330	3940	0.000	0.000	1	75.0-125	E V	E J3 V	30.0	20



L1239884-01,02,08,09,11,13

L1239886-09 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1239886-09 07/19/20 18:24 • (MS) R3550964-8 07/19/20 18:29 • (MSD) R3550964-9 07/19/20 18:38

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Aluminum	1000	12400	9940	13000	0.000	60.0	1	75.0-125	V	J3 V	27.0	20
Antimony	100	2.38	55.6	45.7	53.2	43.3	1	75.0-125	J6	J6	19.6	20
Arsenic	100	29.1	118	115	89.4	85.8	1	75.0-125			3.07	20
Barium	100	195	271	242	76.2	47.2	1	75.0-125		J6	11.3	20
Beryllium	100	0.365	102	94.5	101	94.1	1	75.0-125			7.36	20
Cadmium	100	0.0852	96.9	91.0	96.8	90.9	1	75.0-125			6.30	20
Calcium	1000	597	1210	1230	60.9	63.2	1	75.0-125	J6	J6	1.89	20
Chromium	100	5.39	105	96.9	99.3	91.6	1	75.0-125			7.71	20
Cobalt	100	1.53	106	101	104	99.0	1	75.0-125			5.16	20
Copper	100	15.9	111	105	94.9	89.6	1	75.0-125			4.87	20
Iron	1000	37500	29300	33500	0.000	0.000	1	75.0-125	V	V	13.3	20
Lead	100	159	823	240	664	81.0	1	75.0-125	J5	J3	110	20
Magnesium	1000	7580	4270	6100	0.000	0.000	1	75.0-125	V	J3 V	35.2	20
Manganese	100	433	288	334	0.000	0.000	1	75.0-125	V	V	14.5	20
Nickel	100	1.36	103	98.2	102	96.8	1	75.0-125			5.27	20
Potassium	1000	2010	3420	3220	141	121	1	75.0-125	J5		6.09	20
Selenium	100	3.31	98.9	92.3	95.6	89.0	1	75.0-125			6.85	20
Silver	20.0	U	19.2	17.6	95.9	87.8	1	75.0-125			8.89	20
Sodium	1000	70.6	1150	1020	108	95.3	1	75.0-125			11.8	20
Thallium	100	U	94.1	88.1	94.1	88.1	1	75.0-125			6.68	20
Vanadium	100	32.6	120	118	87.6	84.9	1	75.0-125			2.27	20
Zinc	100	51.8	123	137	70.8	85.5	1	75.0-125	J6		11.3	20

1Cp

2Tc

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Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

MDL	Method Detection Limit.
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
U	Not detected at the Reporting Limit (or MDL where applicable).
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
E	The analyte concentration exceeds the upper limit of the calibration range of the instrument established by the initial calibration (ICAL).
J	The identification of the analyte is acceptable; the reported value is an estimate.
J3	The associated batch QC was outside the established quality control range for precision.
J5	The sample matrix interfered with the ability to make any accurate determination; spike value is high.
J6	The sample matrix interfered with the ability to make any accurate determination; spike value is low.
O1	The analyte failed the method required serial dilution test and/or subsequent post-spike criteria. These failures indicate matrix interference.
V	The sample concentration is too high to evaluate accurate spike recoveries.

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc



Pace National is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our one location design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be YOUR LAB OF CHOICE.

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace National.

State Accreditations

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN-03-2002-34
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey–NELAP	TN002
California	2932	New Mexico ¹	n/a
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina ¹	DW21704
Georgia	NELAP	North Carolina ³	41
Georgia ¹	923	North Dakota	R-140
Idaho	TN00003	Ohio–VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LA000356
Kentucky ^{1 6}	90010	South Carolina	84004
Kentucky ²	16	South Dakota	n/a
Louisiana	AI30792	Tennessee ^{1 4}	2006
Louisiana ¹	LA180010	Texas	T104704245-18-15
Maine	TN0002	Texas ⁵	LAB0152
Maryland	324	Utah	TN00003
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	460132
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	9980939910
Montana	CERT0086	Wyoming	A2LA

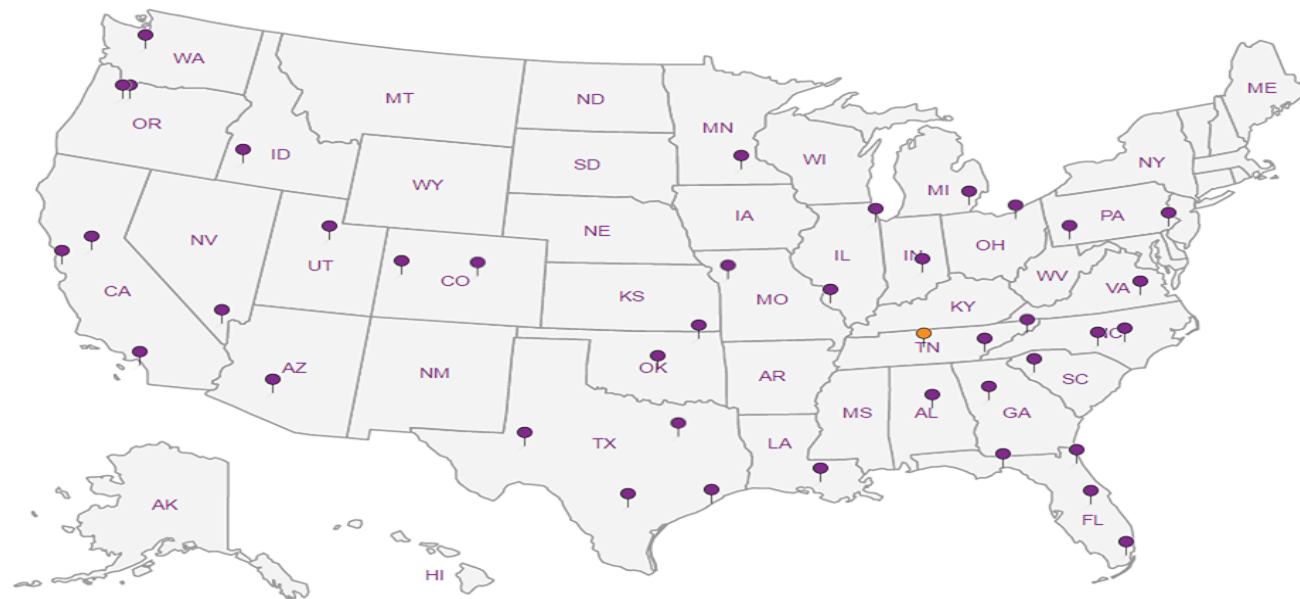
Third Party Federal Accreditations

A2LA – ISO 17025	1461.01	AIHA-LAP, LLC EMLAP	100789
A2LA – ISO 17025 ⁵	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA–Crypto	TN00003		

¹ Drinking Water ² Underground Storage Tanks ³ Aquatic Toxicity ⁴ Chemical/Microbiological ⁵ Mold ⁶ Wastewater n/a Accreditation not applicable

Our Locations

Pace National has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. Pace National performs all testing at our central laboratory.



Applied Intellect

2801 Youngfield St., Ste 250
Golden, CO 80401

Billing Information:

See As Below

Pres
Chk

Analysis / Container / Preservative

Chain of Custody Page ____ of ____

Pace Analytical®
National Center for Testing & Innovation12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859Report to:
Jeff Hart; John DeAngelisEmail To:
jeff.hart@ap-in.com; john.
deangelis@ap-in.comProject TRONEX PAISLS
Description: IRENE MINECity/State: O'Fallon County,
COPhone: 720 884-7404
Fax:Client Project #
USFS CMUG NF

Lab Project #

Collected by (print):
JEFF HARTSite/Facility ID #
IRENE MINE

P.O. #

Collected by (signature):

Rush? (Lab MUST Be Notified)

☐ Same Day ☐ Five Day
☐ Next Day ☐ 5 Day (Rad Only)
☐ Two Day ☐ 10 Day (Rad Only)
☐ Three Day

Date Results Needed

No.
of
CntsImmediately
Packed on Ice N ☐ Y ☒

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	Cnts	Diss. TAL Metals - 250ml HDPE w/HNO3	TAL Metals & Hardness - 250ml HDPE w/HNO3	SPLP TAL Metals - 800 Soil Jar	TAL Metals - 200 Soil Jar								
IR-DA-SO-1	G	SED	NA	7/8/2020	1545	1												
IR-DA-SO-2	G	SED		7/8/2020	1545	1												
IR-DA-SWD-1	G	WW		7/8/2020	1530	1	X											
IR-DA-SWT-1	G	WW		7/8/2020	1530	1		X										
IR-DA-SWD-2	G	WW		7/8/2020	1530	1	X											
IR-DA-SWT-2	G	WW		7/8/2020	1530	1		X										
IR-SS-WP1-1	Comp	SS	0-0.5	7/8/2020	1432	1			X	X								
IR-SS-WP1-2	Comp	SS	0-0.5	7/8/2020	1200	1				X								
IR-SS-WP2-1	Comp	SS	0-0.5	7/8/2020	1620	1			X	X								
ER-TRONEX-7-8-2020	G	DW	NA	7/8/2020	1340	1	X											

* Matrix:

SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other

Remarks:

Samples returned via:

☐ UPS ☐ FedEx ☐ Courier

Tracking #

pH _____ Temp _____

Flow _____ Other _____

Sample Receipt Checklist

COC Seal Present/Intact: ☒ Y ☐ N
COC Signed/Accurate: ☒ Y ☐ N
Bottles arrive intact: ☒ Y ☐ N
Correct bottles used: ☒ Y ☐ N
Sufficient volume sent: ☒ Y ☐ N

If Applicable

VOA Zero Headspace: ☐ Y ☒ N
Preservation Correct/Checked: ☒ Y ☐ N

RAD SCREEN: <0.5 mR/hr

Relinquished by: (Signature)

Date:

Time:

Received by: (Signature)

Trip Blank Received: Yes ☒ No ☐HCL/MeOH
TBR

Relinquished by: (Signature)

Date:

Time:

Received by: (Signature)

Temp ☒ °C Bottles Received: 11

If preservation required by Login: Date/Time

Relinquished by: (Signature)

Date:

Time:

Received for lab by: (Signature)

Date:

Time:

Hold:

Condition:

NCF ☒ OK
-01
-02
-03
-04
-05
-06
-07
-08
-09
-10
-11
-12



Login #: L1239884	Client: APPINTGCO	Date: 07/15/2020	Evaluated by: Billy B.
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Non-Conformance (check applicable items)

Sample Integrity		Chain of Custody Clarification	
Parameter(s) past holding time		Login Clarification Needed	If Broken Container:
Temperature not in range		Chain of custody is incomplete	Insufficient packing material around container
Improper container type		Please specify Metals requested.	Insufficient packing material inside cooler
pH not in range.		Please specify TCLP requested.	Improper handling by carrier (FedEx / UPS / Couri
Insufficient sample volume.	x	Received additional samples not listed on coc.	Sample was frozen
Sample is biphasic.		Sample ids on containers do not match ids on coc	Container lid not intact
Vials received with headspace.		Trip Blank not received.	If no Chain of Custody:
Broken container		Client did not "X" analysis.	Received by:
Broken container:		Chain of Custody is missing	Date/Time:
Sufficient sample remains			Temp./Cont. Rec./pH:
			Carrier:
			Tracking#

Login Comments:

Received ID: IR-SS-BKG-1 07/08/20 @1525

Client informed by:	Call	x	Email	Voice Mail	Date: 7/16/20	Time: 1059
TSR Initials: CMW	Client Contact: John De Angelis					

Login Instructions:

Please run TAL metals

APPENDIX F

Data Validation and Verification



Appendix F

LABORATORY DATA VALIDATION REVIEW

F.1. LABORATORY METHODS AND GENERAL QA/QC REVIEW

Pace Analytical Laboratory (Pace) analyzed total analyte list (TAL) metals in all collected soil, sediment, adit water, and synthetic precipitation leaching procedure (SPLP) soil samples by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES) USEPA Method 6010B and cold vapor technique USEPA Method 7471/7470 (mercury).

Preparation methods were as follows for each of the sampled media:

- Soil digestion: USEPA Method 3050B
- Total adit water digestion: USEPA Method 3015A
- SPLP: USEPA Method 1312

Results from Pace were provided in a single Level III laboratory data package dated July 31, 2020 (see Appendix C). Results from Pace are used to estimate health-based risk to human health and ecological receptors and are quantitative in nature and requirement.

F.1.1 Sample holding times

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method-specified holding times.

F.1.2 Initial and continuing calibration verification (Accuracy)

All ICP-AES initial and continuing calibration verification recoveries were within control ranges ($\pm 10\%$)

F.1.3 Laboratory Control Sample Recoveries (Accuracy)

All laboratory control sample (LCS) recoveries for aqueous and solid matrices were within the QA/QC control range of 80-120%.

F.1.4 Equipment Rinsate Analytical Results (Accuracy)

All TAL metals results from the equipment rinsate sample collected on July 8, 2020 were below laboratory method detection limits (MDLs).

F.2 SOIL AND SEDIMENT QA/QC REVIEW

F.2.1 Detection Limits

As noted in the Applied Intellect (AI) Work Plan and Sampling and Analysis Plan (AI, 2020), USEPA Method 6010B MDLs exceeded project screening levels (PSLs) for the following analytes in soil:



- Antimony (PSL = 0.27 mg/kg, MDL = 0.5 mg/kg)

Laboratory-provided MDLs were corrected for dilution in the provided analytical results. No analytical results were identified for soil and sediment samples that 1) were present at concentrations below the MDL and 2) required dilution resulting in an MDL that exceeded the PSL.

F.2.2. Matrix Spike/Matrix Spike Duplicate Recoveries and Relative Percent Difference (Accuracy, Precision, and Matrix Interference)

Field samples for matrix spike/matrix spike duplicate (MS/MSD) analysis were run for the following soil sample:

- IR-SS-WP1-2

Concentrations of several TAL metals in the original field sample exceeded 4x the MS/MSD spike concentration, which interferes with accurate spike recoveries and relative percent difference (RPD) between MS and MSD recoveries. These analytes are flagged with a “V” qualifier in the laboratory data report and are listed in Table F-1, below. Out of control range MS/MSD recoveries for V-qualified analytes are a function of high concentrations in the original sample and do not, therefore, change the overall findings of this assessment.

Table F-1. V-qualified MS/MSD recoveries, field sample IR-SS-WP1-2

Analyte	Spike Amt (mg/kg)	OS Result (mg/kg)	MS Result (mg/kg)	MSD Result (mg/kg)	MS Rec (%)	MSD Rec (%)	RPD (%)
Copper	100	833	795	886	0	53.2	10.8
Iron	1000	53300	54700	70200	138	1690	24.8
Lead	100	26600	34600	31300	8050	4680	10.2
Zinc	100	7600	5330	3940	0	0	NA

Among non-V-qualified analytes, MS/MSD results for field sample IR-SS-WP1-2 indicate aluminum, antimony, barium, cadmium, magnesium, manganese, and potassium had MS/MSD recoveries outside of the 75-125% quality control range, indicating inaccuracy (see Table F-2).

Table F-2. Non-V-qualified analytes out of MS/MSD and/or RPD control range, field sample IR-SS-WP1-2

Analyte	MS Rec (%)	MSD Rec (%)	RPD (%)	PDS Rec (%)
Aluminum	224	222	0.357	77.3*
Antimony	57.7	60.8	4.98	83.5
Barium	137	113	12.1	86.3
Cadmium	78.8	74.6	3.79	85.8
Magnesium	74.7	75.6	0.573	82.4
Manganese	63.3	63	0.138	82.2
Potassium	128	117	3.79	80.3



With the exception of aluminum, post-digestion spike (PDS) recoveries were within quality control range (80-120%) for non-V-qualified analytes with out of control range MS/MSD recoveries. This indicates inaccuracies were introduced during digestion for these analytes.

Among non-V-qualified analytes with MS/MSD recoveries outside quality control range, aluminum, barium, and potassium were biased high. Because these analytes were both biased high and either did not have or were below established human health and ecological screening levels (SLs), inaccuracy suggested by MS/MSD recoveries is not expected to change the findings of this PA/SI.

Remaining non-V-qualified analytes with MS/MSD recoveries outside quality control range – namely, antimony, cadmium, magnesium, and manganese – were biased low.

Table F-3. Low-biased analytes with out of control range MS/MSD recoveries, field sample IR-SS-WP1-2

Analyte	Max Human Health SL EF	Max Ecological SL EF	Max Background EF	COPC?	COPEC?
Antimony	<0.1	15	2.5	N	N
Cadmium	<0.1	91	89	N	Y
Magnesium	NE	NE	<1	N	N
Manganese	<0.1	0.53	<1	N	N

F.2.3. Field Duplicate Samples (Precision)

Field duplicates were collected for the following soil and sediment samples:

- IR-SS-WP1-1/IR-SS-WP1-2 (soil)
- IR-DA-SD-1/IR-DA-SD-2 (sediment)

The relative percent difference (RPD) for comparison of duplicate samples was calculated as follows:

$$\% RPD = \frac{\text{Difference of duplicate results}}{\text{Average of duplicate results}} * 100$$

When an analyte concentration was less than the MDL in one duplicate, the MDL for that duplicate was used to calculate the RPD. RPDs were not calculated for analytes that were below the MDL in both duplicates. RPDs < 30% are considered correlative for soils, given the inherent heterogeneity of this matrix.

Analytes with calculated RPDs > 30% in duplicate field soil samples IR-SS-WP1-1/IR-SS-WP1-2 are shown in Table F-4.



Table F-4. IR-SS-WP1-1/IR-SS-WP1-2 Duplicates: Analytes with RPD > 30%

Analyte	Sample ID	Result (mg/kg)	Qualifier	RPD (%)
Antimony	IR-SS-WP1-1	4.10	J	48.5
	IR-SS-WP1-2	<2.50		
Arsenic	IR-SS-WP1-1	12.20		41.3
	IR-SS-WP1-2	8.02	J	
Cadmium	IR-SS-WP1-1	11.0		99.3
	IR-SS-WP1-2	32.7		
Copper	IR-SS-WP1-1	1670		67.1
	IR-SS-WP1-2	831		
Magnesium	IR-SS-WP1-1	300	J	82.9
	IR-SS-WP1-2	725		
Manganese	IR-SS-WP1-1	77.8		40.2
	IR-SS-WP1-2	117		
Vanadium	IR-SS-WP1-1	6.00	J	41.1
	IR-SS-WP1-2	9.10	J	
Zinc	IR-SS-WP1-1	3630		87.5
	IR-SS-WP1-2	9280		

Among analytes with RPDs > 30% for duplicate soil samples IR-SS-WP1-1/IR-SS-WP1-2, antimony, arsenic, magnesium, and vanadium had one or more analytical results that were estimated due to being present below the reported detection limit (RDL). In these cases, RPDs > 30% are believed to be associated with the uncertainty introduced by the low concentration in one or both of the duplicate samples.

Analytes with RPDs > 30% that were not J-qualified estimates are shown in Table D-5. Based on analytical results that indicate concentrations of cadmium, copper, manganese, and zinc at least an order of magnitude lower than human health SLs, RPDs > 30% for these analytes are not expected to change the findings of this PA/SI, which did not identify these analytes as COPCs in soil. Similarly, based on analytical results that indicated concentrations of cadmium, copper, and zinc at least an order of magnitude higher than ecological SLs, RPDs > 30% for these analytes are not expected to change the findings of this PA/SI which identified these analytes as COPECs in soil.

Table F-5. Non-J-qualified analytes with RPD > 30% in duplicate field sample IR-SS-WP1-1/IR-SS-WP1-2

Analyte	Max Human Health SL EF	Max Ecological SL EF	Max Background EF	COPC?	COPEC?
Cadmium	<0.1	91	89	N	Y
Copper	<0.1	60	89	N	Y
Manganese	<0.1	0.53	<1	N	N
Zinc	<0.1	200	100	N	Y



Analytes with calculated RPDs > 30% in duplicate field sediment samples IR-DA-SD-1/IR-DA-SD-2 are shown in Table F-6.

Table F-6. IR-DA-SD-1/IR-DA-SD-2 Analytes with RPD > 30%

Analyte	Sample ID	Result (mg/kg)	Qualifier	RPD (%)
Aluminum	IR-DA-SD-1	1340		34.0
	IR-DA-SD-2	951		
Copper	IR-DA-SD-1	73		31.7
	IR-DA-SD-2	53		
Mercury	IR-DA-SD-1	0.03	J	37.5
	IR-DA-SD-2	0.02	J	
Selenium	IR-DA-SD-1	5.16	J	40.6
	IR-DA-SD-2	3.42	J	
Vanadium	IR-DA-SD-1	6.95	J	39.9
	IR-DA-SD-2	4.64	J	
Zinc	IR-DA-SD-1	70.1		34.1
	IR-DA-SD-2	49.7		

Among analytes with RPDs > 30% for duplicate sediment samples IR-DA-SD-1/IR-DA-SD-2, mercury, selenium, and vanadium were present in both duplicate samples at concentrations that were estimated due to being lower than the RDL. In these cases, RPDs > 30% are believed to be associated with the uncertainty introduced by the low concentration in both duplicate samples.

Analytes with RPDs > 30% for duplicate sediment samples IR-DA-SD-1/IR-DA-SD-2 that were not J-qualified estimates are shown in Table F-7. No ecological SLs are established for aluminum; therefore, an RPD greater than 30% between field duplicates for this analyte is not expected to change the findings of this PA/SI. Copper is identified as a COPEC for sediment in this PA/SI, with an EF of 2.6 when compared to ecological sediment SLs; an RPD > 30% between field duplicates is not expected to change this finding. Zinc concentrations had an RPD of 34.1 between duplicate field sediment samples. Based on an RPD only slightly above the established 30% quality control threshold for this analyte, this result is not expected to change the findings of this PA/SI.

Table F-7. Non-J-qualified analytes with RPD > 30% in duplicate field samples IR-DA-SD-1/IR-DA-SD-2

Analyte	Max Ecological SL EF	COPEC?
Aluminum	NE	N
Copper	2.6	Y
Zinc	0.72	N

F.3 ADIT WATER RESULTS - TAL METALS

F.3.1 Detection Limits



As noted in the AI Work Plan and Sampling and Analysis Plan (AI, 2020), USEPA Method 6010B method detection limits (MDLs) exceeded project screening levels (PSLs) for the following analytes in water samples:

- Arsenic (PSL = 0.000052 mg/L, MDL = 0.0044 mg/L)
- Thallium (PSL = 0.0002 mg/L, MDL = 0.00431 mg/L)

Laboratory-provided MDLs were corrected for dilution in the provided analytical results. Adit water samples were not diluted; therefore, corrected MDLs were not required.

F.3.2 Matrix Spike/Matrix Spike Duplicate Recoveries and Relative Percent Difference (Accuracy, Precision, and Matrix Interference)

Field samples for matrix spike/matrix spike duplicate (MS/MSD) analysis were not run for adit water.

F.2.3. Field Duplicate Samples (Precision)

Field duplicate samples were collected for the following adit water samples:

- IR-DA-SWD-1/IR-DA-SWD-2 (dissolved metals analysis)
- IR-DA-SWT-1/IR-DA-SWT-2 (total metal analysis)

The relative percent difference (RPD) for comparison of duplicate samples was calculated as follows:

$$\% RPD = \frac{\text{Difference of duplicate results}}{\text{Average of duplicate results}} * 100$$

When an analyte concentration was less than the MDL in one duplicate, the MDL for that duplicate was used to calculate the MDL. RPDs were not calculated for analytes that were below the MDL in both duplicates. RPDs < 20% are considered correlative for water samples. Field duplicate adit water samples with calculated RPDs > 20% are shown in Table F-8, below. Note that no RPDs > 20% were identified in duplicate adit water samples IR-DA-SWT-1/IR-DA-SWT-2 (total metals analysis)

Table F-8. Field duplicate adit water samples with RPD > 30%

Analyte	Sample ID	Result (mg/L)	Qualifier	RPD (%)
Antimony	IR-DA-SWD-1	0.00674	J	44.2
	IR-DA-SWD-2	<0.00430	U	

Dissolved antimony was present in one of the duplicate adit water samples at a concentration below the MDL and in the other at an estimated concentration below the RDL. The RPD > 20% for this analyte is believed to be associated with the uncertainty associated with the low measured concentration and is not considered significant enough to change the findings of this PA/SI.



APPENDIX G

Site Inspection Photo-Log



Irene Mine Adit Portal and seep in front of adit. View west. Photo taken in 2019.



Water sample collection in front of Irene Adit, July 2020. View northwest



Irene Mine Waste Pile WP1 taken in 2019. View northwest.



Irene Mine adit seep and Waste Pile WP1 in background. View east.