**The Union Milling Contractors**
*P.O. Box 620490*
*Littleton, CO 80162-0490*
*+1.303.947.3499*

DRMS Recd:
December 31, 2021

31 December 2021

Mr. Dustin Czapla
Environmental Protection Specialist
Division of Reclamation, Mining and Safety
Department of Natural Resources
1313 Sherman Street, Room 215
Denver, CO 80203
303-866-3567, ext. 8188
dustin.czapla@state.co.us

**RE: Arkansas Valley Slag (AVS), File # M-2021-058, 112c Application Adequacy Review (01)**

Dear Mr. Czapla,

Union Milling Contractors (UMC) has prepared the following response to the 112c Application Adequacy Review (01).

1. **On page 1 of the application form it states that the permitted acreage will be 56 acres. Rule 6.4.1 (1) requires that Exhibit A - Legal Description identify the affected land, specifying the affected areas. In your Exhibit A (Section 6.4.1), the legal description describes a parcel containing 92.2 acres. Please clarify and describe the actual affected area proposed in this application.**

   **Response**

   CJK Milling -Slag property boundary is 92.2 acres whereas the permit boundary is approximately 56 acres.

2. **Rule 6.4.3 (d) requires that the Exhibit C - Mine Plan Map(s) show the total area to be involved in the operation, including the area to be mined and the area of affected lands. On page 1 of the application form it states that the permitted acreage will be 56 acres. In your Exhibit C (Section 6.4.3) several maps show a permit area of 56 acres, while others (Figures 4-10, 4-14) state the permit area is 92.2 acres. Please clarify the affected area and correct maps as necessary.**

   **Response**

   CJK Milling permit boundary is 56 acres. Permit maps will be modified to clearly delineate and identify the permit boundary.

**3. The operation proposes to remove existing stockpiles of slag from the site. Please clarify the type of processing that might occur. Will crushing occur?**

**Response**

CJK Milling will process the slag using a grizzly and classification screens. As necessary, slag will be crushed to meet customer specifications. An APEN is not required. The estimated emissions from proposed crushing does not trigger the permit submittal requirements.

**4. Please submit acid-base accounting analysis for the slag material in order to show the acid generating potential of the slag.**

**Response**

See Attachment A-Acid-base accounting analysis and Cation Exchange Capacity.
**Attachment A findings**

- "These values indicate that overall, the piles have a low potential for acid generation due substantially to their low levels of pyritic sulfur."
- "The range of values were 7.6 to 10.1 pH units. Thus, the slag is not potentially acid toxic due to acid-base accounting or pH."
- "Overall, the materials tested have low CEC"[1],

**5. Please submit geochemical characterization data for the slag material, including whole rock analysis and leachability test data.**

**Response**

**Appendix B1 Rock Analysis and Leachability Characterization Test Data Selected Rock Analysis and Leachability Findings**

1. Iron and Silica compose the majority of the slag,
2. Primary metals include lead, cadmium, arsenic, and zinc
3. Acid generation potential due to pyritic sulfur, when detected, is more than compensated by neutralization potential due to carbonate species. This results in a negative acid forming potential.
4. SPLP and column leach results, the resulting estimated metals load from the slag piles for lead, cadmium and zinc is conservatively estimated at 44, 2.0 and 230 kilograms per year, respectively.
5. Emissions calculations demonstrate that wind erosion does not occur from the AV slag pile, and it can be concluded that there are no significant impacts from that pile during undisturbed conditions. The air pathway analysis results show that wind erosion is not a significant release mechanism in Leadville.
6. The piles have the potential to contribute a small metals load of three of the elements of concern (lead, cadmium, and zinc). Arsenic loading was not calculated because of the infrequency of detection of this element in the leachates.
7. Transport by human activities has occurred, as slag was historically used for ballast and road maintenance within the site. Characteristics of slag on the railroad

[1] CEC -Cation Exchange Capacity-CEC is reported in units of milli-equivalents per 100 grams of soil (meq/100 g) and can range from below 5 meq/100 g in sandy, low organic matter soils to **over 15meq/100 g** in finer textured soils and those high in organic matter. Low CEC soils are more susceptible to cation nutrient loss through leaching. higher CEC usually indicates more clay and organic matter is present in the soil, high CEC soils generally have greater water holding capacity than low CEC soils.

tracks are represented by the results for the AV ballast-sized subpile samples. The ballast-sized sample results show a low potential for leaching (well below toxicity characteristic criteria).

8. Based upon field observations and chemical analysis of the soils beneath the slag piles, it can be concluded that subslag soils have not been significantly impacted by the placement of slag. The concentration of elements of concern in subslag material is very low.
9. Slag does not appear to be transported from piles onto adjacent soils in rivulets or channels. Pile integrity, especially for fines piles where this is most critical appears intact. This potential release mechanism for slag is not a concern at the site.

**6. Documentation submitted with your application shows that the EPA accepted "No Action" remedy for site remediation contains a contingency for "...future utilization of the slag, if it is encapsulated prior to its use or reuse." Please inform the Division of how CJK will ensure the slag is encapsulated prior to use once it is sold and removed from the site.**

**Response**

**See Appendix B-2 Selected Remedial Remedy Findings**

1. The No Action alternative leaves the stockpiled fine slag in its existing condition with no control or cleanup planned. The No Action alternative, as described in the Proposed Plan, includes a contingency for future utilization of the slag, if it is encapsulated prior to its use or reuse.
2. Encapsulation of the fine slag ensures that the contingency remedy is also protective of human health and the environment. Encapsulation can include the use of the fine slag in concrete or asphalt aggregate; or as road base, backfill or other construction material as long as the fine slag is chemically bound or physically separated from any exposure scenario by a barrier consisting of another material. Dust suppressants to control particulate emissions and best management practices to control stormwater runoff would also be employed to contain contaminant releases during implementation of the contingency remedy

**7. Please inform the Division of whether the Operator will need EPA or CDPHE authorization to remove slag from the site. If not, please provide the basis for that determination.**

**Response**

**EPA or CDPHE authorization**

See **Appendix B-3**. CJK Milling-CJK Aggregates has included e-mails from EPA and CDPHE acknowledging CJK's intention to process and recycle slag with the understanding the material will be utilized in accordance with OU3 Record of Decision. (See **Attachment B-2**) The restrictions limit use of slag material with a size fraction less than 3/8 inches. Material less than 3/8 inches must be encapsulated (asphalt, concrete, road base, pipeline bedding) (See the following OU3 Record of Decision)

**Key Findings**

**Environmental Protection Agency Declaration**
**Stockpiled Fine Slag**
**Arkansas Valley Smelter Slag Pile**
**California Gulch Superfund Site (Operable Unit 3)**
**Leadville, Colorado**

1. "The U.S. Environmental Protection Agency (EPA), with the concurrence of the Colorado Department of Public Health and Environment (CDPHE), presents this Record of Decision"
2. (ROD) for stockpiled fine slag at the Arkansas Valley smelter slag pile of Operable Unit 3 (OU-3) within the California Gulch Superfund Site in Leadville, Colorado. The ROD is based on the Administrative Record for California Gulch OU3, including the Remedial Investigation/ Feasibility Study (RI/FS), the Proposed Plan, and the public comments received."
3. "stockpiled fine slag, the Selected Remedy leaves the slag piles in their existing condition with no remediation, engineering controls, long term maintenance, or clean up planned. The Selected Remedy is protective of human health and the environment and is considered effective because 1) no complete human or ecological exposure pathways were identified for the stockpiled fine slag and 2) the potential for release of metals in leachate from the stockpiled fine slag is minimal."
4. "The Selected Remedy provides a contingency for resource utilization which may be undertaken in the future if regional market demand exists for the material. Resource utilization involves the use or reuse of the slag material as a commercial product. Due to concerns about the potential for release of airborne particulates if resource utilization is undertaken, the EPA has determined that resource utilization of the stockpiled fine slag is only appropriate if it is encapsulated for reuse. Encapsulation can include the use of fine slag in concrete or asphalt aggregate; or as road base, backfill or other construction material as long as the fine slag is chemically bound or physically separated from any exposure scenario by a barrier consisting of another material. Dust suppressants to control particulate emissions and best management practices to control stormwater runoff would also be employed to contain contaminant releases from the fine slag stockpile and during implementation of the contingency remedy. Resource utilization must also take into consideration any toxic leaching potential for the fine slag."

**Appendix B-4 - EPA -CDHPE Slag Use Confirmation**
**Key Findings**

**E-mail from Kyle Sandor**
**CDPHE California Gulch Superfund Site**
**Project Manager**

"From the OU3 ROD that I've attached to this email, the selected remedy describes a future utilization scenario for the fine slag, if it is encapsulated prior to use or reuse. The ROD further states the following:

"Encapsulation of the fine slag ensures that the contingency remedy is also protective of human health and the environment. Encapsulation can include the use of the fine slag in concrete or asphalt aggregate; or as road base, backfill, or other construction material as long as the fine slag is chemically bound or physically separated from any exposure scenario by a barrier consisting of another material. Dust suppressants to control particulate emissions and best management practices to control stormwater runoff would also be employed to contain contaminant releases during implementation of the contingency remedy."

In your email to Doug, you asked specifically about using the slag as pipeline bedding. In order for the slag to be used as bedding material it will either need to be chemically bound or utilize an additional clean fill identification layer between the slag and the pipeline. This additional layer would be necessary to ensure that future pipeline workers would not be exposed to the material unknowingly.

The ROD did not outline a formal process for CDPHE or EPA to follow to review these resource utilization projects, but historically I believe the agencies have reviewed the submitted written requests and provided a letter indicating approval/denial of the proposed use.

**E-Mail Linda Kiefer**
**August 9, 2021**
**USEPA – California Gulch Superfund Site Project Manager 303.312.6689**

"Encapsulation of the fine slag ensures that the contingency remedy is also protective of human health and the environment. Encapsulation can include the use of the fine slag in concrete or asphalt aggregate; or as road base, backfill, or other construction material as long as the fine slag is chemically bound or physically separated from any exposure scenario by a barrier consisting of another material. Dust suppressants to control particulate emissions and best management practices to control stormwater runoff would also be employed to contain contaminant releases during implementation of the contingency remedy."

**8. In Appendix 6-3, Noxious Weed Plan, you have submitted a noxious weed management plan for the Penn Mine. Please submit a weed management plan specific to this site.**

**Response**

See Attachment C.

**9. The Exhibit F –Reclamation Plan Map submitted shows a proposed permit area of 92.2 acres. Please correct the affected area acreage shown on the map so that it is consistent with the rest of the application.**

**Response**

CJK Milling permit boundary is 56 acres. Submitted maps will be modified to clearly delineate the permit boundary.

**10. In Appendix 14-2 APEN Calculations it is stated that 400 tons per day of slag will be transported to the Leadville Mill for processing. The mine plan submitted with this application contains no discussion regarding transport to and processing at the Leadville Mill. Additionally, the Leadville Mill permit contains no discussion or authorization for processing of the slag material. Please clarify the processing that is proposed to occur at the AVS site.**

**<u>Response</u>**

CJK Milling will process the slag using a grizzly and screens. As necessary, slag will be crushed to meet customer specifications. All processing operations will be conducted within the slag permitted boundary. Appendix 14-2 will be corrected to clearly reflect this.

**11. Your application includes structure agreements that are not executed by the structure owners. Please provide the fully executed structure agreements for structures located within 200 feet of the affected area:**

**<u>Response</u>**

Agreements for structures were sent to all owners, as required for the permit application. The owners did not respond, thus requiring that UMC prepare an engineering report for the permit submission. CJK have commissioned an engineer to complete this task. However, the following critical information is required from Leadville Sanitation (LS) before the engineering report can be completed:

- <u>Sewer Easement</u>. The sewer line easement through the AVS property cannot be found in the county records. This item was requested from LS, but they could not locate their copy. CJK was able to locate a copy of the LS easement in its closing documents with Union Pacific (former owner), and shared this with LS. However, this document does not include a map showing the actual location of the sewer. More importantly, the document does not specify the width of the easement. Therefore, neither the actual easement nor the sewer line location within the easement known.
- <u>Waterline Easement (or Right-of Way)</u>. The location of the waterline is not known. The waterline may be located in the CDOT US Highway 24 RoW, but this is not yet confirmed.
- <u>Structure Condition</u>. Both the sewer- and water-lines were installed in 1970-71. The materials of construction, condition, and maintenance of these structures is not known.

CJK is in the process of resolving these issues with LS to facilitate the engineering report. The following action items are currently in place:

- Location Survey: A licensed surveyor was commissioned to locate and survey these structures. This work was recently completed, and the surveyors draft report was submitted to CJK on Tuesday 28 December for review. CJK will provide this report to LS and the Division once finalized. (We can provide this draft if you wish, however it is not final and may change).
- CJK have a meeting scheduled with LS on Wednesday 5 January to discuss and resolve these issues, (and to provide an update on proposed mitigations to LS's concerns with respect to the Leadville Mill (M1990-057) 112 permit application).

CJK are working diligently to complete this permit requirement and will provide the engineering report to the Division as soon as it is completed.

Please contact me for additional information or clarifications. I may be reached by phone at 303-947-3499, nmichael@unionmilling.com.

Sincerely,

*[signed]*

Nick Michael, Member
Union Milling Contractors, LLC

**RESPONSE**
**112 APPLICATION ADEQUACY REVIEW**
**(01)**

**ARKANSAS VALLEY SLAG (AVS)**
**FILE #M-2021-058**

**PREPARED FOR**
**CJK MILLING COMPANY**

**PREPARED BY**
**UNION MILLING CONTRACTORS**
**12.09.2021**

# ATTACHMENTS

## ATTACHMENT A

**GEOCHEMICAL SUMMARY AND CONCLUSIONS**
**ARKANSAS VALLEY SLAG (AVS) AKA CJK SLAG**

## ATTACHMENT B

**ATTACHMENT B-1 PHYSICAL AND CHEMICALCHARACTERIZATION**
**ARKANSAS VALLEY SLAG (AVS) AKA CJK SLAG**

**ATTACHMENT B-2 SELECTED REMEDY-OU-3 RECORD OF DECISION**

**ATTACHMENT B-3 SUMMARY AND CONCLUSIONS**
**ARKANSAS VALLEY SLAG-OU3 AKA CJK SLAG**

**ATTACHMENT B-4 RECORD OF DECISION**
**STOCKPILED FINE SLAG-ARKANSAS VALLEY SMELTER-SLAG PILE**
**CALIFORNIA GULCH SUPERFUND SITE (OU3)**

# ATTACHMENT A GEOCHEMICAL SUMMARY AND CONCLUSIONS
# CJK SLAG

**hemical Characterization, Neutralization, Acid Basin Accounting, Cation Exchange Capacity, Sub-Slag Material Characterization**

Frost action in rock is a result of the water in pores and voids freezing and expanding; therefore, the porosity and permeability of rock are contributing factors to freeze/thaw susceptibility. In general, igneous rocks such as basalt and obsidian have a porosity in the range of 1 to 2 percent (Bell, 1981). Composition of slag is similar to these rock types with the exception of open voids in slag due to cooling in an unconfined condition.

While most of the slag piles in Leadville show no signs of freeze/thaw weathering, visual inspection of the La Plata slag pile shows that the top layer of slag material in many areas has been broken down into smaller pieces to a depth of approximately 6 inches. This reduction in size is likely the result of breakage along laminations formed during deposition, congelifraction and man-made disturbances such as being traversed by heavy equipment. The fissures that occur in the La Plata slag pile (Figure 3-2), are not likely susceptible to freeze/thaw processes. Based on the theory of freeze/thaw fracturing, microfractures are where rock material is forced apart by the pressure of water freezing in cracks. The La Plata fissures are much too wide (on the order of centimeters) to retain water that would freeze, expand, and promote fracturing.

Based on the low porosity and vitrified glass-like nature of slag, the slag is likely has a low susceptibility to congelifraction and high freeze/thaw resistance. The impact of freeze/thaw cycling on slag in the environment is expected to be minimal.

Chemical Characteristics of Slag and Subslag Material

The chemical characteristics of the slag and subslag material, as determined by the analysis program outlined in the SAP and discussed in earlier sections, are presented in this section. Chemical analyses included total compositional analysis, Synthetic Precipitation Leaching Procedure (SPLP) -analysis, and column leaching tests with analysis of the effluent. Compositional analyses included the analyses of the Target Analyte List (TAL) metals (minus mercury plus silicon), water soluble anions, neutralization potential, sulfur forms and cation exchange capacity. SPLP and column leach eluates were analyzed for anions and TAL metals for metals (minus mercury plus silicon).

### 4.5.1 Lead Slag Material

Surface slag and old slag samples from selected lead slag piles were submitted to the compositional analysis program.

#### 4.5.1.1 TAL Metals

Target Analyte List (TAL) metals were analyzed for each of the thirty-eight lead slag samples following digestion by a U.S. Bureau of Mines method as the preparatory technique (Bureau of Mines, 1980). After digestion, most metals analyses were conducted by Inductively Coupled Plasma (ICP) techniques, although some of the metals were analyzed by graphite furnace atomic absorption (GFAA) methods. The elements analyzed by GFAA include arsenic, cadmium, lead and selenium. The use of GFAA was necessitated by matrix interference problems caused by the particular digestion fluid used.

The results of the analyses conducted are presented in the following tables and are discussed in detail in this section. Table 4-9 presents the frequency of occurrence of the elements, along with the minimum and maximum values of each of the elements. Table 4-10 presents the surface slag sample geometric mean concentrations by pile and Table 4-11 presents the surface slag sample range of reported concentration by pile. Iron and silicon comprise the majority of the slag matrix. Iron ranges from 18.9 to 33.2 percent of the slag material, while silicon ranges from 10.1 to 15.1 percent. Calcium values ranged from 4.4 to 14.5 percent. The concentration range and geometric mean of each of four primary elements of concern at the California Gulch site are as follows:

- Arsenic--9.9 to 2,160 mg/kg, mean 217 mg/kg
- Cadmium--4.1 to 37 mg/kg, mean 4.41 mg/kg
- Lead--1,590 to 30,200 mg/kg, mean 8,630 mg/kg
- Zinc--9,800 to 77,300 mg/kg, mean 36,500 mg/kg

Metals of Concern

The geometric mean for cadmium presented above was calculated using non-detect values as one-half of the sample quantitative limit. Results for all other elements in each of the thirty-eight lead slag samples were above detection limits.

#### 4.5.1.2 Anions

Water soluble anions chloride, sulfate, and nitrate/nitrite were analyzed in slag samples. Although carbonate was not directly measured in the water soluble extracts, its concentration was deduced from the neutralization potential results, which are reported as total calcium carbonate. The anions are reported in solid units, mg/kg, by back-calculation from the analyses conducted on the water soluble extract.

## TABLE4-9

| CHEMICAL NAME | Number of Detections | Number of Analyses | RANGE OF DETECTED CONCENTRATIONS WITH DATA QUALIFIERS | | | |
|---|---|---|---|---|---|---|
| | | | Minimum Value (ma/ka) | | Maximum Value (mg/ka> | |
| Aluminum, total | 38 | 38 | 13100.00 | LPO106M00 | 31300.00 | AVS111M00 |
| Antimony, total | 38 | 38 | 25.80 | MES101MOO | 842.00 | AVS110M00 |
| Arsenic, total | 38 | 38 | 9.90 | LPS102MOO | 2160.00 | AVS113MOO |
| Barium, total | 38 | 38 | 348.00 | LPCOLUMN1 | 4950.00 | MES101MOO |
| Berytllum, total | 38 | 38 | 0.34 | HRO105MOO | 3.40 | AVS111MOO |
| Cadmium, total | 29 | 88 | 4.10 | AVS107MOO | 37.00 | AVS105MOO |
| Calcium, total | 38 | 38 | 44000.00 | LPS102MOO | 145000.00 | AVS113MOO |
| Chromium, total | 38 | 38 | 11.90 | LPS101MOO | 1210.00 | MES101MOO |
| Cobalt, total | 34 | 38 | 1.30 | LPS104MOO | 75.40 | AVS110MOO |
| Copper, total | 38 | 38 | 379.00 | HRO106MOO | 2780.00 | AVS104MOO |
| Iron Ill, total | 38 | 38 | 189000.00 | AVO102MOO | 332000.00 | LPS104MOO |
| lead, total | 38 | 38 | 1690.00 | LPS103MOO | 30200.00 | UES101MOO |
| Magnesium, total | 38 | 38 | 2080.00 | LP0106MOO | 31800.00 | HRS101MOO |
| Manganeee, total | 38 | 38 | 4850.00 | LPS101MOO | 49000.00 | HRS102MOO |
| Nickel, total | 28 | 39 | 3.20 | HRS103MOO | 687.00 | MES101MOO |
| Pota811um, total | 38 | 38 | 3040.00 | LPCOLUMN2 | 9090.00 | AVS104MOO |
| Selenlum,total | 9 | 38 | 8.80 | AVS116MOOD | 93.20 | AVS118MOO |
| Silicon, Total | 38 | 38 | 101000.00 | AVS110MOO | 151000.00 | GGS101MOO |
| Soclum,total | 37 | 37 | 179.00 | LP0108MOO | 8210.00 | AVS110MOO |
| Vanaclum, total | 38 | 38 | 32.00 | LPCOLUMN2 | 481.00 | HRS104MOO |
| Zinc, total | 38 | 38 | 9800.00 | HRO105MOO | | AVS112MOO |
| TOTALS | 745 | 798 | | | | |

Table: FREQUENCY OF OCCURRENCE FOR SLAG SAMPLES - TAL METALS

Table 4·10

## Surface Slag Geometric Mean
## Concentrations by Pile

| Analyte | AV Sorted Fines | AV Ballast | AV Mater-quenched | AV Air-cooled | La Plata | Harrison | GG,LE,ME,UE |
|---|---|---|---|---|---|---|---|
| Alunfnun | | | | | | | 20300.00 |
| Aluminum | 22600.00 | 23000.00 | 24100.00 | 23500.00 | 17000.00 | 16300.00 | 20300.00 |
| Antimony | 162.00 | 178.00 | 292.00 | 158.00 | 127.00 | 70.30 | 57.30 |
| Arsenic | 435.00 | 376.00 | 909.00 | 313.00 | 16.10 | 228.00 | 354.00 |
| Barfun Barium | 2140.00 | 2410.00 | 1790.00 | 2130.00 | 691.00 | 1130.00 | 2890.00 |
| Beryll1 Berrlyium | 0.91 | 1.00 | 1.10 | 1.20 | 1.10 | 0.66 | 0.71 |
| Cactnfun Cadmiumu | 11.90 | 16.30 | 16.60 | 9.70 | 8.85 885 | 0.20 | 0.50 |
| Calch.111 Calcium | 104000.00 | 106000.00 | 126000.00 | 103000.00 | 55200.00 | 93200.00 | 94400.00 |
| Chromiun | 29.80 | 45.80 | 79.70 | 36.10 | 25.50 | 21.90 | 359.00 |
| Cobalt | 21.70 | 23.40 | 59.40 | 19.90 | 0.82 | 2.40 | 7.94 |
| Copper | 2190.00 | 2390.00 | 2500.00 | 1890.00 | 1920.00 | 854.00 | 1320.00 |
| Iron Iron | 238000.00 | 245000.00 | 235000.00 | 231000.00 | 314000.00 | 262000.00 | 235000.00 |
| Lead | 10800.00 | 10100.00 | 9650.00 | 11200.00 | 1780.00 | 11100.00 | 17900.00 |
| Magnesftn | 10100.00 | 11500.00 | 7370.00 | 13600.00 | 4680.00 | 14800.00 | 7860.00 |
| Manganese | 18400.00 | 13700.00 | 9650.00 | 17000.00 | 7090.00 | 44700.00 | 29200.00 |
| | 8.00 | 8.46 | | 3.50 | 3.82 | 3.30 | 165.00 |
| Potasshn | 7610.00 | 7940.00 | | 7310.00 | 5410.00 | 4840.00 | 6690.00 |
| Nickel | 5.40 | 3.00 | 64.90 | 5.09 | 2.00 | 4.00 | 1.00 |
| Silicon | 133000.00 | 130000.00 | 108000.00 | 134000.00 | 131000.00 | 117000.00 | 142000.00 |
| Sodhn Icon | 1460.00 | 997.00 | 5500.00 | 1570.00 | 462.00 | 654.00 | 1230.00 |
| | 75.40 | 69.60 | 53.70 | 76.80 | 39.00 | 281.00 | 157.00 |
| | 44000.00 | 44700.00 | 73000.00 | 44100.00 | 39600.00 | 26100.00 | 18300.00 |

Leadtbls\4·10r1 11/4/92

AV-ARKANSAS VALLEY SLAG -OU3

TABLE 4·11

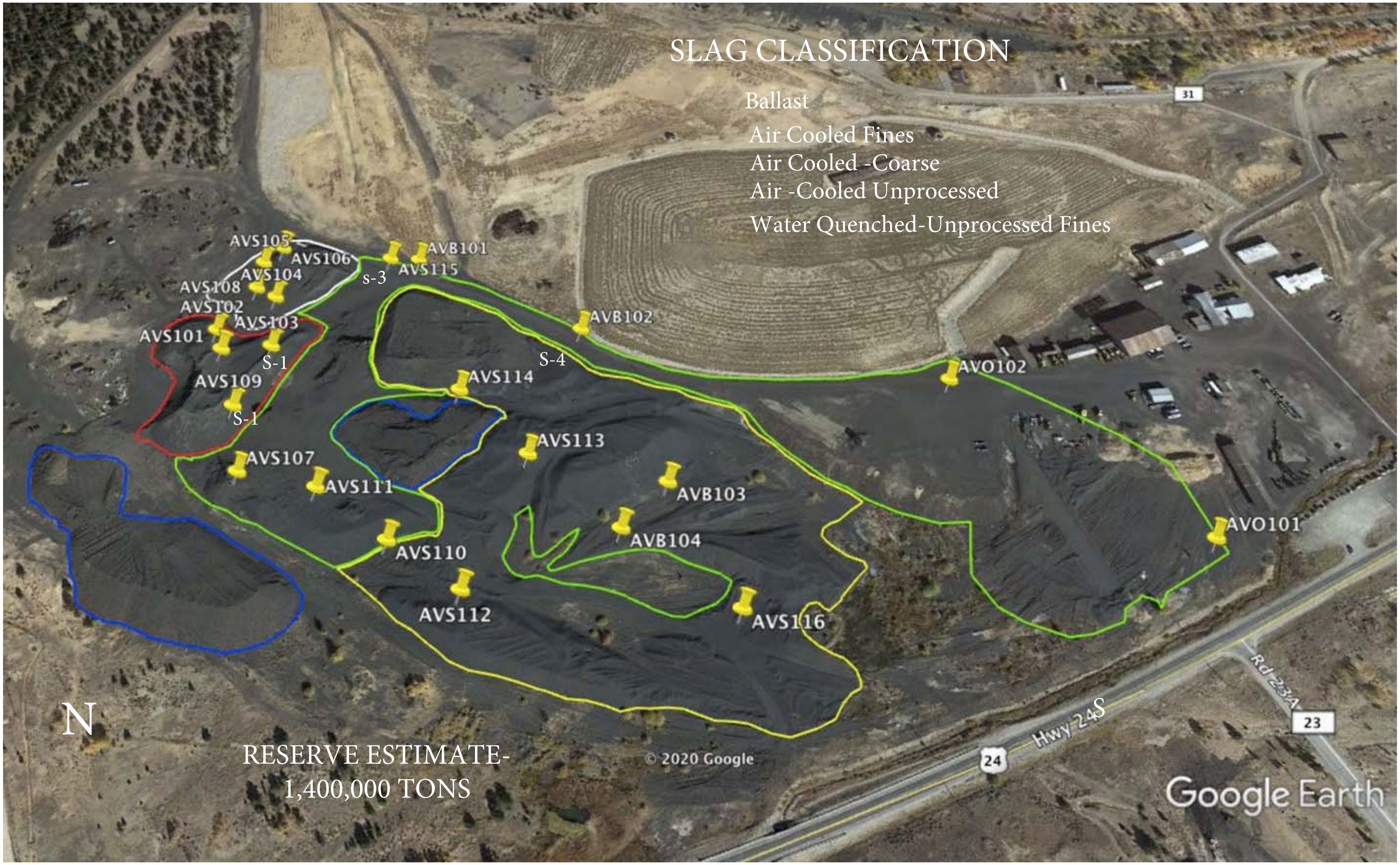
SURFACE SLAG SAMPLE RANGE OF REPORTED CONCENTRATIONS BY PILE (ppm)

**(SEE FIGURE 1-SLAG CLASSSIFICATION SAMPLING SITES**

| ANALYTE | AV SORTED FINES | | AV BALLAST | | AV WATER-QUENCHED | | AV AIR·COOLED | | LA PLATA | | HARRISON | | GG, LE, ME, UE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **MINIMUM** | **MAXIMUM** | **MINIMUM** | **MAX1liJM** | **MINIMUM** | **MAXIMUM** | **MINIMUM** | **MAXIMUM** | **MINIMUM** | **MAXIMUM** | **MINIMUM** | **MAXIMUM** | **MINIMUM** | **MAXIMUM** |
| **Aluninun** | 20200 | 24000 | 22700 | 23600 | 22800 | 25300 | 19100 | 31300 | 13800 | 18800 | 15400 | 1noo | 17600 | 22500 |
| Antimony | **138** | 191 | 154 | 197 | 72.6 | 842 | 116 | 267 | 88.1 | 181 | **52.9** | **92.3** | **25.8** | **116** |
| **Arsenic** | 344 | **506** | 313 | **532** | 456 | 2160 | 200 | 397 | ***9.9*** | **53.8** | 139 | 393 | **235** | 842 |
| **Barium** | 2070 | 2220 | 2180 | 2650 | 1530 | 2140 | 1780 | 2520 | 430 | 964 | *969* | 1510 | 1410 | 4950 |
| Berylliun | 0.82 | 1 | 0.93 | **1.1** | 0.55 | 1.6 | 0.8 | 3.4 | 0.75 | 1.3 | 0.61 | 0.78 | 0.66 | 0.77 |
| Cadmium | 5.7 | 26.4 | 6.1 | 37 | 15.4 | 17.6 | 4.1 | 18 | 6.2 | 15.4 | **N/A** | **N/A** | **N/A** | 7.6 |
| Calciun | 96800 | 111000 | 99900 | 115000 | 113000 | 145000 | 95200 | 109000 | 44000 | 66900 | 81300 | 121000 | 68900 | 126000 |
| Chromiun | 22.9 | 34.2 | 31 | **66.6** | 48.9 | 132 | 24.4 | **66.9** | 11.9 | 61.9 | 20.9 | 23 | 29.3 | 1210 |
| Cobalt | 10.1 | 32.2 | 14 | **35.8** | 41.1 | 75.4 | 13 | **23.6** | 1.3 | **2.2** | **1.7** | 3.7 | **4.3** | 12.2 |
| Copper | **1620** | **2530** | 2050 | 2780 | **2060** | 2760 | 1370 | 2390 | 1690 | 2070 | **559** | 1140 | 1000 | 1640 |
| Iron | 226000 | 247000 | 241000 | 251000 | 219000 | 250000 | 215000 | 243000 | 302000 | 332000 | 200000 | 301000 | 213000 | **278000** |
| **Lead** | 9430 | 13800 | 8820 | 11700 | 8330 | 10900 | 9080 | 14600 | 1590 | 2100 | ***7600*** | 15100 | 10100 | 30200 |
| **Magnesium** | 8560 | 11900 | 9220 | 14100 | 6540 | 8700 | 11800 | 16700 | **3860** | 6110 | 7660 | 31800 | 4200 | 10900 |
| **Manganese** | 12800 | 37200 | 8120 | 24100 | 8390 | 11200 | *9060* | 31200 | 4850 | 17000 | 37800 | 49000 | 22900 | 33400 |
| Nickel | 10.2 | 17.3 | 3.7 | 21.2 | | 21.5 | 7.4 | **8.2** | **4.6** | 18.1 | **3.2** | 5.1 | 12.1 | **587** |
| Potassium | 7180 | 8150 | 7030 | 9090 | 7360 | 8540 | 6020 | 8550 | 3630 | 7130 | 4460 | 5230 | 6030 | 7890 |
| **Seleniun** | **9.2** | ***9.9*** | **N/A** | **N/A** | 44.4 | 93.2 | **N/A** | 11.2 | **N/A** | **N/A** | **N/A** | **N/A** | **N/A** | **N/A** |
| Sil icon | 131000 | 135000 | 123000 | 136000 | 101000 | 112000 | 129000 | 138000 | 113000 | 143000 | 108000 | 131000 | 130000 | 151000 |
| Sodiun | 1270 | 1640 | 866 | 1120 | 5130 | 6210 | 1460 | 1860 | 340 | **575** | 530 | 877 | **952** | 2070 |
| **Vanadiun** | **66.8** | 93.4 | 52.8 | 87.6 | **45.8** | **68.6** | 51.4 | 103 | 33 | 50.4 | 209 | 461 | ***99.6*** | 247 |
| Zinc | 33900 | 49800 | 42100 | 47800 | 67400 | 77300 | 37200 | 54400 | 28100 | 55400 | 16700 | 44800 | 14900 | 26800 |

**N/A** = not applicable (not enough detections to provide a mininun and maximJm)

**CLASSIFICATION SAMPLING SITES**
**CJK AGGREGATES SLAG**




**AVS-ARKANSAS VALLEY SLAG**

FIGURE 1

**CJK MILLING COMPANY**
**CJK AGGREGATES**
**LEADVILLE, COLORADO**

The most prevalent anion in the slag samples is the carbonate anion with a mean of 93,000 mg/kg or about nine percent of the total mass of the material. The range of concentrations of carbonate is from 6,100 to 270,840 mg/kg. The second most prevalent water-soluble anion is sulfate A summary of the anion concentration is listed below:

- Sulfate--40.4 to 2412 mg/kg, mean 414 mg/kg
- Chloride--1.1 to 39 mg/kg, mean 1.77 mg/kg
- Nitrate--1.8 to 20.4 mg/kg, mean 2.51 mg/kg
- Nitrite--1.2 to 3.8 mg/kg, mean 0.64 mg/kg

#### 4.5.1.3 Sulfur Forms

Sulfur forms were determined by EPA Method 3.2.4 and 3.2.6 (EPA, 1978) for input to calculations of acid-base accounting. Total sulfur is comprised of pyritic sulfur, sulfate, and other non-extractable sulfur forms. The mean concentration for total sulfur is 1.66 percent, with non-extractable sulfur the largest fraction by weight of total sulfur. The following provides a breakdown of the sulfur form concentration ranges:

- Total sulfur--1.0-3.86%, mean 1.66%
- Sulfate sulfur--0.23-1.23%, mean 0.64%
- Pyritic sulfur--0.02-0.6%, mean 0.07%
- Non-extractable sulfur--0.12 to 1.99%, mean 0.845%

Evaluation of the results for pyritic sulfur versus total sulfur indicate that pyritic sulfur averages 9.9 percent of total sulfur for all of the slag samples collected. The non-extractable sulfur for all the slag samples averaged 50 percent of the total sulfur.

For use in acid-base accounting, the percent of pyritic sulfur is converted to units of tons of $CaCO_3$ equivalent sper 1000 tons of material (t/kt) ·by multiplying by 31.25, yielding potential acidity.. Multiplying by 31.25 converts parts per hundred sulfur by weight to moles of sulfur. This is set equal to moles of calcium carbonate, which are converted to parts per thousand by weight $CaCO_3$. Therefore:

$$\text{Weight } \%S \times 31.25 = \text{parts per thousand by weight } CaCO_3.$$

The potential acidity due to pyritic sulfur is presented in Table 4-12. The geometric mean potential acidity due to pyritic sulfur for all of the slag samples is 2.04 t/kt. The surface slag and old slag samples of all the piles had very similar geometric means of 2.0 and 1.9 t/kt, respectively.

These values indicate that overall the piles have a low potential for acid generation due substantially to their low levels of pyritic sulfur.

The AV pile has the greatest potential acidity due to pyritic sulfure with a geometric mean of 5.81 t/kt. The Upper, Middle and Lower Evans Gulch and the Georgia Gulch pile samples did not show detectable pyritic sulfur values. The results of the potential acidity due to pyritic sulfur analysis for this RI are significantly less (one order of magnitude) than the results of the maximum potential acidity analysis performed on samples collected in 1989 (EPA, 1990d), although the total sulfur values are similar. The eason for this is that the EPA did not analyze slag for pyritic sulfur in 1990. Rather, they analyzed for total sulfur and assumed that the total sulfur value obtained was all pyritic sulfur. The pyritic fraction, when analyzed separately, obviously less than the total fraction for materials containing several sulfur forms.

### 4.5.1.4 Neutralization Potential and Acid-Base Accountint:

Neutralization Potential (NP) was measured by EPA Method 3.2.3 (EPA, 1978) and is reported in units of tons of $CaCO3$ per 1000 tons of material (t/kt). These values are presented in Table 4-12. The NP for the slag materials showed that the old slag material has the greatest potential for neutralization with a mean of 202 t/kt as compared to surface slag with a mean of 140 t/kt. Georgia Gulch and Upper, Middle and Lower Evans Gulch piles also showed high NP values. The highest NP was found in the composite sample collected from Middle Evans Gulch pile at 444 t/kt.

Acid-base accounting is a technique developed for identifying potentially toxic ,i.e. with the ability to generate acid, levels of pyritic materials in surface mine overburden. The weathering of pyritic overburden can produce acid over time, thereby lowering the pH and creating an environment conducive to leaching metals. The net acid-base account of a mine overburden is defined as it maximum potential acidity minus its neutralization potential with both expressed in units of tons calcium carbonate ($CaCO_3$) equivalents per 1000 tons of material. .Potential acidity is equivalent to the amount of acidity that can be generate.

TABLE4-12

SLAG SAMPLE ACID - BASE ACCOUNTING
(tons of CaCO3 equivalents per 1000 tons of material}

| Sample ID | | Neutralization Potential | Acid Generation Potential due to Pyritic Sulfur | Net Acid-Forming Potential |
|---|---|---|---|---|
| AVS107M00 | AV Air Cooled | 215 | 1.90 | -213.10 |
| AVS114M00 | AV Air Cooled | 240 | 5.00 | -235.00 |
| AVS111M00D | AVAirCooled | 332 | 2.50 | -329.50 |
| AVS115M00 | AV Air Cooled | 219 | 5.00 | -214.00 |
| AVS115M0OD | AV Air Cooled | 342 | 18.40 | -323.60 |
| AVS111M00 | AV Air Cooled | 1 | 9.40 | 8.40 |
| AVS108M00 | AV Ballast | 111 | 7.80 | -103.20 |
| AVS105M00 | AV Ballast | 206 | 7.20 | -198.80 |
| AVS104M00 | AV Ballast | 186 | 5.90 | -180.10 |
| AVS106M0O | AV Ballast | 189 | 4.70 | -184.30 |
| AVO102M00 | AV Old Slag | 240 | 9.10 | -230.90 |
| AVO101M00 | AV Old Slag | 186 | 7.80 | -178.20 |
| AVS103M00 | AV Sorted Fines | 237 | 9.70 | -227.30 |
| AVS109M00 | AV Sorted Fines | 191 | 0.90 | -190.10 |
| AVS102M00 | AV Sorted Fines | 84 | 5.90 | -78.10 |
| AVS116M00 | AVWQ Fines | 101 | 5.60 | -95.40 |
| AVS110M00 | AVWQ Fines | 10 | 13.10 | 3.10 |
| AVS112M00 | AVWQ Fines | 59 | 2.50 | -56.50 |
| AVS113M00 | AV WO Fines | 139 | 13.40 | -125.60 |
| AVS101MO0 | AV Sorted Fines | 205 | 6.60 | -198.40 |
| GGS101M00 | Georgia Gulch | 403 | 0.30 | -402.70 |
| HRO105M00 | Harrison Old | 290 | 6.30 | -283.70 |
| HRO106M00 | Harrison Old | 236 | 0.30 | -235.70 |
| HRS104M00 | Harrison Surf. | 217 | 0.30 | -216.70 |
| HRS101M00 | Harrison Surf. | 183 | 0.30 | -182.70 |
| HRS103MO0 | Harrison Surf. | 188 | 0.30 | -187.70 |
| HRS102M00 | Harrison Surf. | 233 | 1.50 | -231.50 |
| LPO105M00 | La Plata Old | 203 | 0.30 | -202.70 |
| LPO106M00 | La Plata Old | 111 | 2.80 | -108.20 |
| LPCOLUMN2 | La Plata Old | 340 | 0.30 | -339.70 |
| LPS101M00 | La Plata Surf. | 101 | 7.80 | -93.20 |
| LPS102M0O | La Plata Surf. | 83 | 8.10 | -74.90 |
| LPCOLUMN1 | La Plata Surf. | 330 | 5.60 | -324.40 |
| LPS104M0O | La Plata Surf. | 144 | 0.60 | -143.40 |
| LPS103M00 | La Plata Surf. | 103 | 10.00 | -93.00 |
| LES101M00 | Lower Evans | 348 | 0.30 | -347.70 |
| MES101MO0 | Middle Evans | 444 | 0.30 | -443.70 |
| UES101M00 | Upper Evans | 297 | 0.30 | -296.70 |

AV=ARKANSAS VALLEY S
SLAG

Interpretation of the NAG test results (AMIRA 2002)

| NAG pH | NAG (kg H2SO4/t) | Acid Production Potential |
|---|---|---|
| 4.5 | 0 | Non-acid forming (NAF) |
| < 4.5 | 5 | Potentially acid forming – lower capacity (PAF-LC) |
| < 4.5 | > 5 | Potentially acid forming (PAF) |

leadtbls\tb14-12ri 11/03/92

from sulfur compounds (generally sulfide ) is calculated using the pyritic sulfur values. Neutralization potential is the buffering capacity of the material . The difference between potential acidity and neutralization potential is net acid generation potentila of these values for the slag samples are presented i in Table 4-12.

According to *Mine Spoil Potential for Soil and Water Quality* (EPA, 1974), page 128, "From the acid-base account, potentially toxic material is defined as a rock or earth material having a net potential deficiency of 5.0 tons of calcium carbonate equivalent or more per 1,000 tons of material." Regardless of the acid-base account, materials that have a pH of less than 4.0 in a pulverized rock slurry in distilled water are defined as being acid-toxic.

A net acid-forming potential less than 5.0 t/kt indicates excess neutralization potential in relation to the potential acid generation. Only one discrete slag sample, AVS111 (air-cooled) at 8.4 t/kt, exceeded this limit. All of the other samples showed a net acid-forming potential less than 5.0. The neutralization potential of the sample in question is likely invalid due to laboratory error. The laboratory duplicate shows a neutralization potential of 332 ton/kton and a net acid-forming potentia lof -323, which are more consistent with other samples from the same AV subpile. Therefore, D&RGW believes that the value for net acid forming potential from AVS111MOOD (the duplicate) is the correct value. The geometric mean of the net acid-forming potentiaf for all of the piles was -149 t/kt.

The pH of a pulverized slurry was analyzed on 20 of the 53 samples. The results are located in Appendix E. None of the pH results were less than 7.0 pH units, well above the method cutoff of 4.0 pH units. The range of values were 7.6 to 10.1 pH units. Thus, the slag is not potentially acid toxic due to acid-base accounting or pH.

### 4.5.1.5 Cation Exchange Properties

Cation Exchange Capacity (CEC) is a measure of how readily a material will sorb cations onto its surface or into its matrix. The CBC was measured using EPA method 9080 (EPA, 1986) in which results are expressed in milliequivalents (meq) per 100 grams of material. Overall, the materials tested have low CEC, as shown in Table 4-13. The geometric means of the old and surface slag are similar at 1.7 and 1.5 meq/100g, respectively. The L Plata pile had the highest geometric mean CBC at of all the slag piles; 2.8 meq/100g.

TABLE4-13

SLAG CATION EXCHANGE CAPACITY
(meq/100g)

| Sample ID | | Value |
|---|---|---|
| AVS107M00 | AV Air Cooled | 1.8 |
| AVS114M00 | AV Air Cooled | 1.1 |
| AVS111 MOOD | AV Air Cooled | 1.4 |
| AVS115M00 | AV Air Cooled | 9.0 |
| AVS115M00D | AV Air Cooled | 2.3 |
| AVS111M00 | AV Air Cooled | 1.4 |
| AVS108M00 | AV Ballast | 0.4 |
| AVS105M00 | AV Ballast | 0.9 |
| AVS104M00 | AV Ballast | 0.4 |
| AVS106M00 | AV Ballast | 1.0 |
| AVO102M00 | AV Old Slag | 2.5 |
| AVO101M00 | AV Old Slag | 2.2 |
| AVS103M00 | AV Sorted Fines | 1.2 |
| AVS109M00 | AV Sorted Fines | 0.5 |
| AVS102M00 | AV Sorted Fines | 2.0 |
| AVS116M00 | AVWQfines | 0.8 |
| AVS110M00 | AV WO fines | 0.9 |
| AVS112M00 | AV WO fines | 0.8 |
| AVS113M00 | AV WO fines | 1.3 |
| AVS101M00 | AV Sorted Fines | 1.1 |
| GGS101M00 | Georgia Gulch | 1.3 |
| HRO105M00 | Harrison Old | 1.1 |
| HRO106M00 | Harrison Old | |
| HRS104M00 | Harrison Surf. | 1.1 |
| HRS101M00 | Harrison Surf. | 1.3 |
| HRS103M00 | Harrison Surf. | 0.4 |
| HRS102M00 | Harrison Surf. | 1.1 |
| LPO105M00 | La Plata Old | 3.9 |
| LPO106M00 | La Plata Old | 2.0 |
| LPCOLUMN2 | La Plata Old | 3.4 |
| LPS101M00 | La Plata Surf. | 2.5 |
| LPS102M00 | La Plata Surf. | 2.0 |
| LPCOLUMN1 | La Plata Surf. | 2.5 |
| LPS104M00 | La Plata Surf. | 3.7 |
| LPS103M00 | La Plata Surf. | 2.9 |
| LES101M00 | Lower Evans | 2.6 |
| MES101M00 | Middle Evans | 0.5 |
| UES101M00 | Upper Evans | 2.8 |

SEE FIGURE 1
SLAG CLASSIFICATION
LOCATION

AV=ARKANSAS VALLEY
SLAG

### 4.5.2 Subslag Material

Ten samples of subslag material were analyzed for total compositional constituents. The analyses were conducted concurrent with those for slag samples. For the purposes of the following discussion, the sample HRB103T08, collected from beneath the Harrison Street pile, has not been included in the calculations of ranges and means due to the presence of slag in this one sample. This sample was obtained in a 10-foot thick fill encountered beneath the pile. Discussion regarding the physical descriptions of the subslag sample material is provided in Section 4.3.3. The analytical methods used to characterize the subslag are the same as those used for the slag.

#### 4.5.2.1 TAL Metals

Target Analyte List (TAL) metals were analyzed for each of the ten subslag samples following digestion using a U.S. Bureau of Mines method (Bureau of Mines, 1980). As with slag samples, most metals analyses were conducted by Inductively Coupled Plasma (ICP) techniques, although some of the metals were analyzed by graphite furnace atomic absorption (GFAA) methods after digestion. The elements analyzed by GFAA include arsenic, cadmium, lead and selenium. The use of GFAA was necessitated by matrix interference problems caused by the particular digestion fluid used.

Table 4-14 presents the frequency of occurrence of the elements analyzed along with the minimum and maximum values of each of the elements. As with slag, the elements comprising the majority of the subslag matrix are iron and silicon. Iron ranges from 14.2 to 32.3 percent of the subslag material, while silicon ranges from 12.5 to 21.1 percent. Calcium values ranged from 1.9 to 8.8 percent. The range of concentration and geometric mean of each of the four primary elements of concern at the California Gulch site are as follows:

- -Arsenic--5.7 to 54.4 mg/kg, mean 7.3 mg/kg
- -Cadmium--2.1 to 10 mg/kg, detected three times out of ten
- -Lead--84.8 to 794 mg/kg, mean 221 mg/kg
- -Zinc--188 to 1290 mg/kg, mean 415 mg/kg

A comparison of the range of concentrations of metals of concern in subslag material to literature values for other soils is presented in Table 4-15. From this table it is clear that the concentration of the metals of concern in the subslag are similar to natural concentrations Colorado soils, weastern U.S. soils or soils of old mining areas.

TABLE4-14

| FREQUENCY OF OCCURRENCE FOR SUBSLAG SAMPLES - TAL METALS | | | | | | |
|---|---|---|---|---|---|---|
| | | | RANGE OF DETECTED CONCENTRATIONS | | | |
| CHEMICAL NAME | Number of Detections | Number of Analyses | Minimum Value (mg/kg) | | Maximum Value (mg/kg) | |
| Aluminum, total | 10 | 10 | 42000.00 | HRB103T23 | 63400.00 | AVB101T14 |
| Antimony, total | 4 | 10 | 8.90 | HRB101T10 | 31.60 | HRB103T23 |
| Arsenic, total | 6 | 10 | 5.70 | AVB104T19 | 54.40 | LPB101T34 |
| Barium, total | 10 | 10 | 442.00 | HRB103T23 | 1270.00 | AVB103T145 |
| Beryllium, total | 10 | 10 | 0.97 | LPB103T3n | 1.80 | LPB101T34 |
| Cadmium, total | 3 | 10 | 2.10 | AVB101T14 | 10.00 | HRB103T23 |
| Calcium, total | 10 | 10 | 1970.00 | AVB101T14 | 8860.00 | HRB102T10 |
| Chromium, total | 10 | 10 | 6.10 | AVB101T14 | 943.00 | LPB103T377 |
| Cobalt, total | 9 | 10 | 1.40 | AVB103T145 | 8.50 | LPB103T377 |
| Copper, total | 10 | 10 | 21.30 | AVB103T145 | 571.00 | LPB103T377 |
| Iron III, total | 10 | 10 | 14200.00 | AVB101T14 | 32300.00 | HRB101T10 |
| Lead, total | 10 | 10 | 84.80 | AVB103T145 | 794.00 | HRB101T10 |
| Magnesium, total | 10 | 10 | 1910.00 | AVB101T14 | 5730.00 | HAB102T10 |
| Manganese, total | 10 | 10 | 655.00 | AVB101T14 | 4040.00 | AVB103T145 |
| Nickel, total | 8 | 10 | 12.60 | AVB103T145 | 475.00 | LPB103T3n |
| Potassium, total | 10 | 10 | 18800.00 | HRB103T23 | 27600.00 | AVB103T145 |
| Selenium, total | 0 | 10 | N/A | | N/A | |
| Sliicon, Total | 10 | 10 | 125000.00 | LPB101T34 | 211000.00 | AVB101T14 |
| Sodium, total | 10 | 10 | 7140.00 | HRB103T23 | 13800.00 | AVB101T14 |
| Vanadium, total | 10 | 10 | 8.60 | AVB101T14 | 31.50 | HRB101T10 |
| Zinc, total | 10 | 10 | 188.00 | AVB103T145 | 1290.00 | HAB101T10 |
| TOTALS | 180 | 210 | | | | |

AVB=ARKANSAS VALLEY
SLAG-SUBSLAG SAMPLES

TABLE 4-15

**Comparison of Range of Concentrations of Metals of Concern in Subslag Material to Other Soils (ppm)**

| ANALYTE | SUBSLAG MATERIAL | COLORADO SOILS[1] | WESTERN US[2] | OLD MINING AREAS[3] | MINERALIZED SOILS |
|---|---|---|---|---|---|
| Arsenic | 5.7 - 54.4 | 1.2 - 24 | <0.1 - 97 | — | — |
| Cadmium | 2.1 - 10 | < 1 - 4 | - | 0.6 - 14 | — |
| Lead | 84.8 - 794 | 15 - 150 | <10 - 700 | 51 - 21,546 | 1,000 - 10,000 |
| Zinc | 188 - 1,290 | 16 - 300 | 10 - 2,100 | 220 - 66,400 | — |

— No data available.

1. Connor, J.J., and H.T. Shacklette, 1975, *Background Geochemistry of Some Rocks, Soils, Plants,* and *Vegetables in the Conterminous United States,* U.S. Geol. Surv. Pap., 574-F.

2. Schacklette, H.T., and J.G. Boemggen, 1984, *Element Concentrations in Soils* and *Other Surficial Materials of the Conterminous United States,* U.S. Geol. Surv. Prof. Pap., 1270.

3. Kabata-Pendias, A , and H. Pendias, 1984, *Trace Elements in Soils* and *Plants,* CRC Press, Inc., Boca Raton, Florida.

4. Lovering, T.G., 1976, *Lead in the Environment,* U.S. Geol. Surv. Prof. Pap., 956, Washington, DC, 90 pp.

4.5.2.2 Anions

Water soluble anions chloride, sulfate, and nitrate/nitrite were analyzed in subslag material samples. Carbonate was not directly measured in the water soluble extracts, but was calculated from calcium carbonate values determined from neutralization potential analyses. The anions are reported in solid units, mg/kg, by back-calculation from the analyses conducted on the water soluble extract.

The most prevalent anion in the subslag is the carbonate anion with a mean of 6,600 mg/kg or about six-tenths of one percent of the total mass of the material. Carbonate concentrations range from a low of 3,600 to a maximum of 20,040 mg/kg. The second most prevalent water-soluble anion is sulfate, as follows:

- Sulfate--29.6 to 340.1 mg/kg, mean 110 mg/kg
- Chloride--11.2 to 16.1 mg/kg, mean 13.3 mg/kg
- Nitrate--1.9 to 2.6 mg/kg, detected six times out of ten
- Nitrite--1.1 to 1.6 mg/kg, detected three times out of ten

4.5.2.3 Sulfur Forms

Analysis of total sulfur, which consists of sulfides, sulfates, and other sulfur forms, shows a mean of 0.02 percent for subslag material. The breakdown for the various components is as follows:

- Total sulfur--0.01 - 0.04%, mean 0.02%
- Sulfate sulfur--0.01 - 0.02%, detected four times out of ten
- Pyritic sulfur--one detection at 0.16%
- Non-extractable sulfur--0.01 - 0.27%, mean 0.015%

**The acid-forming potential due to pyritic sulfur for all subslag samples does not indicate potential for acid generation.** All of the subslag material tested for pyritic sulfur was below the detection limit, except for LPB103TI77 collected from beneath the La Plata pile, which
was 5.0 tons of $CaCO_3$ per kiloton (t/kt).

4.5.2.4 Neutralization Potential and Acid-Base Accountin

The neutralization potential **for** subslag ranged from 6.0 **to** 34 t/kt. **The** geometric mean **of** neutralization potential for all ofthe subslag materials was 11 ton/kt.

All of the subslag samples showed a negative net acid forming potential. Acid-base accounting data for subslag is presented in Table 4-16, with a geometric mean of -13.7 t/kt. Thus, the subslag sampled is not potentially acid toxic due to acid generation potential.

#### 4.5.2.5 Cation Exchange Capacity

Cation Exchange Capacity (CEC) was measured using EPA Method 9080 (EPA, 1986). Results are expressed in milliequivalents per 100 grams of material (meq). Overall, the materials tested have moderate CEC, with a geometric mean of 8.4 meq. The CEC for all subslag samples are presented in Table 4-17.

### 4.S.3 Leaching Analyses

Two types of leach testing were performed on slag, old slag and subslag material. One method, the Synthetic Precipitation Leach Procedure (SPLP) was a liquid shake extraction test developed to simulate leaching by acidic precipitation. The other test was a laboratory column leach test designed to simulate percolation of precipitation through the materials.

#### 4.5.3.1 Synthetic Precipitation Leaching Procedure

The SPLP (EPA Method 1312) was conducted on each of the slag and subslag samples collected. The sample size was increased in the case of the large blocky material to 1 kilogram, rather than the 100 gram sample specified by the method, to avoid particle size reduction since one piece of the blocky material weighs more than 100 grams. Particle size reduction to less than 9.5mm, as called for in the method, was not conducted on these samples. As explained in Section 3.3.2 of this report, the SPLP method modification waiving particle size reduction, consistent with the SAP, was initiated to ensure that field conditions were represented as closely as possible by the test. Much of the slag in Leadville is greater than 3/8 inches in diameter, and crushing slag to less than this diameter may have created testing conditions more aggressive than actual field conditions by increasing the specific surface area.

The SPLP method calls for comparisons of effluent concentrations with applicable regulatory thresholds, but does not state what these thresholds are. Because the test most closely resembles the Toxicity Characteristic Leaching Procedure **(TCLP)** or Extraction Procedure (EP) toxicity tests, regulatory thresholds associated with these tests were utilized. The results for all elements for all samples were below the toxicity characteristic criteria listed in 40 CFR 261.24. The maximum value for each of the eight metals for which toxicity characteristic criteria exist was generally an order of magnitude lower than the criteria.

TABLE4-16

| SUBSLAG SAMPLE ACID - BASE ACCOUNTING (tons of CaCO3 equivalents per 1000 tons of material) | | | | |
|---|---|---|---|---|
| Sample ID | | Neutralization Potential | Acid Generation Potential due to Pyritic Sulfur | Net Acid-Forming Potential |
| AVB103T14.5 | AV Subslag | 18 | 0.31 | -17.69 |
| AVB104T19 | AV Subslag | 8 | 0.31 | -7.69 |
| AVB101T14 | AVSubslag | 6 | 0.31 | -5.69 |
| AVB102T17 | AV Subslag | 6 | 0.31 | -5.69 |
| HRB101T10 | HR Subslag | 27 | 0.31 | -26.69 |
| HRB103T08 | HR Subslag | 90 | 0.31 | -89.69 |
| HRB102T10 | HR Subslag | 34 | 0.31 | -33.69 |
| HRB103T23 | HR Subslag | 10 | 0.31 | -9.69 |
| LPB102T30.5 | LP Subslag | 9 | 0.31 | -8.69 |
| LRB101T34 | LPSubslag | 9 | 0.31 | -8.69 |
| LPB103T37.7 | LP Subslag | 8 | 5.00 | -3.00 |

AAVVAVB=ARKANSAS VALLEY SLAG-SUBSOIL

## TABLE 4-17

| Subslag Sample Cation Exchange Capacity | | |
| --- | --- | --- |
| **Sample Name** | **Value** | **Units** |
| AVB101T14 | 9.0 | meq/100g |
| AVB102T17 | 10.3 | meq/100g |
| AVB103T145 | 7.3 | meq/100g |
| AVB104T19 | 6.2 | meq/100g |
| HRB101T10 | 7.3 | meq/100g |
| HRB102T10 | 9.9 | meq/100g |
| HRB103123 | 6.1 | meq/100g |
| LPB101T34 | 24.1 | meq/100g |
| LPB102T305 | 9.4 | meq/100g |
| LPB103T377 | | meq/100g |

**AVB=ARKANSAS VALLEY SLAG-SUBSOIL**

Mean values were generally more than two orders of magnitude lower. The following summary compares the mean and maximum values of the leachate to the toxicity criteria or 100 times the secondary drinking water standards:

| Element | Toxicity Criteria | Mean Value | Maximum |
|---|---|---|---|
| Arsenic | 5.0 mg/1 | 0.03 mg/l | 0.42 mg/1 |
| Barium | 100 mg/l | 0.31 mg/I | 1.96 mg/1 |
| Cadmium | 1.0 mg/1 | 0.001 mg/I | 0.04 mg/I |
| Chromium | 5.0 mg/I | 0.002 mg/I | 0.01 mg/I |
| Lead | 5.0 mg/1 | 0.007 mg/I | 0.69 mg/I |
| Selenium | 1.0 mg/I | 0.03 mg/I | 0.09 mg/I |
| Silver | 5.0 mg/1 | 0.002 mg/1 | 0.01 mg/I |
| Zinc | 500 mg/I* | 0.15 mg/1 | 7.88 mg/I |
| Manganese | 5.0 mg/I* | 0.08 mg/I | 0.67 mg/I |
| Iron | 30 mg/I* | 0.09 mg/1 | 2.85 mg/I |
| Copper | 100 mg/I* | 0.007 mg/I | 0.12 mg/I |

- 100 times secondary drinking-water standards.

4.5.3.2 Column Leach Studies

Column leach testing was conducted on four types of the lead slag and one subslag sample: AV water-quenched fines, AV ballast-sized, La Plata surface, La Plata old slag, and La Plata subslag material. The column configurations were designed to be at least 2.5 times the diameter of the nominal particle size. The material in the column was subjected to one-hour leaching cycles, each representing a one-inch rainfall event. The following table lists the column data:

| Test Material | Mode of Flow | Column Diameter (in.) | Volume of one-inch rain(ml) |
|---|---|---|---|
| AV Water-Quench | Downflow | 3 | XXX |
| AV Ballast | Downflow | 8 | 823 |
| LP Surface | Downflow | 4 | 206 |
| LP Old Slag | Downflow | 4 | 206 |
| LP Subslag | Upflow | 3 | 232* |

*Used two-inch rainfall events because one-inch rainfall event would not produce adequate volume for duplicate sample analyses.

The LP subslag material was run in the upflow configuration because the material was saturated at the time of field collection and upflow conditions would allow it to remain saturated throughout the test. The simulated rainfall was introduced to the column over a one-hour interval, followed by a one-hour desaturation/aeration period for the downflow, unsaturated columns. The lixiviant was allowed to drain during this desaturation/aeration period. The tests took place over a period of 200 hours, simulating 100 rainfall events. Considering that Leadville receives about 12.67 inches of rainfall per year, the column leach test cycles corresponded to about eight years of rainfall. The following table presents loading data for the five columns:

| Column ID | Weight Material(g) | Packed Length(in) | Total Vol(ml) | Pore Vcime fuill |
|---|---|---|---|---|
| AV WO (water-quenched) | 5,552 | 35.5 | 4,110 | 900 |
| AV BAL (ballast) | 35,934 | 25 | 20,582 | 7,'100 |
| LP SURF (surface slag) | 2,183 | 42 | 8,645 | 3,100 |
| LP OLD (old slag) | 14,968 | 42 | 8,645 | 2,700 |
| LP SUB (subslag) | 4,590 | 34 | 4,590 | 3,126 |

**The lixiviant used for the column leach testing was the simulated precipitation for areas west of the Mississippi, specified in Method 1312 of SW-846. The precipitation fluid is made by adding a 60/40 weight percent mixture of sulfuric and nitric acid to deionized water until the pH is 5.00 ±0.05 units. The fluid was prepared in a 55-gallon polyethylene drum by adding approximately 2 ml of the acid mixture to 50 gallons of deionized water and mixing. Due to the lack of buffering capacity in the water, the pH dropped to about 4.5 and was readjusted to pH 5.00 ±0.05 by the drop wise addition of 10 percent sodium hydroxide (NaOH).**

**Effluent was collected from each of the precipitation events for each of the columns. Upon collection pH, Eh, and conductance measurements were made using calibrated probes connected to pH/mv and conductance meters. After these measurements were completed, the sample was filtered through Whatman #40 (8µm) filter paper. The sample was split into two separate containers; one for anions analysis and the other for metals analysis. The sample for metals analysis was preserved with nitric acid to a pH less than 2.0.**

At the completion of one hundred cycles, the pore volume of each column was determined. This measurement was made by pumping water to the top of the test material and then measuring the volume of water collected as the water level was lowered to the bottom of the test material. As column LPSUB (subslag) drained very poorly, it was allowed to drain for 24 hours in order to obtain the pore volume.

Tables 4-18 through 4-23 summarize the analytical results for selected metals and anions from the column leach tests. Figures 4-17 through 4-21 depict in graphical form the concentrations of selected metals and anions as a function of effluent number (precipitation event). The complete results of the column leach testing are presented in Appendix B1.

It may be noted that on Figure 4-17, the graph of the column leach test results for lead, the lead concentration in the eluate for certain piles appears to be rising. It is likely that the results appeared to increase at the end of the testing period because the other side of the leaching curve was not evident. The leaching curves will display distribution function which reaches its apex at the saturation point. The height of the apex of this curve depends upon the particular mineral species being leached and the width of the curve depends on the amount of available mineral.

**A D**

Data validation was performed by MK on 100 percent of the analytical data reported by the laboratory. Contract Laboratory Program (CLP) methods were evaluated using accepted criteria and control limits defined by the draft ***Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analyses*** (BPA, 1988b) (Functional Guidelines) and the ***USEPA Contract Laboratory Program, Statement of Work for Inorganic Analysis*** (BPA, 1990b) (SOW). Non-CLP methods were validated using criteria consistent with guidelines applicable to those methods. Control limits specified in the Functional Guidelines were used as guidance in the evaluation of non-CLP Quality Control data, which included duplicate, spike, and laboratory control sample data. The sample group in each data package is referred to as the sample delivery group (SDG). A comprehensive SDG Analytical Data Validation Summary report was prepared for each SDG and includes three sections, as appropriate:

1. A summary of the sample numbers, sample type and matrix, methods of analysis, and overall data useability.

# ATTACHMENT B

ATTACHMENT B-1 PHYSICAL AND CHEMICAL CHARACTERIZATION
ARKANSAS VALLEY SLAG AKA CJK SLAG

ATTACHMENT B-2 SELECTED REMEDY -OU-3 RECORD OF DECISION

ATTACHMENT B-3 SUMMARY AND CONCLUSIONS
ARKANSAS VALLEY SLAG-OU3
AKA CJK SLAG

ATTACHMENT B-4 RECORD OF DECISION
Stockpiled Fine Slag Arkansas Valley Smelter Slag Pile,
AKA CJK SLAG, California Gulch Superfund Site (OU3),

# ATTACHMENT B-1
# PHYSICAL AND CHEMICAL CHACTERIZATION ARKANSAS VALLEY SLAG
# (CJK SLAG)

## ATTACHMENT B-1
## PHYSICAL AND CHEMICAL CHARACTERIZATION
## ARKANSAS VALLEY SLAG (CJK SLAG)

### 6.0 SUMMARY AND CONCLUSIONS

This section summarizes the findings of the Lead Slag Pile Remedial Investigation based on the data collected and evaluated to date. Each of these results have been described in greater detail earlier in the RI.

### 6.1 Summary of Lead Slag Characteristics

The results of the field reconnaissance, physical testing, and analytical testing, as well as impacts to water, soil, and air are summarized below.

Physical Characteristics The sizes of particles occurring in the lead slag piles are primarily coarse, as the material is often blocky or welded. However, the AV sorted fines, AV water-quenched fines and LE slag pile contain up to six percent (by weight) of fines material less than 100 um and approximately one percent less than 10 um.

Only the LP and UE piles show signs of geotechnical instability. This instability is related to vertical or overhanging walls of slag, which have the potential for collapse along the slag pile perimeter and walls of canyon-like features. No collapsing would occur into streams or ponded waters. The talus slopes noted at the base of some of the piles are stable at their angle of repose.

The low porosity and vitrified, glass-like nature of slag results in a low susceptibility to congelifraction (disintegration due to freezing water) and high freeze/thaw resistance.

Therefore, the impact of freeze/thaw cycling on slag is minimal. Chemical Characteristics

Iron and silicon compose the majority of the slag material ranging up to 33 percent and 15 percent, respectively. The geometric mean concentrations of the primary metals of

Lead--8600 mg/kg
Cadmium--4.4 mg/kg
Arsenic--220 mg/kg
Zinc--36,000 mg/kg

The concentrations of primary metals of concern in soils below slag piles are much lower than the concentrations in slag.

The mineral species with which these metals are bound (e.g., oxide, sulfide, sulfate) will be determined by other investigators and reported in forthcoming metals speciation reports.

The dominant form of sulfur is non-extractable sulfur. Acid generation potential due to pyritic sulfur, when detected, is more than compensated by neutralization potential due to carbonate species. This results in a negative acid forming potential.

The Synthetic Precipitation Leaching Procedure (SPLP) results for all elements for all samples were below the toxicity characteristic criteria, listed in 40 CFR 261.24, of 100 times primary drinking water standards. Mean values were generally more than two orders of magnitude lower than toxicity characteristic criteria. Additionally, results for those analytes that were compared to criteria of 100 times the secondary drinking water quality standards were lower than those criteria.

Statistical Analyses

The results of the statistical analyses confirm that the constituents within the slag and subslag samples are log-normally distributed in each of the data sets.

Comparisons of each of the data sets analyzed show that the slag piles are similar to each other with the exception of the La Plata pile, AV water-quenched fines piles and the zinc slag pile.

Water Quality Impacts

Based on the metals concentrations in the eluants of the two types of leaching tests performed on slag samples (SPLP and column leach), potential annual metals load from the slag piles has been estimated. Calculations were performed for three of the primary elements of concern -- lead, cadmium and zinc. Arsenic metal loading was not calculated because of non-detectable concentrations for the majority of the arsenic analyses.

Using the combination of SPLP and column leach results, the resulting estimated metals load from the slag piles for lead, cadmium and zinc is conservatively estimated at 44, 2.0 and 230 kilograms per year, respectively. These loading estimates may be refined as additional information becomes available.

Soil Quality Impacts

Results of the reconnaissance of the slag piles showed no obvious impacts to surface soils in the vicinity of the piles. No evidence of particulate movement off the piles, except for talus, was noted.

Air Quality Impacts

Emissions calculations demonstrate that wind erosion does not occur from the AV slag pile and it can be concluded that there are no significant impacts from that pile during undisturbed conditions.

## 6.2 Conclusions Regarding the Site Conceptual Model

The site conceptual model for the Slag Pile RI was developed by EPA and the Risk Assessment Technical Assistance Committee and presented in the work plan for the Slag Pile RI (MK 1991a). The human health conceptual site model for slag piles, Figure 1-2, presented five potential release mechanisms for the slag piles. These are:

-wind
-leaching
-mixing by human activities
-runoff (of slag)
-direct contact

If certain release mechanisms can be shown not to occur, then secondary sources, exposure routes and potential receptors do not form a complete pathway. The following discussion applies the conclusions of the RI activities to each of the primary release mechanisms in order to show whether the conceptual model is valid for that particular mechanism. Each release mechanism is addressed in the order presented above.

Release Mechanism 1 - Wind

The air pathway analysis results show that wind erosion is not a significant release mechanism in Leadville. Hourly average wind speed data multiplied by the appropriate factor to determine the maximum sustained wind gust does not meet or exceed the velocity necessary to lift particles off the stationary pile. The conclusion is that wind erosion is not a viable release mechanism for the lead slag piles, including the AV water-quenched and sorted fines piles.

Release Mechanism 2 - Leaching

Leaching of elements of concern were tested by two different leaching procedures (SPLP and column leach) yielding the quantity of metals leached from a given mass or volume of a slag pile. Quantities of metals leached were calculated by portioning each of the piles by whether they could most likely be represented by column leach or SPLP testing results. The piles have the potential to contribute a small metals load of three of the elements of concern. Arsenic loading was not calculated because of the infrequency of detection of this element in the leachates. These values have been calculated for each pile and for the sum of all piles.

Additional data collection activities are currently being undertaken under other PRP work plans to better define the hydrologic system in the vicinity of the major slag piles and along California Gulch. Key additional data to be evaluated include the portions of the Gulch that are gaining and losing streams; water quality data from piezometers, monitor wells, and surface water sampling; and flow rates during the course of the year. Another key consideration is the calculation of the residual sediment load and the contribution from other sources (i.e. tailings and soils) to the stream channel. At this time, the evaluations of impacts from leaching were concluded at the point where potential maximal loading from each pile was calculated (Section 5.2). Additional considerations such as soil sorption, evaporation, dilution by ground and surface water, and sheet runoff of precipitation will need to be further evaluated before estimates of contribution to the hydrologic system can be completed. At this time, leaching as a release mechanism is retained.

Release Mechanism 3 - Mixing Human Activities

Transport by human activities has occurred, as slag was historically used for ballast and road maintenance within the site. Characteristics of slag on the railroad tracks are represented by the results for the AV ballast-sized subpile samples. The ballast-sized sample results show a low potential for leaching (well below toxicity characteristic criteria).

Based upon field observations and chemical analysis of the soils beneath the slag piles, it can be concluded that subslag soils have not been significantly impacted by the placement of slag. The concentration of elements of concern in subslag material is very low. Although background concentrations have not been fully established, subslag concentrations may be within the range of background values for soils at the site. At this time, release mechanisms relative to soils beneath the slag can be deleted from the conceptual model.

Release Mechanism 4-Runoff of Slag

No evidence of transport of slag fines by surface runoff was observed at any of the piles examined. Slag does not appear to be transported from piles onto adjacent soils in rivulets or channels . Pile integrity, especially for fines piles where this is most critical appears intact .This potential release mechanism for slag is not a concern at the site.

Release Mechanism 5-Direct Contact

Direct contact with the slag piles was considered insignificant in BPA's Preliminary Baseline Human Health Risk Assessment (EPA 1991a). Therefore, it can be eliminated as a release mechanism.

Summary of Verification of the Conceptual Model

Of the five primary release mechanisms identified in the site conceptual model, only one is considered viable based on findings provided in this Slag Pile Remedial Investigation. The one retained release mechanism is leaching. Before determining the actual contribution of leached constituents from the slag piles, collation and summarization of data collected as part of other work programs will need to be evaluated. All other primary mechanisms have been eliminated as a result of this remedial investigation.

# ATTACHMENT B-2
# SELECTED REMEDY-OU-3
# ARKANSAS VALLEY SLAG
# RECORD OF DECISION

**ATTACHMENT -B-2**
**(OU-3)**
**DOCUMENTATION)**

## 9.0 SELECTED REMEDY

Based upon consideration o f CERCLA requirements, the detailed analysis o f alternatives, and public comments, EPA has determined that the No Action alternative presented in the Proposed Plan, with no modifications, is the appropriate remedy for the stockpiled fine slag at the AV Smelter Slag Pile o f OU3 within the California Gulch Superfund Site. The No Action alternative leaves the stockpiled fine slag in its existing condition with no control or cleanup planned. The No Action alternative, as described in the Proposed Plan, includes a contingency for future utilization o f the slag, i f it is encapsulated prior to its use or reuse.

The No Action alternative is protective o f human health and the environment, and is considered effective because no complete human or ecological exposure pathways were identified and because the potential for release o f metals in leachate is minimal. Based on subslag sampling, metals have not leached and will not leach from the stockpiled fine slag in concentrations that will have an adverse impact on soils, surface water, or groundwater in the area. Slag hardness, the lack o f acid-generating potential, and the absence o f any significant metals beneath the slag also indicate that the potential for exposure to metals o f concern found in the slag is unlikely to change in the long term. This alternative is technically feasible and cost effective, since it does not rely on any technology and has no cost.

Resourc'e utilization would only implemented i f future regional market demand exists for the material. Encapsulation o f the fine slag ensures that the contingency remedy is also protective o of human health and the environment. Encapsulation can include the use o f the fine slag in concrete or asphalt aggregate; or as road base, backfill or other construction material as long as the fine slag is chemically bound or physically separated from any exposure scenario by a barrier consisting o f another material. Dust suppressants to control particulate emissions and best management practices to control stormwater runoff would also be employed to contain contaminant releases during implementation o f the contingency remedy.

# APPENDIX B-3

## Record of Decision Stockpiled Fine Slag
## Arkansas Valley Smelter Slag Pile
## California Gulch Superfund Site (OU3)
## Leadville Colorado.

**CDM** Federal Programs Corporation

*A Subsidiary of Camp Dresser & McKee Inc.*

1526 Cole Boulevard, Suite 150
Golden, Colorado 80401
Tel: 303 232-0131 Fax: 303 232-0904

May 15, 1998

Ms. Rebecca Thomas
U.S. Environmental Protection Agency
Region VIII, Mail Code (8EPR-SR)
999 18th Street, Suite 500
Denver, CO 80202-2466

Project: RAC Region VIII, Contract No. 68-W5-0022
Work Assignment No.014-RSBD-0829

DCN: 3280-014-RT-DECD-02656

Subject: Final Record of Decision for Stockpiled Fine Slag, Arkansas Valley Smelter Slag Pile, California Gulch Superfund Site (OU3), Leadville Colorado.

Dear Ms. Thomas:

Enclosed please find 10 copies of the May 1998 Final Record Of Decision for Stockpiled Fine Slag, Arkansas Valley Smelter Slag Pile, Operable Unit 3 of the California Gulch Superfund Site, Leadville Colorado. The signed signature page has been incorporated into these copies. If you have any questions or comments regarding this document please feel free to call.

Sincerely,

CDM FEDERAL PROGRAMS CORPORATION

Ken Black
Project Manager

Jim Moore
Task Manager

Enclosures

cc: DCN

# RECORD OF DECISION

## STOCKPILED FINE SLAG
## ARKANSAS VALLEY SMELTER SLAG PILE
## CALIFORNIA GULCH SUPERFUND SITE (OPERABLE UNIT 3)
## LEADVILLE, COLORADO

The U.S. Environmental Protection Agency (EPA), with the concurrence of the Colorado Department of Public Health and Environment (CDPHE), presents this Record of Decision (ROD) for stockpiled fine slag at the Arkansas Valley smelter slag pile of Operable Unit 3 (OU 3) within the California Gulch Superfund Site in Leadville, Colorado. The ROD is based on the Administrative Record for California Gulch OU3, including the Remedial Investigation/ Feasibility Study (RI/FS), the Proposed Plan, and the public comments received. The ROD presents a brief summary of the RI/FS, actual and potential risks to human health and the environment, and the Selected Remedy. EPA followed the Comprehensive Environmental Response, Compensation, and Liability Act, as amended, the National Contingency Plan (NCP), and appropriate guidance in preparation of the ROD. The three purposes of the ROD are to:

1. Certify that the remedy selection process was carried out in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. 9601 *et seq.*, as amended by the Superfund Amendments and Reauthorization Act (collectively, CERCLA), and, to the extent practicable, theNCP;

2. Outline the engineering components and remediation requirements of the Selected Remedy; and

3. Provide the public with a consolidated source of information about the history, characteristics, and risk posed by the conditions of the stockpiled fine slag at the Arkansas Valley Smelter slag pile of OU 3, as well as a summary of the cleanup alternatives considered, their evaluation, the rationale behind the Selected . Remedy, and the agencies' consideration of, and responses to, the comments received.

The ROD is typically organized into the following three distinct sections:

1. The Declaration section functions as an abstract for the key information contained in the ROD and is the section of the ROD signed by the EPA Acting Regional Administrator and the CDPHE Director;

2. The Decision Summary section provides an overview of the OU 3 characteristics, the alternatives evaluated, and the analysis of those options. The Decision Summary also identifies the Selected Remedy and explains how the remedy fulfills statutory requirements; and

3. The Responsiveness Summary section addresses public comments received on the Proposed Plan, and other information in the Administrative Record. However, since the EPA did not receive any written public comments, this ROD will not contain a Responsiveness Summary.

# DECLARATION

## SITE NAME AND LOCATION

Stockpiled Fine Slag
Arkansas Valley Smelter Slag Pile
California Gulch Superfund Site (Operable Unit 3)
Leadville, Colorado

## STATEMENT OF BASIS AND PURPOSE

This decision document presents the Selected Remedy for stockpiled fine slag at the Arkansas Valley smelter slag pile of Operable Unit 3 within the California Gulch Superfund Site in Leadville, Colorado. EPA, with the concurrence of CDPHE, selected the remedy in accordance with CERCLA and the NCP. Note that this decision addresses stockpiled fine slag only. Other activities required for OU3, including other slag piles, the railroad easement, and the railroad yard, are addressed under a Consent Decree with the Denver & Rio Grande Western Railroad.

This decision is based on the Administrative Record for the stockpiled fine slag at the Arkansas Valley smelter slag pile of OU 3 within the California Gulch Superfund Site. The Administrative Record (on microfilm) and copies of key documents are available for review at the Lake County Public Library, located at 1115 Harrison Avenue in Leadville, Colorado, and at the Colorado Mountain College Library, in Leadville, Colorado. The complete Administrative Record may also be reviewed at the EPA Superfund Records Center, located at 999 18th Street, 5th Floor, North Terrace in Denver, Colorado.

## ASSESSMENT OF THE SITE

The stockpiled fine slag at the Arkansas Valley smelter slag pile does not present an imminent or substantial endangerment to public health, welfare, or the environment.

## DESCRIPTION OF THE SELECTED REMEDY

The Selected Remedy is the No Action Alternative, which was presented in the Final Stockpiled Fine Slag Feasibility Study Report (FS) (Terranext, 1996a). The FS used a comparative analysis to evaluate several alternatives and identify the advantages and disadvantages of each. Selection of the No Action Alternative was based on this analysis. For the stockpiled fine slag, the Selected Remedy leaves the slag piles in their existing condition with no remediation, engineering controls, long term maintenance, or clean up planned. The Selected Remedy is protective of human health and the environment, and is considered effective because I) no complete human or ecological exposure pathways were identified for the stockpiled fine slag and 2) the potential for release of metals in leachate from the stockpiled fine slag is minimal.

The Selected Remedy provides a contingency for resource utilization, which may be undertaken in the future if regional market demand exists for the material. Resource utilization involves involves the use or reuse of the slag material as a commercial product. Due to concerns about the potential for release of airborne particulates if resource utilization is undertaken, the EPA has determined that resource utilization of the stockpiled fine slag is only appropriate if it is encapsulated for reuse. Encapsulation can include the use of fme slag in concrete or asphalt aggregate; or as road base, backfill or other construction material as long as the fine slag is chemically bound or physically separated from any exposure scenario by a barrier consisting of another material. Dust suppressants to control particulate emissions and best management practices to control stormwater runoff would also be employed to contain contaminant releases from the fine slag stockpile and during implementation of the contingency remedy. Resource utilization must also take into consideration any toxic leaching potential for the fine slag.

DECLARATION STATEMENT

No remedial action is necessary to ensure protection of human health and the environment.

Max H. Dodson (signature) — 5/6/98

Max H. Dodson
Assistant Regional Administrator
Ecosystems Protection and Remediation
U.S. Environmental Protection Agency, Region VIII

Date

# APPENDIX B-4
# EPA -CDHPE
# SLAG USE DOCUMENTATION

## gmlrob@gmail.com

**From:** Kiefer, Linda <Kiefer.Linda@epa.gov>
**Sent:** Monday, August 9, 2021 9:19 AM
**To:** gmlrob@gmail.com; kyle.sandor@state.co.us; colleen.brisnehan@state.co.us
**Cc:** 'Nick Michael'; 'Steve Craig'
**Subject:** RE: OU 3 Fine Slag Use

Hi George,
Regarding your question on the definition of "fine slag", from footnote section of page DS-1 of the Record of Decision, "fine slag is sorted slag which is less than 3/8 inch. Sorted slag is slag that has been physically separated into fractions for the purpose of railroad ballast production."

I agree with Kyle.

To comply with the Record of Decision resource utilization contigency measure for fine slag below, submit a written request to Kyle and I outlining:

- the proposed use of the fine slag with
- the measures to encapsulate fine slag and
- the best management practices to suppress dust and manage stormwater runoff.

EPA and the State will provide a letter of approval/denial.

Resource utilization contingency measure from the Record of Decision

> "Encapsulation of the fine slag ensures that the contingency remedy is also protective of human health and the environment. Encapsulation can include the use of the fine slag in concrete or asphalt aggregate; or as road base, backfill, or other construction material **as long as the fine slag is chemically bound or physically separated from any exposure scenario by a barrier consisting of another material.** Dust suppressants to control particulate emissions and best management practices to control stormwater runoff would also be employed to contain contaminant releases during implementation of the contingency remedy."

Best regards,

Linda Kiefer
USEPA – California Gulch Superfund Site Project Manager
303.312.6689

---

**From:** gmlrob@gmail.com <gmlrob@gmail.com>
**Sent:** Wednesday, August 4, 2021 6:03 PM
**To:** kyle.sandor@state.co.us; Kiefer, Linda <Kiefer.Linda@epa.gov>; colleen.brisnehan@state.co.us
**Cc:** 'Nick Michael' <nmichael@unionmilling.com>; 'Steve Craig' <scraig@unionmilling.com>
**Subject:** RE: OU 3 Fine Slag Use

8.4.2021

To all

Point of clarification. Please provide a definition of fine slag. We envision selling the material for railroad ballast, > 3inch, gabions+4 inch+, coarse grained landscape and foot path material +3/8 inch,

**From:** Sandor - CDPHE, Kyle <kyle.sandor@state.co.us>
**Sent:** Monday, August 2, 2021 4:05 PM
**To:** gmlrob@gmail.com; Kiefer, Linda <Kiefer.Linda@epa.gov>; Brisnehan - CDPHE, Colleen <colleen.brisnehan@state.co.us>
**Subject:** OU 3 Fine Slag Use

Good Afternoon Mr. Robinson,

My name is Kyle Sandor and I'm the CDPHE project manager for the California Gulch Superfund Site. Doug Jamison forwarded me your email regarding utilization of OU3 slag now owned by CJK Milling Company. From the OU3 ROD that I've attached to this email, the selected remedy describes a future utilization scenario for the fine slag, if it is encapsulated prior to use or reuse. The ROD further states the following:

"Encapsulation of the fine slag ensures that the contingency remedy is also protective of human health and the environment. Encapsulation can include the use of the fine slag in concrete or asphalt aggregate; or as road base, backfill, or other construction material **as long as the fine slag is chemically bound or physically separated from any exposure scenario by a barrier consisting of another material.** Dust suppressants to control particulate emissions and best management practices to control stormwater runoff would also be employed to contain contaminant releases during implementation of the contingency remedy."

In your email to Doug you asked specifically about using the slag as pipeline bedding. In order for the slag to be used as bedding material it will either need to be chemically bound or utilize an additional clean fill identification layer between the slag and the pipeline. This additional layer would be necessary to ensure that future pipeline workers wouldn't be exposed to the material unknowingly.

The ROD did not outline a formal process for CDPHE or EPA to follow to review these resource utilization projects, but historically I believe the agencies have reviewed the submitted written requests and provided a letter indicating approval/denial of the proposed use. I've included my EPA counterpart, Linda Kiefer, on this email to allow her to weigh in on the information I've presented to you, as well as, add any input she may have to the process.

If you have any questions or would like us to set up a meeting to discuss this further please let me know.

Thanks,
Kyle

**I am teleworking at this time and can be reached on my cell phone: 203.520.9509**

**Kyle Sandor**
Environmental Protection Specialist II

P 303.692.6394
4300 Cherry Creek Drive South, Denver, CO 80246
kyle.sandor@state.co.us | www.colorado.gov/cdphe

**grobinson@unionmilling.com**

| | |
|---|---|
| **From:** | grobinson@unionmilling.com |
| **Sent:** | Monday, October 18, 2021 6:03 PM |
| **To:** | 'Sandor - CDPHE, Kyle' |
| **Cc:** | 'Kiefer, Linda'; 'Nick Michael'; 'Steve Craig'; 'Gary Knippa KNIPPA' |
| **Subject:** | RE: CJK Milling Company-AKA CJK Specialty Aggregates (Slag) -Request to use slag for drainage control (>4inch rock) |

10.25.2021

Good Afternoon

We will have a grizzly, screens and scales on site. All product leaving the site will be inventoried by size and weight.

I am a CPG -we will provide confirmation the slag will not be "fine slag (3/8")" per stipulated end use.

Regards

George

George M.L. Robinson
Union Milling Contractors
3926 North State Highway 67
Sedalia, Colorado 80135
720.641.2534
grobinson@unionmilling.com

---

**From:** Sandor - CDPHE, Kyle <kyle.sandor@state.co.us>
**Sent:** Monday, October 18, 2021 4:19 PM
**To:** grobinson@unionmilling.com
**Cc:** Kiefer, Linda <Kiefer.Linda@epa.gov>
**Subject:** Re: CJK Milling Company-AKA CJK Specialty Aggregates (Slag) -Request to use slag for drainage control (>4inch rock)

Good Afternoon George,

Thank you for sharing the details of your plans to use the slag material for surface water control at the mill site. I see in the drawings a reference to 4-6" material being proposed for the project, can you confirm for me that fine slag (< 3/8") won't be used as surface water control.

Thanks,
Kyle

**I am teleworking at this time and can be reached on my cell phone: 203.520.9509**

**Kyle Sandor**
Environmental Protection Specialist II

P 303.692.6394
4300 Cherry Creek Drive South, Denver, CO 80246
kyle.sandor@state.co.us | www.colorado.gov/cdphe

On Mon, Oct 18, 2021 at 2:51 PM <grobinson@unionmilling.com> wrote:

10.18.2021

Good afternoon, Kyle

Please finds a CJK Milling Company's -General Mill Drainage Map. The map indicates the location where specific "slag aggregates" (OU-3) will be placed to control mill permit area surface water control.

I have also attached a mine map illustrating the location of ballast (riprap) material proposed to be used for riprap erosion control.

If you have any questions, please call or send me a note.

George M.L. Robinson

Union Milling Contractors

3926 North State Highway 67

Sedalia, Colorado 80135

720.641.2534

grobinson@unionmilling.com

# APPENDIX C

# NOXIOUS WEED

# CJK SLAG

# MANAGEMENT PLAN

# Noxious Weed Management Plan

**CJK Milling**
**CJK Slag**
**Leadville, Colorado**
**December 8, 2021**

## 1. Plan Objective

The objectives for the CJK Slag Noxious Weed Management Plan for the CJK Slag are to:

1. provide the steps necessary for the CJK Slag to assess the existence of noxious weeds within and adjacent to the property boundaries.
2. provide the CJK Slag with preventive and treatment measures which will control the spread and establishment of noxious weeds; and
3. identify monitoring needs and frequency of monitoring.

## 2. Description of the Project

The CJK Slag site permitted area consist of 26 acres located about 1.5 miles south of the town of Leadville. It is on the north side of Highway 24 at an elevation of 9,750 feet.

## 3. Weed Management Techniques

The key principle to Canada thistle control is to stress the plant and force it to use stored root nutrients. Canada thistle can recover from almost any stress, including control attempts, because of root nutrient stores. Therefore, returning infested land to a productive state occurs only over time. Success requires a sound management plan implemented over several years.

The techniques below are based on the CSU web site's recommendations but have been modified because the CJK Slag is not a range or grass land environment.

**Cultural control.** Grasses can compete effectively with Canada thistle if their growth is favored by good management. Fertility and moisture must be maintained at optimum levels to favor grass growth. Soil analysis can easily determine fertility needs; however, caution must be used with nitrogen fertilizers because excess available soil nitrogen will favor weed growth.

These are essential management steps to ensure optimum desirable plant growth and competition. However, competition alone seldom is effective against Canada thistle.

**Chemical control.** Research at Colorado State University shows that Tordon 22K (picloram), Milestone (aminopyralid), Transline (clopyralid), Banvel/ Vanquish/Clarity (dicamba) and Telar (chlorsulfuron) are effective against Canada thistle. Canada thistle is difficult to control and re-treatment for one to three or more years after the initial application is common. These herbicides are most effective when combined with cultural and/or mechanical control.

CJK Slag chooses to use Milestone as the chemical control. It is a broadleaf herbicide that works well in the mountainous area where the mill is located.

Milestone will be used at the rate of 5 to 7 fl oz /acre modified for a two-gallon weed sprayer. The thistle will be spot sprayed during July and Aug before they bloom.

**Mechanical control.** Mowing may be combined with the cultural and chemical control.

**Biological control.** No biological control will be used.

## 4. Monitoring Plan

The CJK Slag will monitor the site for any noxious weed species on the state A list or the Chaffee/Lake County. Monitoring inspection will occur once a month (June, July, August).

References: Colorado State University's web site for weed control - http://www.ext.colostate.edu/pubs/natres/03108.html