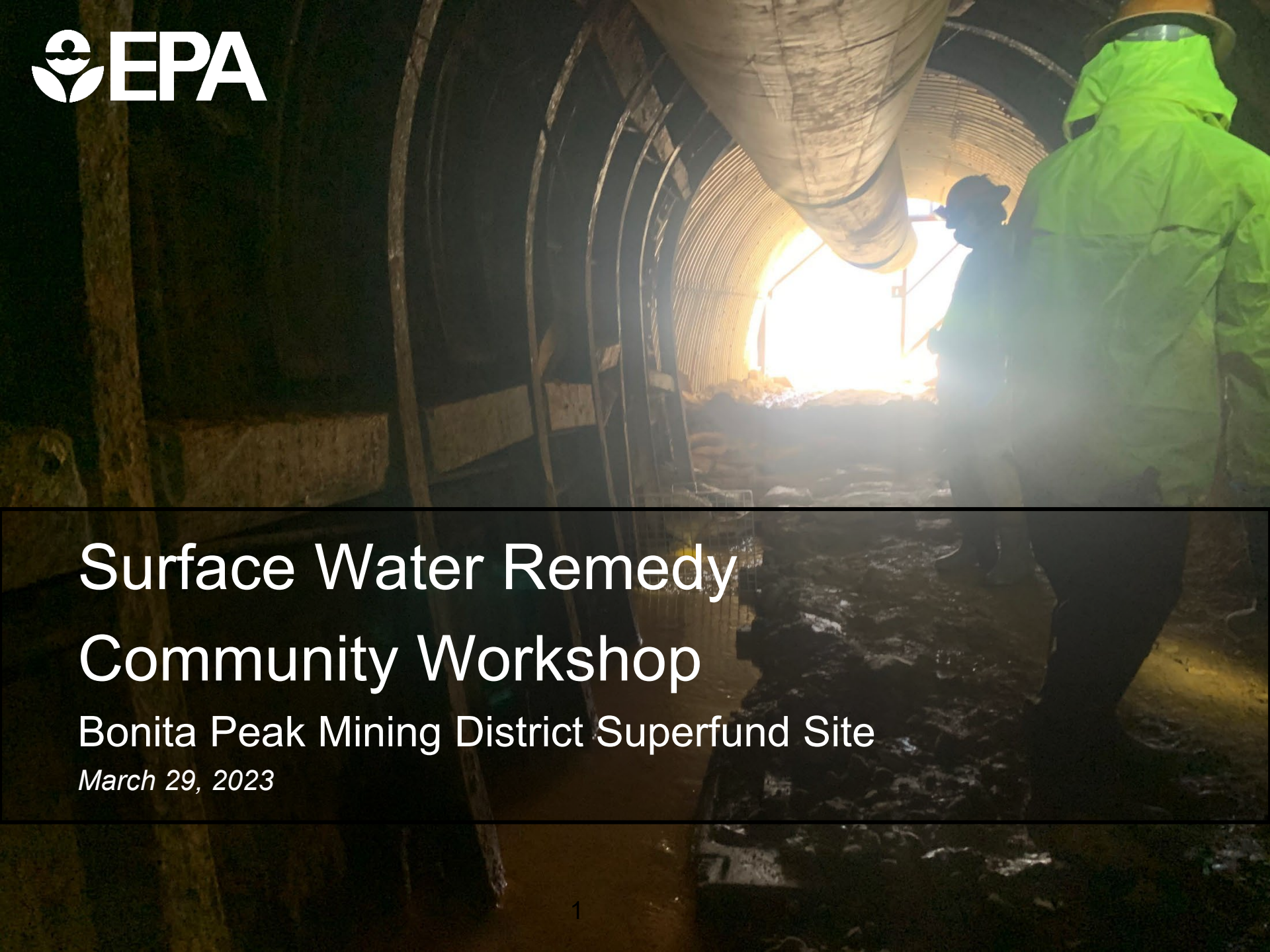


# Surface Water Remedy Community Workshop

## Bonita Peak Mining District Superfund Site

*March 29, 2023*

# Workshop Agenda

- Welcome & Introduction
- Purpose and Goals
- Presentations
- Listening/Feedback Sessions

# Welcome & Introductions

## Workshop Purpose

Engage the community *early in the process* on water treatment options for contaminated surface water at BPMD.

# Workshop Goals

- **Engage.** Dialogue with community about active water treatment as a potential long-term remedy to achieve water quality goals.
- **Understand.** Listen to community concerns regarding water treatment options and gather information to aid in future evaluations.
- **Be transparent.** Share current actions and a road map to decision.

# Part 1. Presentation

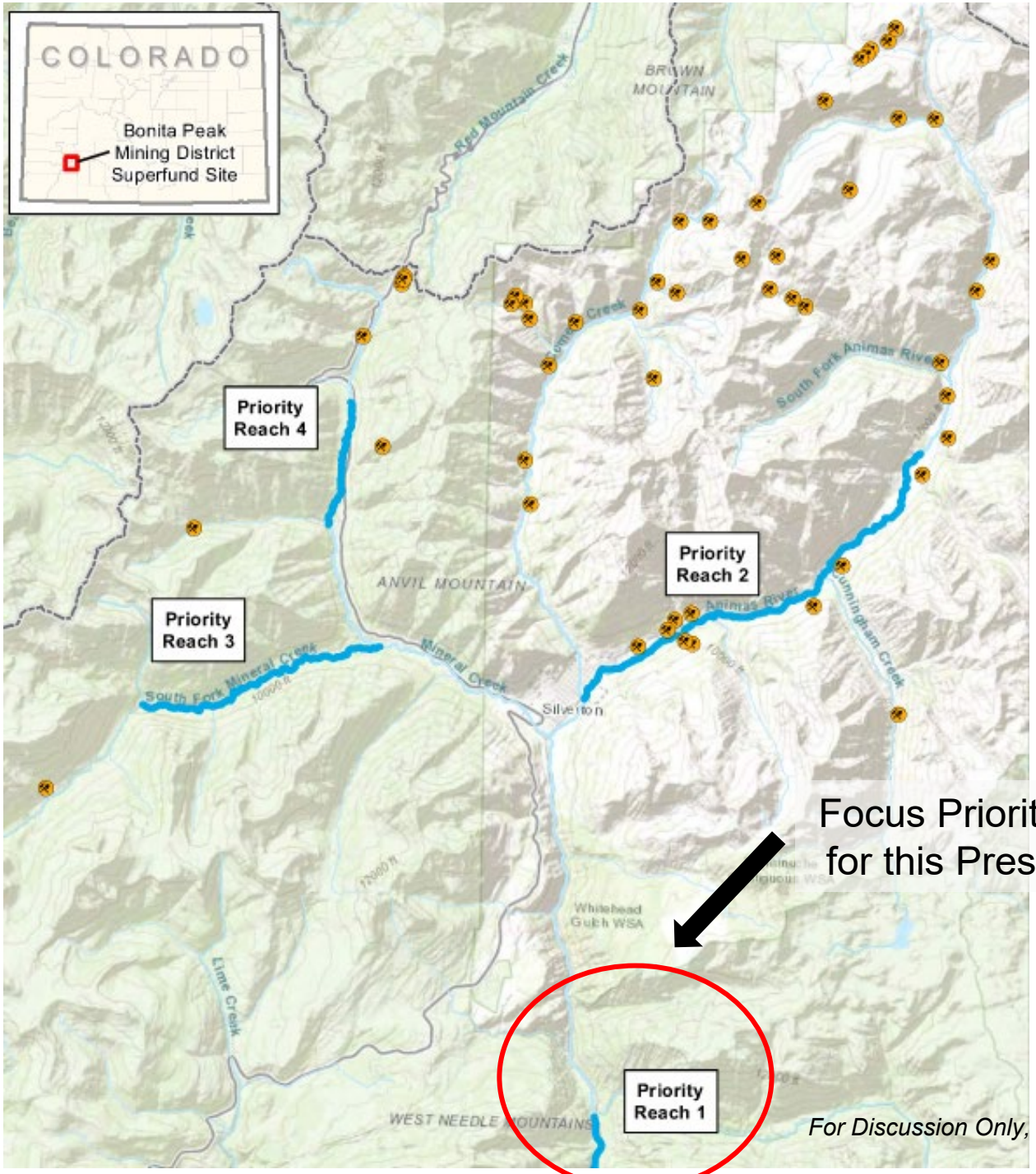
- Watershed Loading
- Reductions Needed
- Discussion of Technologies and Uncertainties
- Road Map to a Decision

# Goals for Response Actions

- **Goal 1**. "*Improve water quality with a focus on mine drainage.*"
- **Goal 2.** "*Stabilize source areas with a focus on solid media.*"
- **Goal 3**. "*Minimize unplanned releases.*"

# Objectives to Address Goal 1

- *"Identify achievable actions necessary to meet Table Value Standards (TVS) in the Animas River at a location downstream of Elk Creek."*
- *"Improve water quality to meet or exceed State water quality goals in priority reaches."*




*For Discussion Only, Not for Publication*

# Priority Reach 1

- *"Undertake activities necessary to meet TVS in the Animas River at a location below Elk Creek (with the possible exception of aluminum due to high background concentrations)."*
- This objective will be primarily attained by reducing loading to surface water through a combination of:
  - Remediation at individual mine source areas;
  - Centralized treatment of Upper Cement Creek sources

# Terminology

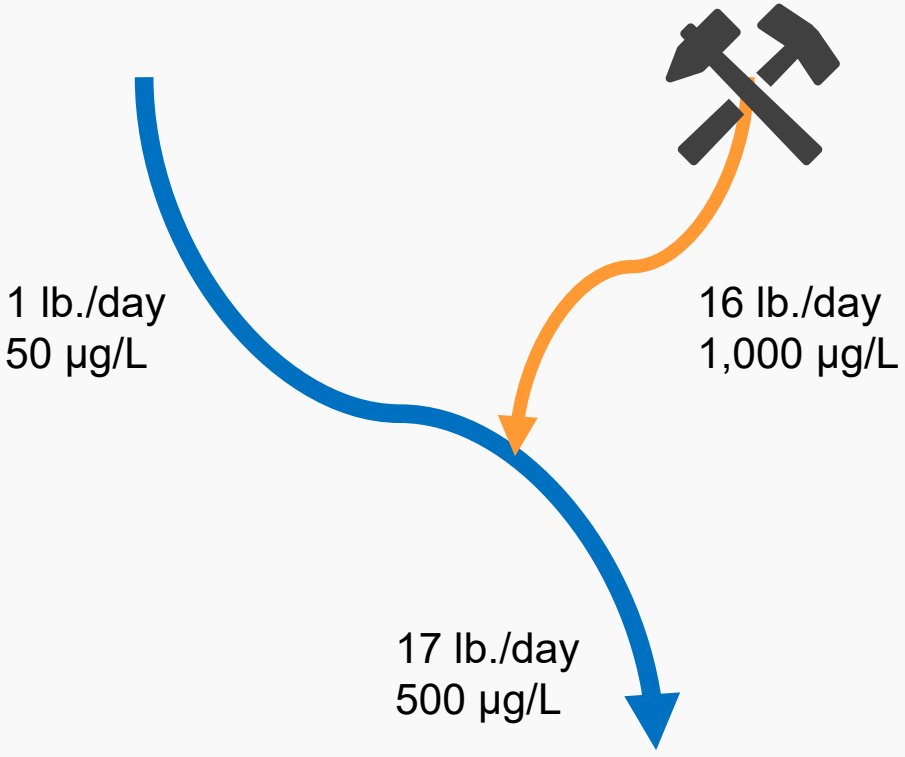
- **Concentration** – mass of metal per unit volume. Compare to Table Value Standards to determine potential impairment
- **Load** – mass of metal per unit time. Used to evaluate rates of treatment needed to reduce concentrations

Load = Concentration * Flow

Concentration is what the aquatic life experiences and basis of Table Value Standards (TVS)

Load is used to calculate needed reductions of metals

# Metals Loading From Mines




In order to evaluate the effects of cleaning up a source such as a mine, the basic loading math is used to estimate the new metals load and concentration.

Load = Concentration * Flow
Add loads 1 + 16 = 17
Concentration = Load / Flow

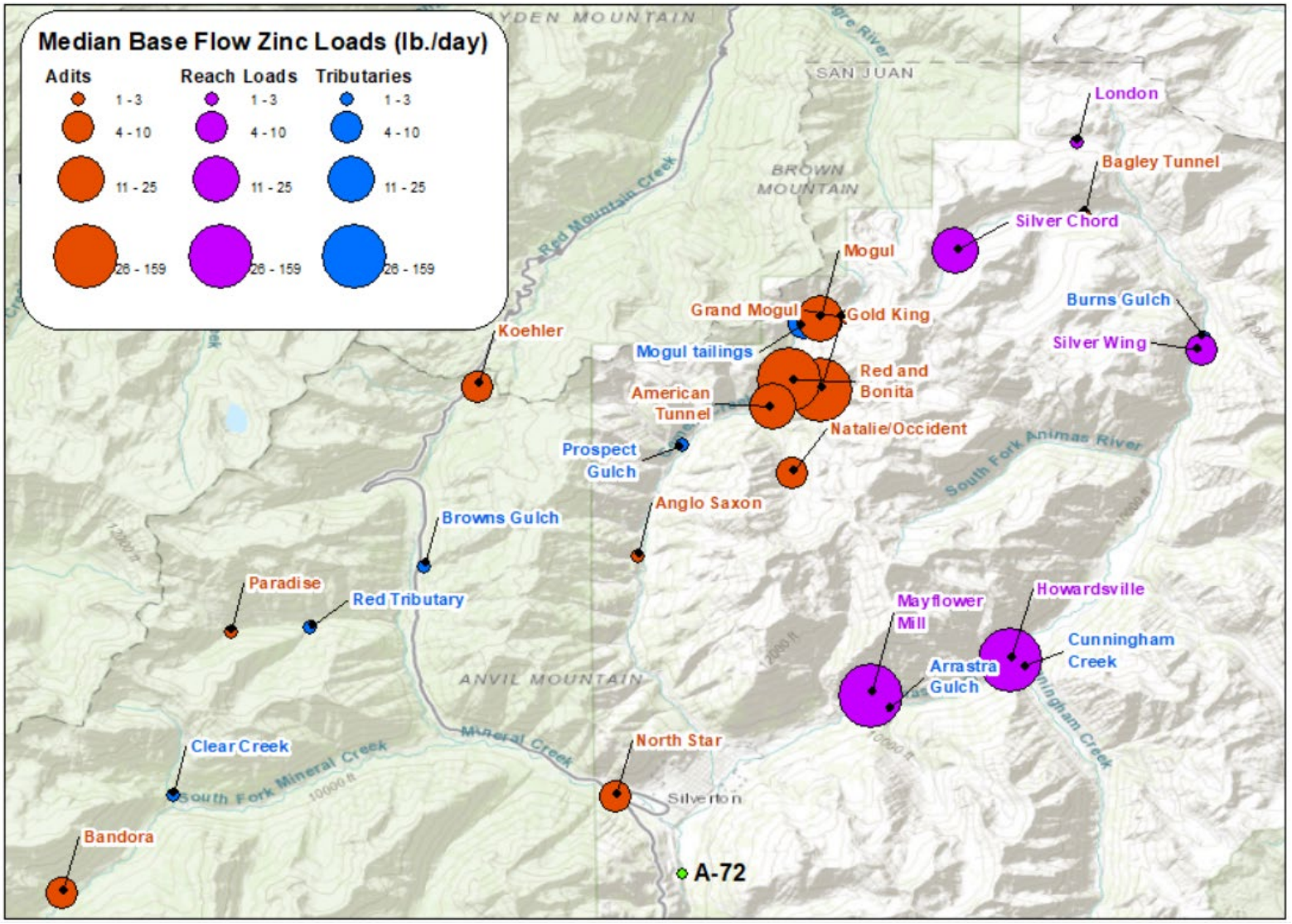
# Focus on Zinc

- Zinc is used in the Loading Tool because:
  - Widespread contaminant at BPMD
  - Relatively conservative in water
  - Generally, addressing zinc contamination will also address other metals
  - Loading tool cannot account for precipitation reactions that remove metals from surface water
    - such as ferricrete or aluminum hydroxysulfate
  - Zinc is a driver for aquatic life
- Manganese, cadmium, lead & aluminum* also of concern

# Focus on Base Loads from Fall Sampling

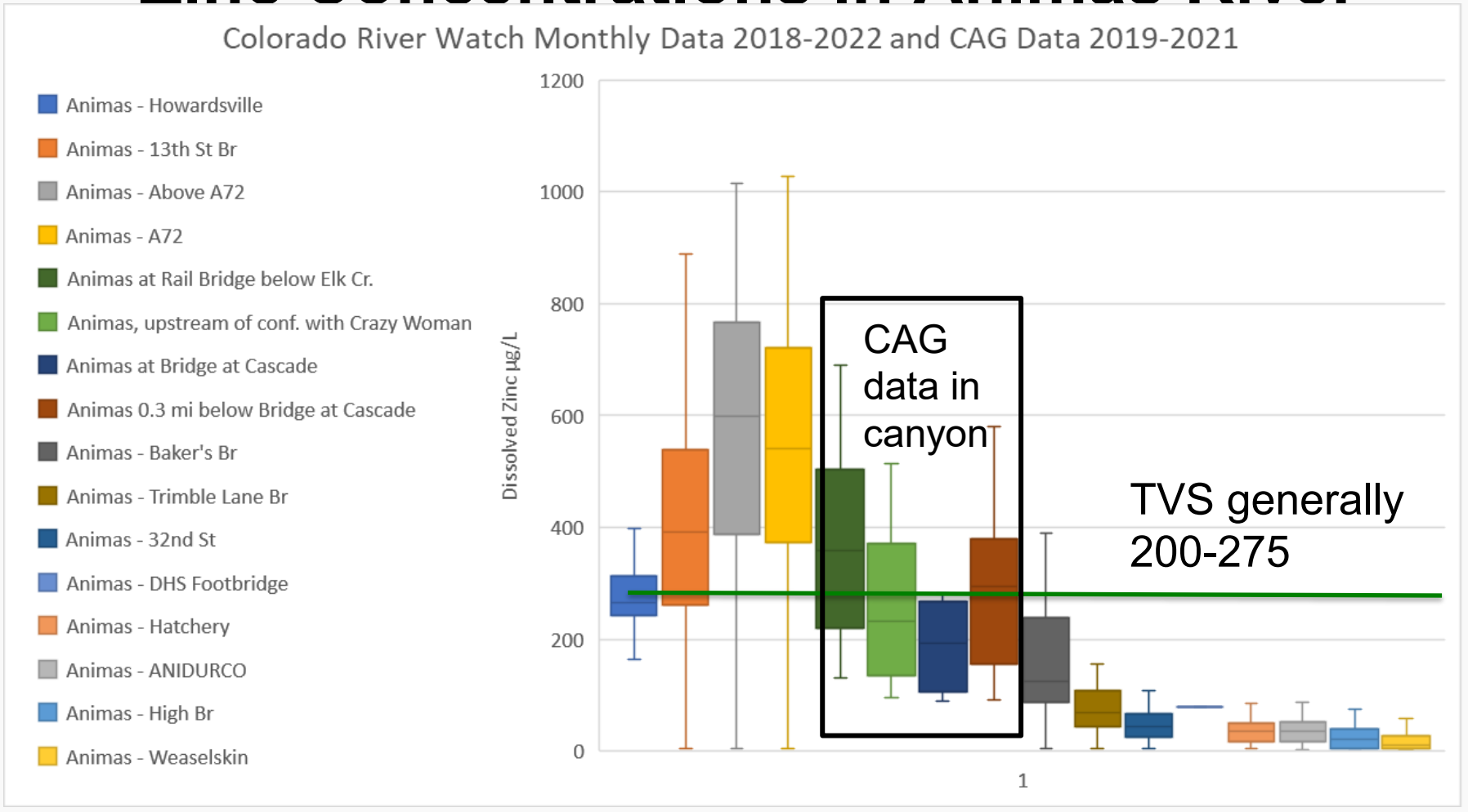
- Loading Tool uses base flows (fall dataset)
- Why?
  - Annual low flow sampling conducted by EPA from 2015-2021
  - Consistently in October during base flow
  - Relatively stable flow conditions
  - Best access to high elevation sites
  - Able to collect all sample locations in a short time frame for quasi - synoptic sampling
  - Runoff sampling is highly variable (big variability in June)
    - discharge is commonly not measured for safety reasons & not sufficient as a synoptic data set
    - Loads from runoff may present opportunities for source control?

# Sources of Contamination: Focus on Zinc

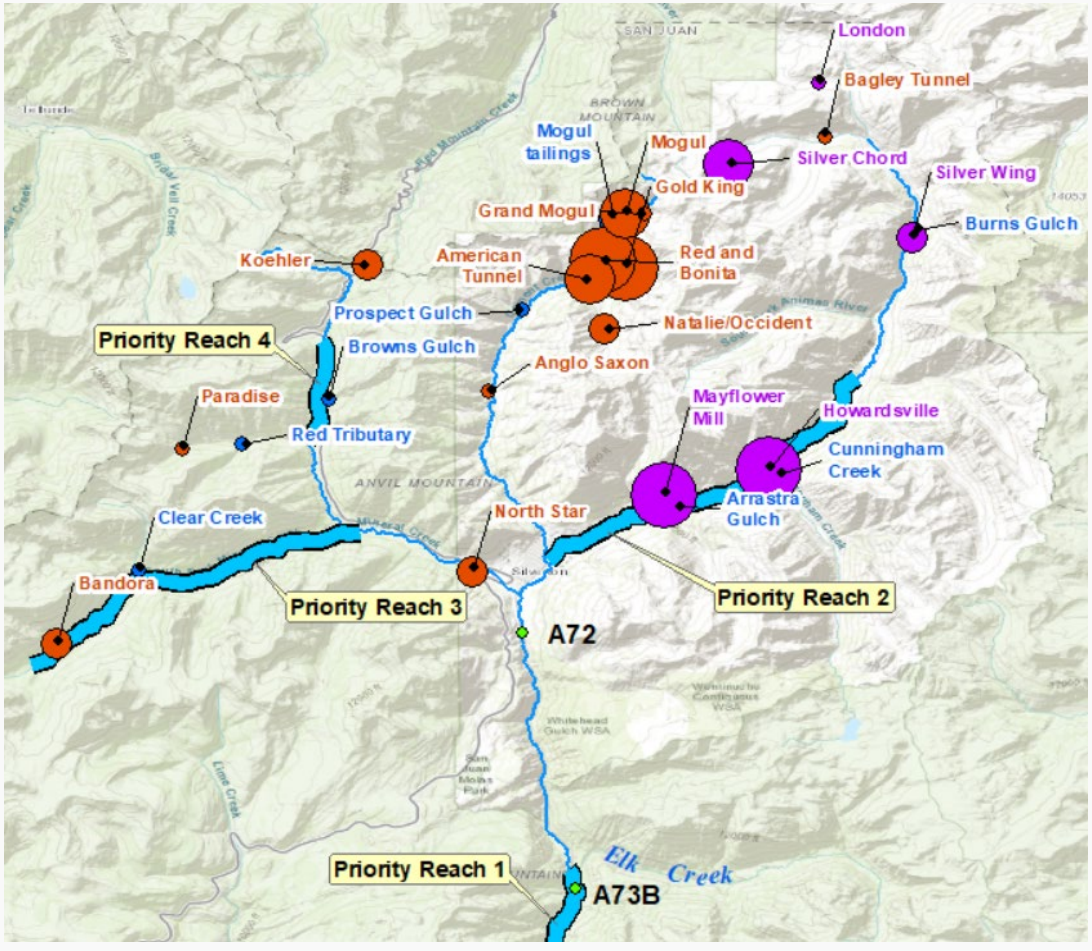


| Metals Source | Type | Drainage | Median zinc load lb./day |
|---|---|---|---|
| **North Star** | Adit | Mineral | 3.9 |
| **Bandora** | Adit | Mineral | 3.7 |
| **Koehler** | Adit | Mineral | 3.1 |
| **Paraside** | Adit | Mineral | 2.3 |
| | **Mineral largest sources** | | **13** |
| **Gold King Level 7** | Adit | Cement | 159 |
| **Red and Bonita** | Adit | Cement | 53 |
| **American Tunnel** | Adit | Cement | 20 |
| **Mogul** | Adit | Cement | 16 |
| **Natalie/Occidental** | Adit | Cement | 4.1 |
| **Grand Mogul** | Adit | Cement | 1.6 |
| **Anglo-Saxon** | Adit | Cement | 1.3 |
| | **Upper Cement sources** | | **255** |
| | **Upper Cement sources less Gold King** | | **96** |
| **Mayflower Mill area** | Impoundments | Animas | 52 |
| **Howardsville** | Impoundments | Animas | 27 |
| | **Howardsville + Mayflower Mill** | | **79** |
| **California Creek above Silver Chord** | Reach | Animas | 11 |
| **Silver Wing/Burns** | mine area | Animas | 10 |
| **London** | Adit | Animas | 2.9 |
| **Bagley Tunnel** | Adit | Animas | 1.6 |
| | **Other Animas Sources** | | **26** |

# Zinc Concentrations in Animas River



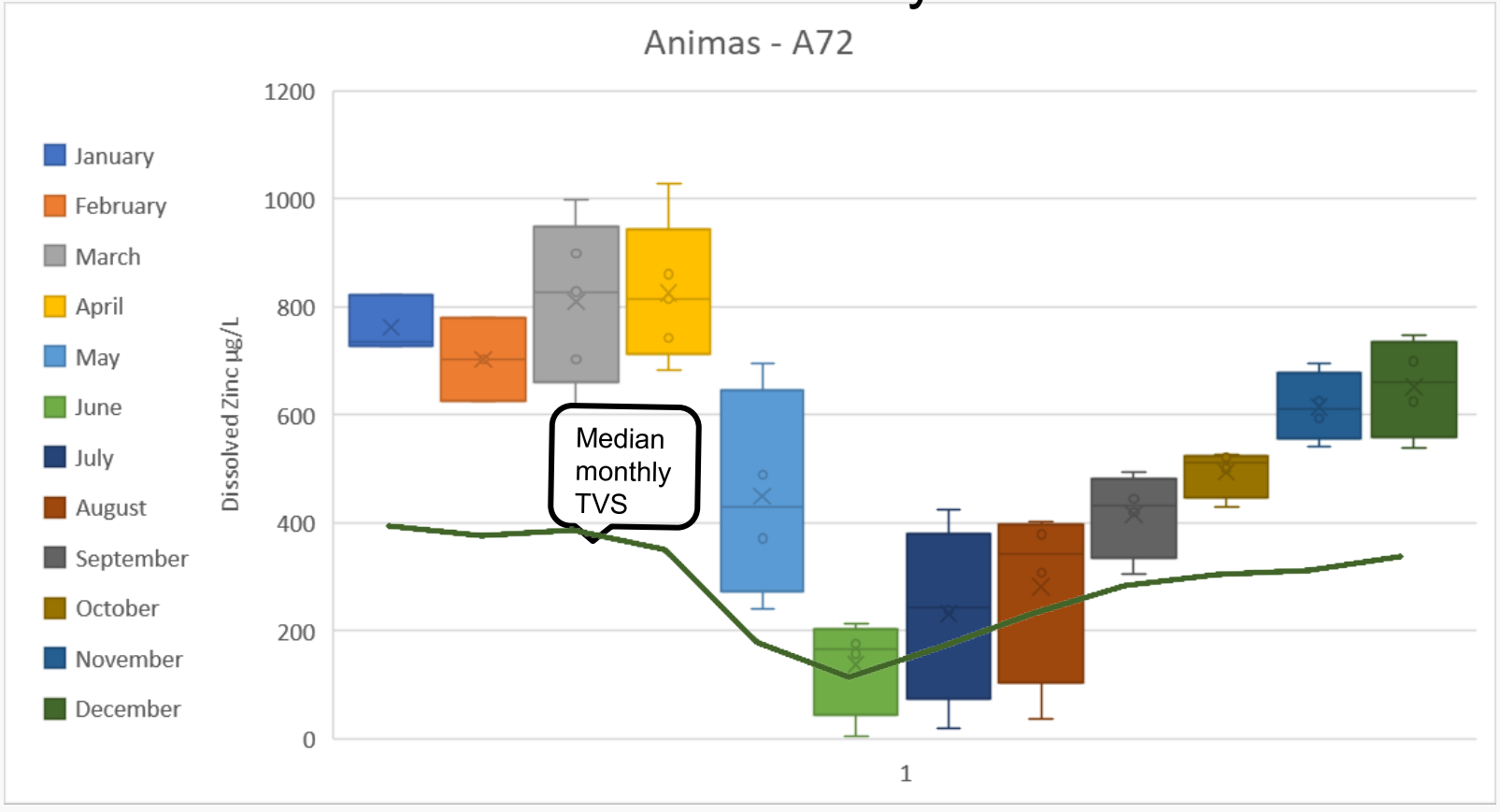
# A72 as a Surrogate Point of Compliance




- Priority Reach 1 begins at Elk Creek
- Station A73B is difficult to access. A72 has a larger data set.
- A72 is a good starting point at POC
- May need to consider downstream locations with lower hardness = lower TVS values

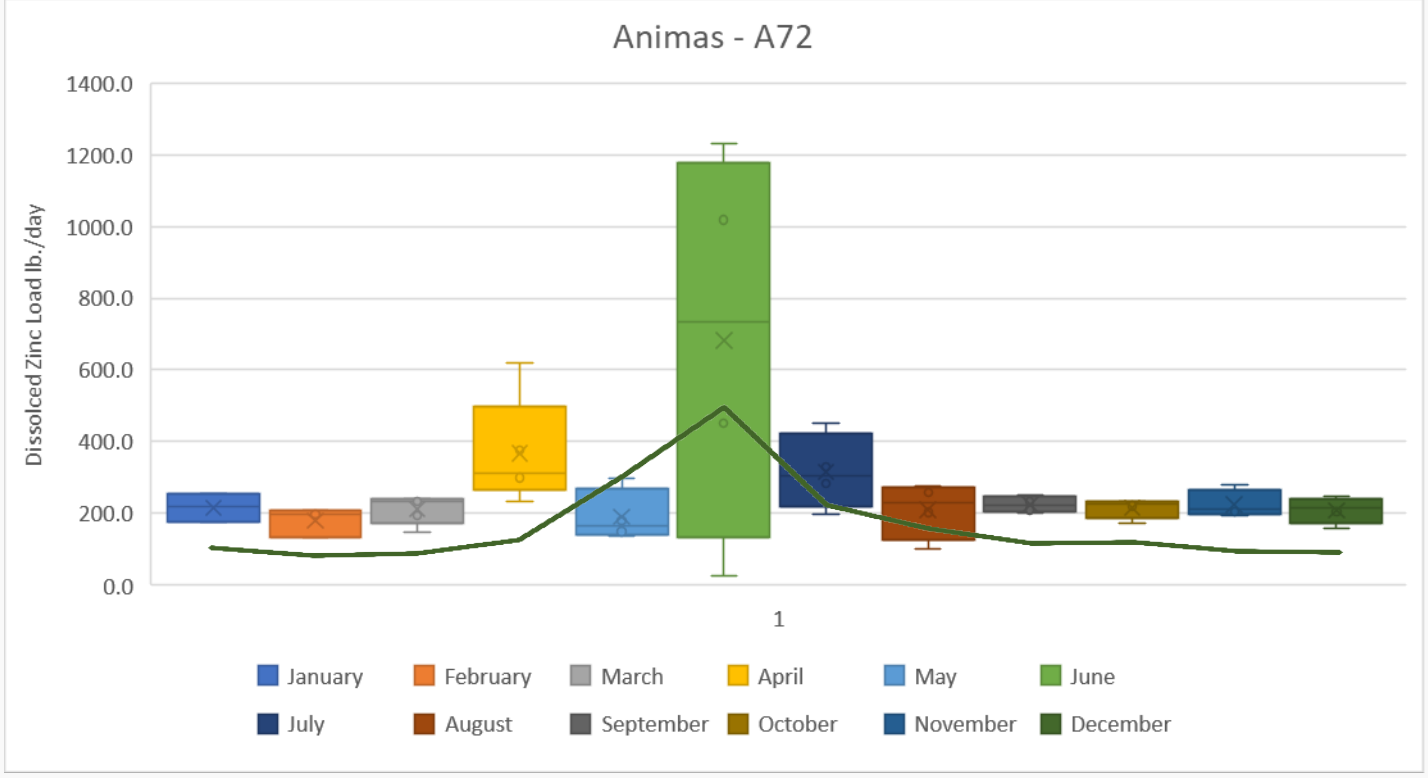
# A72 Zinc Concentrations

## Colorado River Watch Monthly Data 2018-2022



# A72 Zinc Loads

## Colorado River Watch Monthly Data 2018-2022
## USGS Discharge used to Calculate Loads



# A72 Zinc Loads

## EPA Annual Fall Data 2015-2021

| Station | Median Dissolved Zinc µg/L | Median Discharge cfs | Median Dissolved Zn load lb./day |
|---|---|---|---|
| A72 | 560 | 102 | 276 |

# Refining the range of removal needed: Goal 1 – Zinc at A72 (Surrogate) Using base flows (fall data set):

| | | | |
|---|---|---|---|
| Water Quality Goal at A72 (Zinc TVS) | 255 µg/L | Load Goal at 102 cfs and 255 µg/L | 141 lb./day |

| A72 Existing Load lb./day | | Load Goal lb./day | | Reduction Needed lb./day |
|---|---|---|---|---|
| 276 | - | 141 | = | 135 (49%) |

# Refining the range of removal needed:
# Goal 1 – Zinc below Elk Creek
# Conservative Reduction Target (year round):

| | | | |
|---|---|---|---|
| Water Quality Goal: | *No more than one exceedance of zinc TVS per 3 years* | Estimate load reduction needed | **70%** |

| Existing Load at A72 lb./day | Reduction Needed lb./day | Resulting A72 Ambient Load lb./day |
|---|---|---|
| 276 - | 193 (70%)= | 83 |

# Cement Creek Only-Adit Loading

| Adit | Median zinc load lb./day |
|---|---|
| Red and Bonita | 53 |
| American Tunnel | 20 |
| Mogul | 16 |
| Natalie/Occidental | 4.1 |
| Grand Mogul | 1.6 |
| **Total** | **95** |
| *49% Reduction needed* | *135* |
| *Shortfall* | *40* |
| *70 % Reduction needed* | *193* |
| *Shortfall* | *98* |

Main point:
-Treating the discharges in the upper Cement Creek area, including Gold King Level 7, will still require additional load reductions to meet TVS in the Animas
-Spring flows will need additional source reductions

# What other zinc load removal is feasible?

Tailings & waste rock sources will have less than complete capture

- Howardsville 27 lb./day
  - Future remedies might reduce by 70-80% (22 lb./day)
- Mayflower Mill 52 lb./day
  - Future remedies might reduce by 70-80% (42 lb/day)
- Total 64 lb./day possible reduction
- **Base flow: may meet overall zinc load reductions**
- **Spring melt: highly variable; additional loading from erosion. Look for additional non-point load reduction**

# Take Aways

- Load reduction needs are different during base flows (fall) and spring runoff
- A72 can be used as a surrogate for Priority 1 but locations further downstream may have lower hardness increasing the zinc removal needs
- Will continue to refine water quality goals and load reductions

# Listening/Feedback Session

# Surface Water Remedy Options

- Localized
- Centralized

# Localized Source Controls

**Examples**

- Plugging Mine Workings (Bulkheads)*
- Cap and Cover
- Containment Barriers
- Diversion
- Excavation and Consolidation
- In-situ Passive Treatment
- Stabilization/Solidification
- Others

# Localized vs. Centralized Strategies

- Localized source controls
  - Uncertain performance
  - May not reduce sufficient loading
- Centralized treatment
  - Can be designed to remove 99.9% of zinc

# Centralized Treatment
# Primary Types

- Passive (or Semi-Passive) Treatment
- Active Treatment

# Passive or Semi-Passive Treatment Methods

- Constructed wetlands
- Sulfate reducing bioreactors
- Anoxic limestone drains
- Open limestone channel
- In-situ treatment inside flooded mine workings
- Aeration channels
- Settling ponds

# Passive or Semi-Passive Treatment

- Relies on a variety of mechanisms - adsorption, filtration, sedimentation, metal oxides/hydroxides, precipitation of metal sulfides, microbial metabolism, and plant uptake.
- Slow process, therefore requires long retention time/large footprint
- Sensitive to changes in water quality and temperature
- Will require solids management (often ignored)

# Active Treatment Methods

- Chemical Precipitation (lime treatment)
- Membranes (reverse osmosis, ultra filtration)
- Biological (membrane or fluidized bed reactor, etc.)
- Ion Exchange
- Electrocoagulation
- Proprietary Media or Technologies

# Active Treatment

- Can use similar mechanisms as passive for metals removal and/or more complex technologies
- But has active, precise control of flow rates, chemical additions, & water residence times
- Active monitoring to adjust as needed
- Can be designed to target specific contaminants
- Smaller foot print: controlled conditions = faster reaction times

# Centralized Treatment Plants

| Technologies | Advantages | Disadvantages |
|---|---|---|
| Active Treatment | • Relatively small footprint (size constraint)<br>• Proven treatment technology.<br>• Generally exceeds performance of passive approach.<br>• Direct control over treatment operations to achieve discharge limits.<br>• Address changes in flow and concentration effectively. | • Higher capital and operation/maintenance costs.<br>• Industrial look of facility (but can use more historic facades).<br>• Generates sludge to be disposed offsite. |
| Passive (or Semi-Passive) Treatment | • Typically, low operating and capital costs (depending on flow rates)<br>• Lower carbon footprint.<br>• Operates for periods of time unsupervised.<br>• More natural look. | • Requires large footprint to operate (size constraint).<br>• Less control to reliability. achieve effluent standards<br>• May not fully function in winter conditions.<br>• Generates sludge to be disposed offsite. |

# Major Technology Constraint: Footprint Sizing

| Site | Type | Avg Flow | Design Peak Flow | Treatment Area |
|---|---|---|---|---|
| Rico Argentine | Semi-Passive | 400 | 600 | 35 acres |
| Upper Blackfoot | Passive | 65 | 130 | 3 acres |
| Upper Blackfoot | Active | 100 | 180 | 0.5 acre |
| Bunker Hill | Active | 3,500 | 8,000 | 6 acres |
| Argo Tunnel | Active | 250 | 700 | 1 acre |
| Summitville | Active | 1,600 | 2,100 | 1.5 acres |
| Eagle Mine | Active | 210 | 300 | 10 acres** |

# Rough estimate of facility size for treatment

- Rough Estimate Upper Cement adits including Gold King:
- 1500 avg, 2000 peak gpm

- Similar to Summitville rate: 1.5 acres for plant
- 4x Rico treatment rate: 60 acres semi-passive

# Active Treatment Example

**Summitville**

Flow Rate:

- 1,600 gpm (design)
- 2,100 gpm (peak)

Footprint:

- 85 x 160 ft building
- 1.5 acre trtmt area
- *28 acre water storage pond prior to trtmt

# Passive Treatment Example

**Rico**

Flow Rate:

- 400 gpm avg
- 600 gpm max effective

Footprint:

- 35 acres

# Potential Treatment Technology

## *Screening based on Technical Implementability*

**Active Treatment – feasible**

- Proven effective year-round technology
- Measurable success at several locations in Colorado
- Relatively small surface area requirements
- More implementable in mountainous community than passive or semi-passive that requires a much larger surface area

**Centralized Passive Treatment –not feasible**

- Size not feasible in the area
- Less control of outcomes
- May be feasible for small remote sources elsewhere at Site

# Active Treatment Considerations

- Influent water management - storage & flow rate control
- Conveyance pipelines & pumping & maintenance
- Chemical deliveries
- Equipment maintenance & replacement
- Media/filter replacement
- Power reliability
- Remote operation reliability
- Treatment generated solids management & disposal

# Next Step in Community Engagement

**Interviews** with Neutral Facilitator Pam Avery

# Listening/Feedback Session

# Summary & Wrap Up

# Thank You!