Acid Mine Drainage Source Control Program Design Investigation

Upper Tenmile Creek Mining Area Site

Angela Frandsen, PE
Helena, Montana

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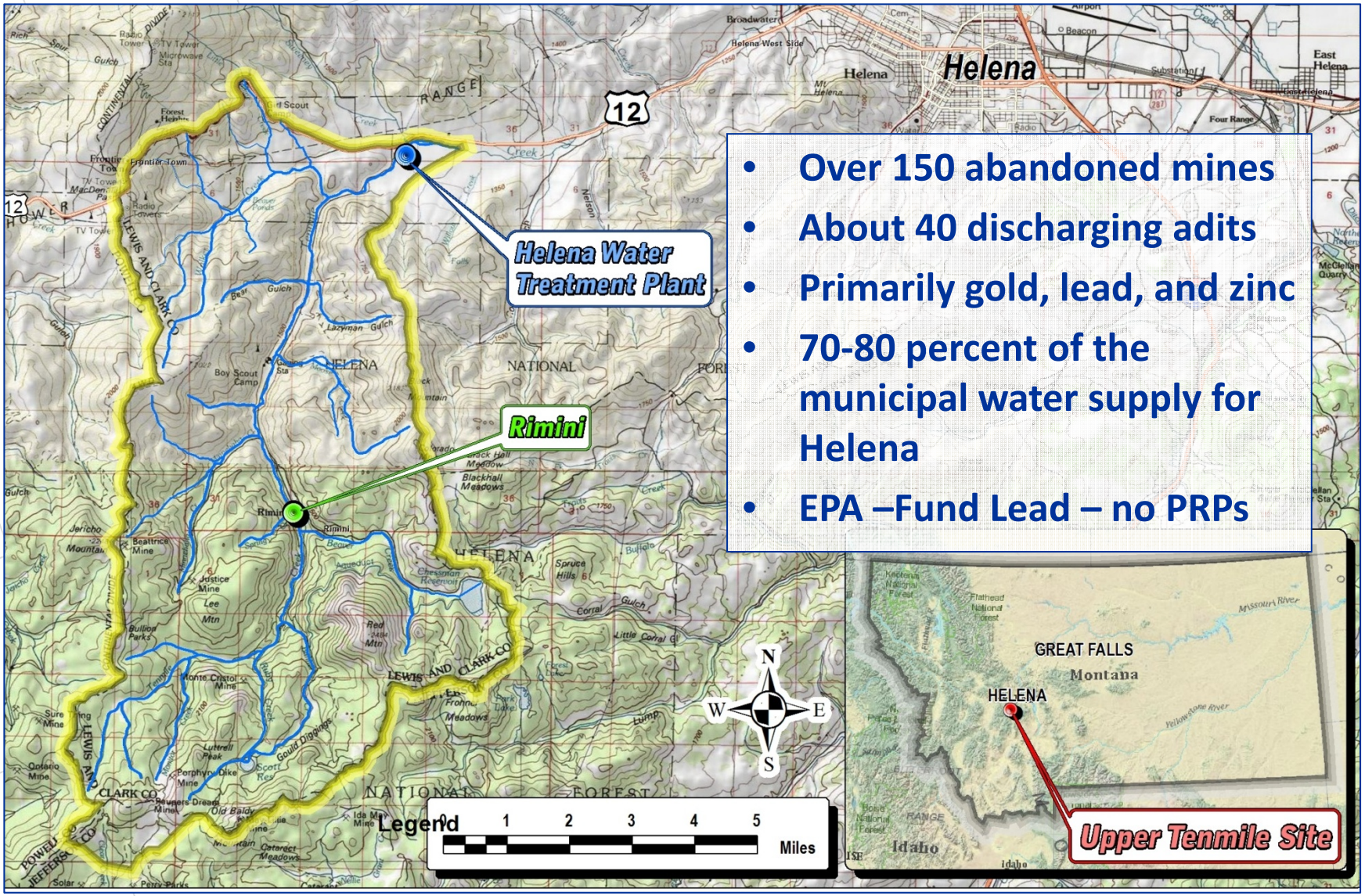
Overview

- Tenmile Creek Superfund Background
- Adit Discharge Source Control Program
- Susie/Upper Valley Forge and Lee Mountain Source Control Findings
- Upcoming Work

Site Background



- Over 150 abandoned mines
- About 40 discharging adits
- Primarily gold, lead, and zinc
- 70-80 percent of the municipal water supply for Helena
- EPA –Fund Lead – no PRPs

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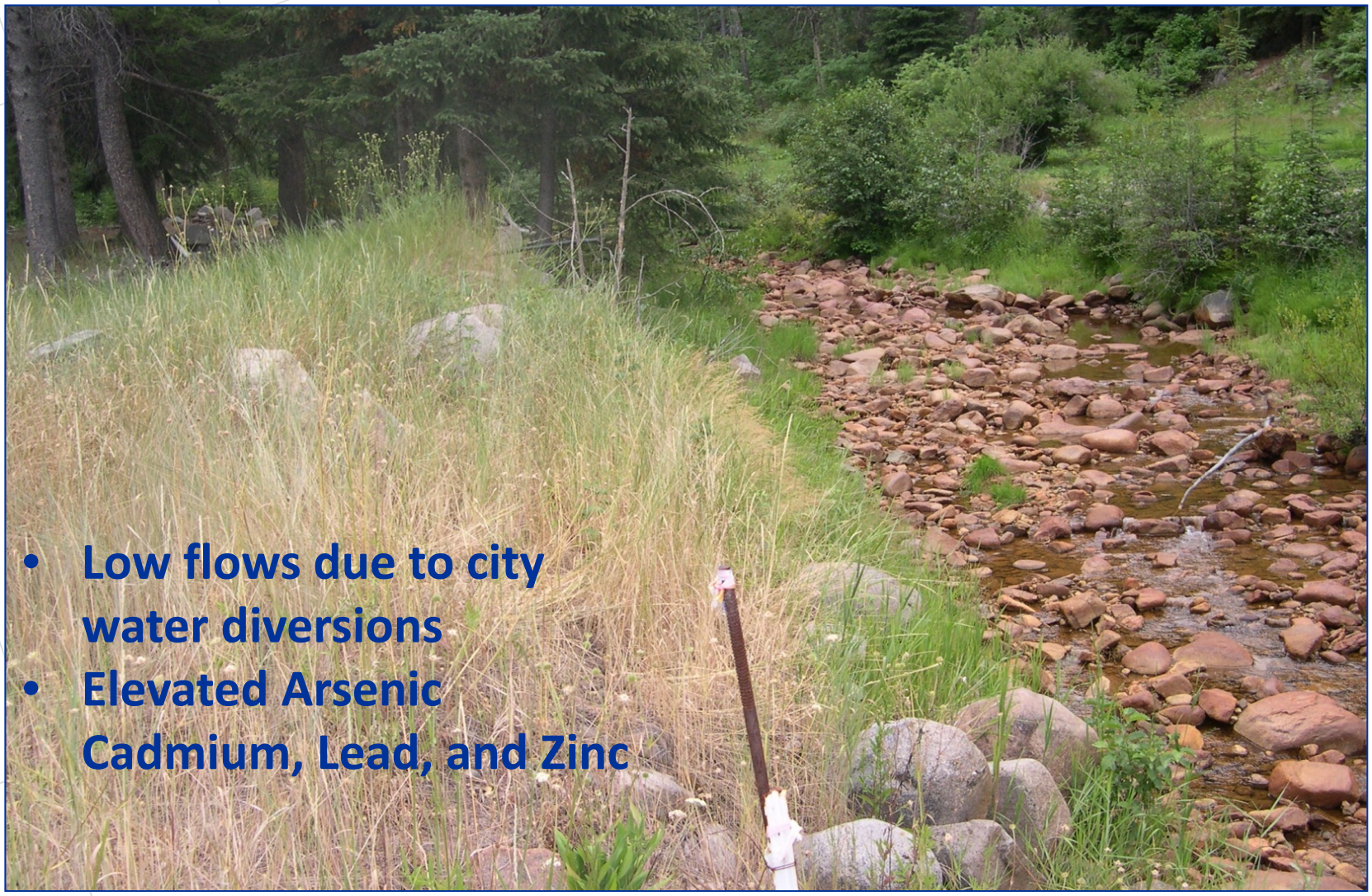
Tenmile Creek in Rimini



Record of Decision (2002)

Overall Goals of Selected Remedy:

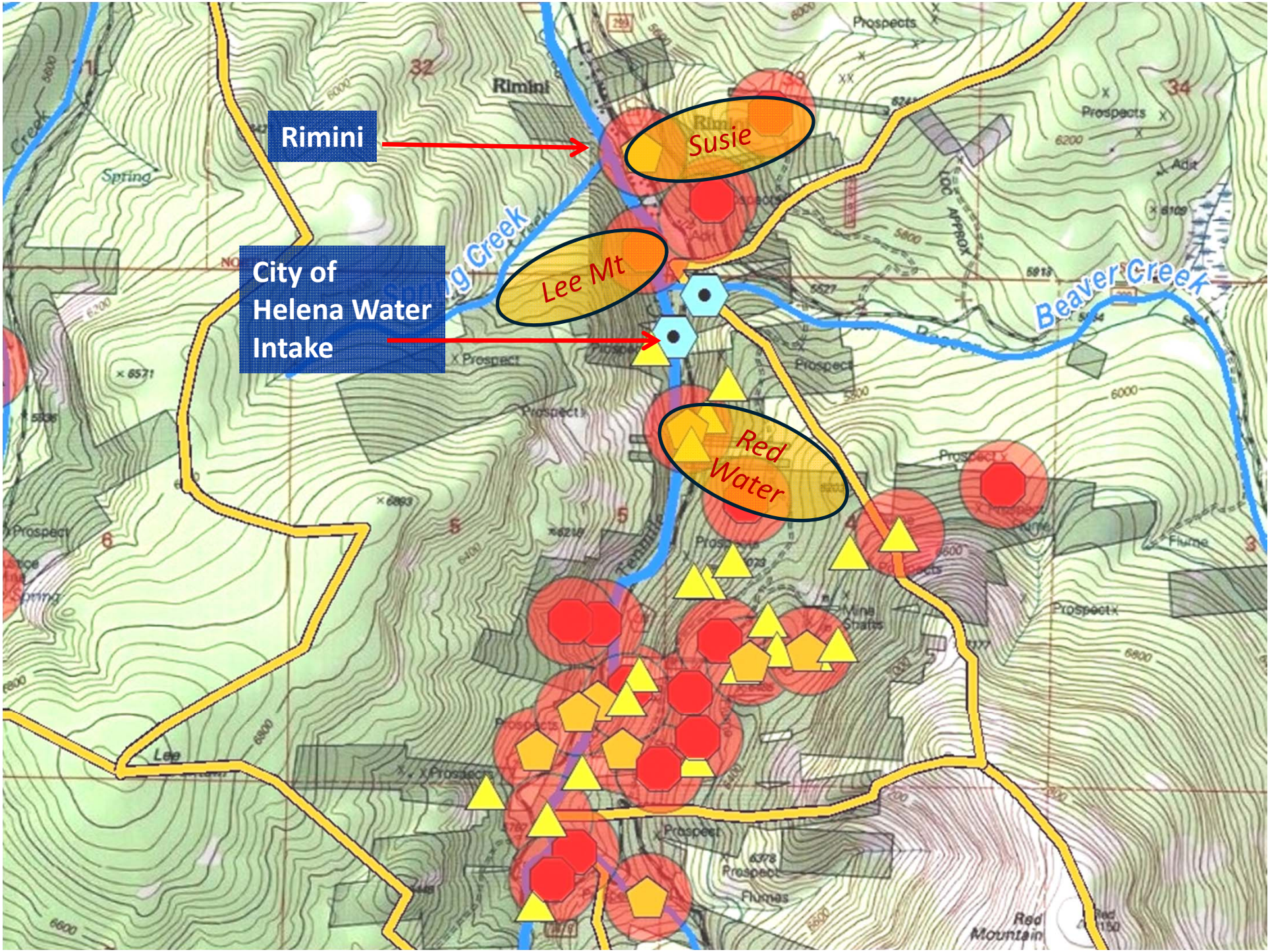
- Protect watershed which serves City of Helena
- Remove mine wastes from 70 abandoned sites to repository
- Remove contaminated residential yard soils to repository
- **Adit discharge source control and treatment**

Tenmile ROD Requirements for Adit Discharge

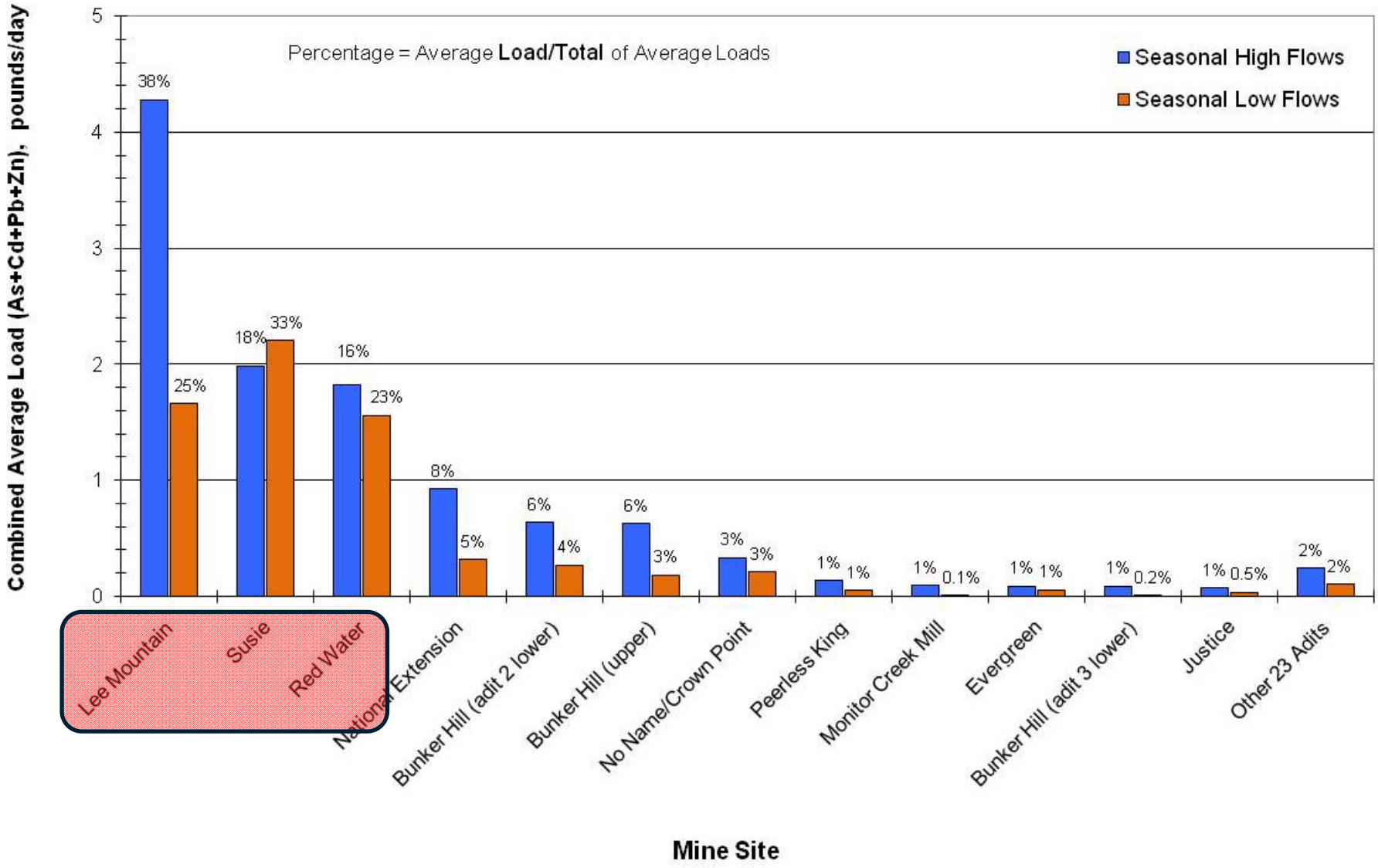
- "Four-Phase" Source Control Program to reduce contaminant loading from discharging adits to the watershed.
- Three adit discharges qualify as "Principle-Threat Wastes"
  1. Lee Mountain
  2. Susie
  3. Red Water

  These three account for 70-80% of metals loading from adit discharge

  "…source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or that would present a significant risk to human health or the environment should exposure occur"
- Expectation of treatment under the NCP


Rimini
City of Helena Water Intake
Susie
Lee Mt
Red Water
Beaver Creek
Rimini
Prospects
Spring
Prospect
Flumes
Red Mountain
Lee

Site Wide Mass Load Ranking



Source Control Program

- Phase 1 – Initial Design Investigations
  - Site Prioritization
  - Figure out the unique hydrology/geochemistry of the mine
  - Tracers, historic workings maps, flow measurements
- Phase 2 – Source Control and Flow Reduction Design Studies
  - Pilot scale - regrading, rerouting drainages, plugging, grouting, flooding, dewatering
- Phase 3 – Source Control and Flow Reduction Implementation
  - Implement full scale if successful
- Phase 4 – Design and Construction of Treatment Facilities – Passive or Active

Phase I Design Investigations on the Susie and Lee Mountain Adits

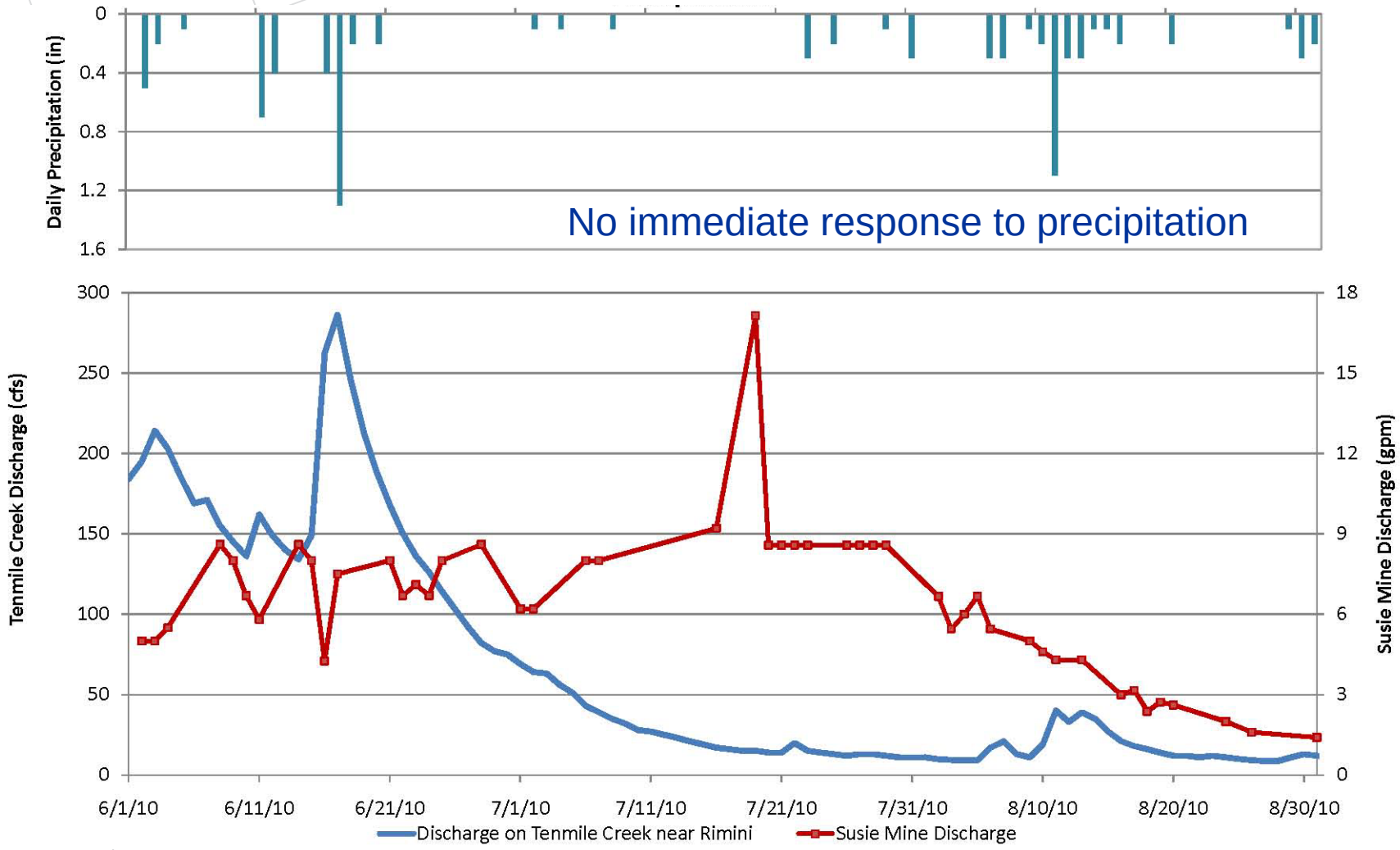
- Two discharging adits on opposite sides of the canyon
- Within the Community of Rimini
- Less than 1,500 feet apart
- Understanding the internal workings is critical to reducing flows and contaminant loading
- Results – these two adits require different source control strategies

Susie Adit

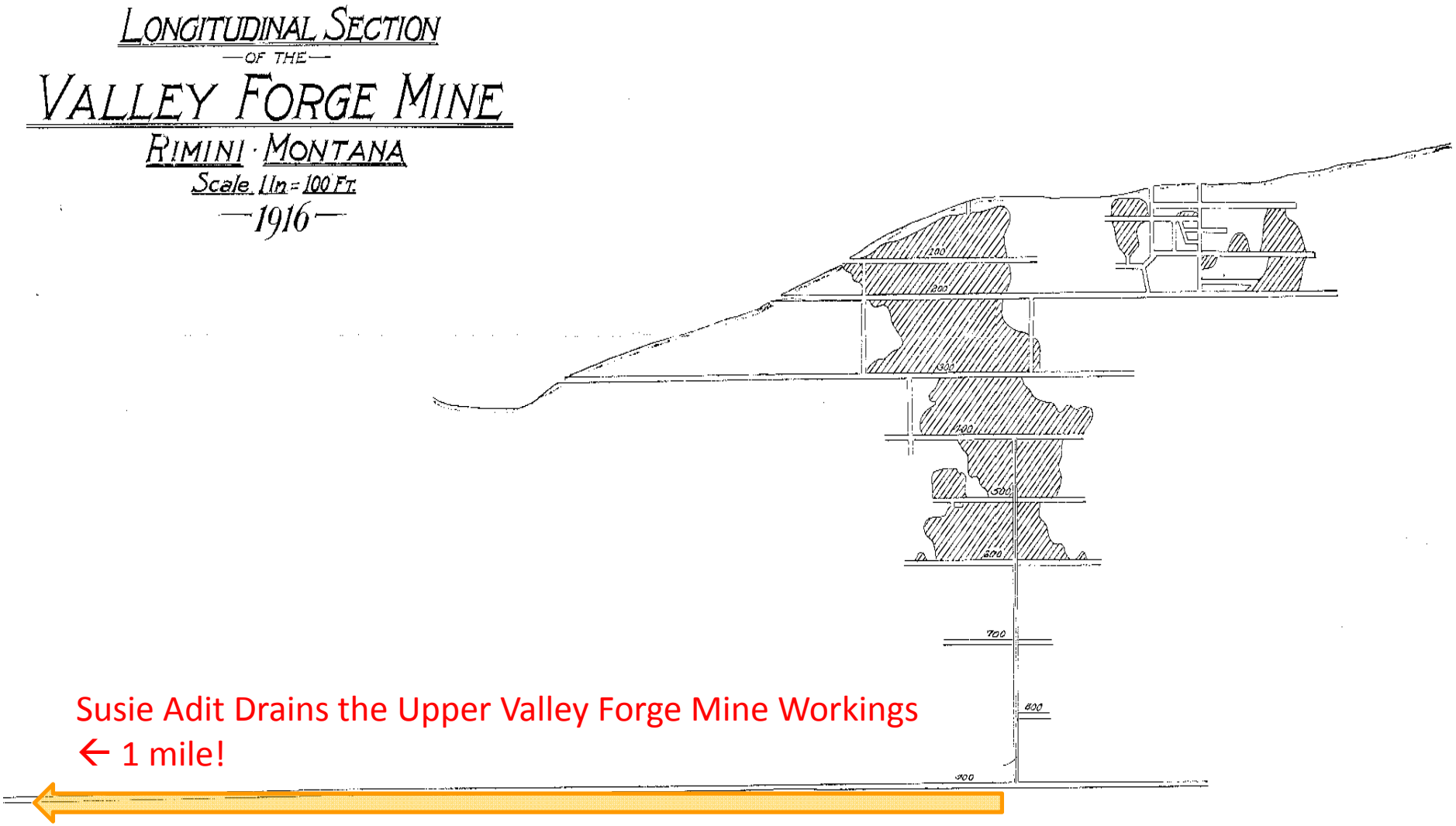
- Drains Upper Valley Forge
- 5-10 gpm
- pH 3.5-4.3
- As = 10-20 mg/L
- Fe = 150-200 mg/L
- Al ~ 1 mg/L
- Cd ~ 200 ug/L
- Zn ~ 30 mg/L
- These are several orders of magnitude above water quality standards

Adit reopening in 2005

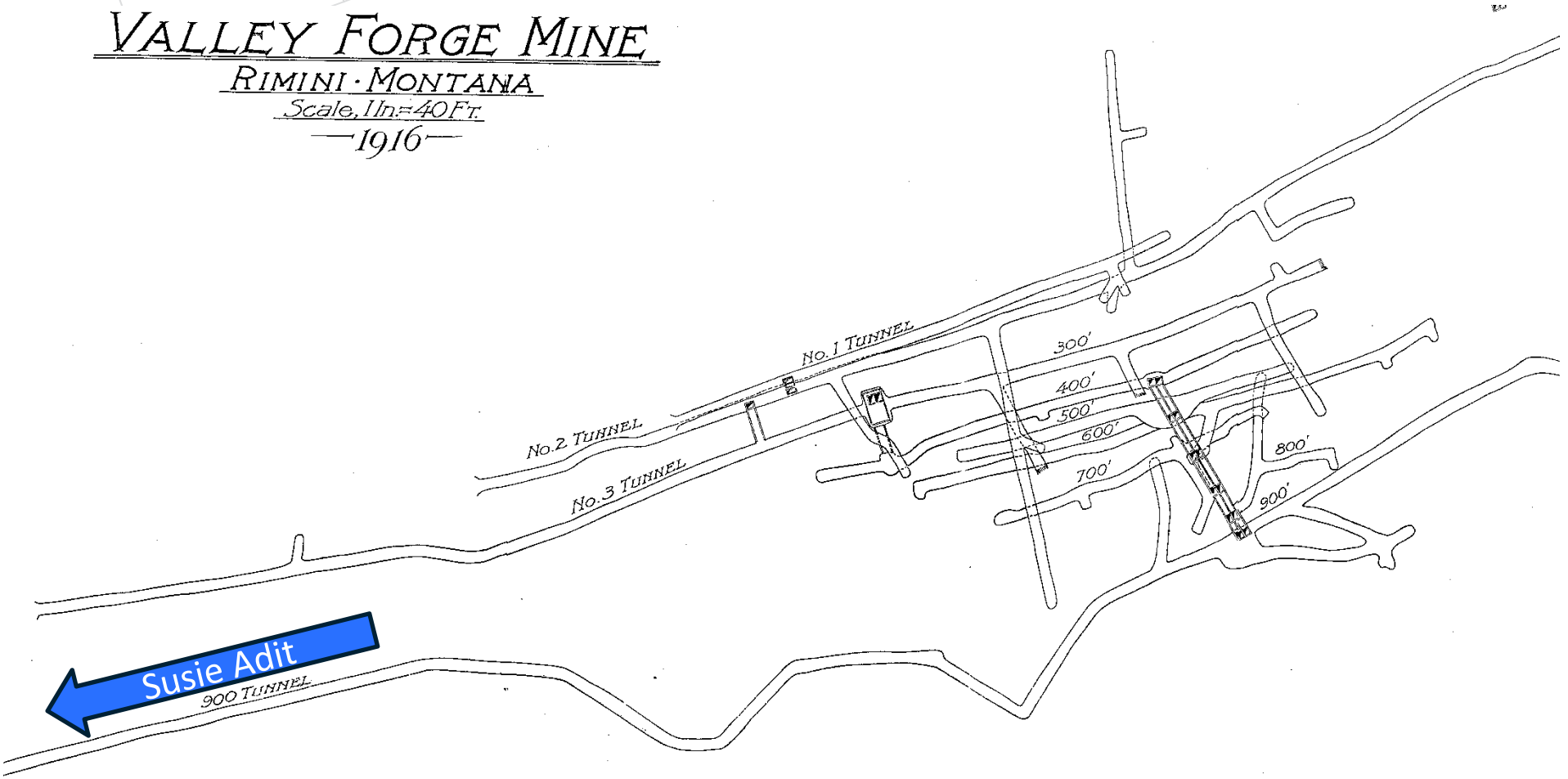
2010 Susie Discharge



Historic Mine Workings



Historic Mine Workings – Plan View



Can we reduce infiltration from the surface to the workings?

2010 Site Reconnaissance

- Identify possible areas of recharge
- Plan Tracer Study

2011 Tracer Study

- Determine if hydraulic connection between surface water bodies and the adit discharge.
- Presence/Absence
- Three injection points dosed with three different dyes:
  - Two small ponds
  - Losing reach of Moore's Spring Creek
- From a remediation standpoint, the two ponds and the creek are the features that could most easily be altered to limit infiltration to the mine workings

2011 Tracer Study

- 5 pounds of Eosine introduced in Moore's Spring Creek
- 6 pounds of Fluorescein introduced into Pond 2
- 5 pounds Rhodamine WT introduced into BMP Pond
- Activated carbon sample points:
  - Susie Adit
  - Two residential wells upgradient and downgradient of the adit
  - Mouth of Moore's Spring Creek
  - Residential springs upgradient and downgradient of Moore's Spring Creek

Tracer Study

Tracer Study

Tracer Results

- Dye tracer detected at mouth of Moore's Spring Creek
  - Expected
- No detections in Susie adit, springs, or groundwater wells
  - Travel time?
  - Insufficient tracer mass?
  - No connection?
- Still sampling once per month

Susie - Next Steps

- Bulkhead evaluation
  - Would the water discharge somewhere else?
  - Any other unmapped connected workings?
- Stability and safety going underground
- Safety of Rimini residents

Ceiling Void

Lee Mountain Adit

- 2-8 gpm
- pH <3 (2.5-3)
- As ~ 25-30 mg/L
- Fe ~ 250 mg/L (dissolved)
- Al ~ 20 mg/L (dissolved)
- Cd ~ 0.5-1 mg/L
- Zn ~ 50-80 mg/L
- Pb ~ 0.3-0.6 mg/L
- Orders of magnitude above standards

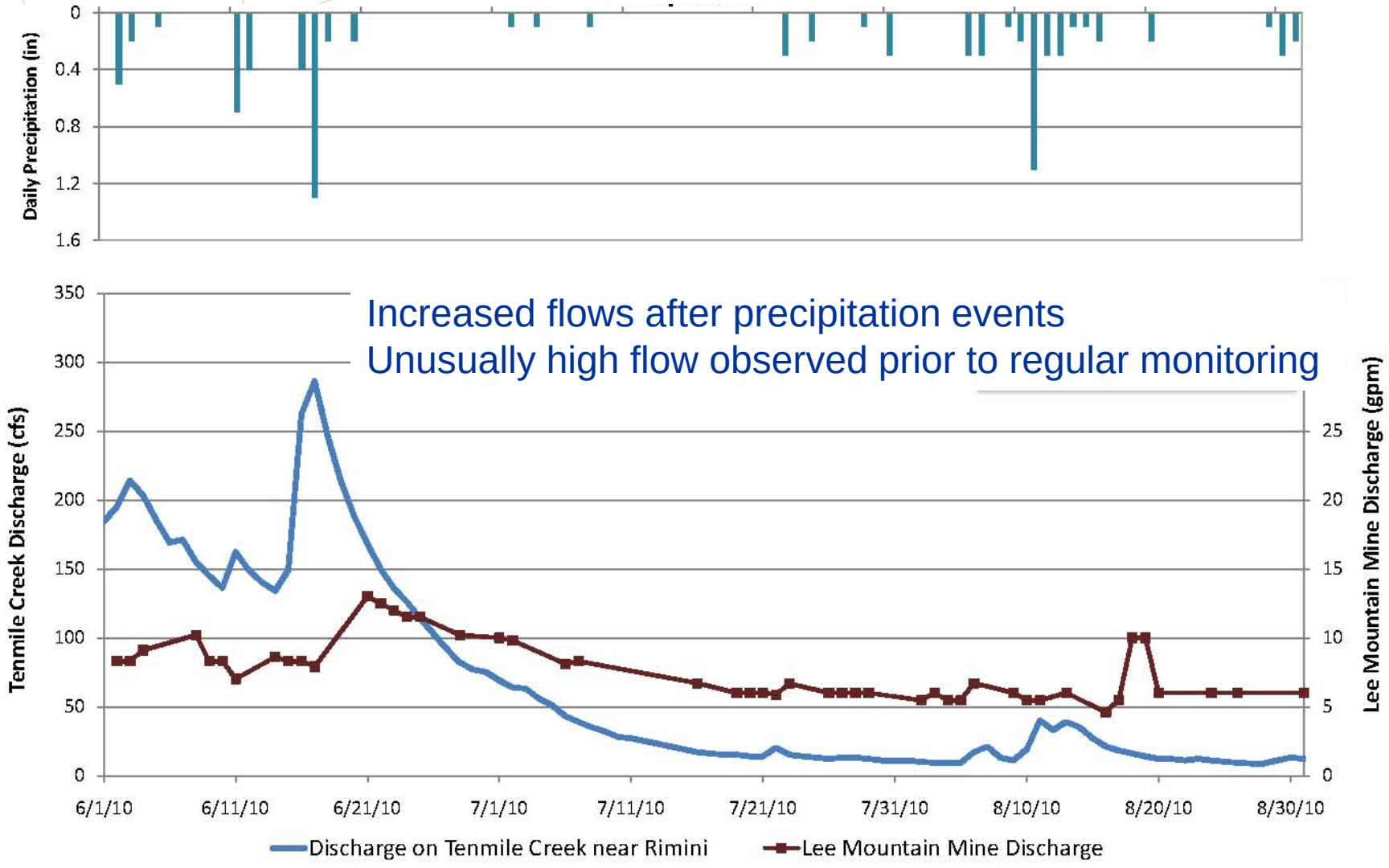
Adit reopening in 2005

Lee Mountain – Waste Piles

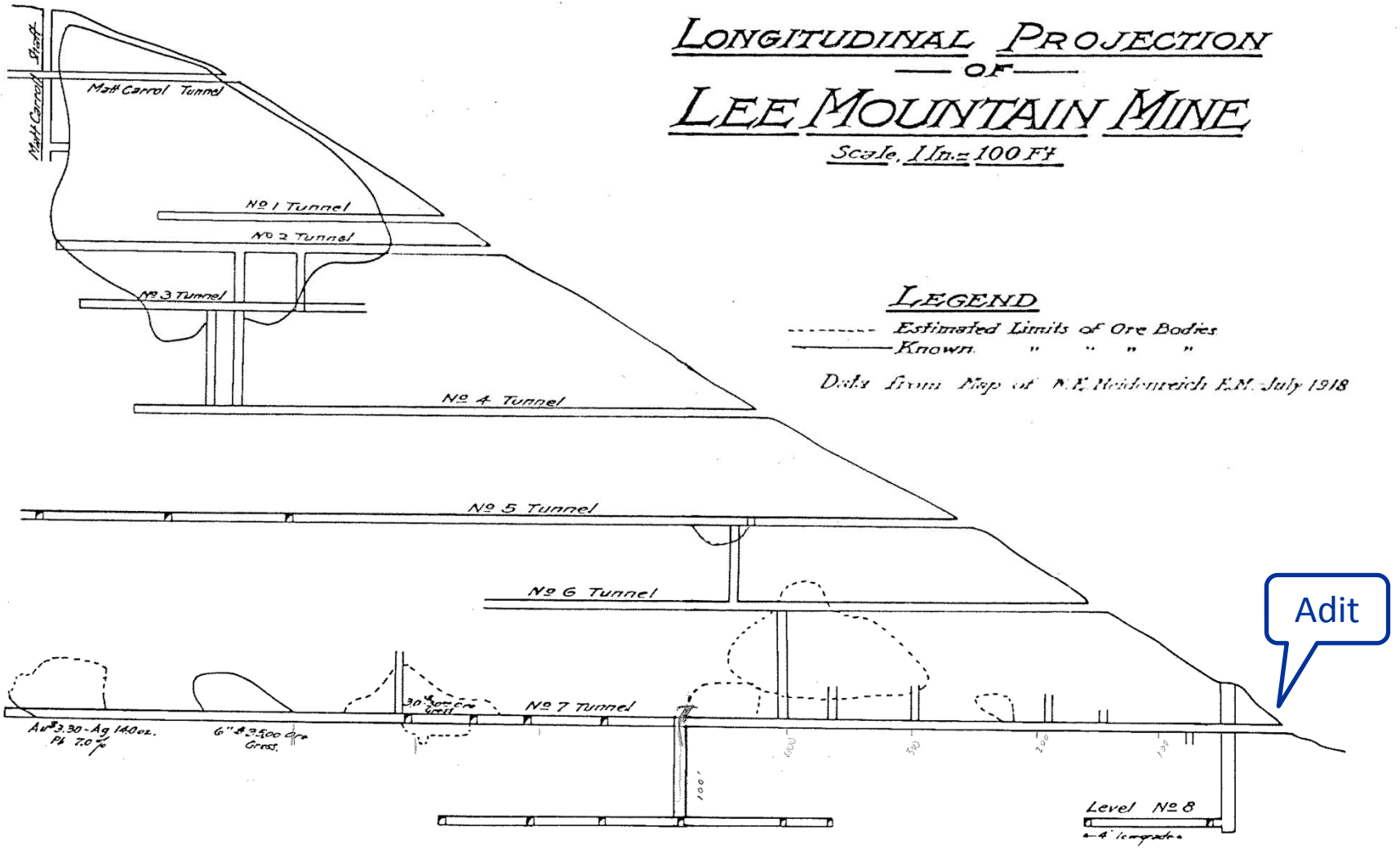
Lee Mountain

- Waste removals occurred incrementally

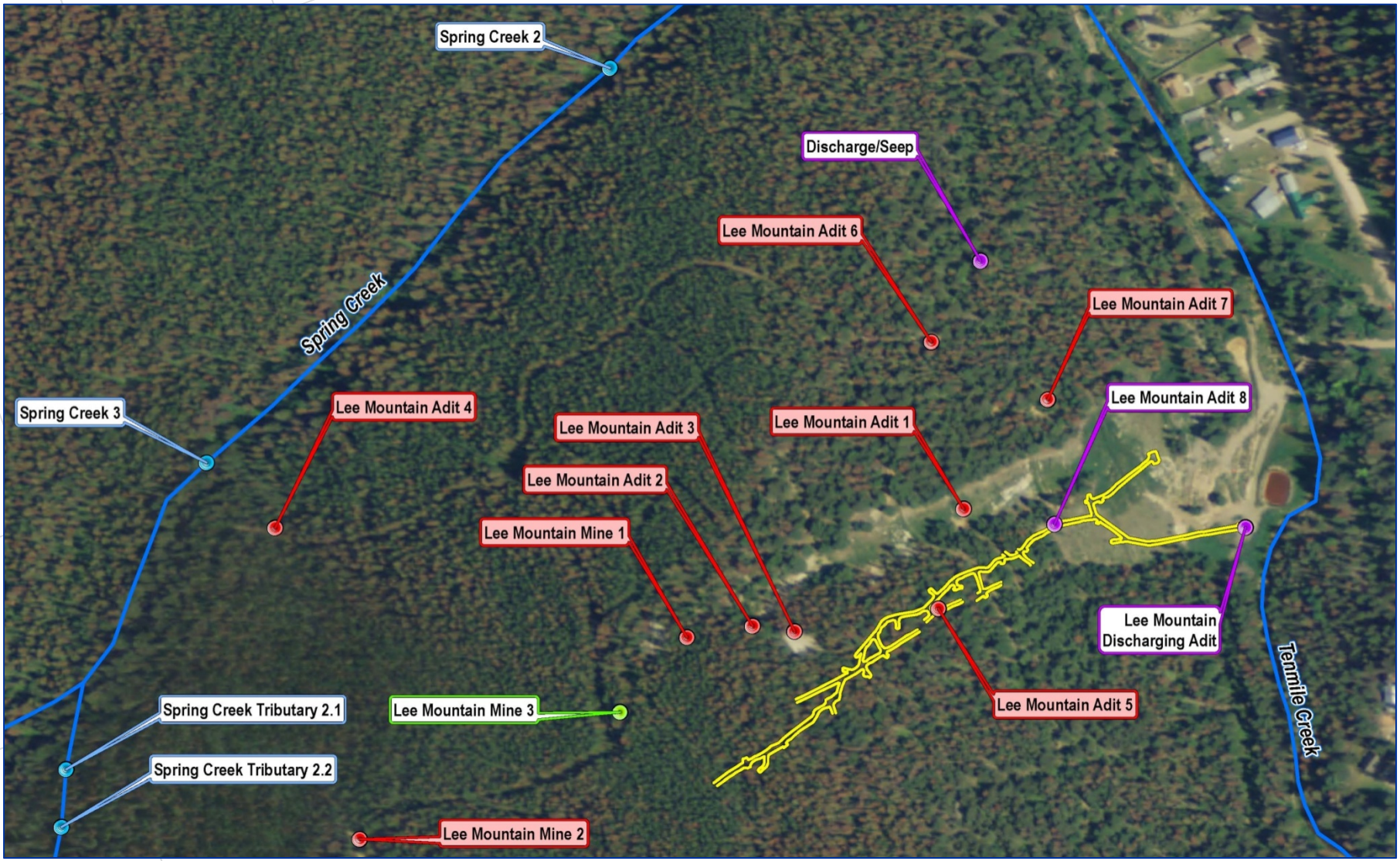
2010 Lee Mountain Discharge



Lee Mountain Cross Section - 1918



700-Level Workings and Reconnaissance



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2010 Reconnaissance

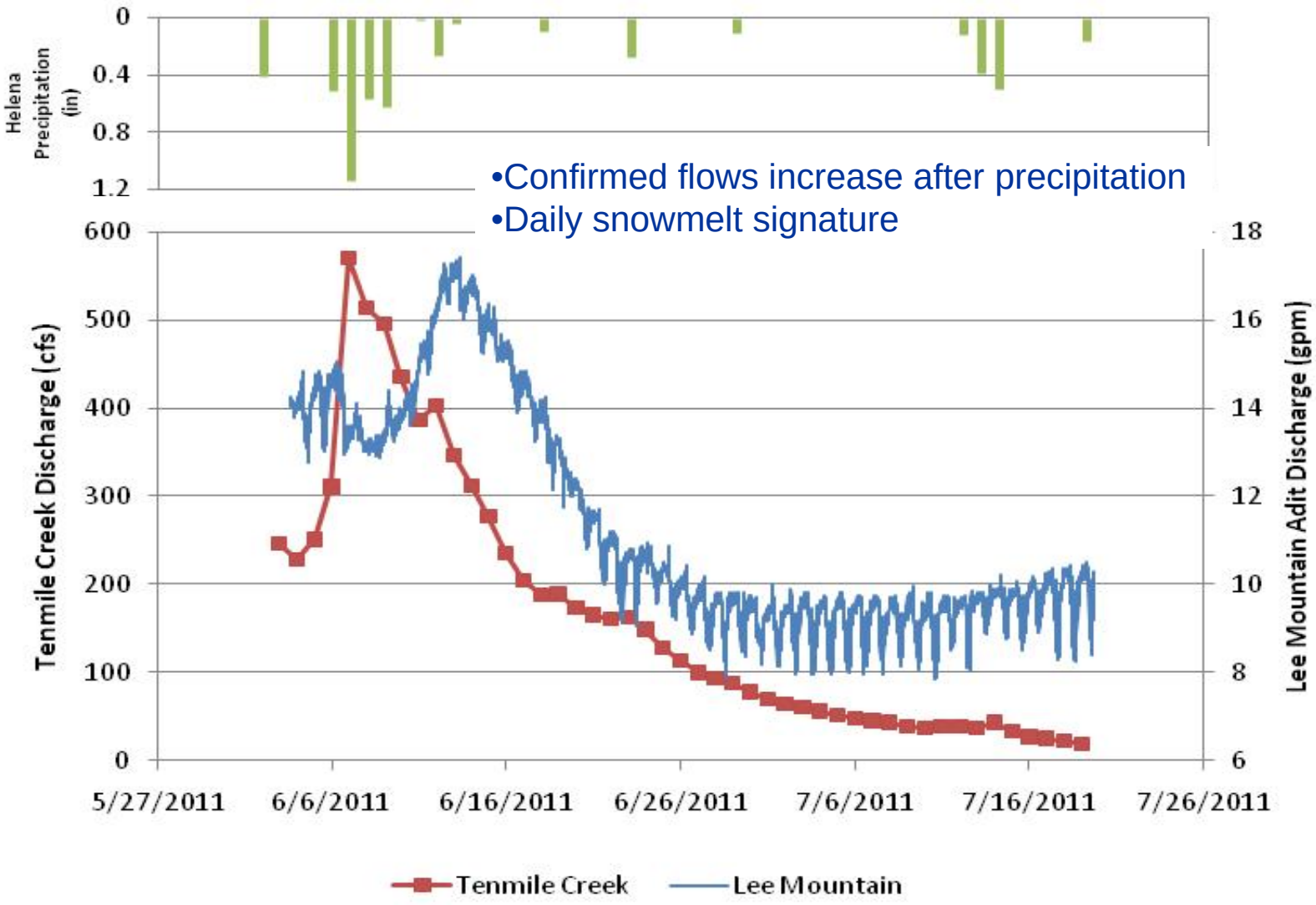
- Adits and shafts and waste rock farther up very steep hill
- Previously unknown discharging adit – “Caplice” mine
- Shaft with snow inside
- Deep exploration trenches
- Minimal connection with nearest creek

2011 Flow Measurements

- Install continuous recorder prior to spring runoff to capture the peak and to determine flow variation
- Tenmile Creek reached over 600 cfs on June 7, 2011

Cutthroat Flume and Stage Recorder

Lee Mountain Discharge - 2011



Lee Mountain - Next Steps

- Bulkhead ruled out due to interconnected workings and adits higher on the mountainside
- Can we drill horizontal wells to dewater the mountain away from the mine workings?

Upcoming Work and Tough Questions

- Scoping for bulkhead feasibility (Susie) and horizontal drilling (Lee Mountain)
- Red Water adit investigation
- Evaluate further source control costs versus long-term water treatment costs – is it worth chasing these source control measures for these two adits?
  - Good access and existing infrastructure
  - Success of source control uncertain – if 75% reduction is achieved, are we still killing fish? Will we still need treatment?
- Each mine site is unique!!