

What's the big deal with Lincoln Creek?



Natural Mineralized Tributary in Ruby Area draining to Lincoln Creek. (July 2022)

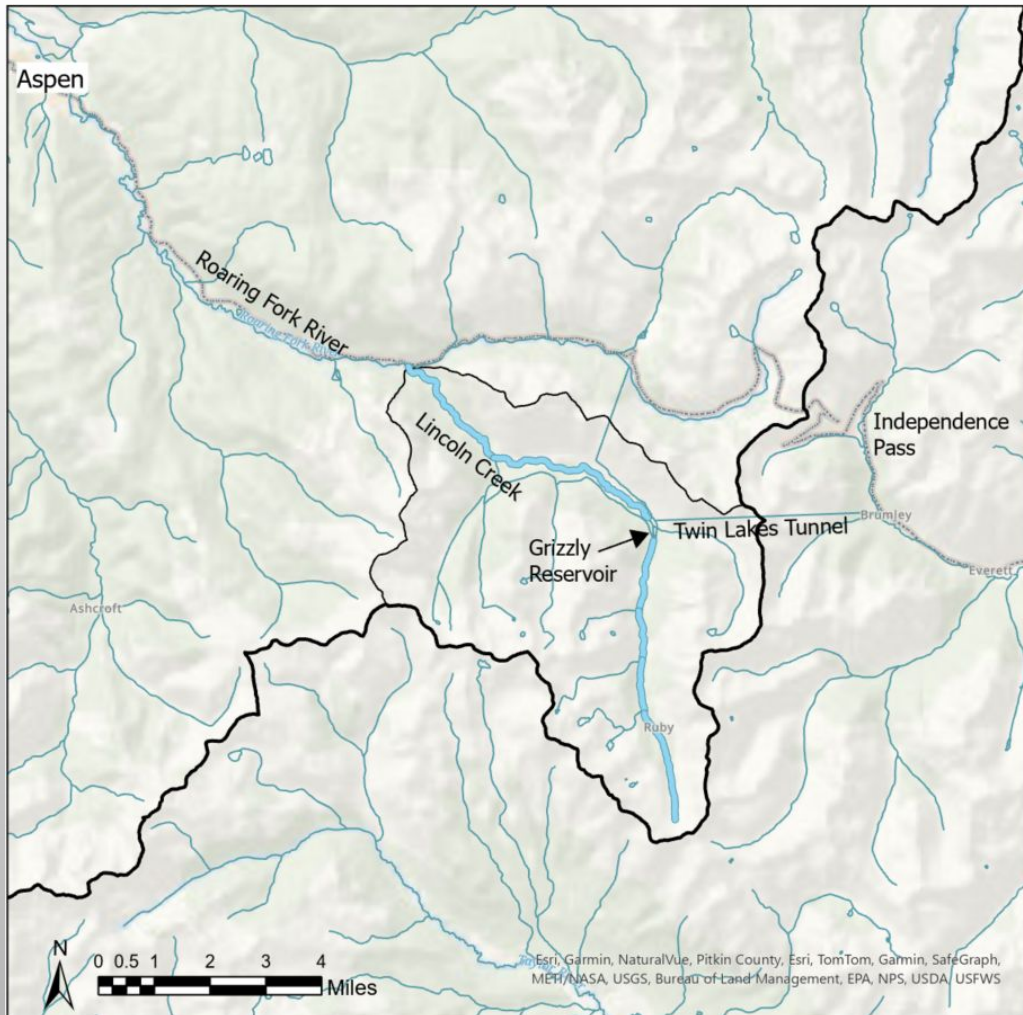
Chad Rudow - Water Quality Program Manager, Roaring Fork Conservancy
Megan McConville - Colorado Parks and Wildlife, River Watch Program



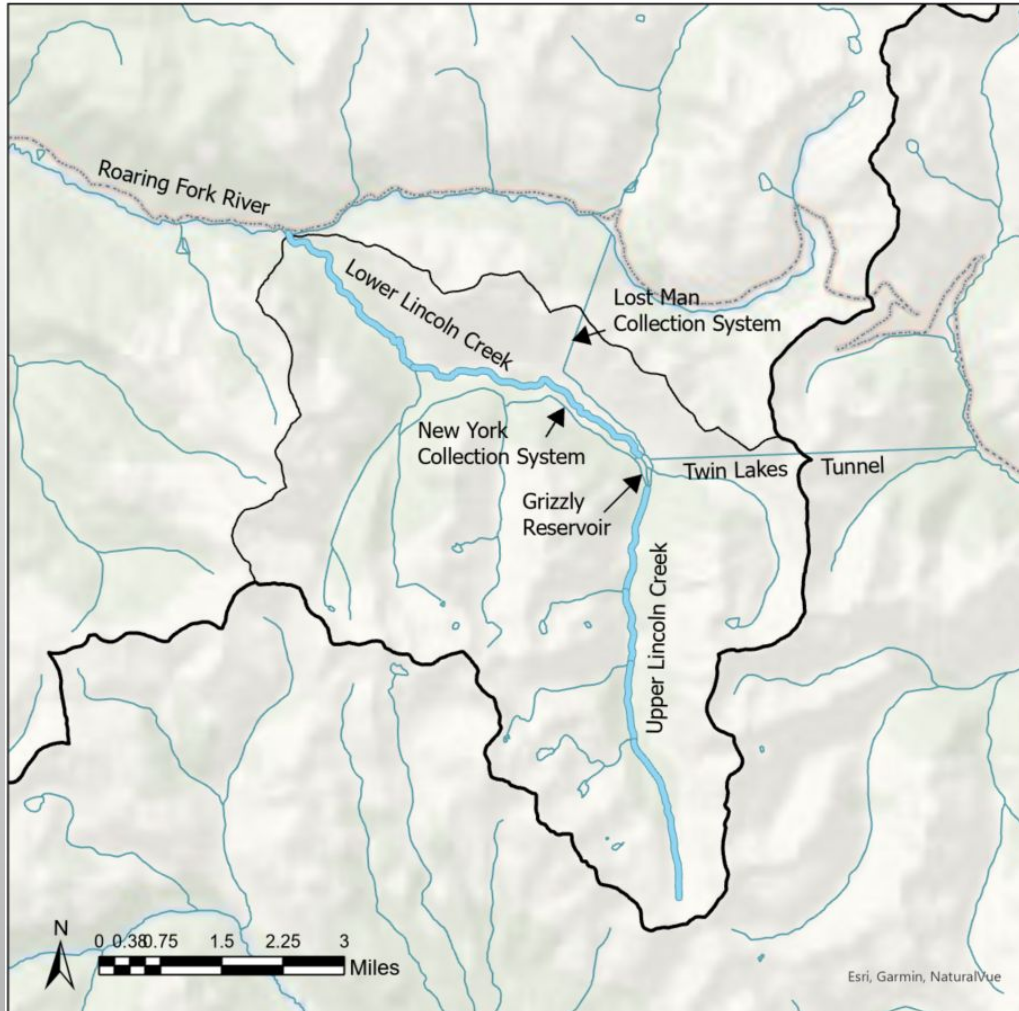
Let's Set the Stage: Where is Lincoln Creek?



Zooming in on Lincoln Creek

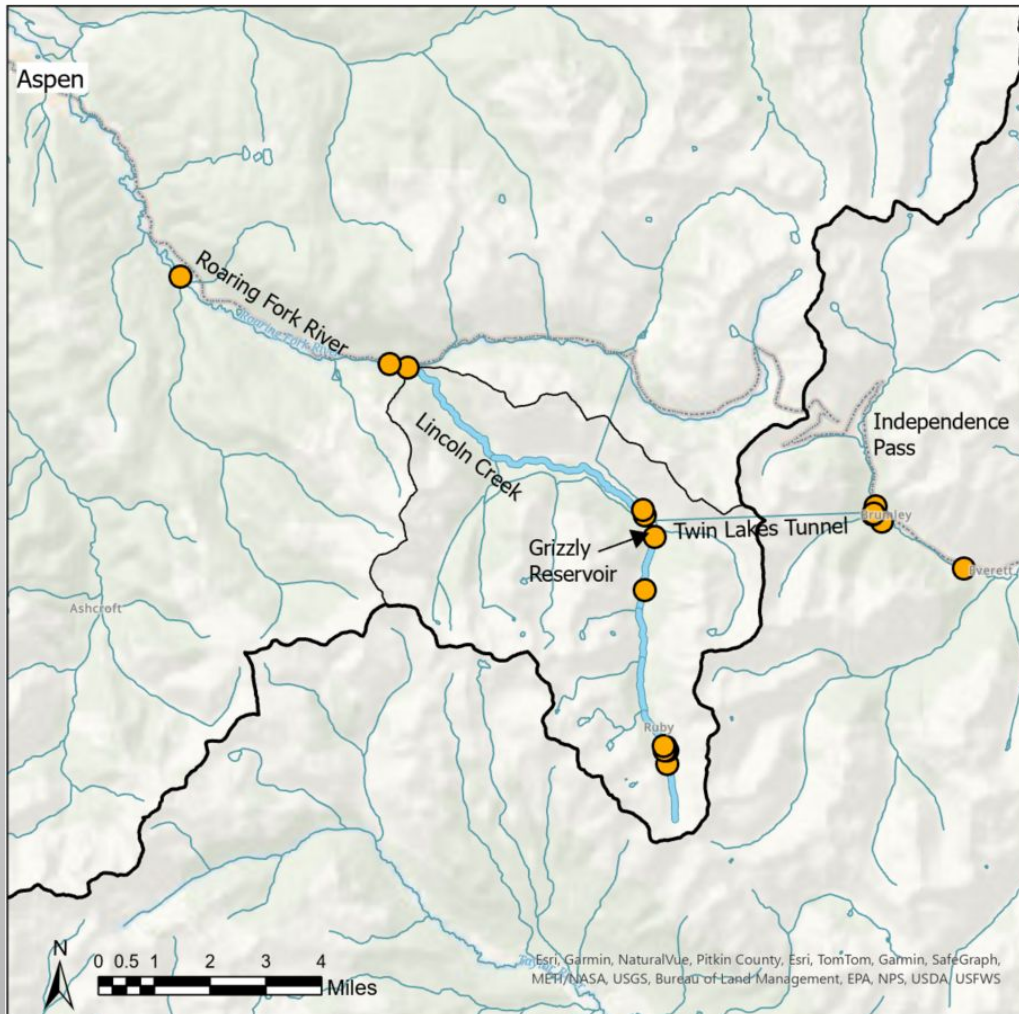


Lincoln Creek, Grizzly Reservoir and Water Diversion

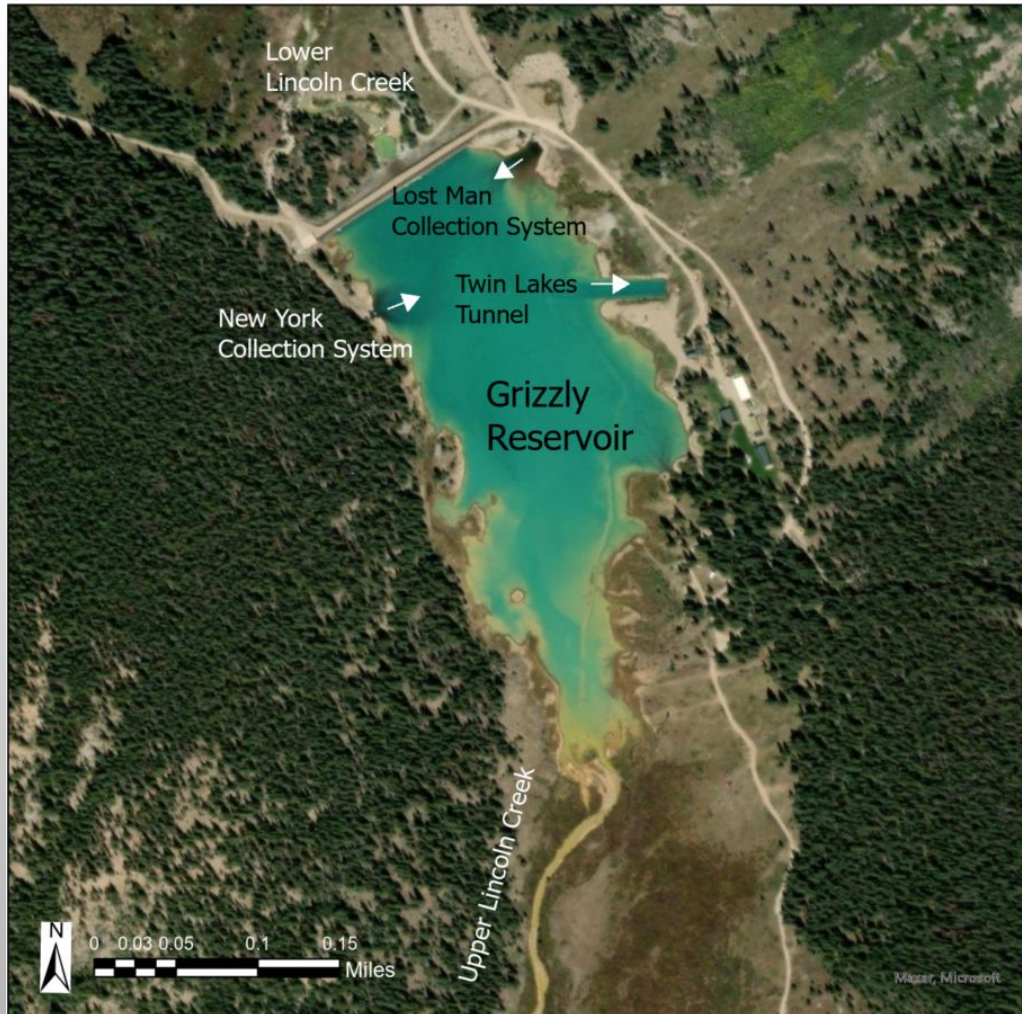


Zooming in on Lincoln Creek

● Locations monitored by
the Lincoln Creek
Workgroup in 2024

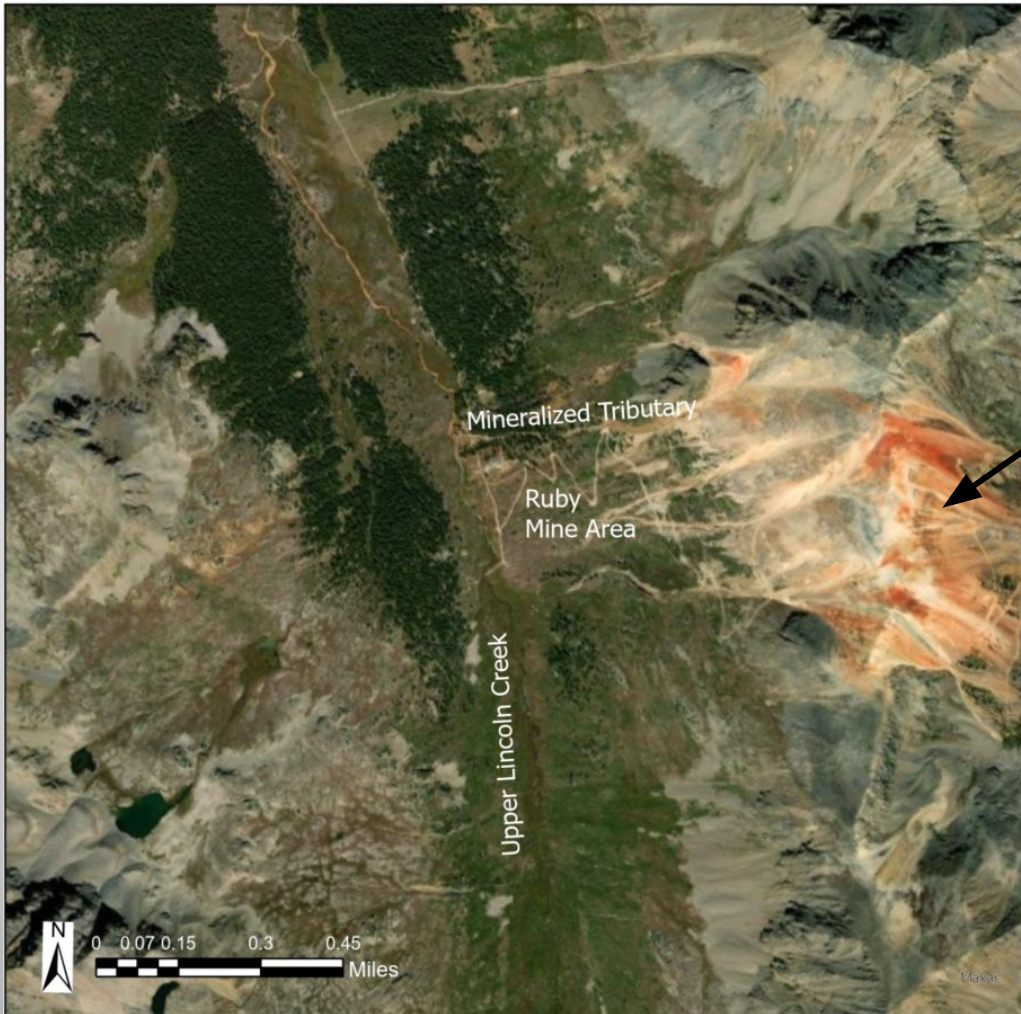


Grizzly Reservoir



Red Mountain, Ruby Mine Area

Intense hydrothermal
alteration



Zooming in on Ruby Mine and Mineralized Tributary Areas



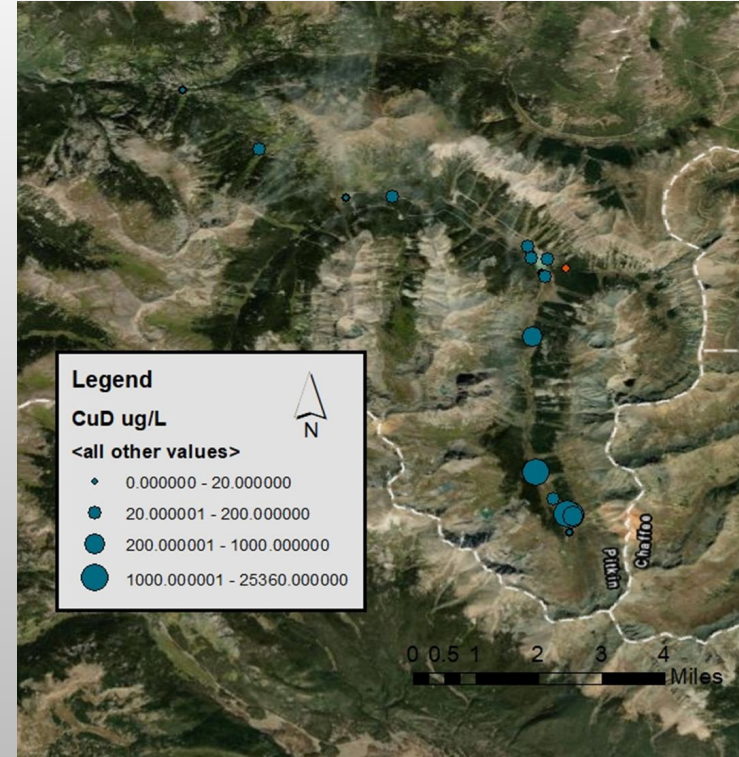
How did we get involved initially?

- CPW has monitored Lincoln Creek for many years to assess fish populations



Grizzly Res. (Aug 31, 2021)

- Actively stock catchable trout in Grizzly Reservoir
- August 2021 - fish kill
- Sampling indicated high copper coming from the Ruby Mine Area
- Prompted CPW to contact the EPA



EPA Led Investigation of Sources - July, Sept. 2022

- EPA led a broad coalition of stakeholders to investigate sources of contamination
- EPA organized and funded two sampling events in July & Sept. 2022
- Combined Assessment Report (CAR) was produced Nov. 2023



Primary Findings of EPA Study

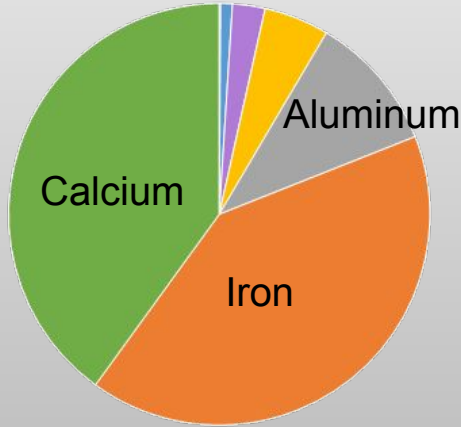
- High copper in Lincoln Cr & Grizzly Res. likely contributed to 2021 fish kill.
- Dramatic increase in metal loading in past 20 years, specifically copper:
 - **Ruby Mine Copper:**
2001 = 100 ug/L → 2022 = 3,000 ug/L
 - **Mineralized Tributary Copper:**
2001 = 9,000 ug/L → 2022 = 60,000 ug/L
- Increase is likely due to climate change



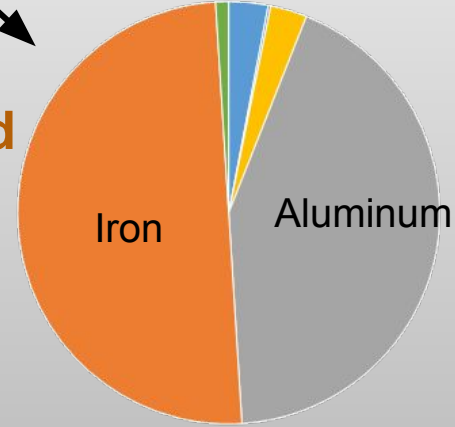
Primary Findings of EPA Study

- Two primary sources of metal loading exist:
 - **Ruby Mine** Adits and Legacy Mining Activity (~ 2% copper)
 - The **Mineralized Tributary**, downstream of Ruby Mine (~98% copper)
- Unique chemical signatures:

**Ruby Mine
Source Area:**



**Mineralized
Tributary:**

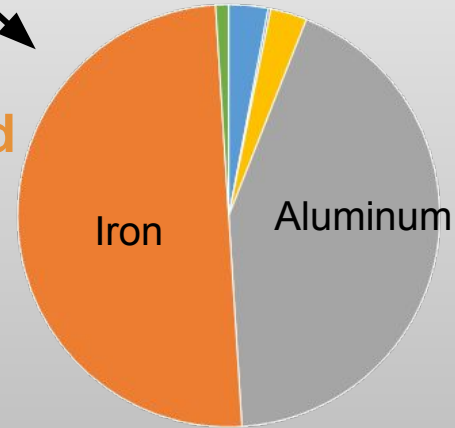


Primary Findings of EPA Study

- Two primary sources of metal loading exist:
 - **Ruby Mine** Adits and Legacy Mining Activity (~ 2% copper)
 - The **Mineralized Tributary**, downstream of Ruby Mine (~98% copper)
- Unique chemical signatures:

- Zinc
- Copper
- Manganese
- Magnesium
- Aluminum
- Iron
- Calcium

Mineralized Tributary:



Ruby Mine Source Area:



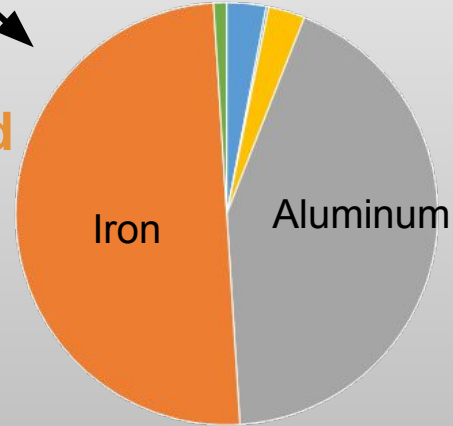
Primary Findings of EPA Study

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**Ruby Mine
Source Area:**



**Mineralized
Tributary:**



- Because the majority of contamination is natural, EPA does not have the authority to conduct clean-up actions



Metal Impacts to Aquatic Life

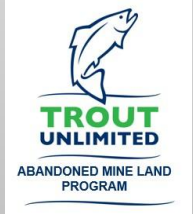
- Metals can be essential micro nutrients AND can be toxic, even at small amounts.
- High metals can affect the survival, reproduction, growth and behavior of aquatic organisms
- EPA establishes water quality standards for different metals, setting maximum allowable concentrations to protect aquatic life.



Assessing trout for organ damage

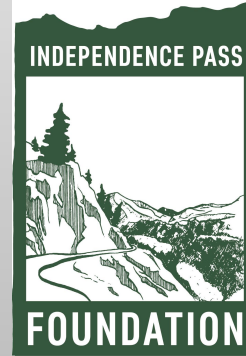


Lincoln Creek Workgroup

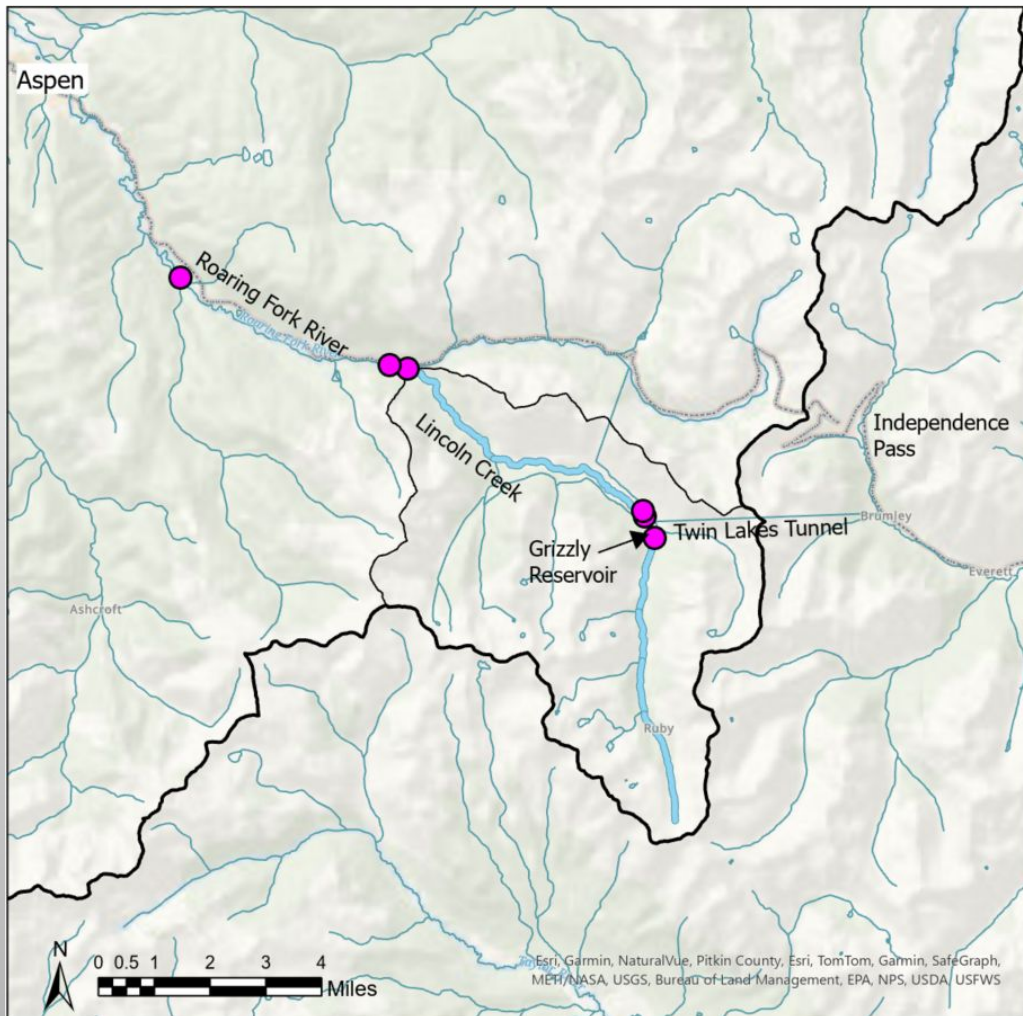


Twin Lakes Reservoir & Canal Company

Water Quality Team



Special thanks to community partners for their assistance with ground truthing, and additional monitoring.



RFC / Pitkin EH

Downstream focus -

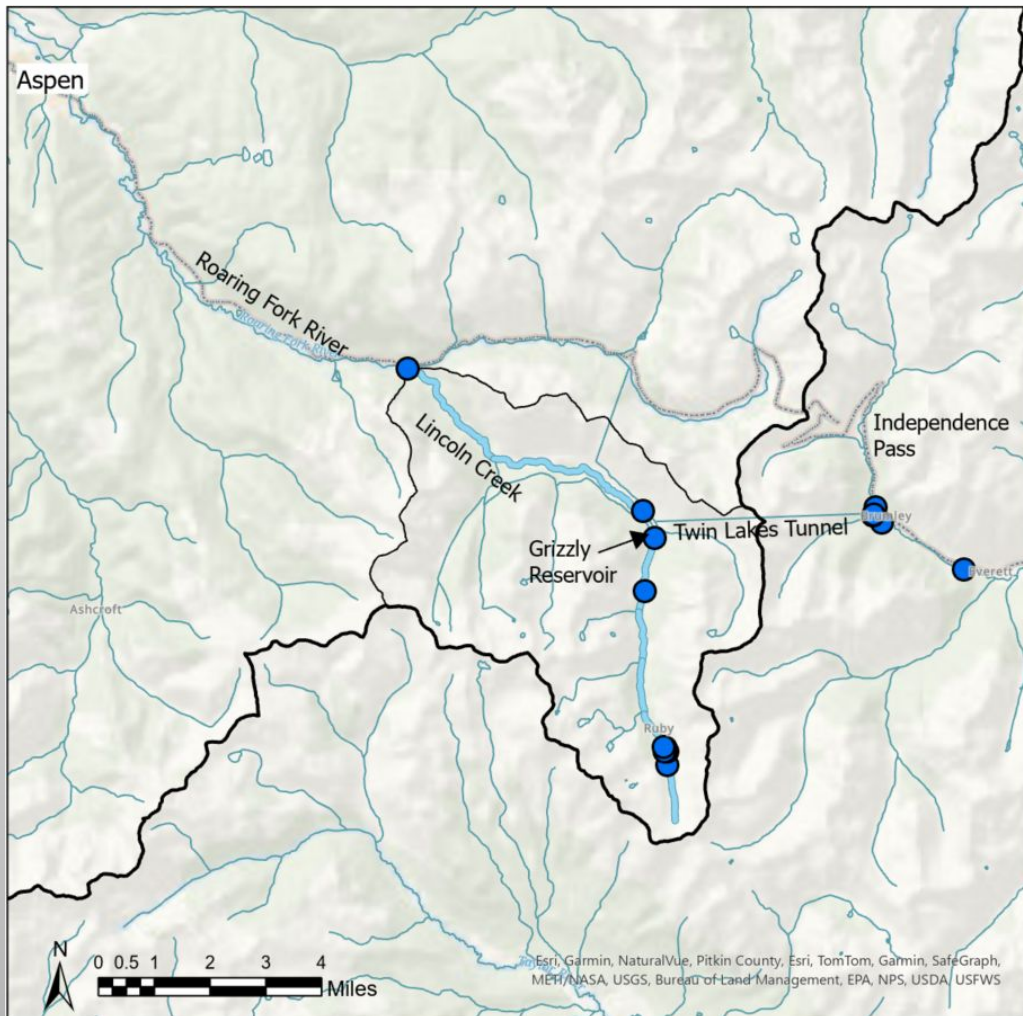
Lower Lincoln Creek and
Roaring Fork River

Short Term focus - Water

quality related to Grizzly
Dam rehabilitation project

 RFC / Pitkin EH
Monitoring Locations





CPW

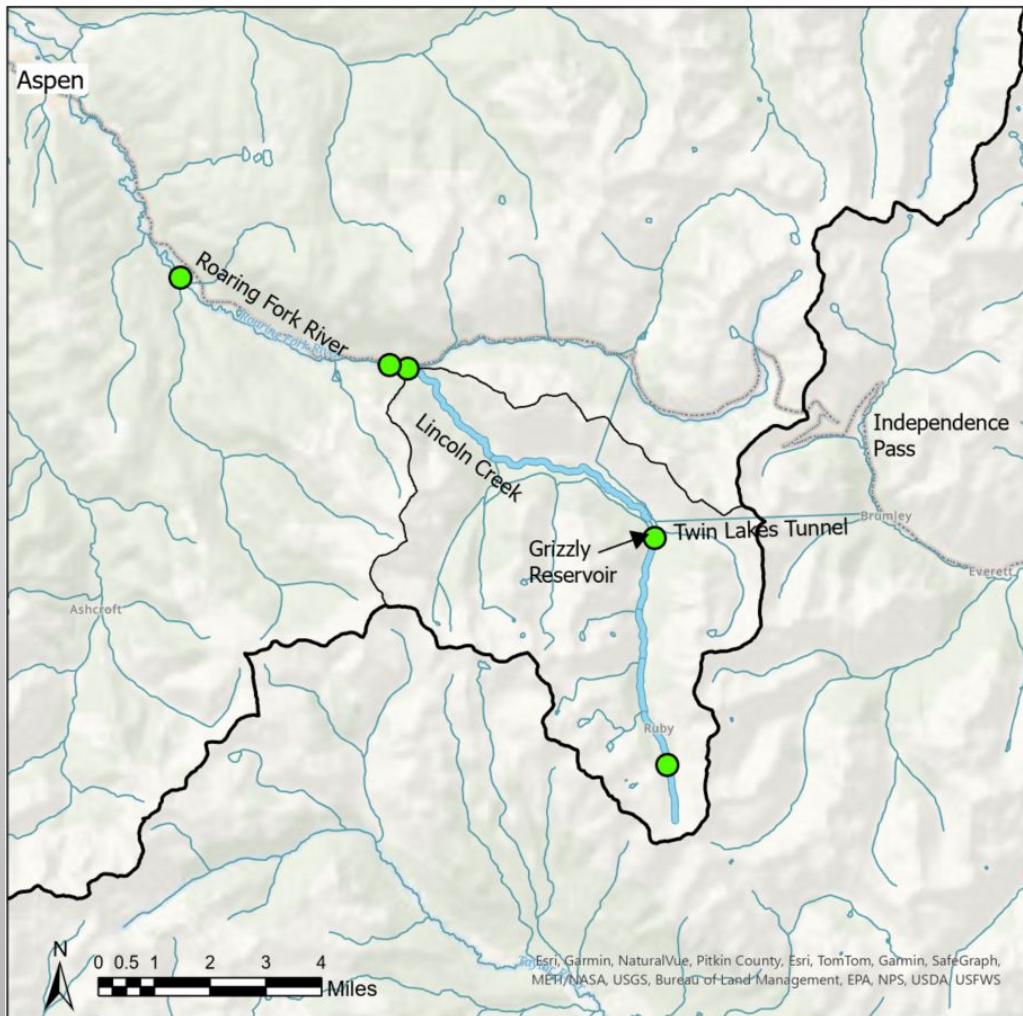
Upstream focus - Upper Lincoln Creek and tributaries

Long term focus - Baseline and source sampling, looking at changes over time

Fishery health and resiliency

● CPW Monitoring Locations






USFS

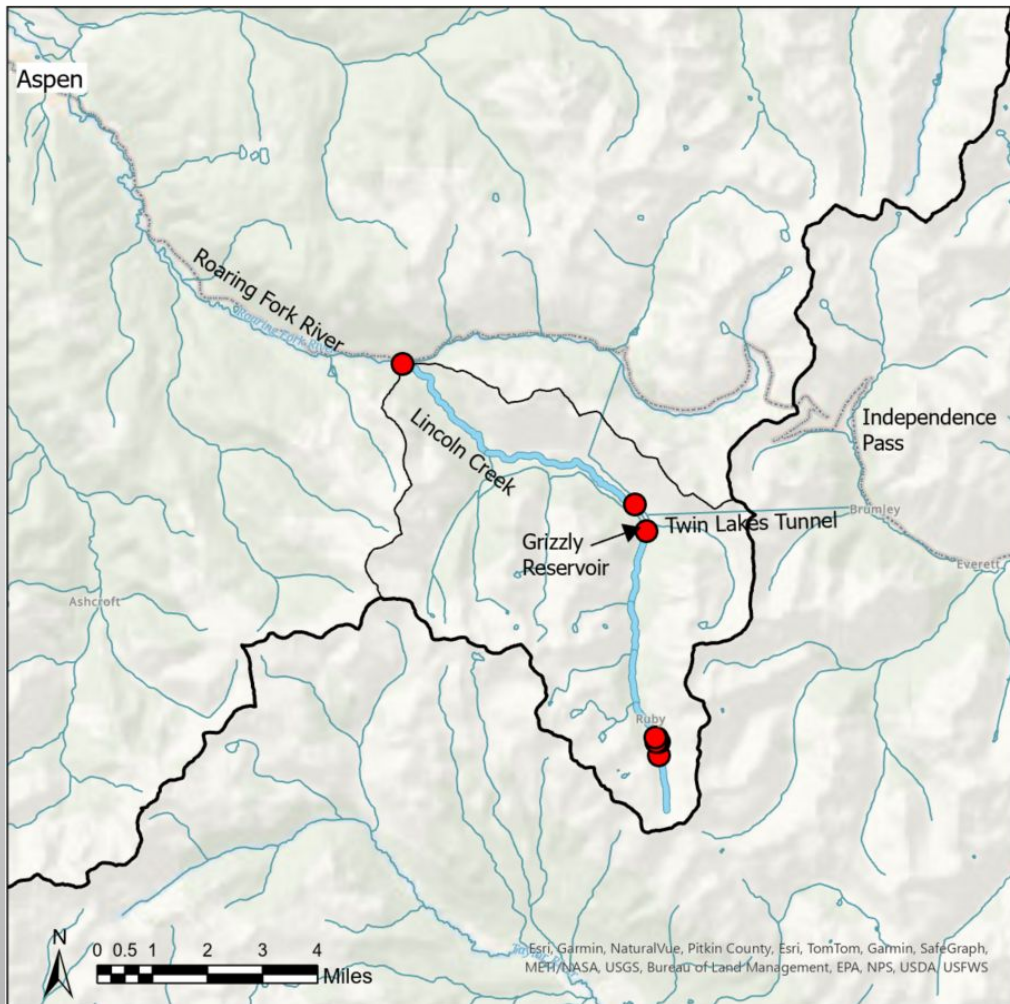
System-wide focus - Lincoln Creek and Roaring Fork River

Flow - Collecting flow measurements for loading

Biology - Macroinvertebrate sampling

 USFS Monitoring Locations





INSTAAR - CU Boulder

Lincoln Creek focus - Lincoln Creek and Ruby Mine Area

Unique water quality focus - rare earth elements and metals

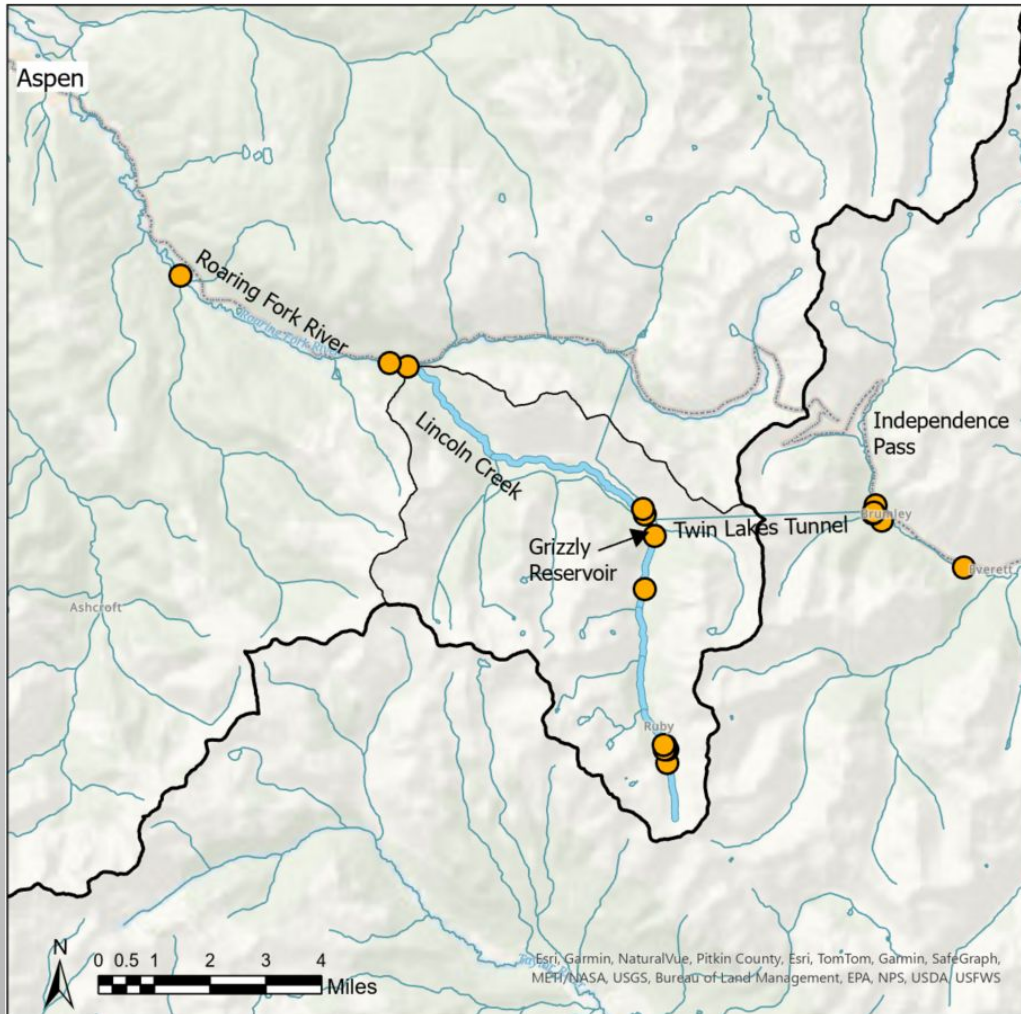
Additional focus - sediment and macroinvertebrates

● INSTAAR - CU Boulder Monitoring Locations



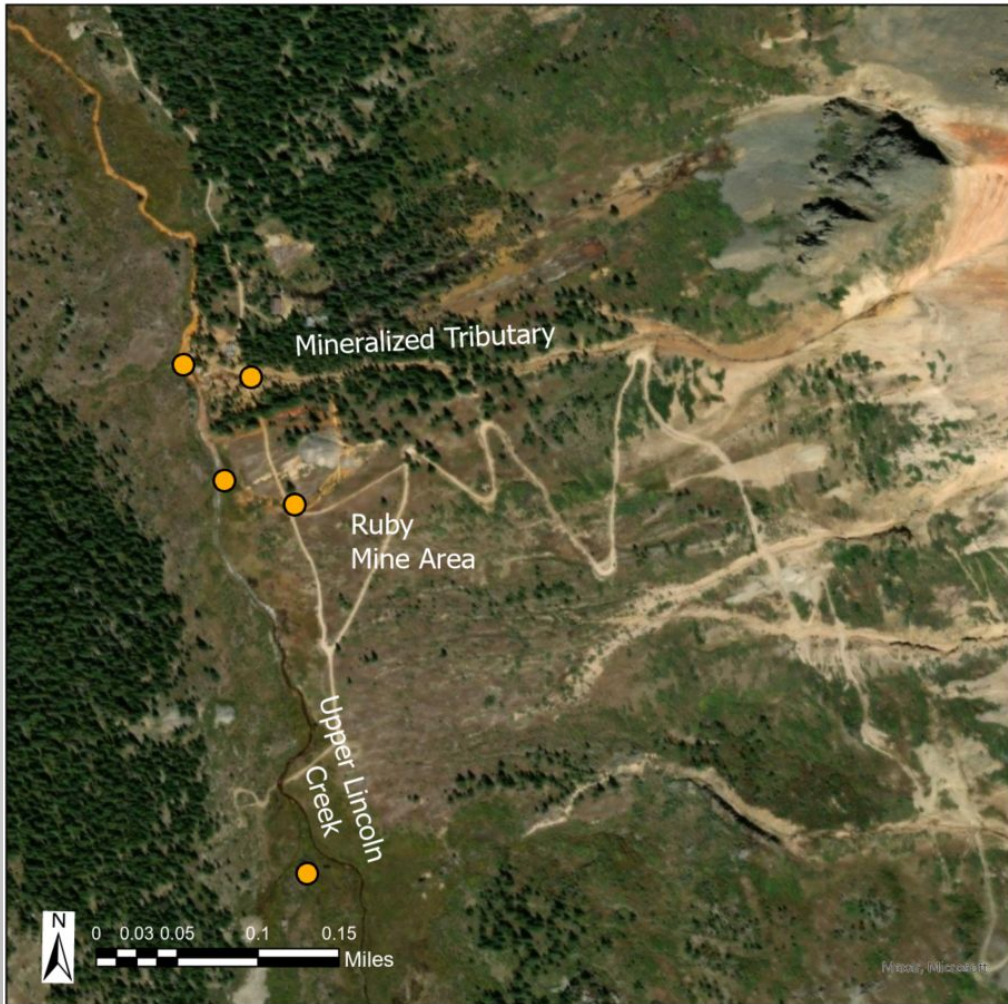
2024 Workgroup Monitoring Efforts

- Locations monitored by the Lincoln Creek Workgroup in 2024



Zooming in on Red Mountain

- Locations monitored by the Lincoln Creek Workgroup in 2024



“Behind the Scenes” Field Work - Preparation

- Planning Logistics
- Supply Needs
- Equipment prep



Field Work - Travel



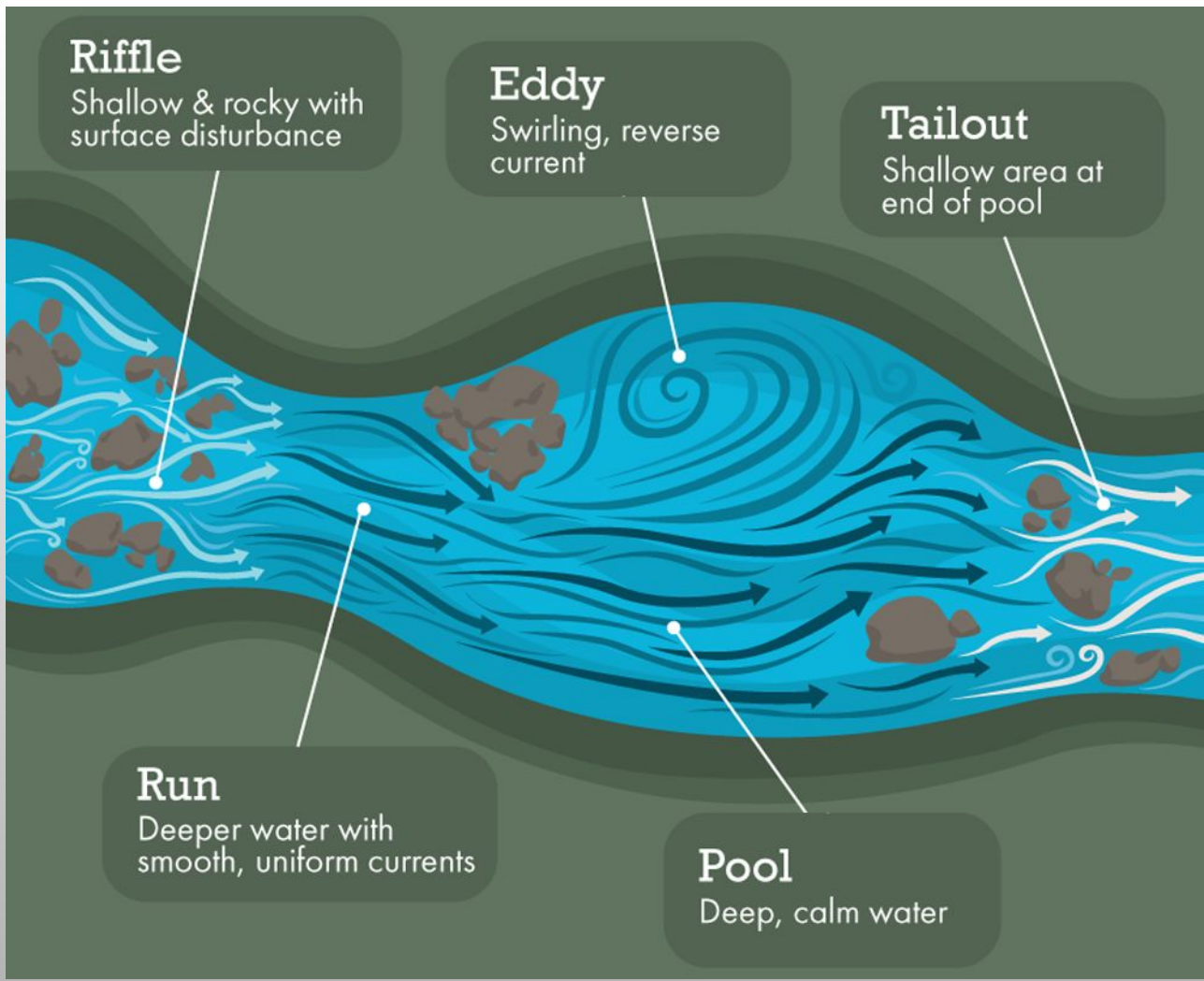
Field Work - Travel



Lincoln Creek Workgroup - First Sample Event



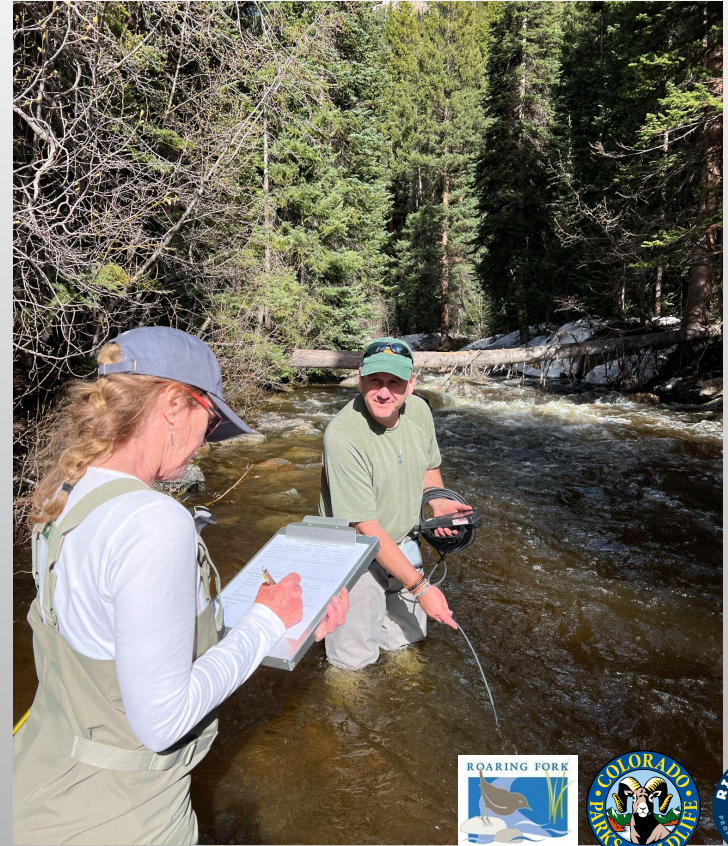
Field Work - Site Selection



Charlie Robinton blog post "Where's That Trout"



Field Work - Water Quality Measurements



Field Work - Measuring Flow



Field Work - Collecting Samples

Amounts and types of water samples are incredibly diverse and project specific.

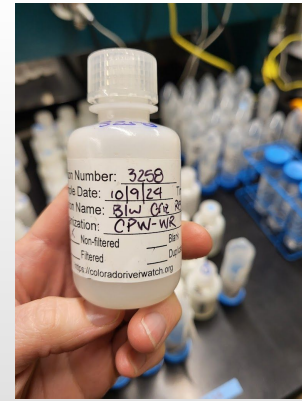
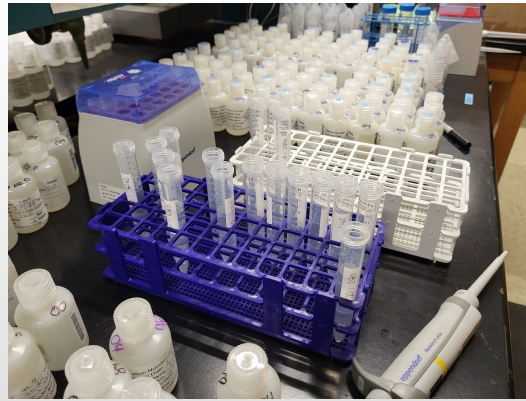
Lincoln Creek Project focus:

- Metals - 13 Filtered and Non-filtered
- Alkalinity
- Hardness

INSTAAR collected different/additional parameters per their scope of work.



From Field to Lab



How Does an ICP-OES Work?

ICP = Inductively Coupled Plasma

OES = Optical Emission Spectrometer



ICP - OES



How Does an ICP-OES Work?

ICP = Inductively Coupled Plasma

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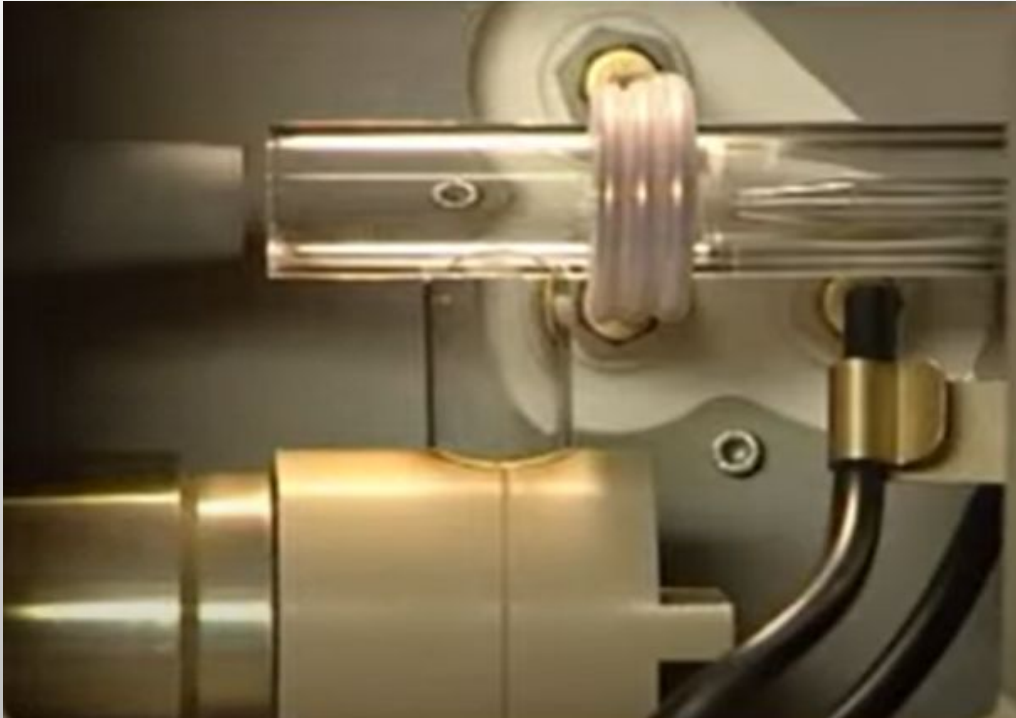


Shutterstock:

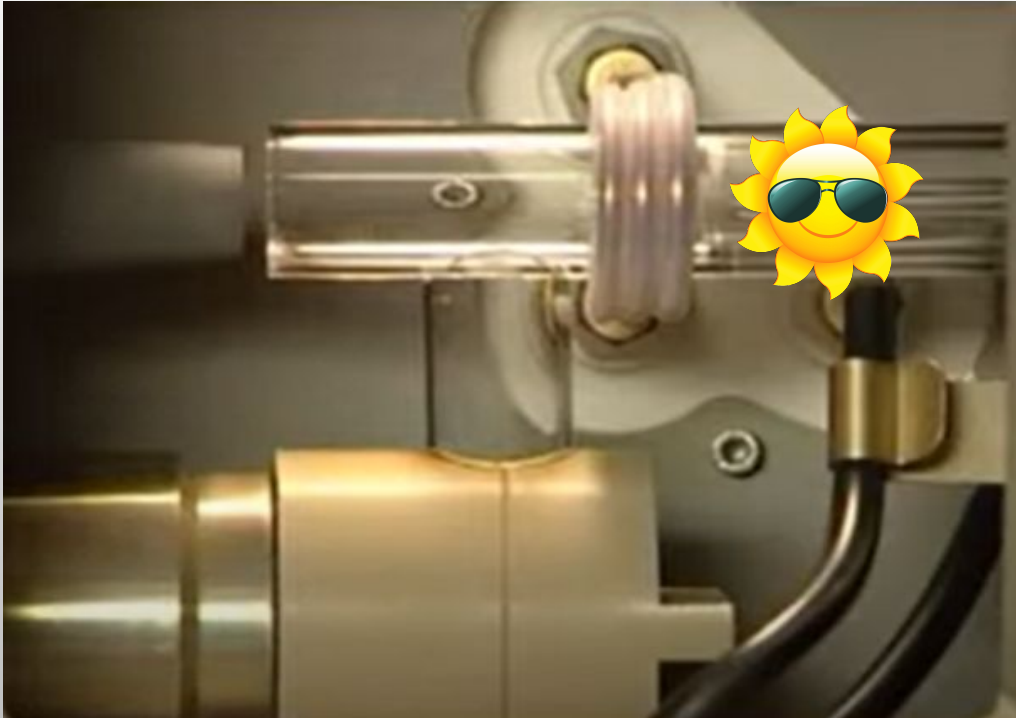
ICP - OES



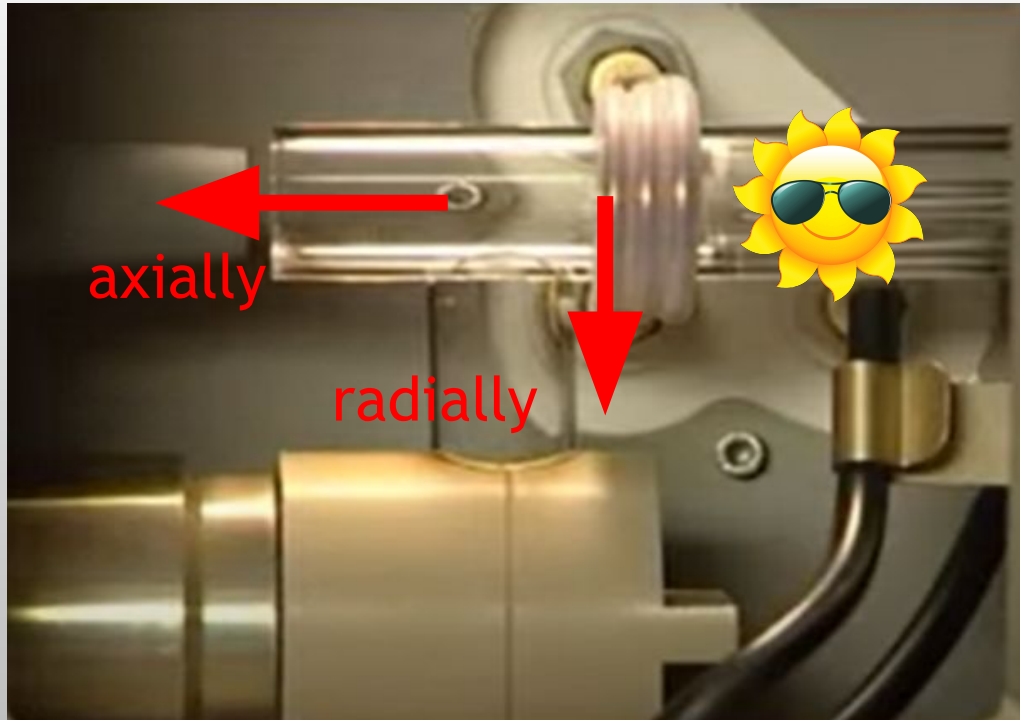
Liquid Sample Vaporized and Then...



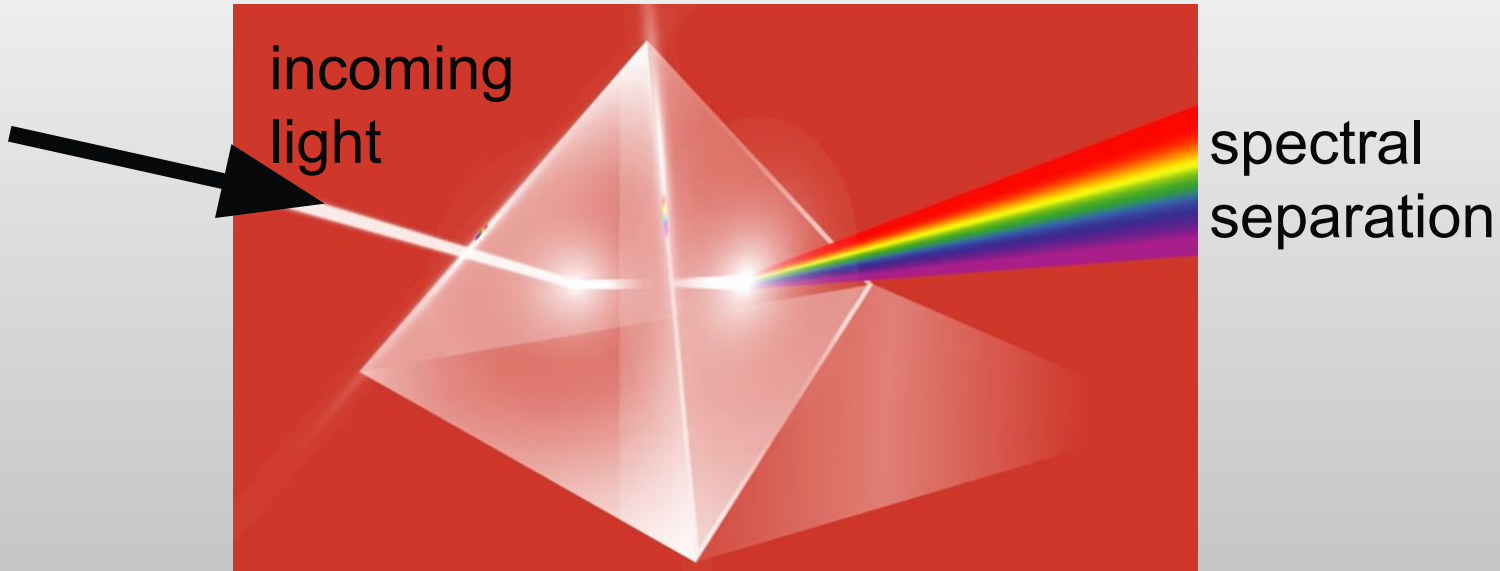
Elements Atomized & Ionized !!



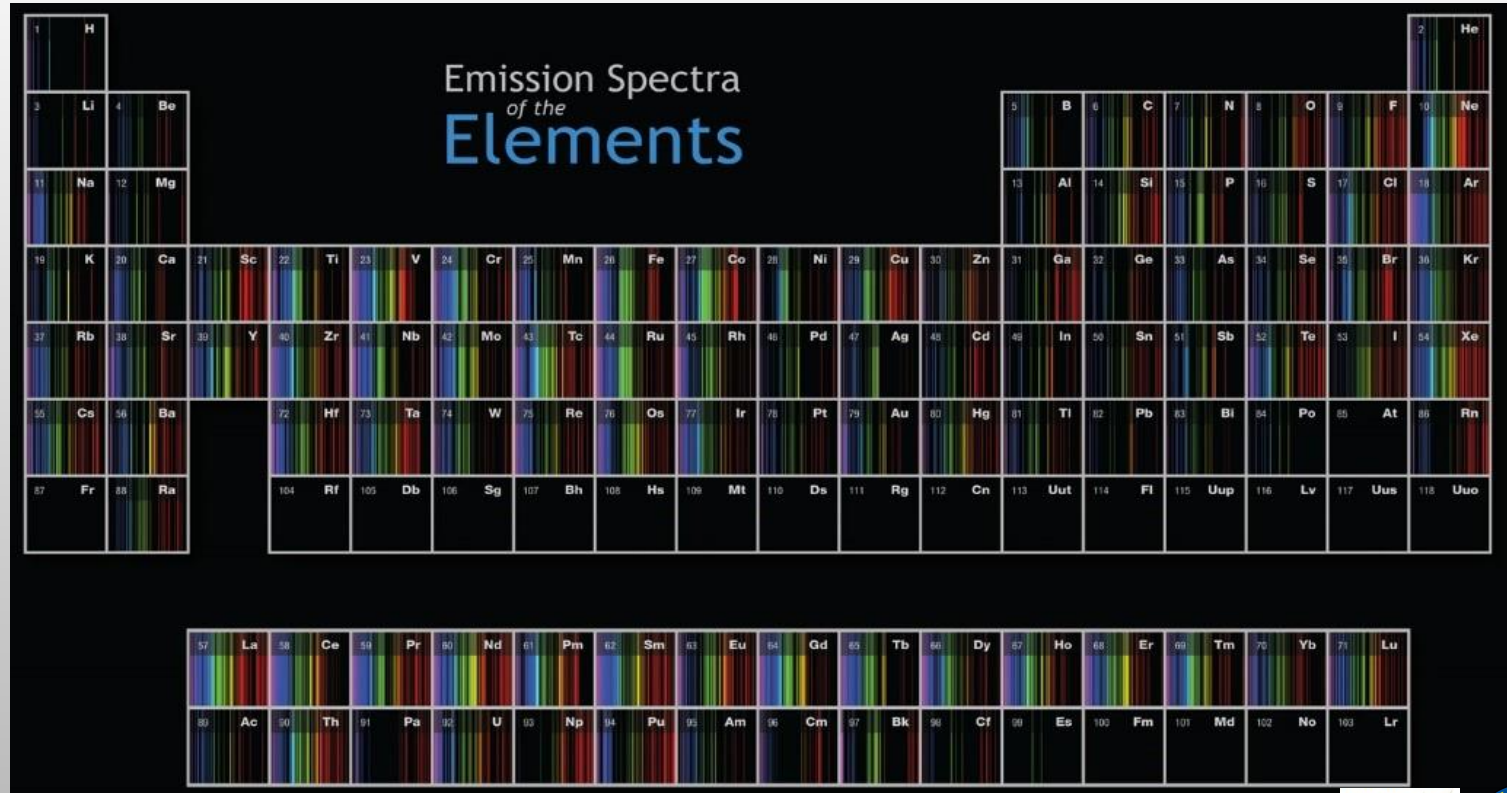
Atoms & Ions Emit Light



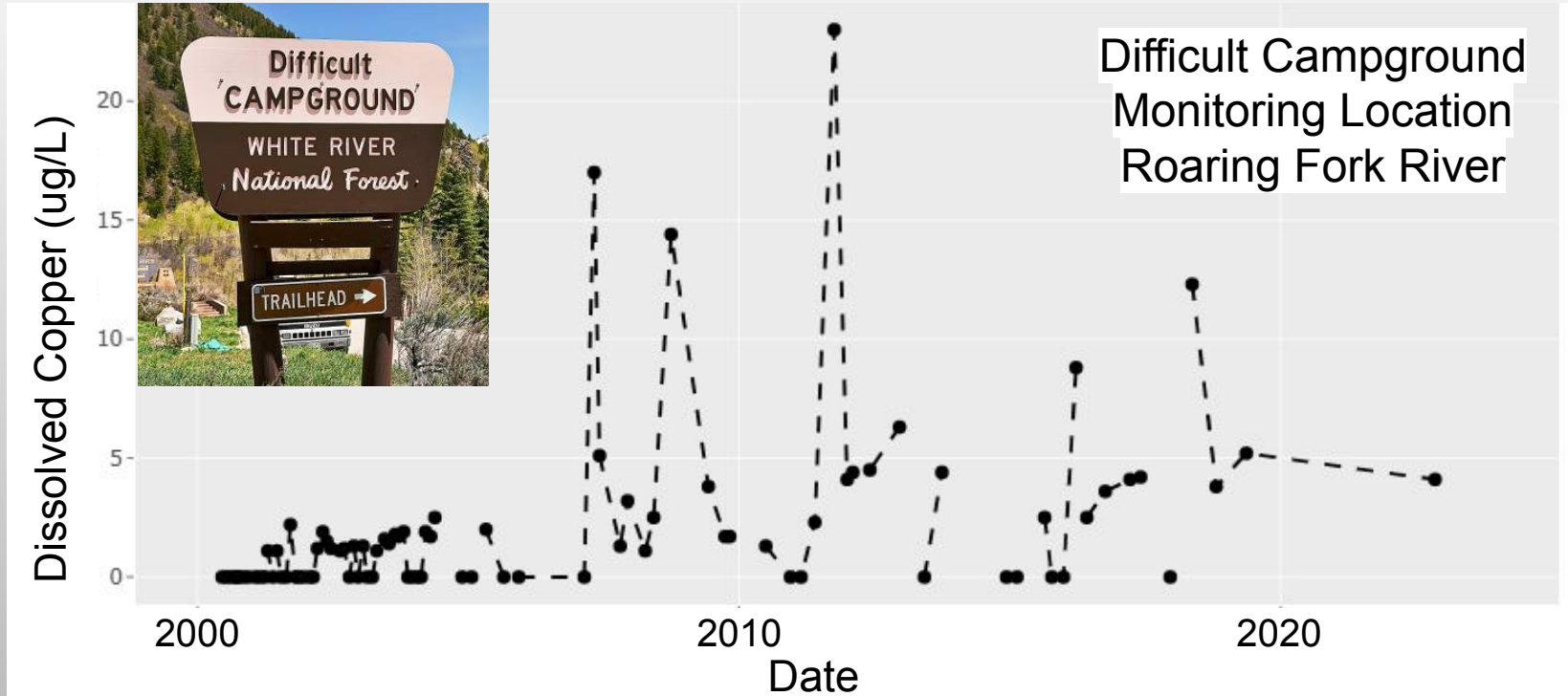
Light is Captured and Separated



Spectra Used as Fingerprints to Identify Elements



Light Energy Quantified → Metal Concentrations



What's Next?

Lincoln Creek Workgroup next steps:

- Complete 2024 data analysis and interpretation
- Coordinated water quality monitoring plans for 2025 and beyond
- Engage contractor for Phase II work
- Community Education and Outreach Presentations by
 - INSTAAR CU Boulder
 - 2024 Lincoln Creek Summary



Questions?

With gratitude to
the many people
involved in this
work, past, present
& future.

