New Mexico Environment Department

Copper Site Specific Criteria – Pajarito Plateau

2025 ACWA WQS Workshop

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Presentation Topics

- Introduction
- Background and Rationale
- Regulatory Framework
- Monitoring Data and Criteria Development
- Conclusions

Introduction

20.6.4 NMAC

Standards for Interstate and Intrastate Surface Waters

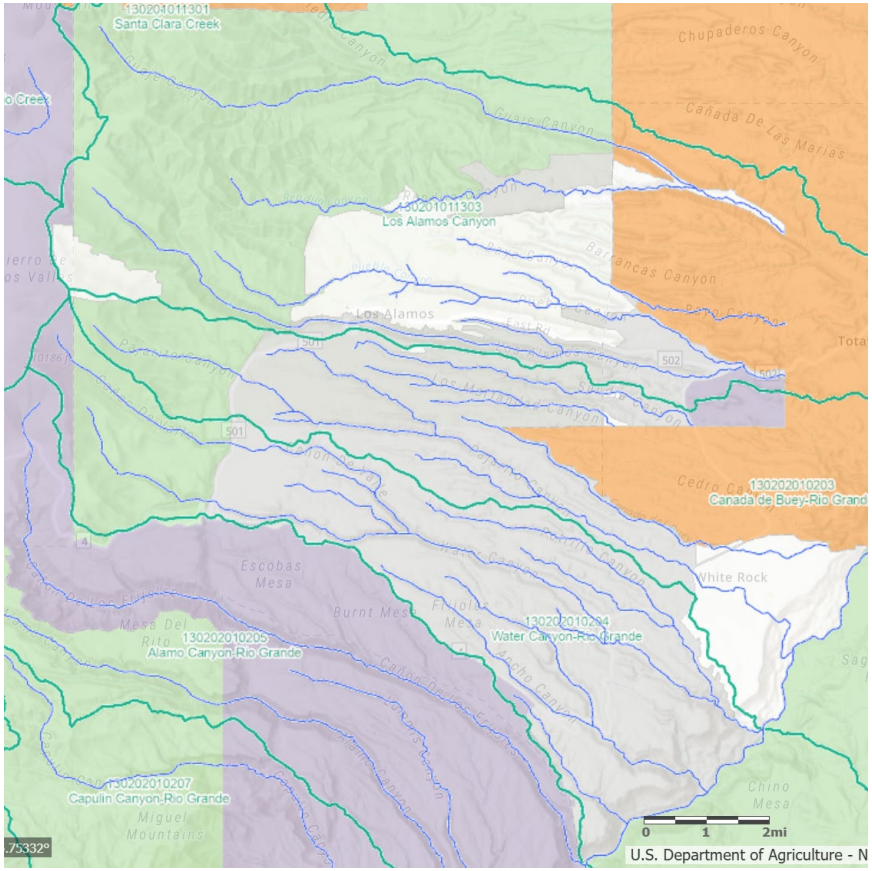
Section 900(I)

Acute and chronic aquatic life criteria for metals

- Amendments to New Mexico's WQS
  - Third-party Rulemaking
    - Los Alamos National Laboratory
      - Triad (Operator), N3B (Contractor), & DOE
        - Winward Environmental (N3B Contractor)
    - Applicable to Pajarito Plateau Surface Waters
  - Acute and Chronic Copper (Cu) Criteria
    - SSC MLR Equations - pH, DOC, hardness ($CaCO_3$)
    - Statewide Criteria - hardness
  - Adopted by the Water Quality Control Commission
    - Public Hearing – January 15, 2025
    - Signed Decision – April 8, 2025
    - Effective date – May 22, 2025
- Presentation based on Third-Party Technical Work
  - Fulton BA. 2023. *Copper Site-Specific WQC: Demonstration Report*. Windward Environmental LLC. WQCC 24-31(R)

Geographic Setting

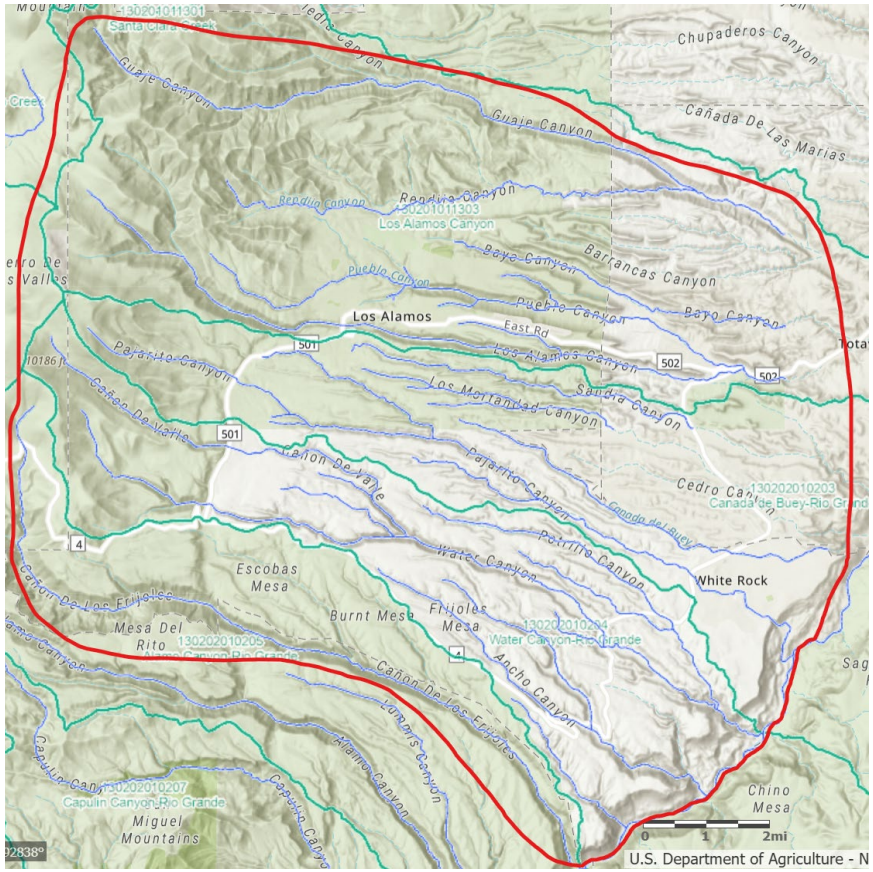
- Los Alamos National Laboratory (LANL)
  - 35 miles NW of Santa Fe
  - Est. 1943 - Manhattan Project
  - Nuclear Weapons Design and Production
  - National Security, Science, Technology, and Engineering
  - Triad National Security, LLC
    - Battelle, Texas A&M, and University of California
  - 40 mi^2, 900 facilities - 8.4 M ft^2
  - NPDES Permits
    - Industrial Wastewater – NM0028355
    - Storm Water IP – NM0030759



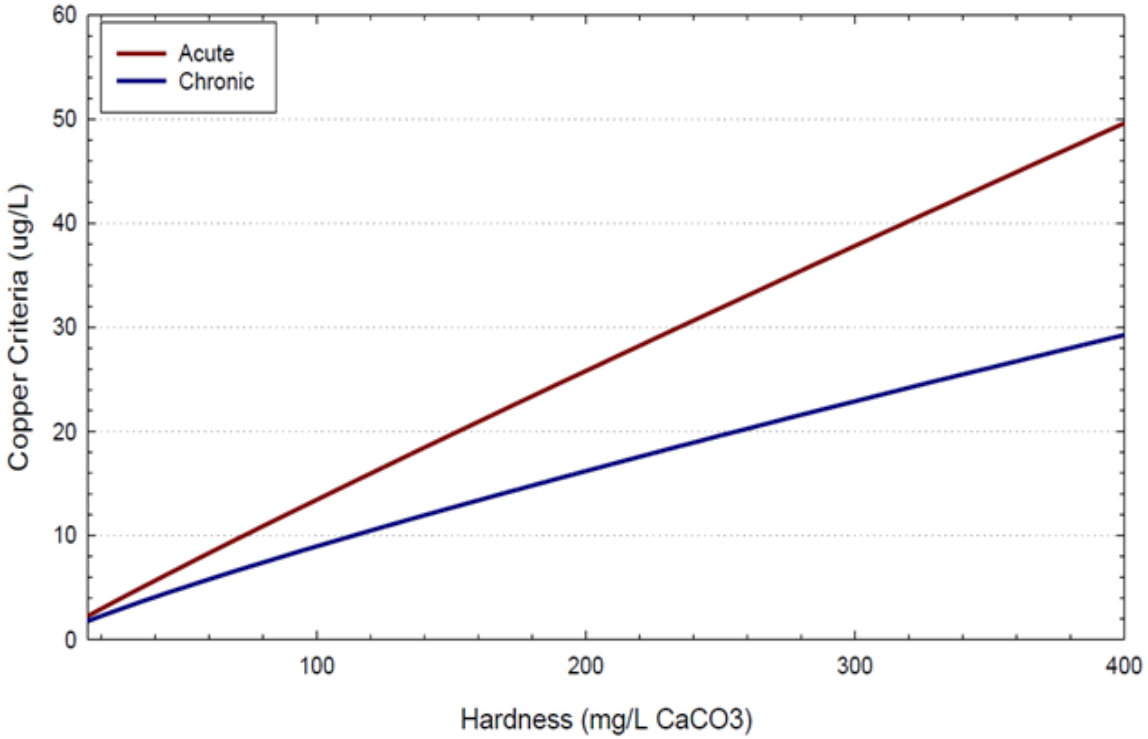
Land Ownership – Gray = DOE; White = Private; Green = USFS; Purple = NPS; Orange = Tribal

Geographic Setting

- Pajarito Plateau
  - Jemez Mountains
    - West - Sierra de los Valles
    - East – Puye Escarpment
- Surface Waters
  - Guaje Canyon - North
  - Rito de los Frijoles – South
  - Headwaters to Rio Grande
  - All tributaries and streams



Current Statewide Cu Criteria



- Acute = $\exp(0.9422[\ln(CaCO_3)] - 1.700)(0.960)$
- Chronic = $\exp(0.8545[\ln(CaCO_3)] - 1.702)(0.960)$
  - For $[CaCO_3] > 400$ mg/L; Criteria for 400 mg/L apply

Rationale for Cu SSC

Statewide Cu Criteria

- EPA 304(a) Recommended Criteria
  - Protection of Aquatic Life in Ambient Water
  - Published 1996
- Hardness-Based
  - mg $CaCO_3$/L
- Can be over- or under-protective
  - Depends on Site-Specific Water Chemistry

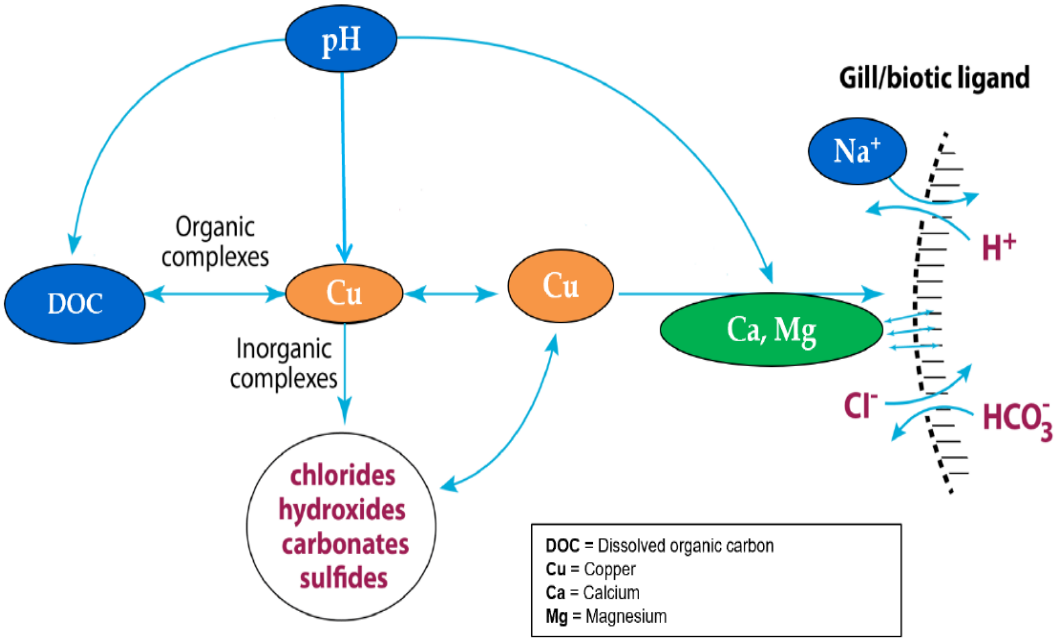
Cu SSC for Pajarito Plateau

- Based on EPA 304(a) Recommended Cu Criteria
  - Biotic Ligand Model (BLM)
  - 2007
- Multiple Linear Regression (MLR) Equations
  - "Modified" BLM
  - DOC, pH, and hardness
    - Important parameters for Cu Bioavailability and Toxicity
  - Scientifically based and consistent with Metals CRADA

Regulatory Framework

- EPA 304(a) Guidance
- 2007 - BLM for Cu Criteria
  - Best Available Science
    - Aquatic Toxicology Software Tool
      - Bioavailability
      - Bioaccumulation
    - Temperature, pH, DOC, Ca, Mg, Na, K, SO_4, Cl, and alkalinity.
- NM Triennial Reviews
  - Not adopted statewide
  - Lack sufficient data

BLM Conceptual Model



Green: Hardness-based parameters; Blue: BLM- based parameters

Adopted from *Copper Site-Specific WQC: Demonstration Report*

Site-Specific Criteria

40 CFR 131.11(b)(1)(ii)

Numerical Criteria established based on modified 304 (a) guidance to reflect site-specific conditions

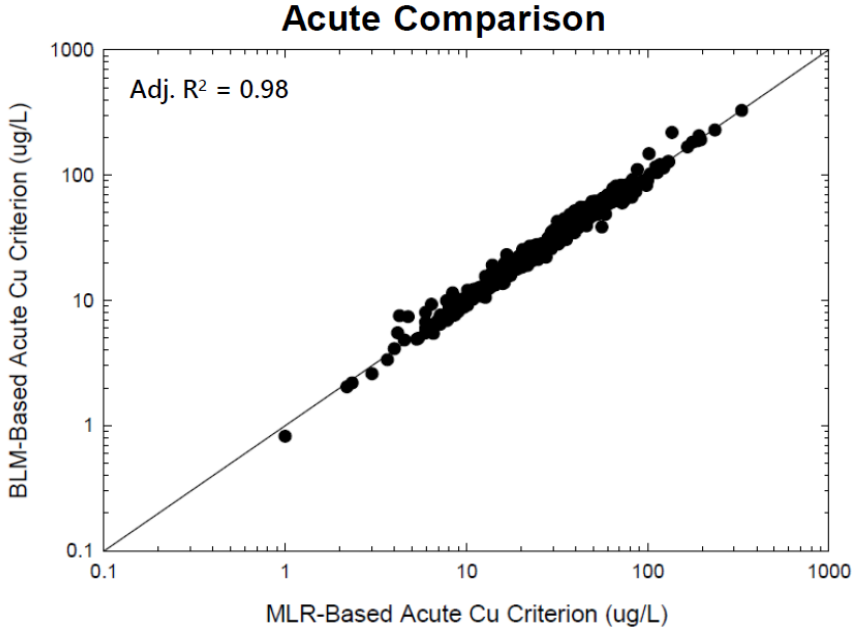
- 20.6.4.10(F) NMAC
  - Numerical Criteria
    - Chemical characteristics
      - alter bioavailability and toxicity
  - Fully Protect Designated Use
  - Anyone can petition the WQCC
    - Identify the water body, explain rationale, public involvement, public hearing
  - Scientifically Defensible Method
    - Cu BLM cited as an example

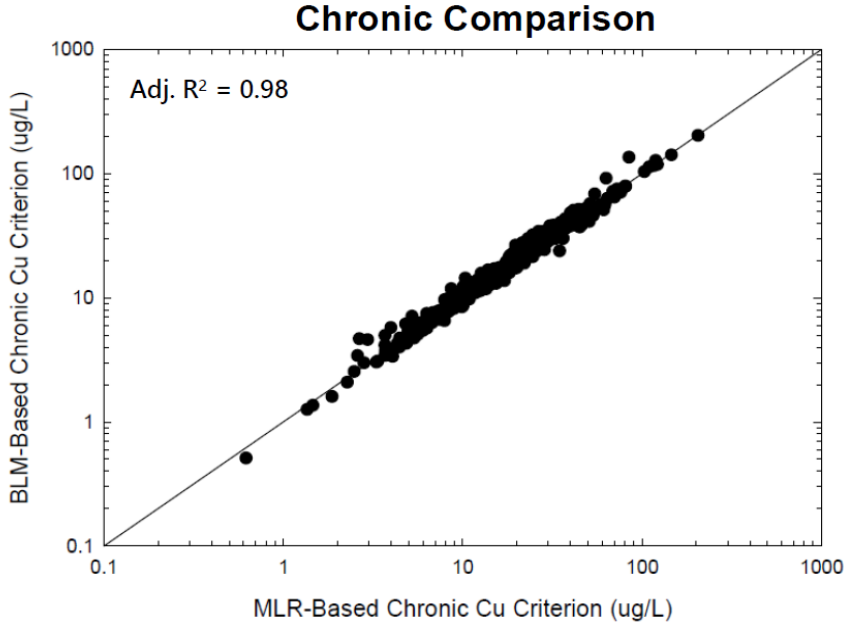
Development of Cu SSC

- Data Collection – Sampling and Analysis
  - Nine LANL Streams - Various locations (2005-2019)
    - Included background sites
  - DQOs Defined and Data Quality Assessment Performed
    - Resulted in 517 useful samples
- BLM Criteria Calculated
  - BLM Software using water chemistry parameters from samples
- Statistical Evaluation
  - DOC, pH, and Hardness
  - Most important for BLM-based criteria
- MLR Equations Developed
  - Three independent variables
    - Cu Criteria = exp[Intercept + ƒ(DOC) + ƒ(hardness) + ƒ(pH)]
  - Accurately calculated BLM-based criteria

Development of Cu SSC

- SSC_{acute} = exp(-22.914 + 1.017*ln(DOC) + 0.045*ln(hardness) + 5.176*pH – 0.2618*pH^2)
- $SSC_{chronic}$ = exp(-23.391 + 1.017*ln(DOC) + 0.045*ln(hardness) + 5.176*pH – 0.2618*pH^2)
  - Work well for ephemeral, intermittent, perennial streams across the Plateau
- BLM-based Criteria v SSC (Figure 5-5 in Demonstration)
  - Solid line is 1:1 relationship
  - Adjusted R2 = 0.98 (i.e., DOC, pH, and Hardness account for 98% of the variation)





Development of Cu SSC

- Additional Validation of Equations
  - BLM Criteria = dashed lines and circles
  - MLR Criteria = Solid lines and triangles
  - Blue, red, and green plots = 10th , 50th, and 90th percentile of each parameter in BLM dataset
  - The 5th and 95th percentiles for each parameter are shown on x-axes

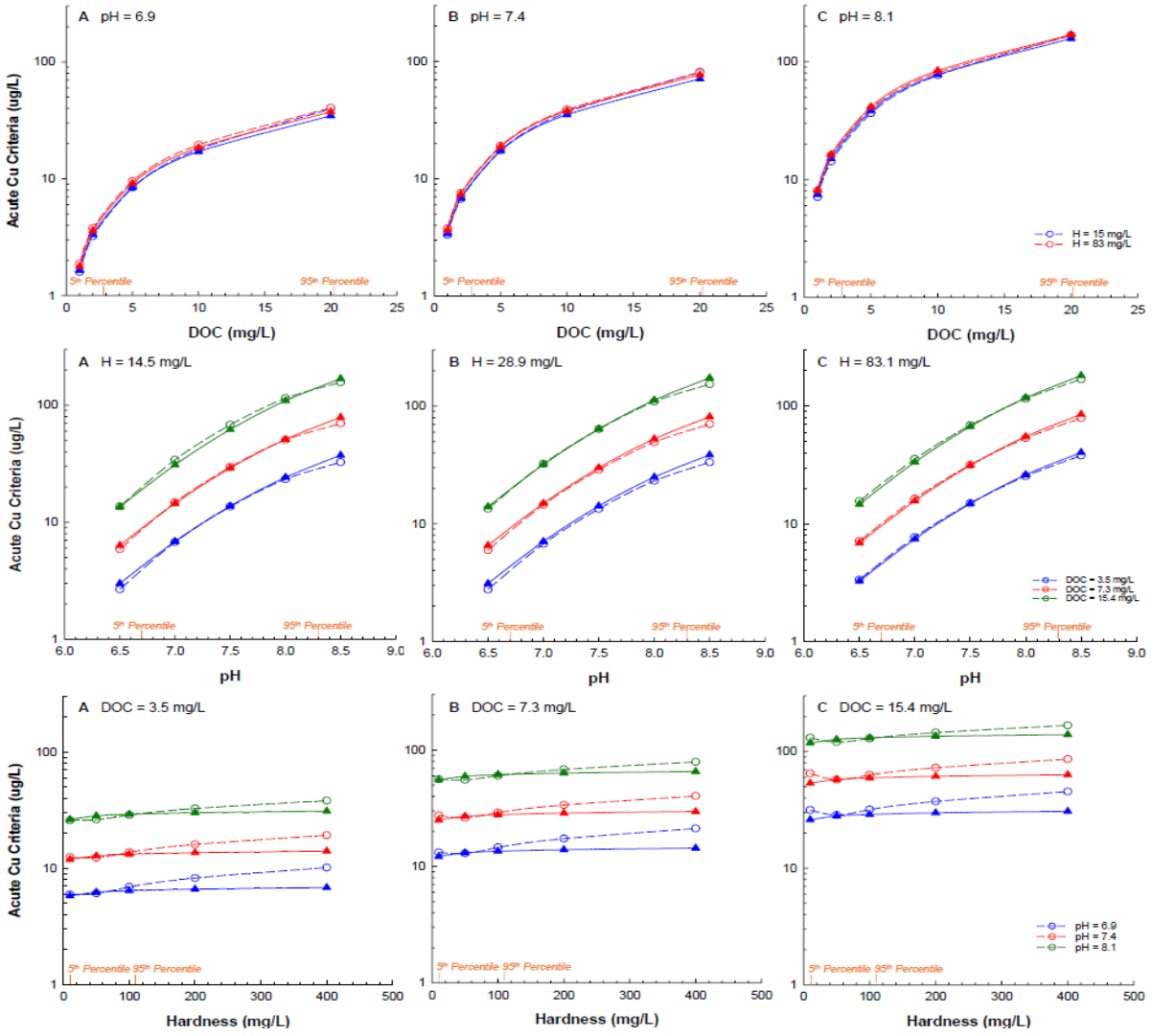


Figure 5-6 in Demonstration

Conclusions

- Scientifically-defensible approach
  - MLR equations recommended for Al and NH_3 Criteria
  - MLR equations for Metals CRADA
  - Robust site-specific study
- Equations are easily incorporated into NM's WQS
- No BLM software or training required
- Streamlines monitoring and assessment
  - 3 parameters instead of 10
- Approved at Public Hearing on January 15, 2025
  - Public Involvement starting in 2020
  - Formal adoption signed on April 8, 2025
- Apply only to Pajarito Plateau Surface Waters
  - Effective on May 22, 2025
- Submittal to EPA Forthcoming (40 CFR § 131.5)
  - CWA § 303(c) review and action

Questions and Contact Info

Bandelier National Monument by Sally King/NPS.

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Rule Amendment Website:

https://www.env.nm.gov/surface-water-quality/proposed-copper-criteria-for-pajarito-plateau-surface-waters/