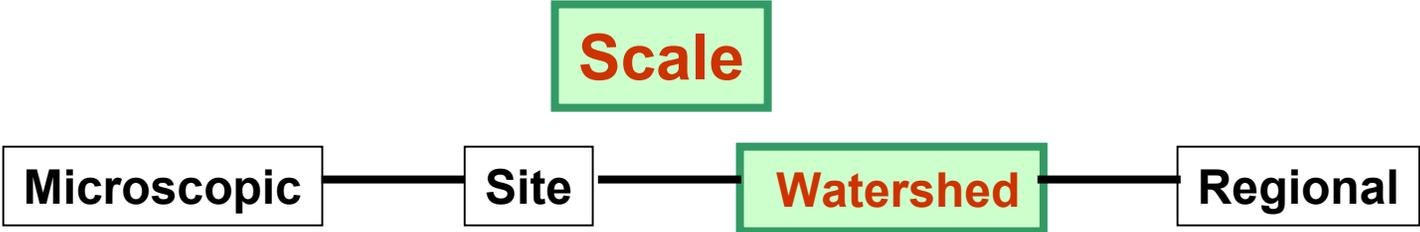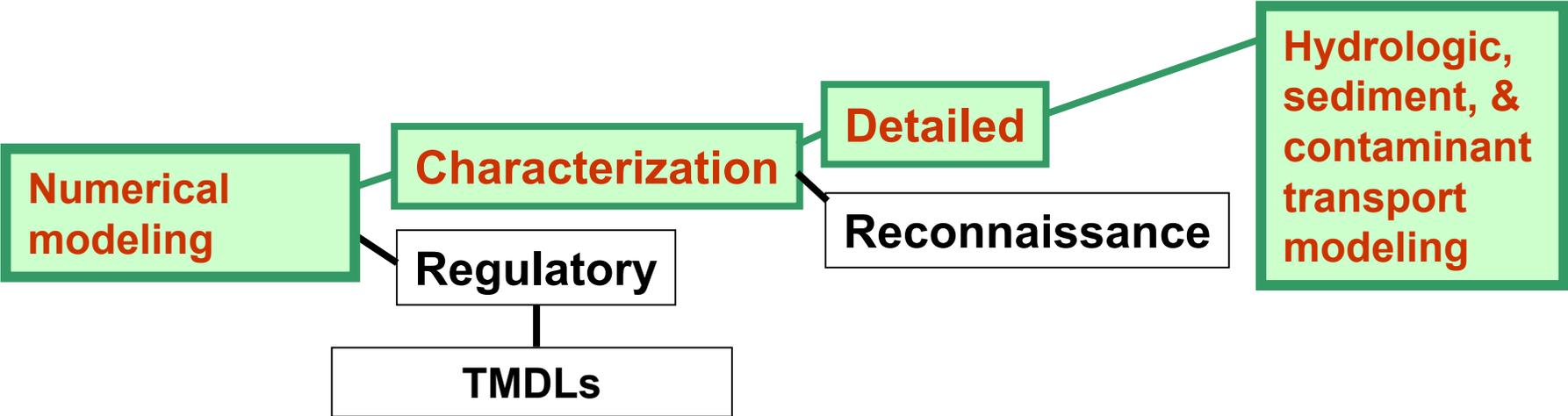# Fate and Transport of Metals and Sediment in Surface Water

Rosalia Rojas, Pierre Julien, Mark Velleux

Colorado State University

Billings Symposium / ASMR Annual Meeting

Assessing the Toxicity Potential

of Mine-Waste Piles Workshop

June 1, 2003

FLOW CHART FOR RANKING AND PRIORITIZATION

Numerical modeling

Characterization

Detailed

Hydrologic, sediment, & contaminant transport modeling

Regulatory

Reconnaissance

TMDLs

Scale

Microscopic — **Site** — **Watershed** — **Regional**

PROBLEM: Erosion

Oro City

PROBLEM: … Transport

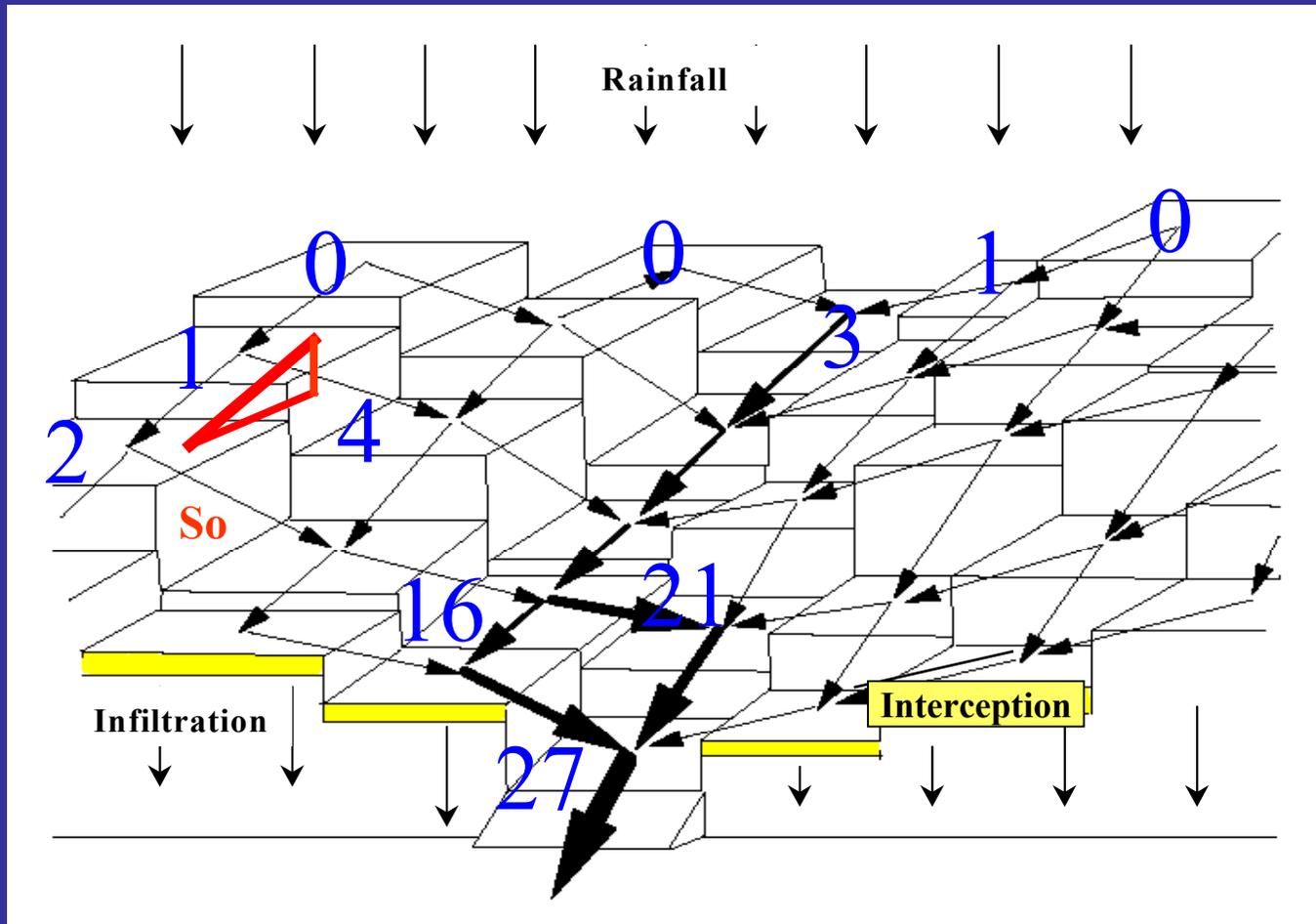# PROBLEM: … and Deposition

AR3

(@ Confluence)

Objectives

- Physical characterization of waste piles.

- Numerical modeling of fate and transport of sediment and metals at the watershed scale
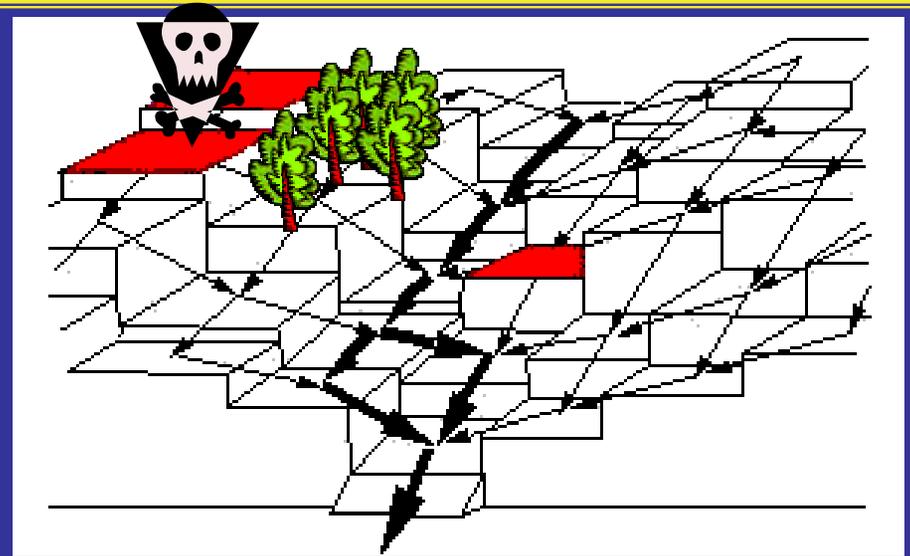
CASC2D-SED

CASC2D- Julien et al. (1995)
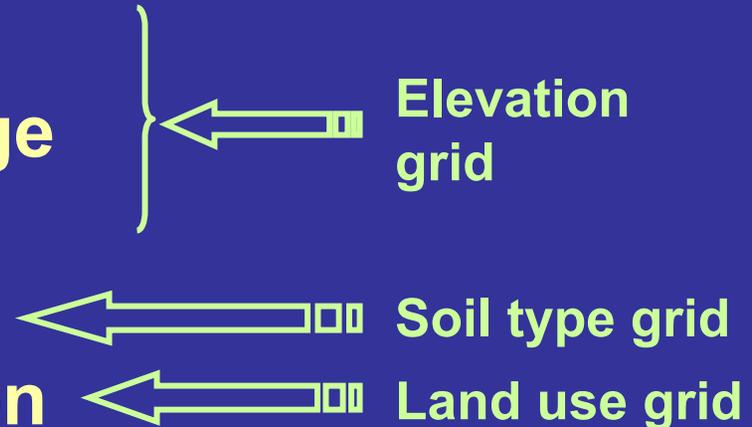**CASC2D-SED – Johnson et al. (2000), Rojas (2002)**
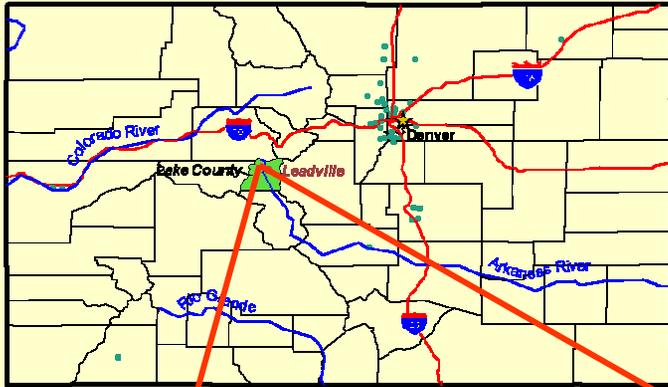
Physical Characterization of Waste Piles

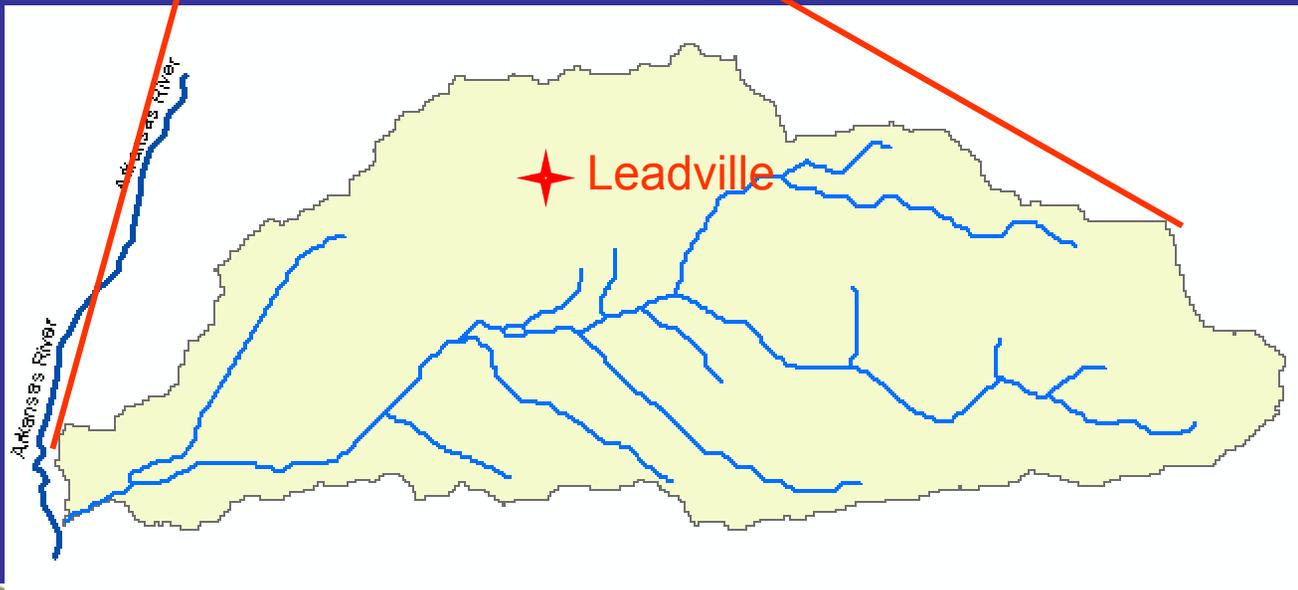**Model accounts for key physical characteristics at the watershed scale:**

☑ **Waste pile slope**
☑ **Proximity to a drainage channel** → **Elevation grid**
☑ **Degree of erosion** ← **Soil type grid**
☑ **Presence of vegetation and kill zones** ← **Land use grid**

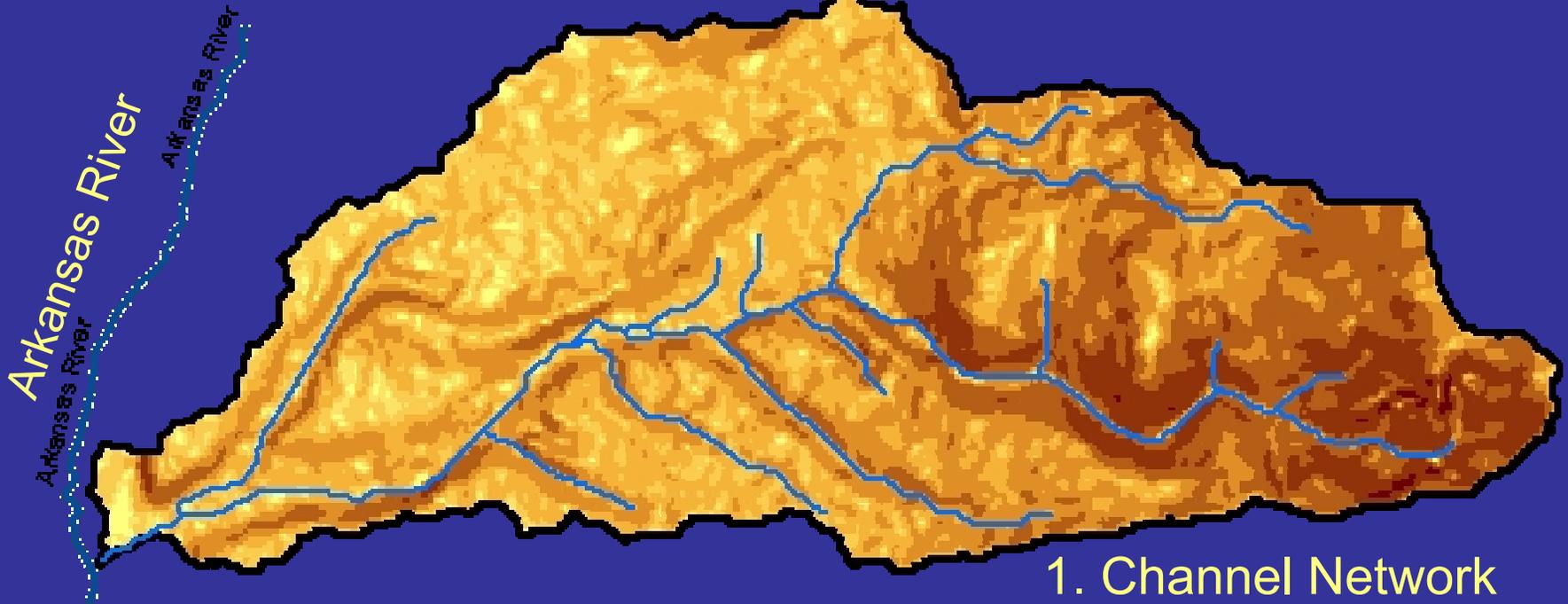# California Gulch Watershed

- EPA Superfund Site

- Location: Lake County (CO)

- Area: 30.6 Km^2

- 100-year flood: 2-h: 1.73 in

Leadville

INPUT DATA (DEM)

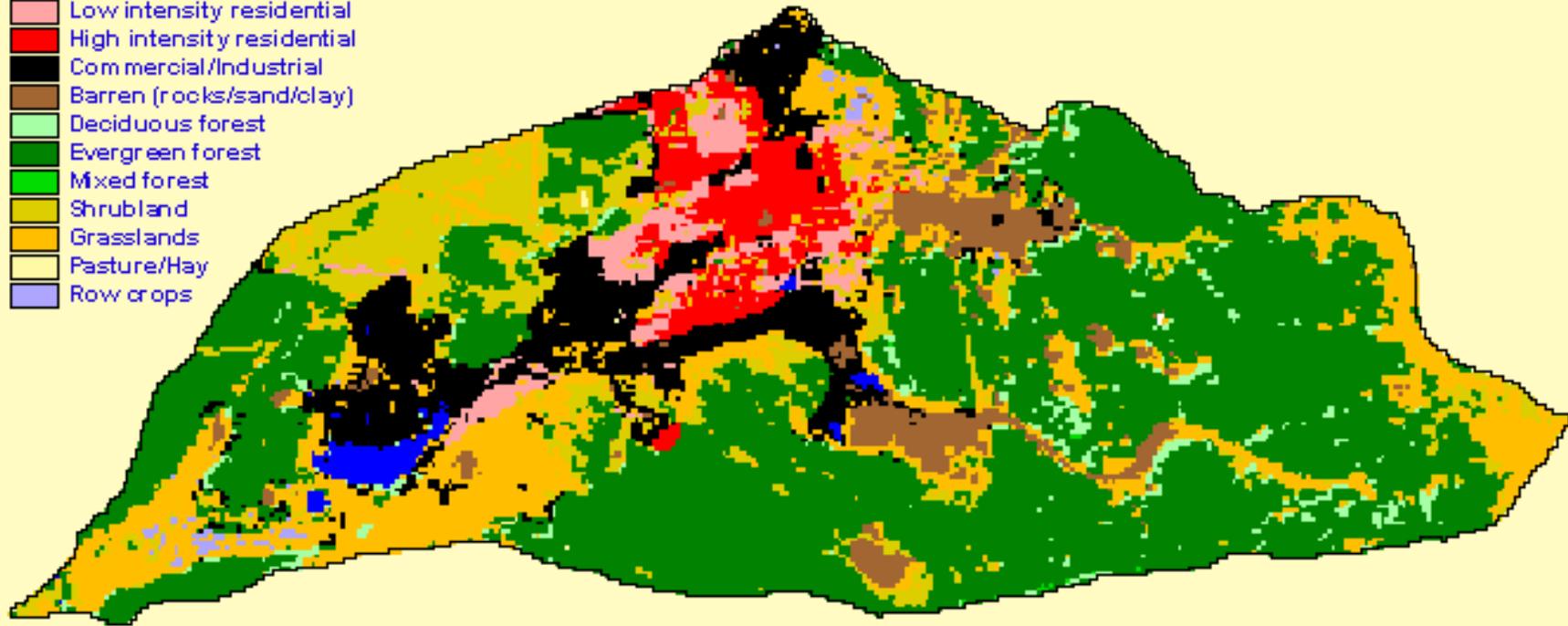Digital Elevation Model

1. Channel Network

2. Terrain Slopes

INPUT DATA (land use)

Land Use
- OpenWater
- Pernnial ice/snow
- Low intensity residential
- High intensity residential
- Commercial/Industrial
- Barren (rocks/sand/clay)
- Deciduous forest
- Evergreen forest
- Mixed forest
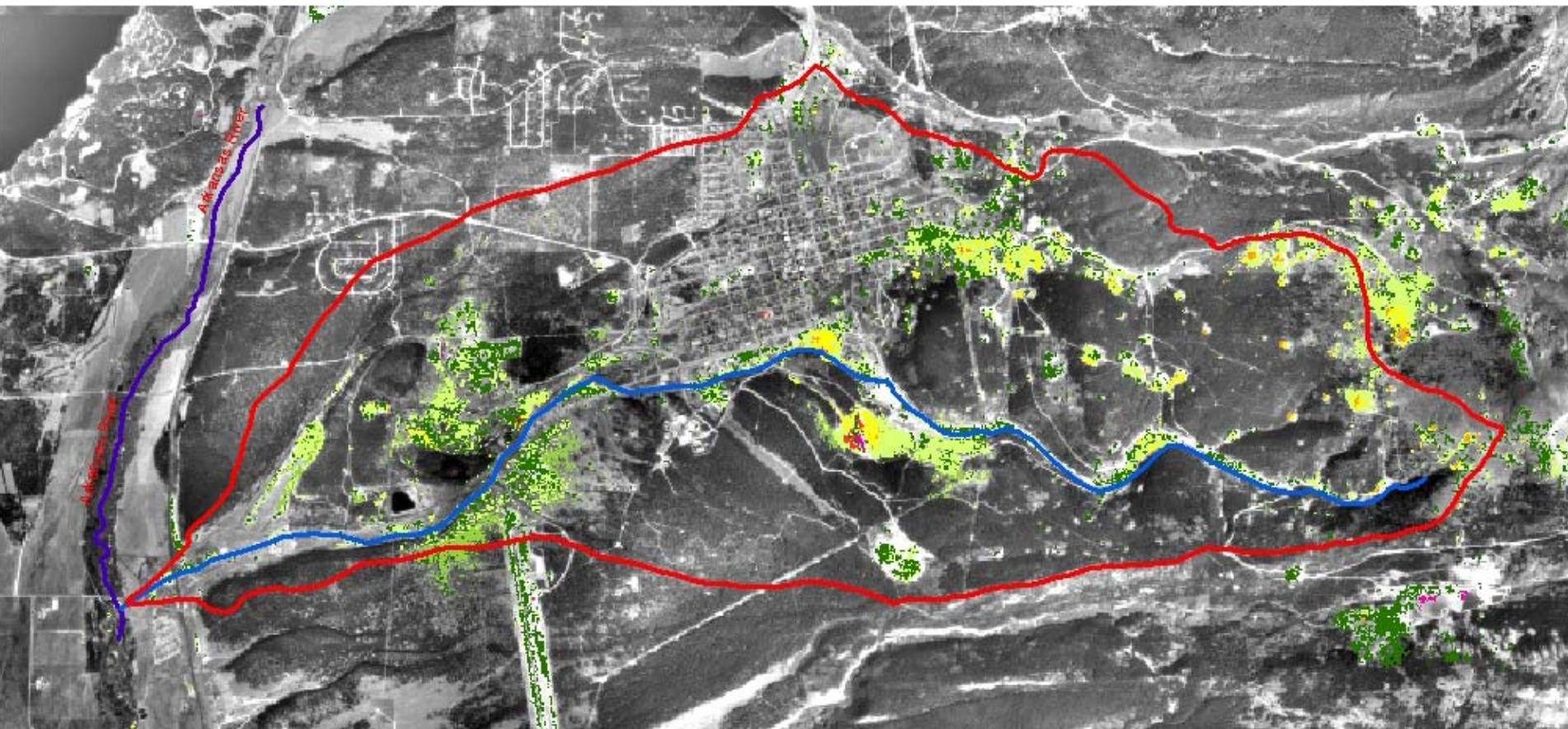- Shrubland
- Grasslands
- Pasture/Hay
- Row crops

AVIRIS image reclassified to 7 minerals (Swayze et al., 2000)

ACIDIC High Leachability

NEUTRAL Low Leachability

Pyrite
Low pH water
Jarosite
Jarosite + Goethite Areal Mix
Goethite
Hematite 1
Hematite 2

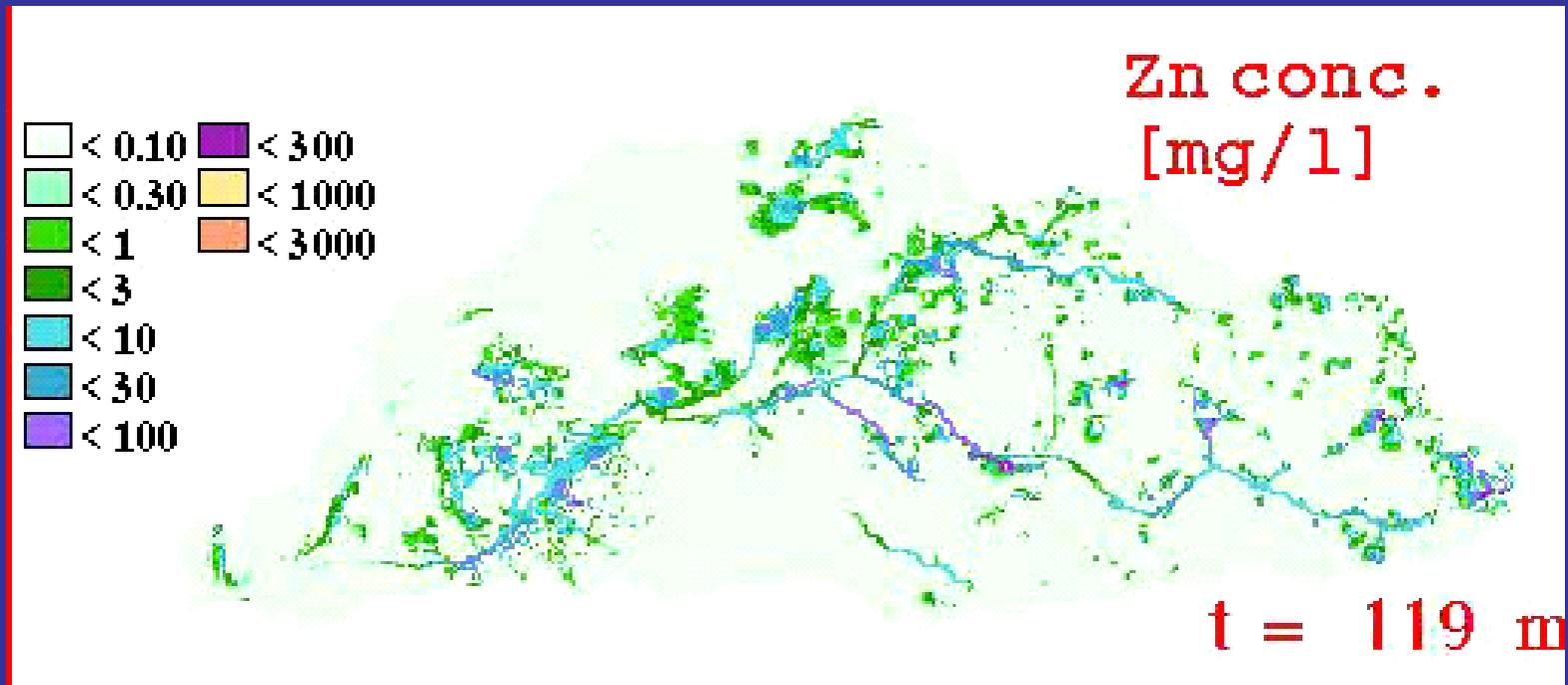0   0.5   1   2   3   Kilometers
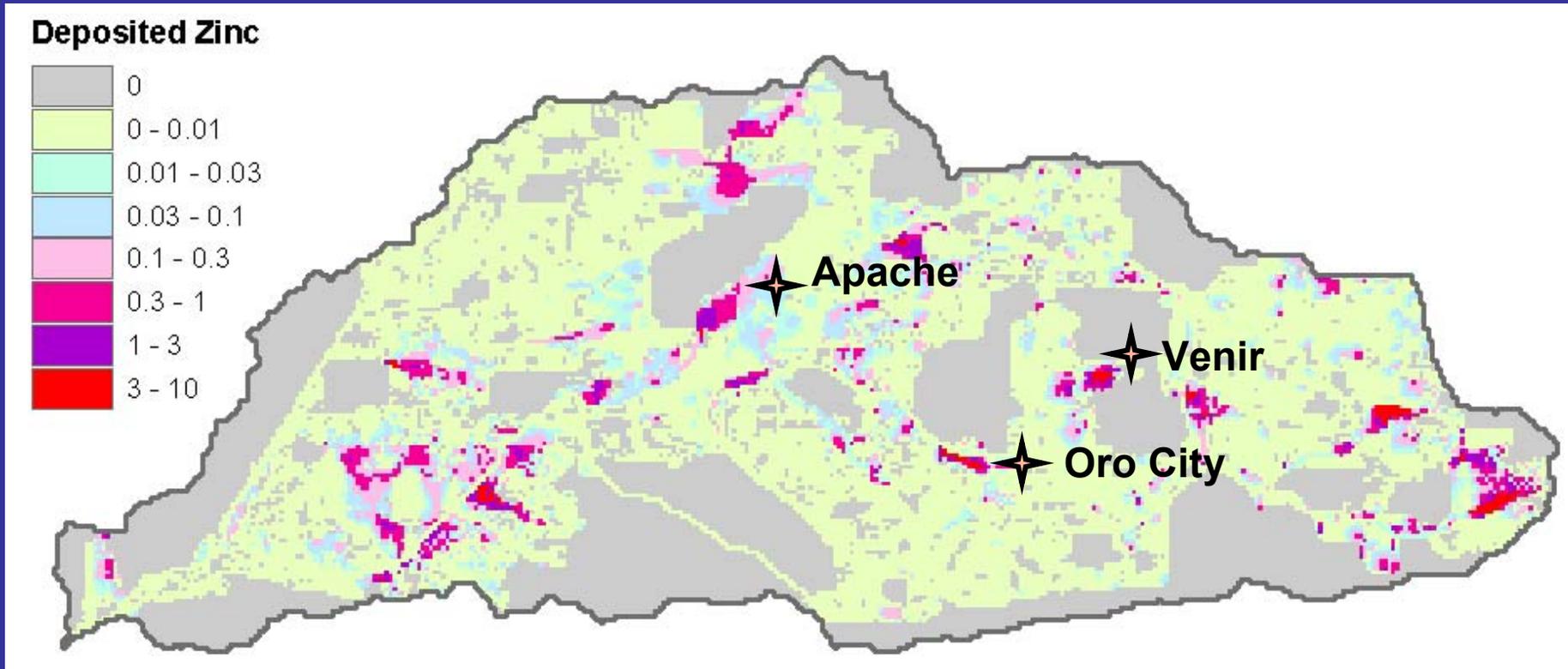
N

Arkansas River

GEOVISUALIZATION: rainfall-runoff

Metals Transport

Metals Deposition

Conclusions

1. Physical characterization of piles

2. Numerical modeling of fate and transport of sediment and metals at the watershed scale

3. Ultimate Goal: Analyze different remediation scenarios to establish clean-up priorities