A SUITE OF OPTIONS AT TAR CREEK

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Quapaw Tribe of Oklahoma

American Society of Mining and Reclamation
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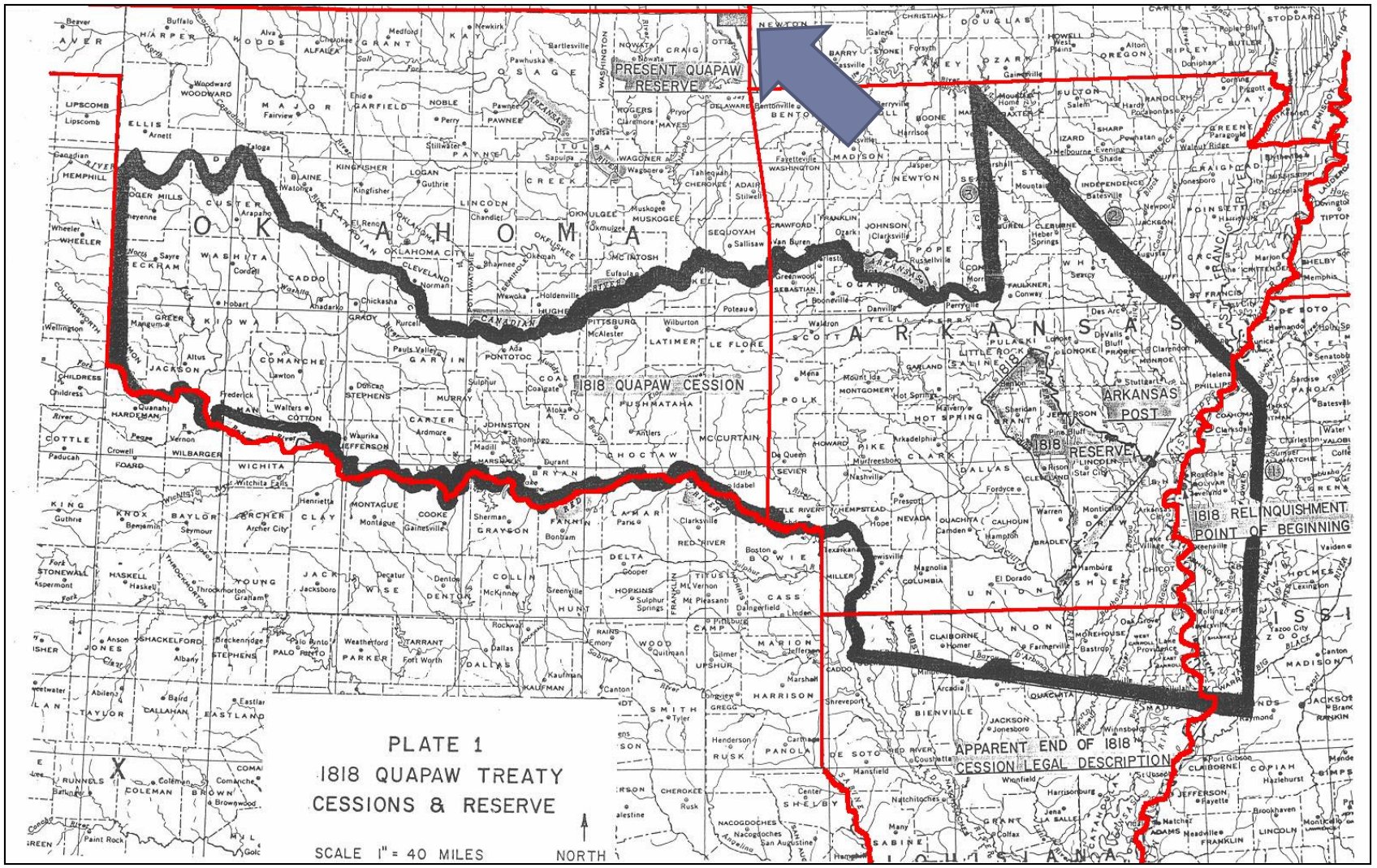
PRESENTATION OVERVIEW

- History
- Tar Creek Superfund Site
- Past, Present And Future Remedial Projects
- “We need more options!”
  - Soil Amendments
  - GIS Kriging
  - Ecological Risk values
- Questions/Answers

QUAPAW TRIBE HISTORY

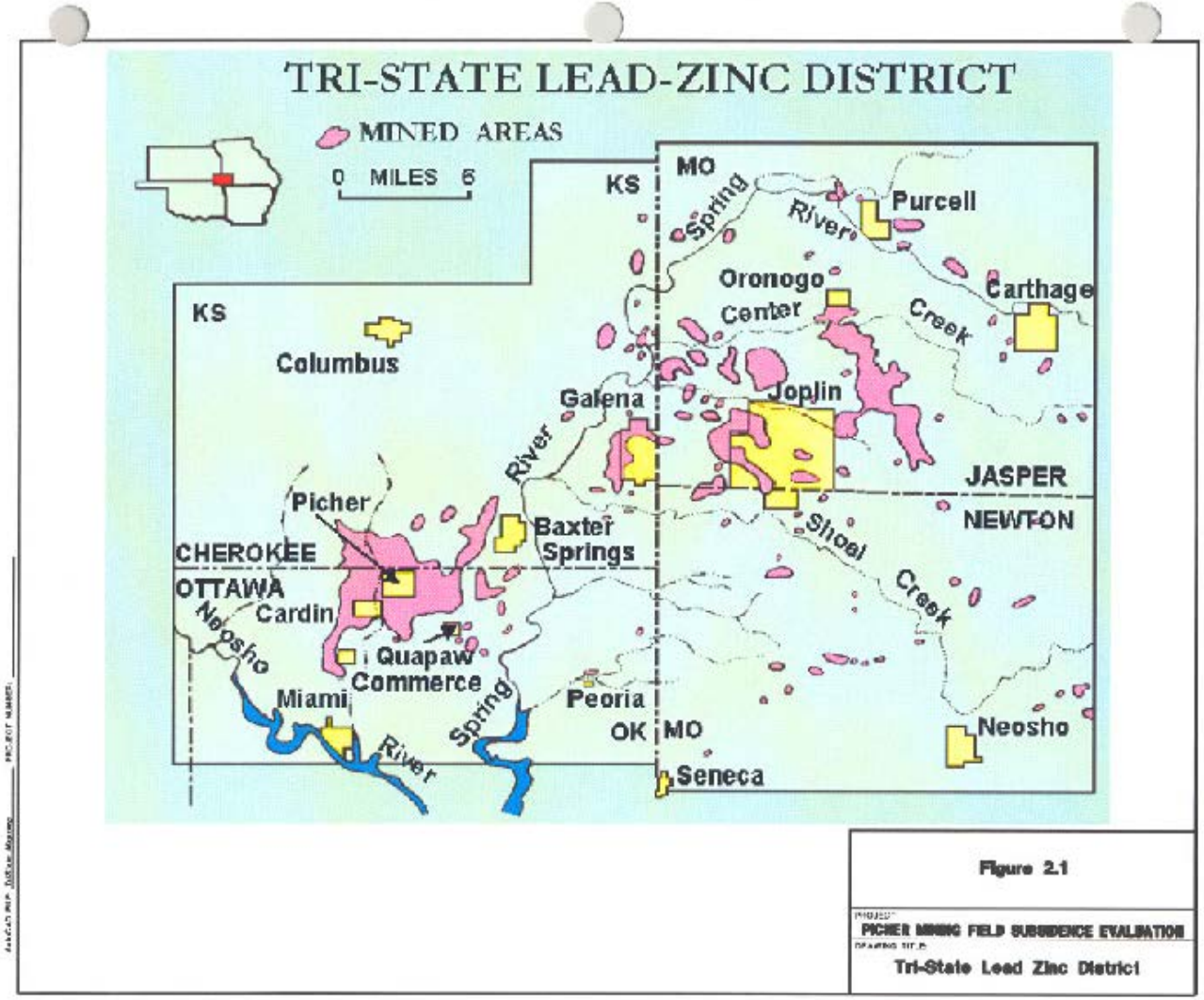
- Several hundred years ago, the Quapaw were a division of a larger group known as the Dhegiha Sioux. They split into the tribes known today as the Quapaw, Osage, Ponca, Kansa, and Omaha.
- The Quapaw moved down the Mississippi River into Arkansas. This is how the Tribe became known by other Tribes as “Ugaxpa” (“Ugakhpa”), which means (roughly) “the downstream people.”
- The Quapaws settled in the area where the Arkansas River met the Mississippi River.
- This is where the Quapaw stayed until they were pushed out by the Arkansas Territorial, and US Governments in the 1820s.
- After being removed from Arkansas, the Quapaws suffered greatly from disease and starvation until the US Government was finally convinced in 1833 to establish a reservation for them in Oklahoma.


PRESENT QUAPAW RESERVE
1818 QUAPAW CESSION
ARKANSAS POST 1818 RESERVE
1818 RELINQUISHMENT POINT OF BEGINNING
APPARENT END OF 1818 CESSION LEGAL DESCRIPTION
PLATE 1
1818 QUAPAW TREATY
CESSIONS & RESERVE
SCALE 1" = 40 MILES
NORTH
OKLAHOMA
ARKANSAS
LOUISIANA

TAR CREEK SUPERFUND SITE

- Tri-State Mining District
- Mining began in the area during the late 1800's and lasted until approximately 1970
- Mining and milling of ore (primarily lead and zinc) produced more than 500 million tons of waste in area
- Two primary types of wastes from mining processes: chat and fine tailings

TAR CREEK SUPERFUND SITE



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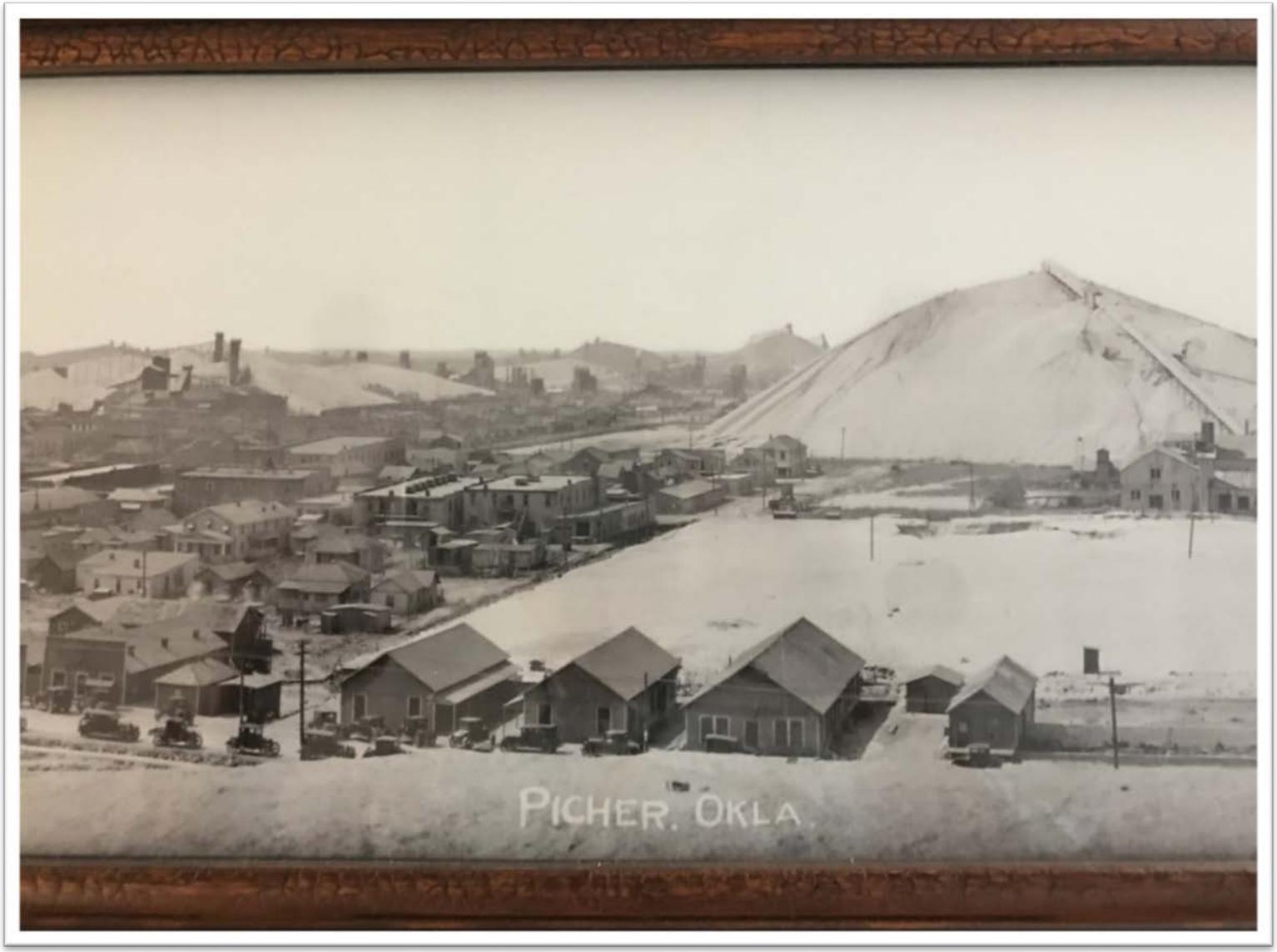

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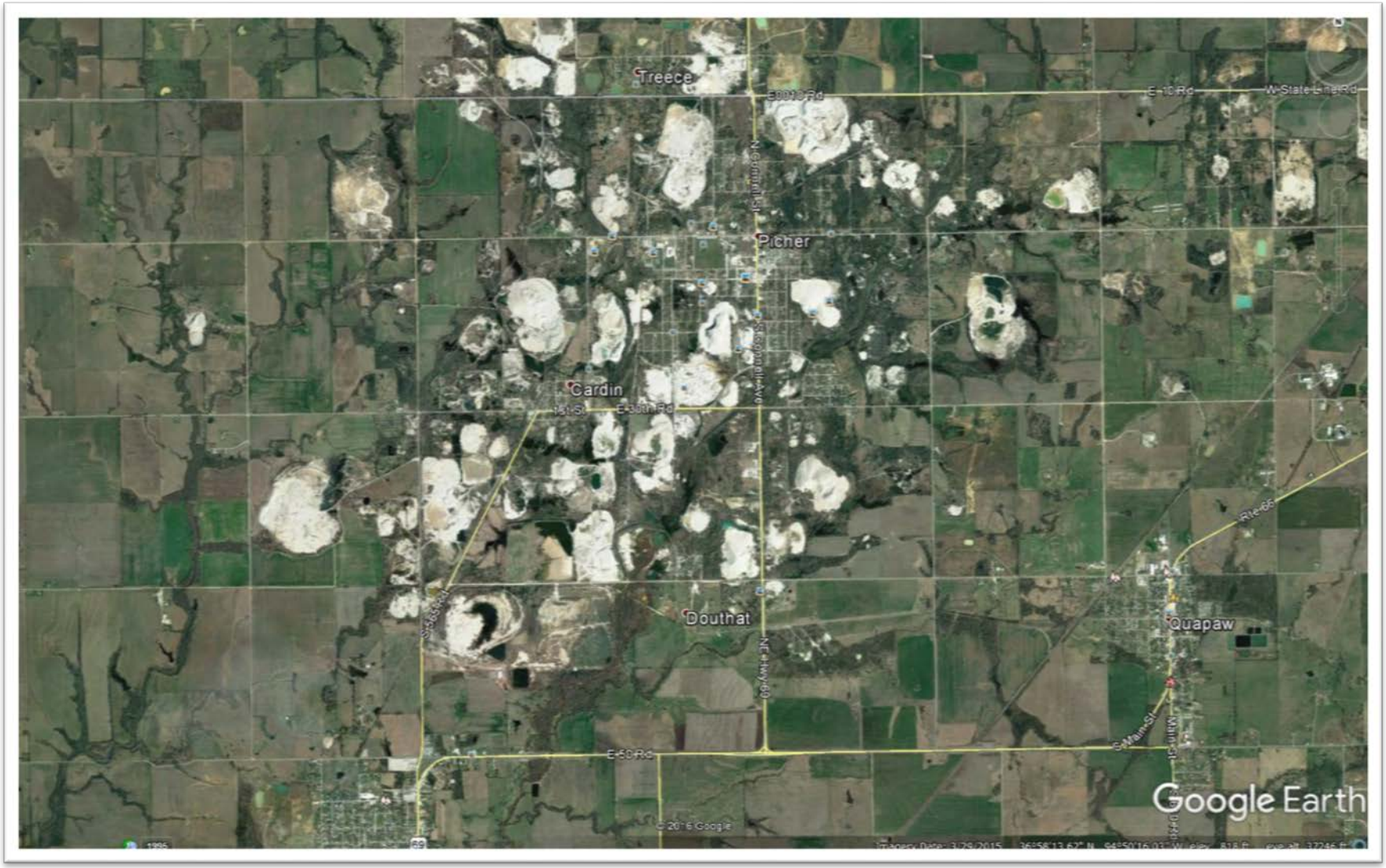

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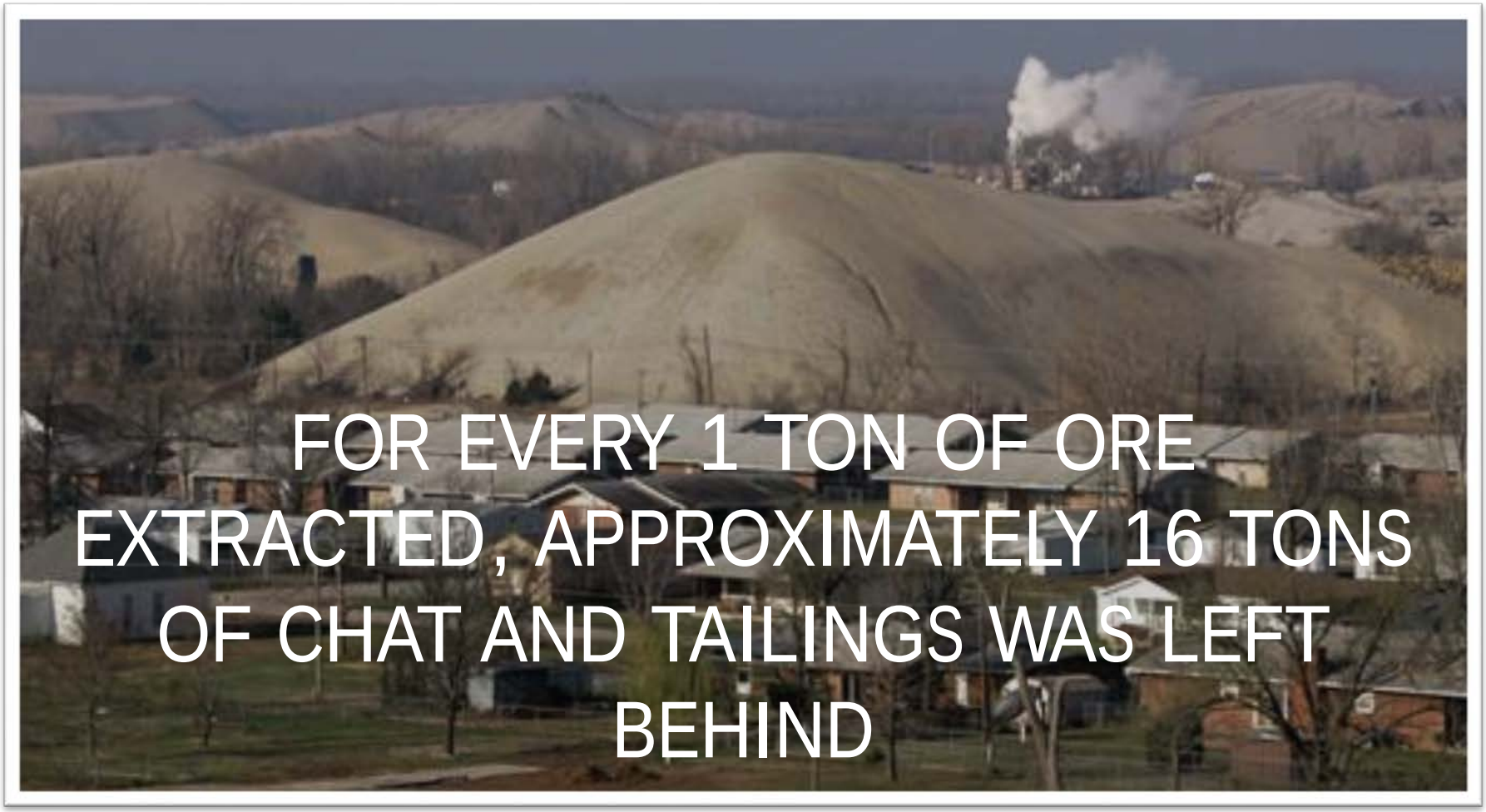


TAR CREEK SUPERFUND SITE

REMEDIAL ACTION ACTIVITIES

CATHOLIC 40

- “Catholic 40”
- Tribal Trust Land
- 40-acre parcel owned by the Quapaw Tribe of Oklahoma and was set aside in 1892 to the Catholic Church for religious and education purposes. In that same year, St. Mary’s of the Quapaw, a Catholic Church, a cemetery, and a boarding school was established.
- St. Mary’s operated up until 1927, following abandonment, the church leased the property for mining in 1937.
- In 1975, the Catholic Church deeded the property back to the Quapaw Tribe of Oklahoma.

REMEDIAL ACTION ACTIVITIES

CATHOLIC 40

A.3.2. Building 2: St. Mary's of the Quapaw school, three-story school and dormitory.

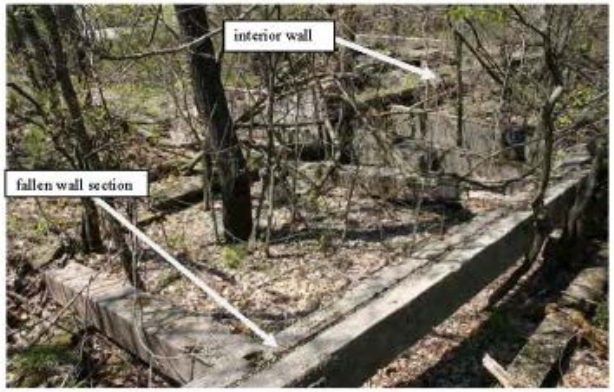


Figure A-8: St. Mary's of the Quapaw school, Building 2 (1915 Dormitory Building), view northwest of fallen wall section and interior floor support walls.

Figure A-9: St. Mary's of the Quapaw school, Building 2 (1915 Dormitory Building), view east of interior wall frame fallen into the interior of the structure.

A.3.7. Building 8: St. Mary's of the Quapaw school, chapel/classroom/dorm

Figure A-18: St. Mary's of the Quapaw school, Building 8, view south of north façade with upper stairway landing with arched entrance of stairway to lower story. Alcove at right may have been for firewood.

Figure A-19: St. Mary's of the Quapaw school, Building 8, view southwest of the east elevation and part of the north façade.

REMEDIAL ACTION ACTIVITIES

CATHOLIC 40

- The Quapaw Tribe Environmental Office, retained the services of a consulting engineering firm to assist in generating plans and specifications, and other pre-construction documents.
- Remedial Action began in December 2013 and involved: excavation, hauling, and disposal of approximately 107,000 tons of source material (chat).

REMEDIAL ACTION ACTIVITIES

CATHOLIC 40

REMEDIAL ACTION ACTIVITIES

CATHOLIC 40

- Confirmation Sampling
- Soil amendments added to TZ soils to reduce Bioavailability of Metals
  - Agricultural Lime
  - Chicken Litter, and
  - Mushroom Compost
- Common Grass Seeding
  - Fescue
  - Rye
  - Bermuda

TOTAL TONS REMOVED BY TRIBE SO FAR

Catholic 40	107,310
Beaver Creek North	60,193
Distal 6a	83,838
Distal 7 North	4,251
Beaver Creek URT1	103,667
Distal 13	759,937
Distal 10-12	380,975
Elm Creek URT1	142,851
Total	**1,643,023**
2018	242,502 (through 5-29-18)

APPROACHES TO MEETING THE OBJECTIVES OF THE ROD

- How are we ensuring that the objectives of the Record of Decision are being accomplished?
  - Confirmation Sampling and additional excavation
  - Soil amendments
  - Moving-window approach
  - Eco-Risk evaluation and raising of Cadmium and Zinc goals
  - Screening with X-Ray Fluorescence

Soil Amendments

- With the addition of appropriate soil amendments, metals in the amended areas are chemically precipitated and/or sequestered by complexation and sorption mechanisms within the contaminated substrate.
- Metal availability to plants is minimized, and
- Metal leaching into groundwater and surface water can be reduced
- How to determine its effectiveness:
  - Circumneutral (pH7) soils, and
  - Substantive biomass yield

Soil Amendments

- Transition zone soils generally express the following:
  - Low in organic matter (affects bioavailability)
  - Low in nitrogen and phosphate
  - Soil pH low
- Amendments to address these deficiencies include:
  - 10 tons/acre of Calcitic limestone (agricultural lime) to raise pH to approx. 7.5 to reduce the bioavailability of metals
  - 5 tons/acre of chicken litter to added nitrogen to deficient soils
  - 20 tons/acre of mushroom compost to increase the organic content of the soil and add phosphate to deficient soils

Soil Amendments

- 5 sites included in pilot project
  - 52 acres
  - Lead up to 7,710 mg/kg (15x)
  - Zinc up to 6,830 mg/kg (6x)
  - Cadmium up to 70 mg/kg (7x)
- Leaves valuable topsoil in place
- Reduces the amount of material hauled to permanent repository
- Components
  - Mushroom Compost
    - 20 tons/acre
  - Chicken Litter
    - 5 tons/acre
    - 50 foot buffer from waterways
  - Agricultural Lime
    - 10 tons/acre
    - Split into two applications

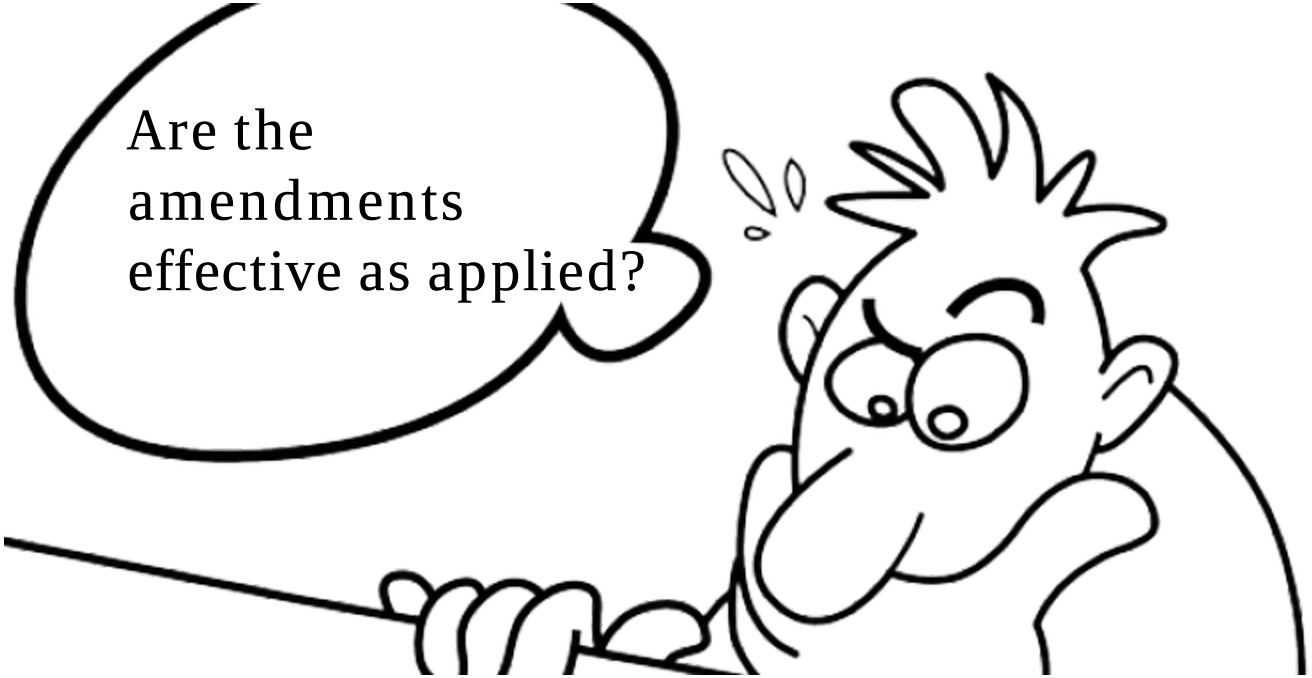
Short Term Performance Measures

- Total vegetative ground cover
  - Daubenmire Cover Class
  - 70% cover
- Total Organic Matter/Total Organic Carbon
- Phosphate
  - Mehlich 3
- Soil pH
- Nitrate/Nitrite and Phosphate in Surface Waters
- Dissolved Metals in Surface Waters

Vegetative Cover = six months during growing season

All others = quarterly for one year

Technical Performance Measures

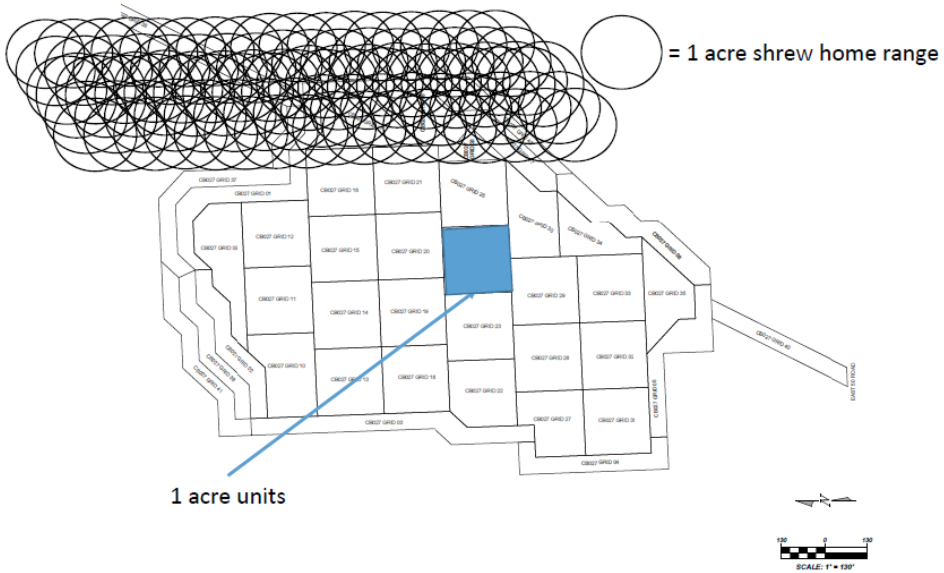


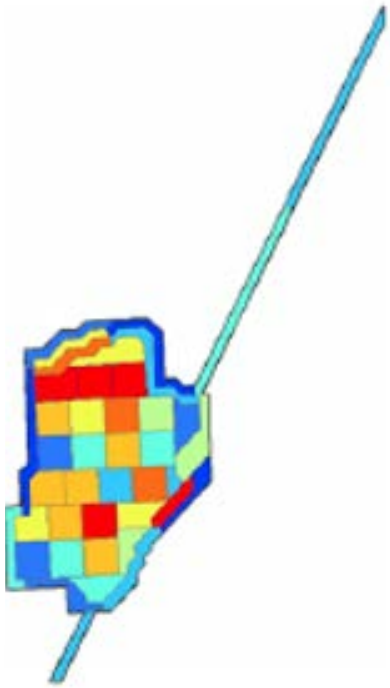
Long Term Performance Measures

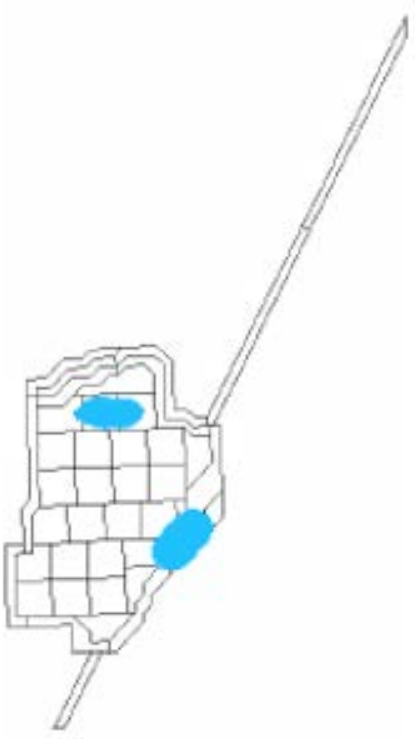
- Total Metals
- Soil pH
- Soil Organic Matter
- Lime Requirement
- Soil Water Soluble Metals
  - Saturated Paste
- Erosion
- Bare Areas
- Plant Cover
- Biomass Production
- Metals in Vegetation
- Surface Water Dissolved Metals

- Long Term Performance Measures are designed to be completed in years 1, 5 and 10 after completion of short term performance measures.
  - Remediation
  - Revegetation
  - Short Term Performance Measures (1 year)
  - Long Term Performance Measures (10 years)

GIS Kriging – Moving Window







Ecological Risk Values

- Record of Decision Goals
  - Lead 500 mg/kg
  - Zinc 1,100 mg/kg
  - Cadmium 10 mg/kg
- Ecological Risk Goals
  - Lead 800 mg/kg
  - Zinc 5,500 mg/kg
  - Cadmium 38 mg/kg
- Driving factors
  - Human health risks
  - Tribal use scenario
- Ecological factors
  - Shrew
    - 1 acre home range
  - Woodcock
    - 15 acre home range

Which option works best?

- It depends on the site!
  - Sites with shallow bedrock do well with soil amendments
  - Sites with ample material do well with eco-risk values
  - Complex sites work well with moving window approach
  - XRF screening has reduced the amount of material removed by pinpointing hot spots

Grids by the Numbers

- Soil amendments
  - Utilized on 52 grids
    - Saved 55,000 tons topsoil
- Eco-risk values
  - Zinc
    - Utilized on 33 grids
    - Saved 53,000 tons
- Contaminates
  - 30% Lead
  - 88% Zinc
  - 69% Cadmium
- Elevated Grids
  - 45% excavated
  - 31% soil amendments
  - 19% eco-risk
  - 4% depth average/deep till
  - 1% capped

FUTURE WORK AT SITE

- Based on the Tribe's performance at the Catholic 40 and at subsequent RA sites, the Tribe is now performing all remediation at the site.

- Elm Creek Watershed
  - Within the next 5 years, the Tribe is projected to remediate over 1.2 million tons of mine waste concentrating on the Elm Creek watershed (represents close to $24 million of EPA funding).

  - Operable Unit 5 (sediments) in the RI process. Tribe anticipates having the same leadership roll in remediation of OU5

Before and After

THANK YOU!!!

QUESTIONS and/or COMMENTS???

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