REMEDIAL STRATEGIES AT THE TAR CREEK SUPERFUND SITE

Tim Kent, Craig Kreman and Summer King
Quapaw Tribe of Oklahoma

Tribal Lands and Environment Forum
August 17, 2017
PRESENTATION OVERVIEW

• History
• Tar Creek Superfund Site
• Environmental Office
• Building Capacity
• Past, Present And Future Remedial Projects
• Sampling And Restoration
• Other Exciting Projects
• 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 when they left the Ohio Valley.

• 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 Tribe’s name eventually became “Quapaw” which was easier to pronounce for Euro-American explorers and settlers.

• Another tribe (the Illinois Tribe) referred to the Quapaws as “Arkansa”; thus the name of the Arkansas River and the State of Arkansas.

• French explorers also applied the name of the river to the Quapaw people-Riviere des Arks or d’Asark from which Ozark (as in “Ozark Mountains”) was derived.
The Quapaws settled in the area where the Arkansas River met the Mississippi, where the meandering of the two massive rivers had deposited nutrient-rich soil conducive to farming.

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 (then known as “Indian Territory”).
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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FOR EVERY 1 TON OF ORE EXTRACTED, APPROXIMATELY 16 TONS OF CHAT AND TAILINGS WAS LEFT BEHIND
TAR CREEK SUPERFUND SITE
QUAPAW TRIBE INVOLVEMENT AT TAR CREEK

- Through the EPA Region 6 General Assistance Program (GAP), the Quapaw Tribe Environmental Office was established on October 1, 1997.
- In June of 1998, the Quapaw Tribe Chairman and the EPA Region 6 Administrator signed a Tribal Environmental Agreement, which established a formal agreement between the Tribe and EPA to address the issues raised regarding the environmental protection of lands within the Quapaw Tribe’s jurisdictional lands.
Currently, the Quapaw Tribe is administering an EPA Superfund management assistance grant under an existing Superfund support agency cooperative agreement.

The Tribe entered into this support agency cooperative agreement with EPA in 2001.

This management assistance grant has enabled the Tribe to have “meaningful and substantial involvement” in the decisions related to the development and implementation of remedial activities.
QUAPAW TRIBE INVOLVEMENT AT TAR CREEK

- Working together with EPA and other stakeholders on Tar Creek issues over the past 15 years has enabled the Quapaw Tribe Environmental Office to develop the technical capacity required to administer a remedial response cooperative agreement.
- Consequently, in 2013, the Tribe negotiated a remedial response cooperative agreement with EPA Region 6 to self-perform the remediation of an historic and culturally significant tribal property known to the Quapaw as the “Catholic 40.” This is the first-ever Tribal-led Superfund Cleanup in the nation.
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

Figure A-5: St. Mary’s of the Quapaw School, post-1915
NOTE THE LARGE CHATECOTE STRUCTURE CONSTRUCTED 1915 (PHOTO FROM NIEBERDING 1953).

Figure A-3: St. Mary’s of the Quapaw School, undated. Note the same 2-story building as in the previous figure and small building that may have been John Quapaw’s school. (Photo from Quapaw Pow-wow Program, 1990)

Figure A-4: St. Mary’s of the Quapaw School photo showing the reverse side of the same buildings as the previous photo (photo courtesy of the Dodson Museum, Ottawa County Historical Society).

Figure A-6: St. Mary’s of the Quapaw School, post-1915. View of the school toward the south showing the 1915 three story building and two-story frame building (photo courtesy of the Dodson Museum, Ottawa County Historical Society).
REMEDIAL ACTION ACTIVITIES
CATHOLIC 40

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

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

Figure A-7: 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-8: 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-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.

Figure A-10: St. Mary’s of the Quapaw school, Building 8, view southwest of the east elevation and part of the north façade.
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
REMEDIATION ACTION ACTIVITIES
CATHOLIC 40

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

DISTAL 6a

- SE Distal Zone, Distal 6a
- Unrestricted Property
- State-led project, with the request that the Tribe do the remediation work as the “contractor” through an intra-agency agreement
- Adjacent to “Catholic 40” property
- Remedial Action began in June 2014 and involved: excavation, hauling, and disposal of approximately 82,000 tons of source material
REMEDIAL ACTION ACTIVITIES
DISTAL 6a
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DISTAL 6a

Same soil amendment activities as conducted at “Catholic 40”
REMEDIAL ACTION ACTIVITIES
BEAVER CREEK NORTH

• SE Distal Zone, Beaver Creek North
• Mixed-Ownership Property (Restricted and Unrestricted Interest)
• Cooperative agreement with EPA to conduct remedial action activities
• Remedial Action began in June 2015 and involved: excavation, hauling, and disposal of approximately 47,000 tons of source material (chat).
• Marketable and Unmarketable chat present
Remedial Action began in October 2015 and involves: excavation, hauling, and disposal of over 700,000 tons of source material (chat).

- Marketable and Unmarketable chat present
- The source material is being disposed of at the Central Mill Tailings Repository.
- Project still ongoing...
REMEDIATION ACTION ACTIVITIES
DISTAL 10 and 12

- Remedial Action began in March 2017 and involves: excavation, hauling, and disposal of over 500,000 tons of source material (chat).
- Unmarketable chat present
- The source material is being disposed of at the Central Mill Tailings Repository.
- Project still ongoing...
REMEDIAL ACTION ACTIVITIES

- A Day in the Life at Tar Creek Video
  https://youtu.be/8QAB_R9RiXs
**TOTAL TONS REMOVED BY TRIBE SO FAR**

<table>
<thead>
<tr>
<th>Location</th>
<th>Tons</th>
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<tbody>
<tr>
<td>Catholic 40</td>
<td>107,310</td>
</tr>
<tr>
<td>Beaver Creek North</td>
<td>60,193</td>
</tr>
<tr>
<td>Distal 6a</td>
<td>83,838</td>
</tr>
<tr>
<td>Distal 7 North</td>
<td>3,515</td>
</tr>
<tr>
<td>Beaver Creek URT1</td>
<td>103,667</td>
</tr>
<tr>
<td>Distal 13</td>
<td>703,081</td>
</tr>
<tr>
<td>Distal 10-12</td>
<td>144,477</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,206,083</strong></td>
</tr>
<tr>
<td><strong>2017</strong></td>
<td><strong>274,796</strong></td>
</tr>
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</table>
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 3-5 yrs, the Tribe is projected to remediate over 1.7 million tons of mine waste concentrating on the Elm Creek watershed (represents close to $30 million of EPA funding).
  - Operable Unit 5 (sediments) in the RI process. Tribe anticipates having the same leadership roll in remediation of OU5
SAMPLING ACTIVITIES

- Follows a inspection of grids for source material removal completeness
- Includes a five-point aliquot sample
- Sampling intervals: 0-6 inches and 6-12 inches
- QA/QC include: field duplicates, rinsate and field blanks
- Video link: https://youtu.be/MYei8VwUKqY
- Number of grids sampled to date: 314
  - Have approximately 104 grids left to sample on funded projects
- While small portion of total budget, important part to decision making at site
The work included herein represents conditions existing at the time the data was created. The construction grading plan was developed expecting these conditions will be removed and restoration is warranted within this area. Final implementation of this work described herein is not warranted by CH2M-HILL. Certification of the validity of the implementation of the work will not be provided by CH2M-HILL. CH2M-HILL does not assume liability for any services or certification provided by a third party.
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
- Screening with X-Ray Fluorescence
What confirmation sampling is telling us?

• The percentage of grids coming up elevated for each contaminant is as follows:
  ▫ Lead: 19%
  ▫ Cadmium: 44%
  ▫ Zinc: 37%

• This has led to the addition of approximately 47,000 tons of transition zone soil being hauled off and properly disposed.

• What can be done to limit removal of this vital top soil?
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

- The transition zone soils generally express:
  - Low in organic matter (affects bioavailability)
  - Low in nitrogen and phosphate
  - Soil pH low
- Amendments to address these deficiencies:
  - 10 tons/acre of Calcitic limestone (agricultural lime) to raise pH to neutral or slightly higher 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
Technical Performance Measures

- Short term measures evaluate:
  - Total Vegetative Ground Cover
  - Dissolved Metals in Surface Water
  - Storm Water BMPs
  - Total Organic Matter
  - Phosphate
  - Soil pH
  - Nitrate/Nitrite and Phosphate in Surface Water
- What did we see at Catholic 40 and Distal 6a...
Total Organic Matter (%)
Performance Standard - >2.0%

[Bar chart showing Total Organic Matter (%) from CB011-04... to CB011-21... with performance standard indicated by a horizontal line at 2.0%.

Legend:
- 15-Apr
- 15-Jul
- 15-Oct
- 16-Jan]
Soil pH
Performance Standard - $\rightarrow$ pH 7.0

Soil pH (standard unit)

- 15-Apr
- 15-Jul
- 15-Oct
- 16-Jan
Technical Performance Measures

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Units</th>
<th>Baseline^</th>
<th>Apr-15</th>
<th>Jul-15</th>
<th>Oct-15</th>
<th>Jan-16</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC50RD Lead, Soluble in SW (EPA Method 200.8)</td>
<td>mg/L</td>
<td>0.005</td>
<td>0.005</td>
<td>0.005</td>
<td>0.005</td>
<td>0.005</td>
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<tr>
<td>BC50RD Cadmium, Soluble in SW (EPA Method 200.8)</td>
<td>mg/L</td>
<td>0.0011</td>
<td>0.0010</td>
<td>0.0010</td>
<td>0.0010</td>
<td>0.0012</td>
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<tr>
<td>BC50RD Zinc, Soluble in SW (EPA Method 200.7)</td>
<td>mg/L</td>
<td>1.31</td>
<td>1.13</td>
<td>1.41</td>
<td>1.08</td>
<td>1.29</td>
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<tr>
<td>BCPG Lead, Soluble in SW (EPA Method 200.8)</td>
<td>mg/L</td>
<td>0.005</td>
<td>0.005</td>
<td>0.005</td>
<td>0.005</td>
<td>0.005</td>
</tr>
<tr>
<td>BCPG Cadmium, Soluble in SW (EPA Method 200.8)</td>
<td>mg/L</td>
<td>0.0010</td>
<td>0.0010</td>
<td>0.0010</td>
<td>0.0010</td>
<td>0.0010</td>
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<tr>
<td>BCPG Zinc, Soluble in SW (EPA Method 200.7)</td>
<td>mg/L</td>
<td>0.351</td>
<td>0.356</td>
<td>0.371</td>
<td>0.238</td>
<td>0.556</td>
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<tr>
<td>Total Organic Matter (Modified Walkley-Black)</td>
<td>%</td>
<td>2.73%</td>
<td>2.54%</td>
<td>3.29%</td>
<td>3.28%</td>
<td>2.76%</td>
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<tr>
<td>Total Organic Carbon</td>
<td>%</td>
<td>1.35%</td>
<td>1.47%</td>
<td>1.93%</td>
<td>1.91%</td>
<td>1.58%</td>
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<tr>
<td>Phosphate in Soil (Mehlich-3 Method)</td>
<td>ppm P</td>
<td>20.5</td>
<td>33.4</td>
<td>67.0</td>
<td>82.5</td>
<td>40.3</td>
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<tr>
<td>Soil pH (ASTM D4972)</td>
<td>1:1 Soil:Water</td>
<td>6.7</td>
<td>7.0</td>
<td>7.0</td>
<td>7</td>
<td>7</td>
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<tr>
<td>BC50RD Nitrate/Nitrite in SW (EPA Method 353.2)</td>
<td>mg/L</td>
<td>0.100</td>
<td>0.100</td>
<td>0.100</td>
<td>0.100</td>
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<tr>
<td>BC50RD Phosphate in SW (EPA Method 365.1)</td>
<td>mg/L</td>
<td>3.00</td>
<td>0.077</td>
<td>0.104</td>
<td>0.160</td>
<td>0.077</td>
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<tr>
<td>BCPG Nitrate/Nitrite in SW (EPA Method 353.2)</td>
<td>mg/L</td>
<td>0.100</td>
<td>0.100</td>
<td>0.100</td>
<td>0.100</td>
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<tr>
<td>BCPG Phosphate in SW (EPA Method 365.1)</td>
<td>mg/L</td>
<td>3.00</td>
<td>0.077</td>
<td>0.077</td>
<td>0.077</td>
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<tr>
<td>Total Vegetative Cover (Daubenmire Cover Class Method)</td>
<td>%</td>
<td>44%</td>
<td>78%</td>
<td>80%</td>
<td>79%</td>
<td>72%</td>
<td>73%</td>
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</tbody>
</table>

^Baseline soil samples were collected in October 2014, while surface water samples were collected in December 2014. As of January 7, 2015 no additional seeding has taken place at Catholic 40 due to below freezing temperatures and frozen ground.

Measurements highlighted yellow indicate below PQL.
Technical Performance Measures

Are the amendments effective as applied?
Before and After Video
https://youtu.be/oJ3CBHyw1FY
Other Projects

- Migratory Bird Survey
Other Projects

- Drone Mapping Project and Quantity Take-Offs
Average Ground Sampling Distance (GSD) 1.04 cm / 0.41 in
Area Covered 29.1547 acres
Images median of 51410 keypoints per image
Dataset 893 out of 893 images calibrated (100%), all images enabled
DSM and Orthomosaic Resolution 1 x GSD (1.04 [cm/pixel])
THANK YOU!!!

QUESTIONS and/or COMMENTS???

CONTACT INFO:
Quapaw Tribe Environmental Office
Office Phone: (918) 238-3097

Tim Kent, Director
tkent@quapawtribe.com

Craig Kreman, Assistant Director
ckreman@quapawtribe.com

Summer King, Environmental Scientist
sking@quapawtribe.com