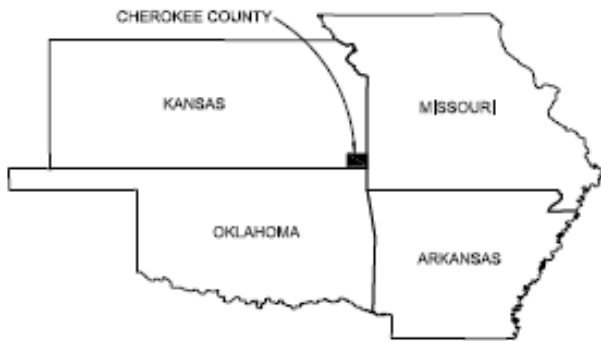


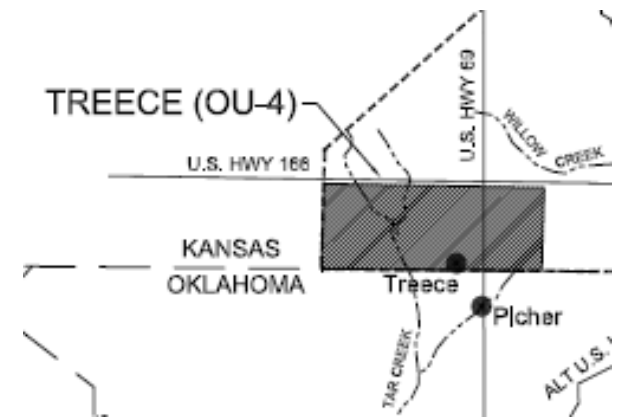
# Cherokee County Superfund Site Operable Unit 4 - Treece

Remediation of Tar Creek and Adjacent Mine Waste Areas





# INTRODUCTION



- Cherokee County Superfund Site is located in the southeastern portion of Kansas and is part of the Tri-State Mining District
- Operable Unit (OU) 4 – Treece Subsite is a U.S. Environmental Protection Agency (EPA) Superfund site
- OU-4 is located in and around Treece, Kansas and encompasses approximately 11 square miles or about 7,040 acres
- OU-4 includes Tar Creek and adjacent mine waste areas between State Line Road and Highway 166
- Surface water runoff impacts to Tar Creek from adjacent mine waste areas





# PRESENTATION AGENDA

- Project Goals
- Summarize existing conditions
- Describe remediation strategy
- Provide preliminary project phasing plan
- Conclusions



# PROJECT GOALS

# PROJECT GOALS

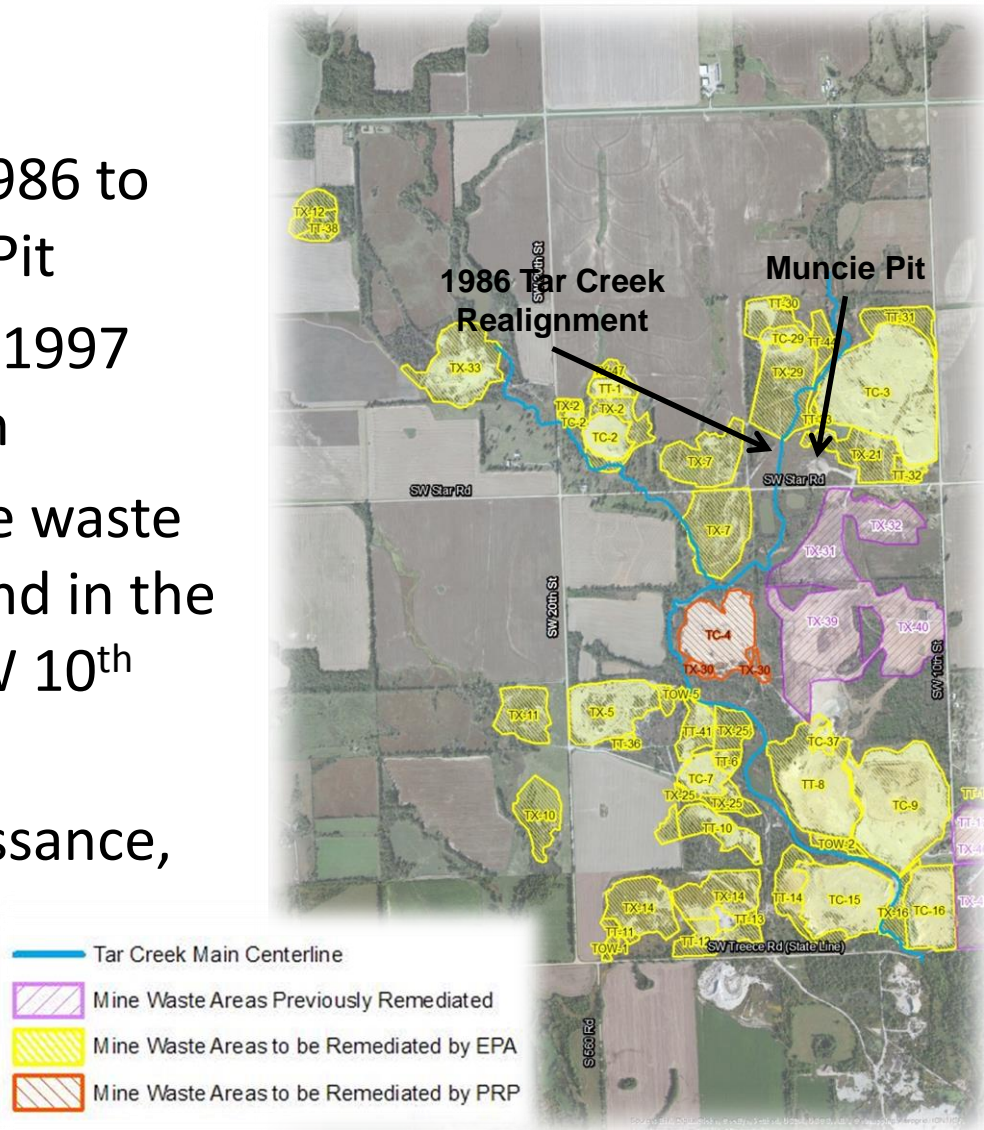
- Eliminate ecological and human health risk pathways resulting from exposure to mine waste
  - Consolidate and cover mine waste
- Reduce cadmium, lead and zinc loading on Tar Creek
  - Mine waste removal and consolidation to eliminate water and sediment contamination from existing surficial mine waste
- Stabilize and restore Tar Creek
- Provide sampling data to determine if remediation goals\* are achieved.



# SUMMARY OF EXISTING CONDITIONS

## PREVIOUS WORK COMPLETED

- USACE rerouted Tar Creek in 1986 to prevent drainage into Muncie Pit
- Cleanup criteria established in 1997 through the Record of Decision
- Majority of EPA fund-lead mine waste areas east of SW 10th Street and in the SW corner of Star Road and SW 10<sup>th</sup> Street have been remediated
- Aerial mapping, field reconnaissance, and exploratory test pits completed at the remaining OU-4 subsites





# IDENTIFIED MINE WASTE AREAS

- Tar Creek and the majority of adjacent mine waste areas west of SW 10<sup>th</sup> Street remain to be remediated
- Approximately 5,300,000 cubic yards of mining wastes were identified in OU-4
- Approximately 1,900,000 cubic yards of mining wastes remediated to date in OU-4





# TAR CREEK SURFACE AND SOIL SEDIMENT SAMPLING

- Sediment and surface soil sampling within the immediate floodplain was conducted north of State Line Road along and within Tar Creek and its northwest tributary in 2013
- Samples analyzed with hand-held XRF for cadmium, lead, and zinc
- Near-surface contamination related to mining wastes identified along Tar Creek and its northwest tributary in the creek channel and adjacent floodplain
- Mine waste observed in Tar Creek adjacent to mine waste areas



# 2013 SAMPLING RESULTS SUMMARY

Sample Depth (ft bgs)	No. of Samples	Cadmium		Lead		Zinc	
		Min	Max	Min	Max	Min	Max
		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
surface	48	BDL	243	19	11,967	281	78,200
0-6"	29	BDL	79	BDL	2,136	48	14,500
12-18"	28	BDL	59	BDL	6,432	32	12,700
24-30"	15	BDL	57	BDL	1,081	14	15,500
30-36"	10	BDL	194	BDL	1,552	32	27,767

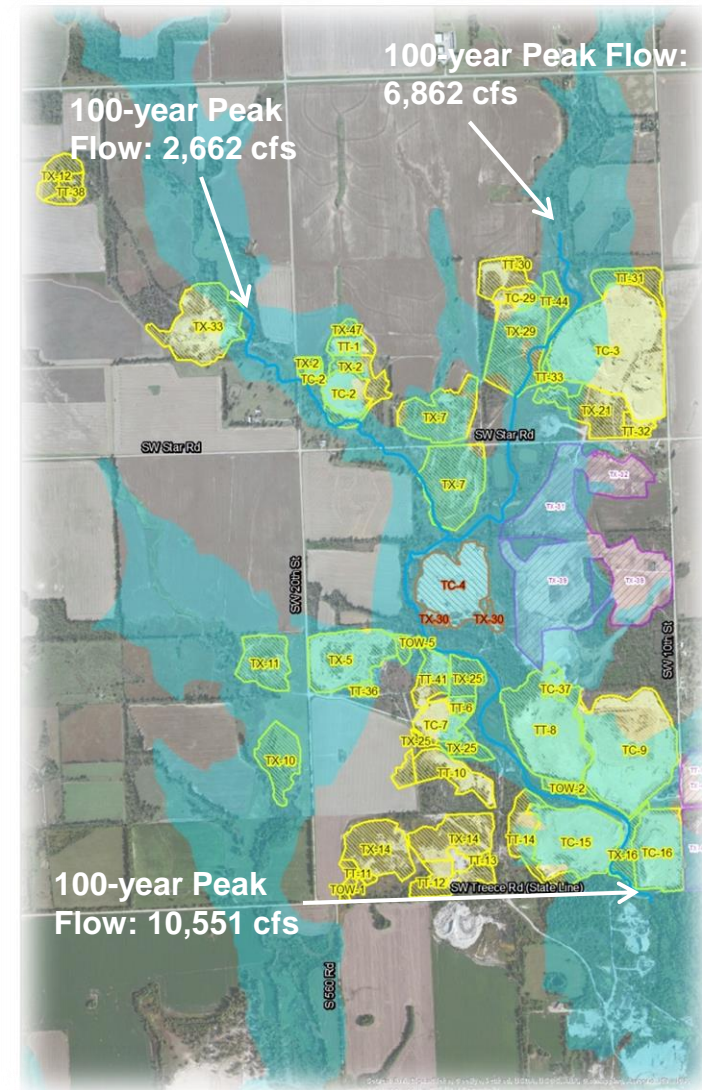
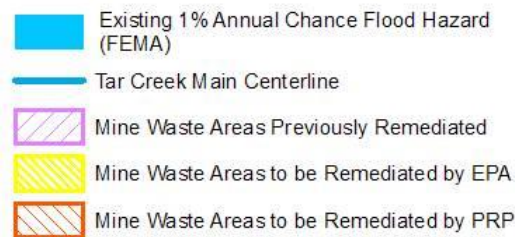
**Notes:** BDL = below detection limit of XRF

ROD Cleanup Goals = Cadmium (10 mg/kg), Lead (400 mg/kg), Zinc (1,100 mg/kg)



# TAR CREEK OU-4 HYDRAULICS AND HYDROLOGY

- Utilize Hydrologic Engineering Centers River Analysis System (HEC-RAS) version 4.1 to assist in remedial design of waste areas adjacent to the Tar Creek floodplain
- Map existing and proposed (remediated) 100-year floodplains





# EXISTING STREAM CROSSINGS

- Many of the existing stream crossings at county roads in the project area are in poor condition
  - Downstream of project area is a low-water crossing (State Line Road)
  - Culverts for main channel of Tar Creek are reinforced concrete pipes and the bridge is cast-in-place concrete
  - Culverts for Northwest Tributary are cast-in-place concrete bridges and have an open bottom



State Line Road Low-Water Crossing





# EXAMPLE OF EXISTING STREAM CROSSINGS



Tar Creek - SW Star Road Culverts  
Southwest of Muncie Pit



Northwest Tributary - SW Star Road Culvert  
Southeast of TC-2



# STREAM DEGRADATION ON NORTHWEST TRIBUTARY

- Examples of stream degradation include:
  - Headcutting, where the stream lowers grade
  - Bank erosion, caused by high velocities downstream of stream crossing as well as headcutting
  - Impaired water quality and wildlife habitat



Example of Bank Erosion



Example of Headcutting



# ENCROACHMENT OF WASTE PILES

- Waste piles at the downstream portion of the main channel infringe on the stream
- Sediment contamination from surficial mine waste
- Resuspension of sediments and metals is a mechanism of mine waste transport
- High stream velocities caused by waste piles on both sides of stream bank
- Potential for future stream degradation



Example of Mine Waste Encroachment

# EXISTING POOLS OF WATER

- Existing pools of water
  - Abandoned structures from old mining-related haul roads and railroad crossings impound water on Tar Creek
  - Animal activity, such as beaver dams also impound water



Example of Existing  
Structure Impounding Water

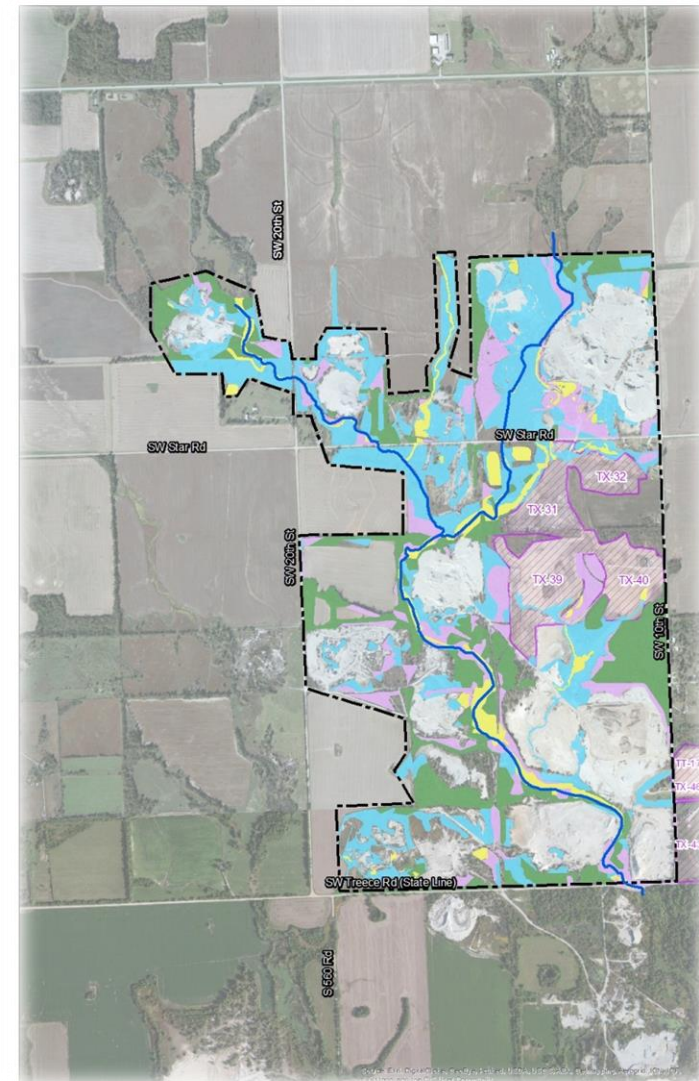


Example of Existing  
Structure Impounding Water



# WETLANDS

- Phase 1 – Review of publicly available data
  - 212 acres of wetlands and water bodies
- Phase 2 - Field verification
  - 445 acres of wetlands and water bodies observed
    - Palustrine forested wetland (125 acres)
    - Palustrine scrub-shrub wetland (74 acres)
    - Palustrine emergent wetland (201 acres)
    - Open water (45 acres)



# PALUSTRINE FORESTED WETLAND

- Characterized by woody vegetation that is 20 feet or taller. Dominated by broad-leaved deciduous trees.





# PALUSTRINE SCRUB-SHRUB WETLAND

- Dominated by woody vegetation less than 20 feet tall. Includes true shrubs and young trees or shrubs that are small or stunted because of environmental conditions.



# PALUSTRINE EMERGENT WETLAND

- Vegetation is present for the majority of the growing season in most years. Dominated by perennial plants that normally remain standing at least until the beginning of the next growing season.





# OPEN WATER

- Perennial pools within vegetated wetlands and largely un-vegetated portions of ponds and streams.
- May be located in topographic depressions or within a stream channel.
- Lacks emergent trees and shrubs and is devoid of emergent herbaceous vegetation much of the time.



# REMEDIATION STRATEGY

# GENERAL REMEDIATION STRATEGY

- Excavate mine waste, contaminated soil, and contaminated sediment and transport to and dispose at mine waste consolidation areas
- Cover mine waste consolidation areas with 12 inches of select fill and 6 inches topsoil
- Abandon vent pipes and open mine shafts
- Backfill excavated areas as needed for positive surface drainage



# GENERAL REMEDIATION STRATEGY (cont.)

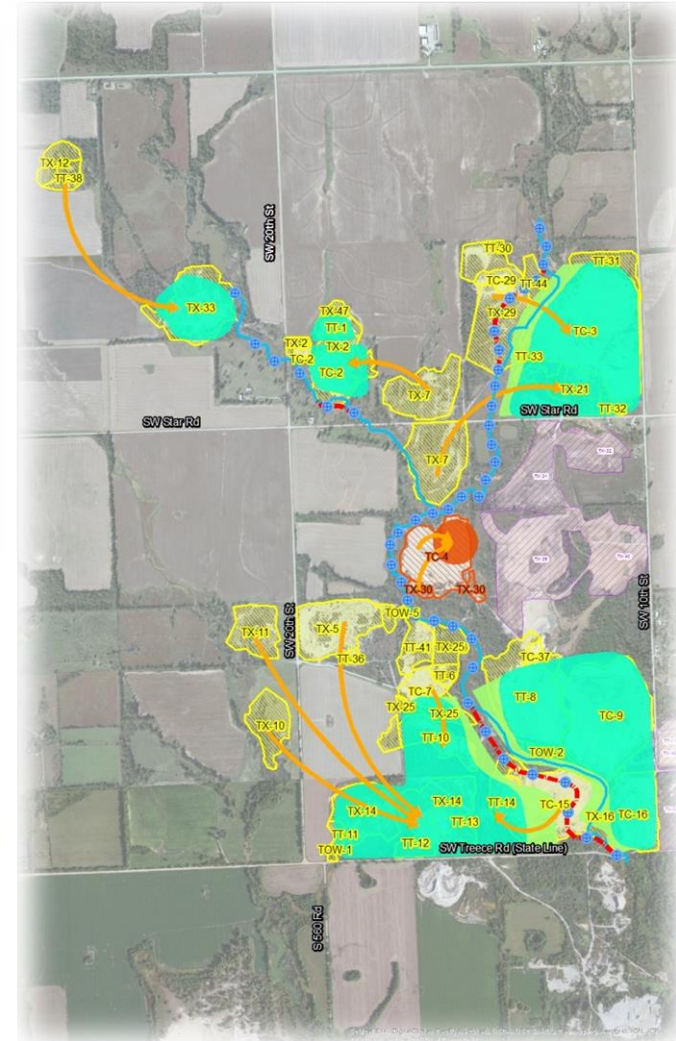
- Reduce the quantity of impacted watershed runoff to improve Tar Creek water quality
  - Consolidate and cover the mining wastes then revegetate the areas
  - Realign Tar Creek to provide separation from the mine waste consolidation areas
- Construct grade control structures to maintain stream elevations and alignments
- Seed disturbed areas
- Restore wetlands





# PRELIMINARY LOCATIONS OF MINE WASTE CONSOLIDATION AREAS

- Proposed locations were selected based on the following:
  - Proximity to existing mine waste areas
  - Volume of mine waste already present
  - Availability to expand existing mine waste consolidation area



# STREAM RESTORATION STRATEGIES

- Excavate mine waste and contaminated sediment and soil
  - Excavate visible mine waste adjacent to and within Tar Creek
  - Excavate 12-inches of contaminated sediment from Tar Creek
  - Backfill Tar Creek excavation to within 6 inches of original grade as needed
- Protect adjacent mine waste consolidation areas
  - Pull mine waste away from stream where practical
  - Realign stream away from large mine waste consolidation areas
  - Install turf reinforcement mat at the toe of the mine waste consolidation areas and within the creek channel
  - Construct flood benches near mine waste consolidation areas



# STREAM RESTORATION STRATEGIES (cont.)

- Restore creek hydraulics to a pre-remediation condition and address existing stream degradation
  - Construct Newbury riffles to hold stream in place
  - Install riprap aprons at downstream crossings to resist high velocities
  - Grade and vegetate banks to stabilize slope



Example of Newbury Riffle



# STREAM RESTORATION STRATEGIES (cont.)

- Replace artificial obstructions within creek to enhance ponded areas
  - Remove abandoned structures from old mining-related haul roads and railroad crossings that impound water
- Protect creek alignment upstream of existing road crossings
  - Construct in-stream structures upstream of road crossings to protect stream alignment in the event of future road improvements by county/state road departments



# WETLAND RESTORATION

- Goal of exceeding a minimum 1:1 ratio of wetlands for pre- and post-construction conditions
- Use wetland seed mix for restoration in majority of areas along creek
- Use wetland plugs in selected areas
- Provide additional maintenance of restored wetland areas to assist establishment

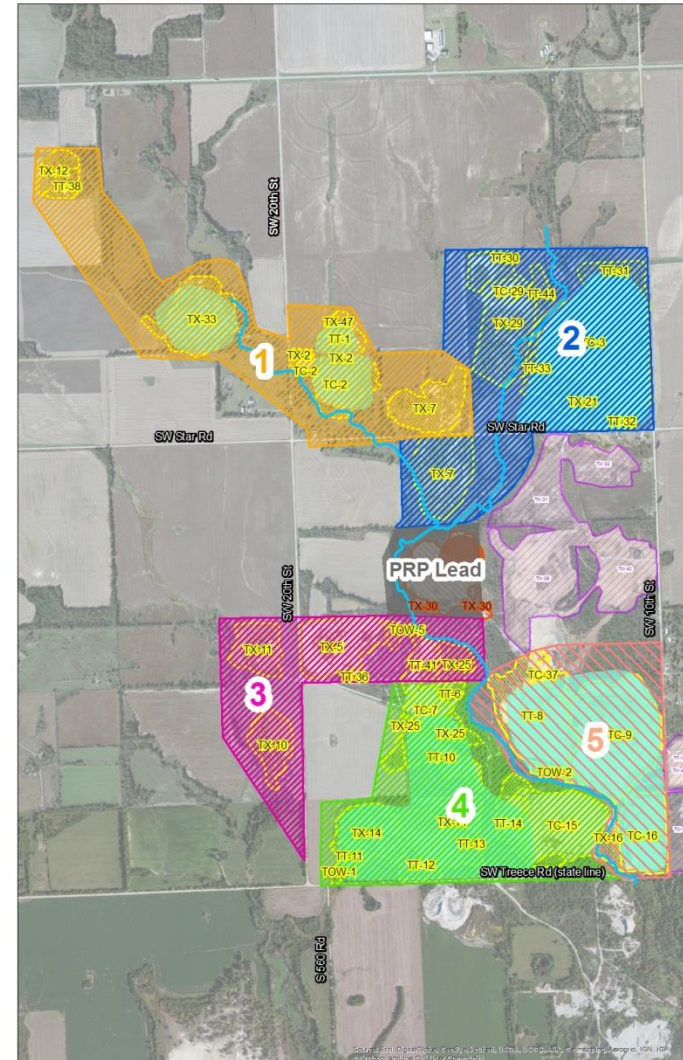


# PRELIMINARY PROJECT PHASING PLAN



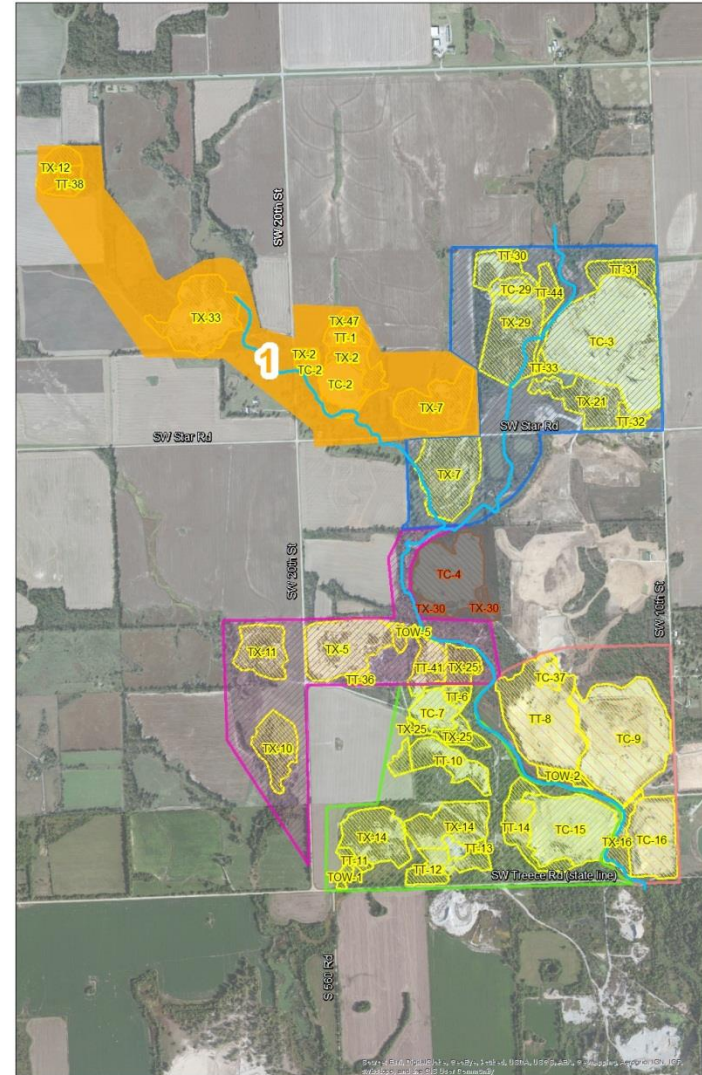
# PRELIMINARY PROJECT PHASING PLAN

- Remediation work would proceed from north (upstream) to south (downstream) to prevent recontamination of remediation areas
- Phases dependent on available funding
- Minimum of five phases may be needed to complete remediation



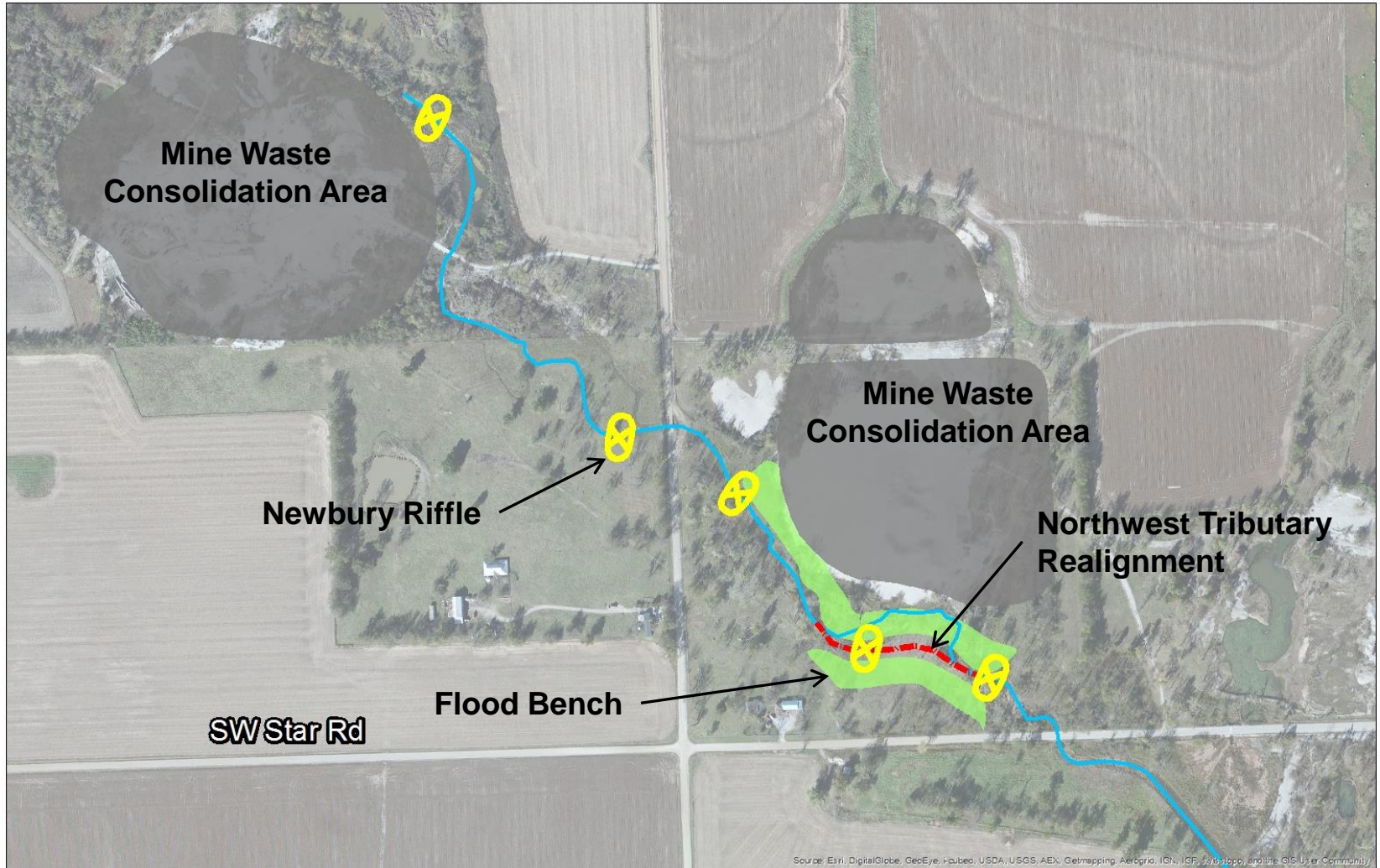
# PHASE 1

- Design for Phase 1 is currently underway
- Remediate Northwest Tributary of Tar Creek north of Star Road
- Excavate mine waste, contaminated soil, and contaminated sediment
- Consolidate material on the east and west sides of SW 20<sup>th</sup> Street, and construct cover
- Realign tributary to avoid existing structures
- Restore and revegetate existing pastures and wetlands





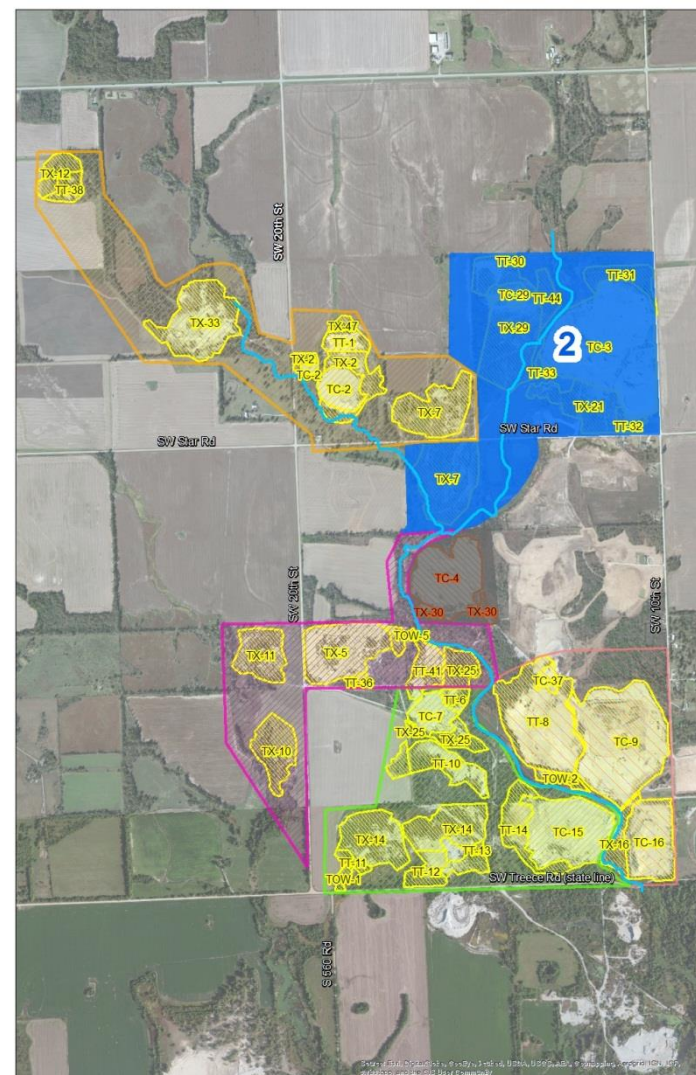
## PHASE 1 (cont.)



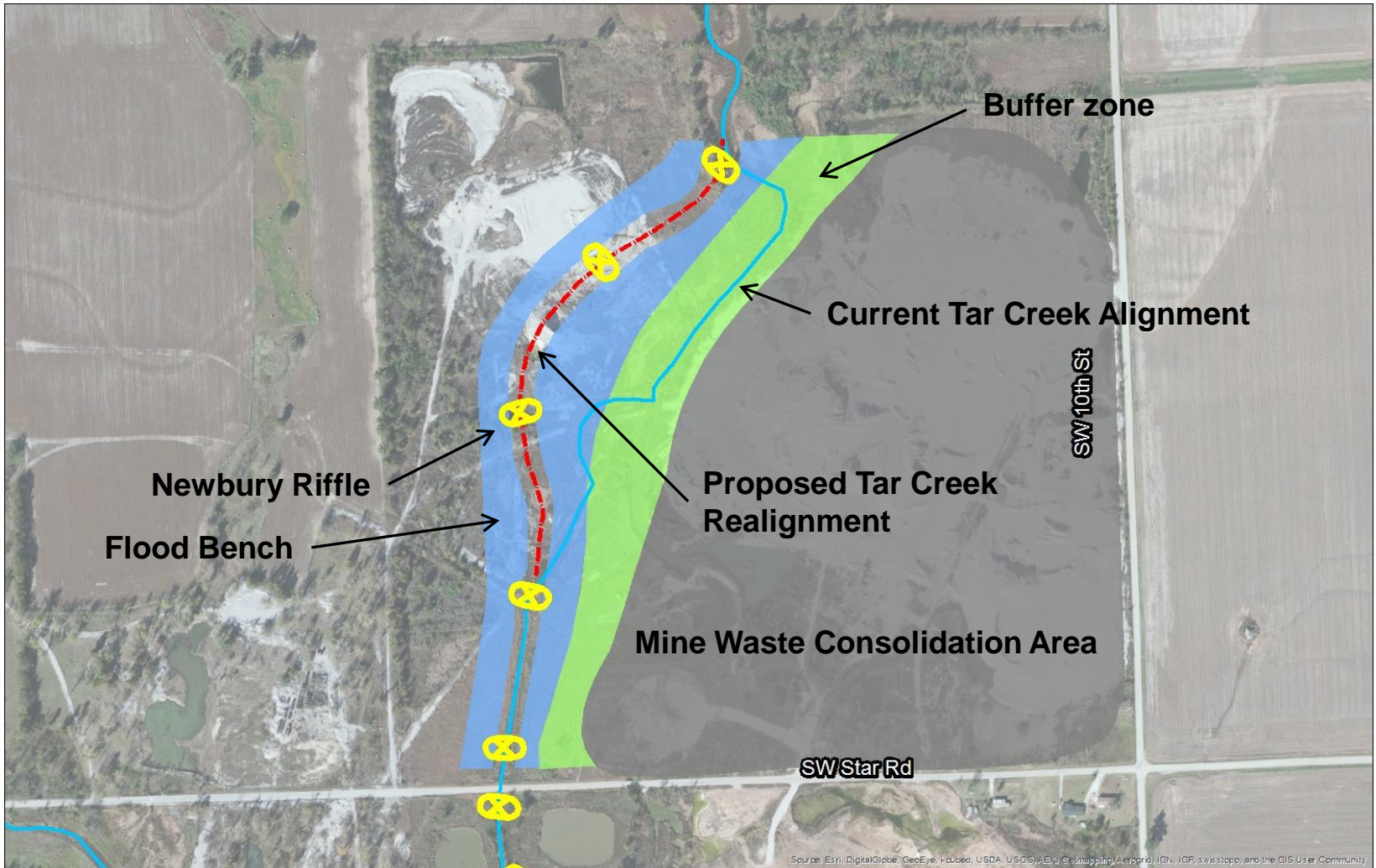


## PROPOSED PHASE 2

- Remediate Tar Creek north of Star Road, northwest tributary south of Star Road (TX-7 South), and adjacent mine waste areas
- Excavate mine waste, contaminated soil, and contaminated sediment
- Consolidate material on existing TC-3 mine waste area
- Place cover on mine waste consolidation area
- Realign Tar Creek to the west in existing mine waste area to provide separation from mine waste consolidation area

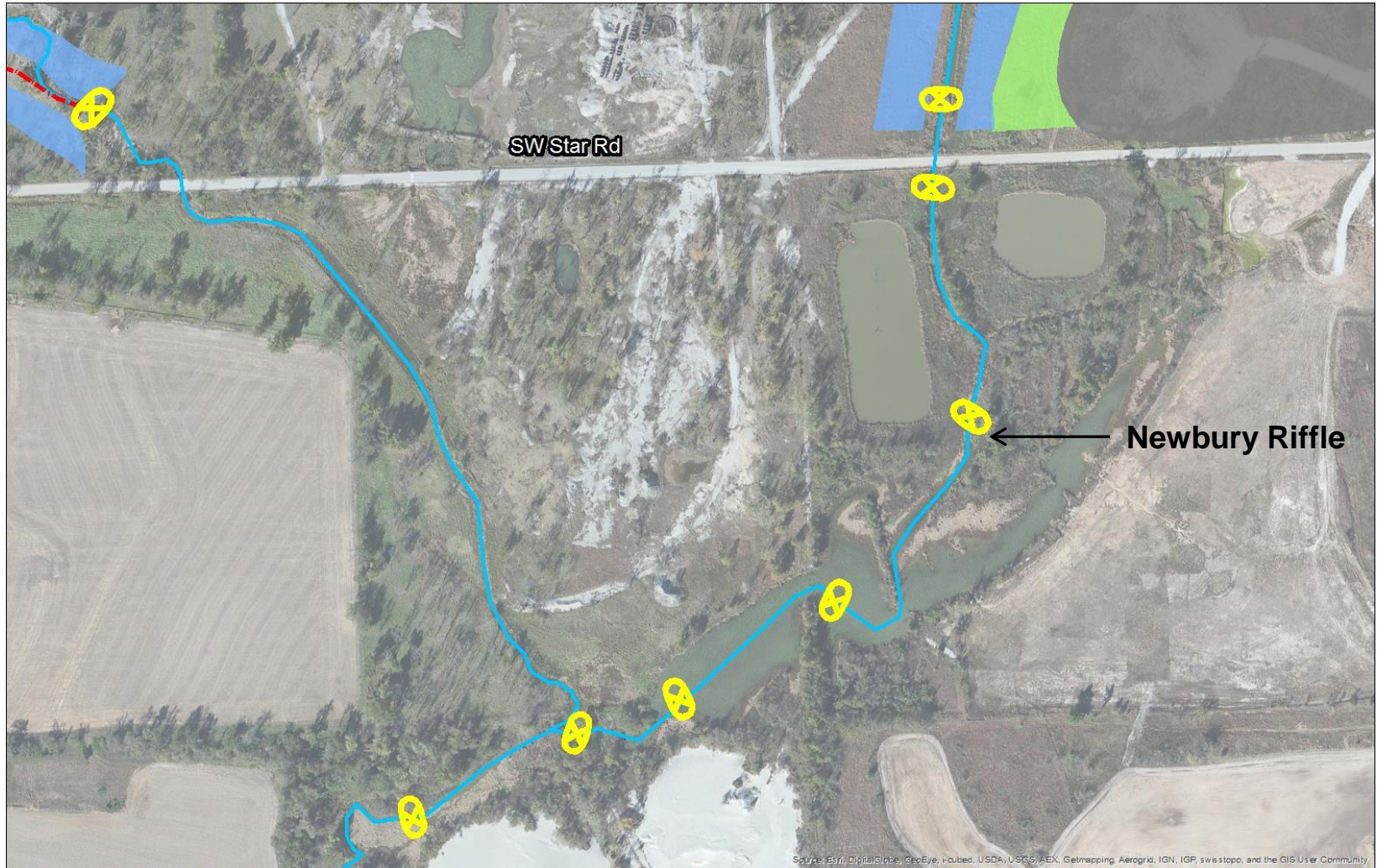


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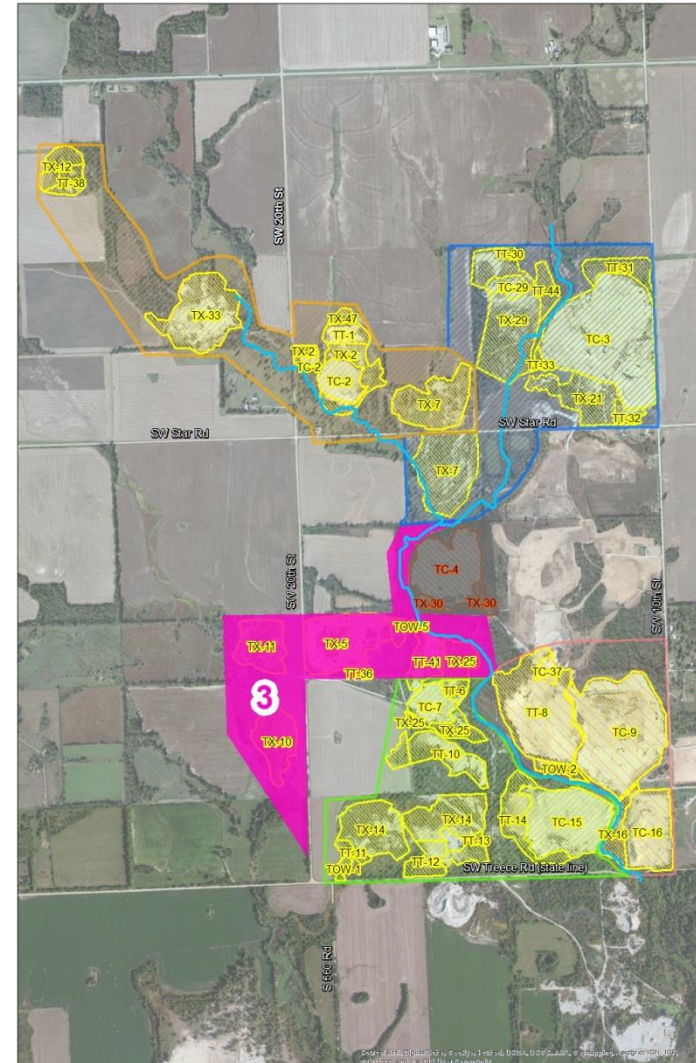
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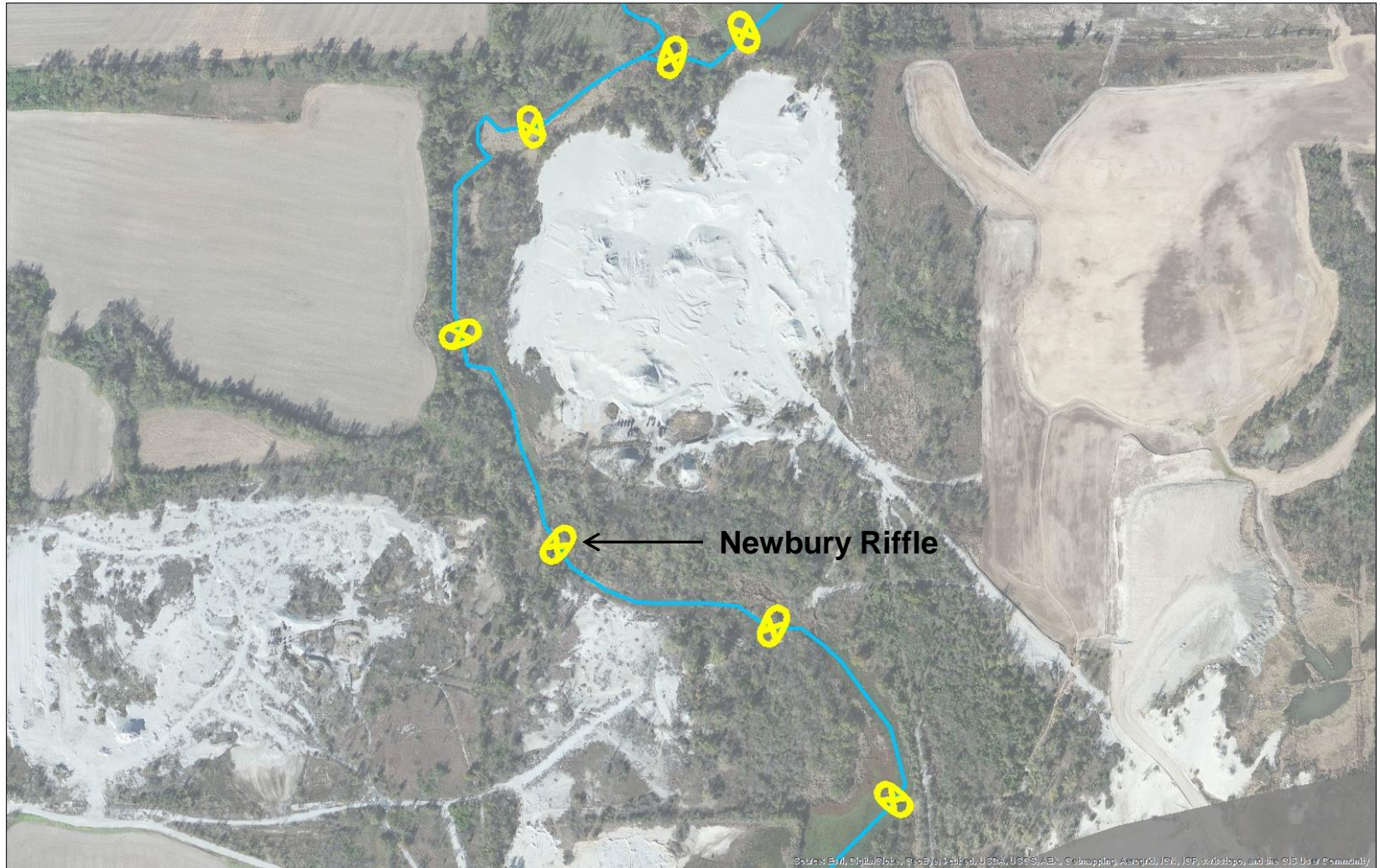


# PROPOSED PHASE 3

- Remediate Tar Creek south of Star Road to TC-4
- Excavate mine waste, contaminated soil, and contaminated sediment and place at southwest mine waste consolidation area
- Remedial action design and implementation at TC-4 will be conducted by a potentially responsible party (PRP) which will be incorporated into the overall design for Tar Creek



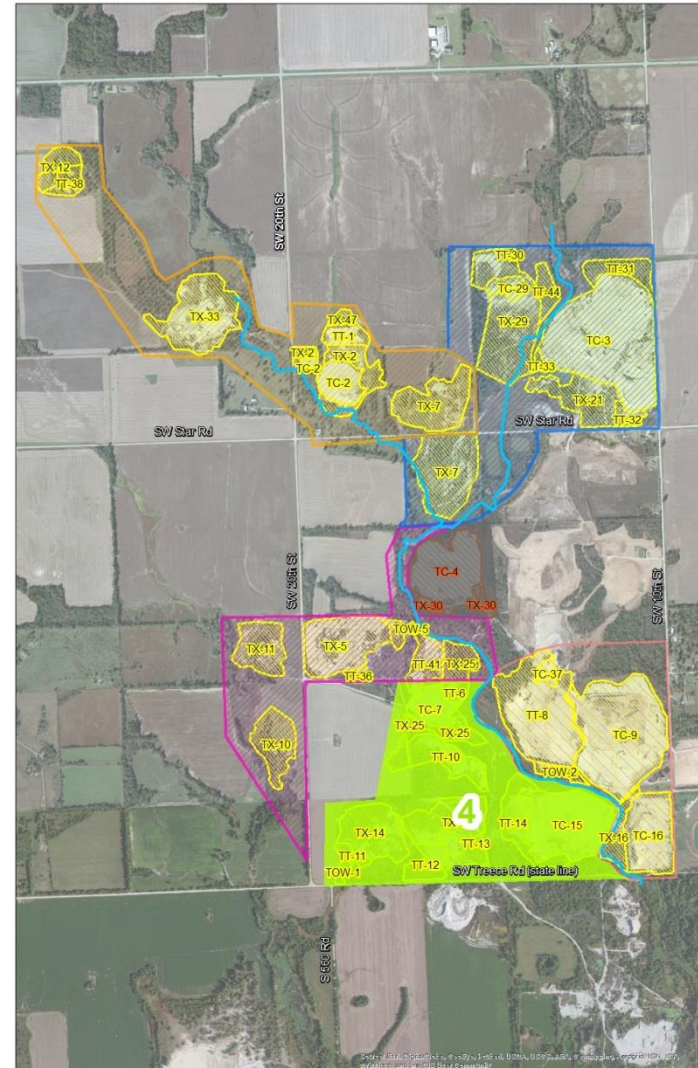
## PROPOSED PHASE 3 (cont.)





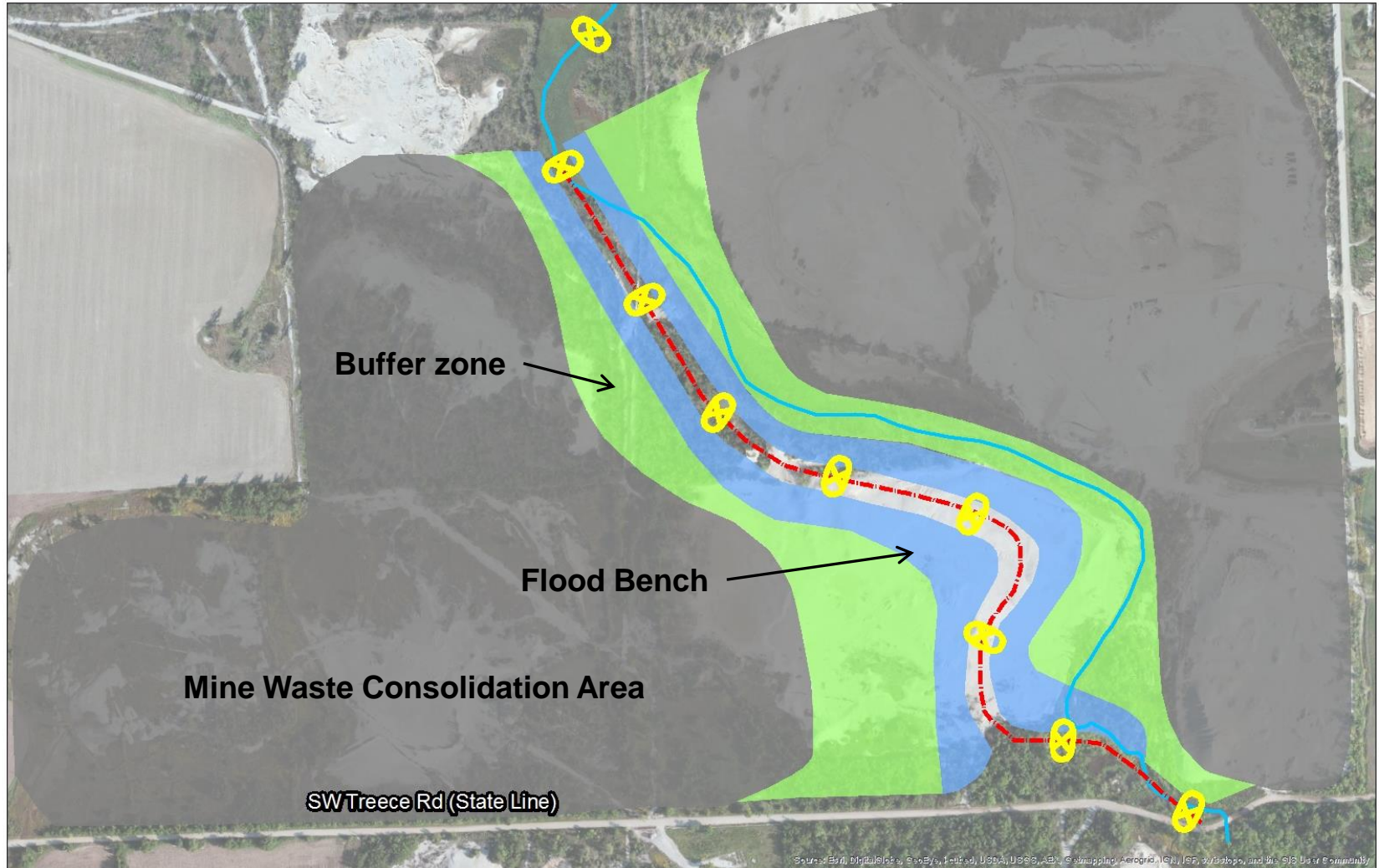
## PROPOSED PHASE 4

- Pull back mine waste and contaminated soil from areas TC-15/TT-14 for later realignment of Tar Creek
- Excavate mine waste, contaminated soil, and contaminated sediment and place in southwest mine waste consolidation area
- Place cover on southwest mine waste consolidation area



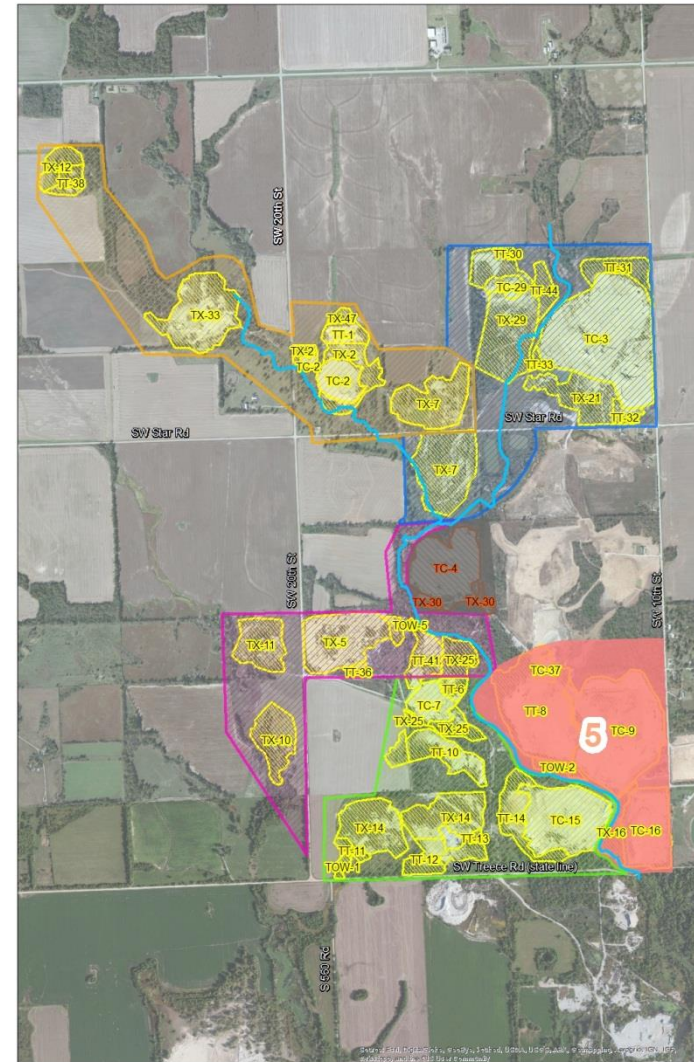


# PROPOSED PHASE 4 (cont.)



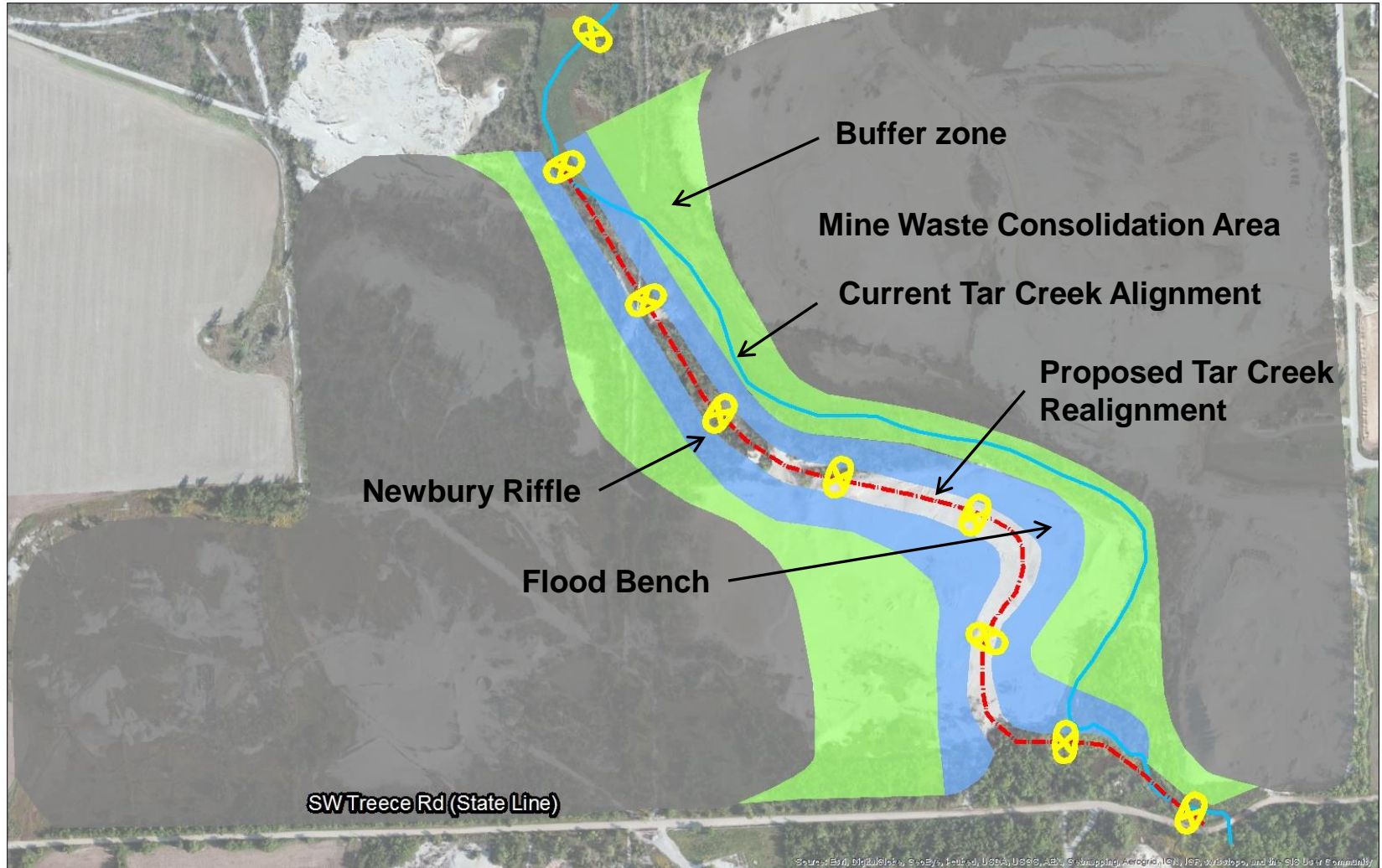
## PROPOSED PHASE 5

- Remediate Tar Creek from the former railroad spur to State Line Road in areas not subject to realignment
- Realign Tar Creek to provide separation from TC-9/TT-8/TOW-2 mine waste consolidation area and address previous concerns regarding leaching from subsurface contaminants
- Excavate mine waste, contaminated soil, and contaminated sediment and place at mine waste consolidation area
- Redirect drainage north of mine waste consolidation area to west Tar Creek





# PROPOSED PHASE 5 (cont.)





# Water Quality Sampling

- Design team is developing a water quality sampling program for OU-4
- Build upon previous efforts in the Tri-State area
- Sampling protocol
  - Sample pre- and post-construction for each phase
  - Sample upstream and downstream of remediated areas
- Long-term sampling will provide indication of success of the remediation



# Tar Creek Aquatic Macroinvertebrate Study

## Goals

1. Determine ecological success of stream remediation and restoration.
  - Steady increase in aquatic macroinvertebrate diversity over time,
  - Increase in pollution (heavy metals) sensitive insect larvae over time, which includes the Orders; Ephemeroptera (Mayflies), Plecoptera (Stoneflies), and Trichoptera (Caddisflies) (**EPT**).



**E**



**P**



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# Tar Creek Aquatic Macroinvertebrate Study Continued...

## Process

1. Identify sites, collect baseline (pre-remediation) aquatic macroinvertebrate samples and physical stream habitat information (e.g. habitat sheets). Identify, enumerate, and analyze the invertebrates at EPA's STC (metrics; including richness, diversity indices, EPT, %Chironomidae, etc.).
2. Collect the same samples post remediation/restoration annually for five years.





# Tar Creek Aquatic Macroinvertebrate Study Continued...

## Results

- A final document containing yearly information including taxonomic lists, metrics, graphs, habitat sheets, and a summary of conclusions describing our findings.



A healthy aquatic insect population in a stream is an excellent food source for fish and other ecological receptors. The Clean Water Act also requires that we look at the biological integrity of our waters when determining ambient water quality.

# CONCLUSIONS

# CONCLUSIONS

- Remove and consolidate remaining mine waste, contaminated soil, and contaminated sediment adjacent to and within Tar Creek and OU-4
- Remediate Tar Creek from upstream to downstream in multiple phases.
- Restore and stabilize Tar Creek and adjacent areas including wetlands
- Conduct pre- and post-construction water quality/macroinvertebrate sampling.
- Determine validity of remediation.





QUESTIONS?