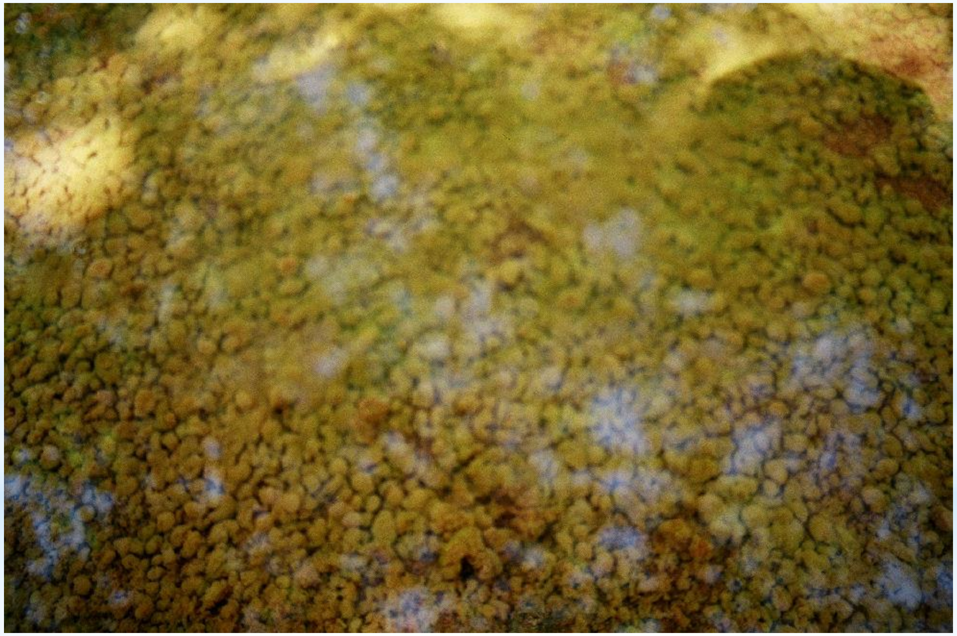
Concentrations, loads, and trends of iron, lead, and zinc in streams and sediments in the Oklahoma part of the Tri-State mining district, 2000-2006



By W.J. Andrews, M.F. Becker, S.L. Mashburn, and S.J. Smith,

USGS Oklahoma Water Science Center

for the 31st National Meeting of the American Society of Mining and Reclamation

Oklahoma City, Okla.,

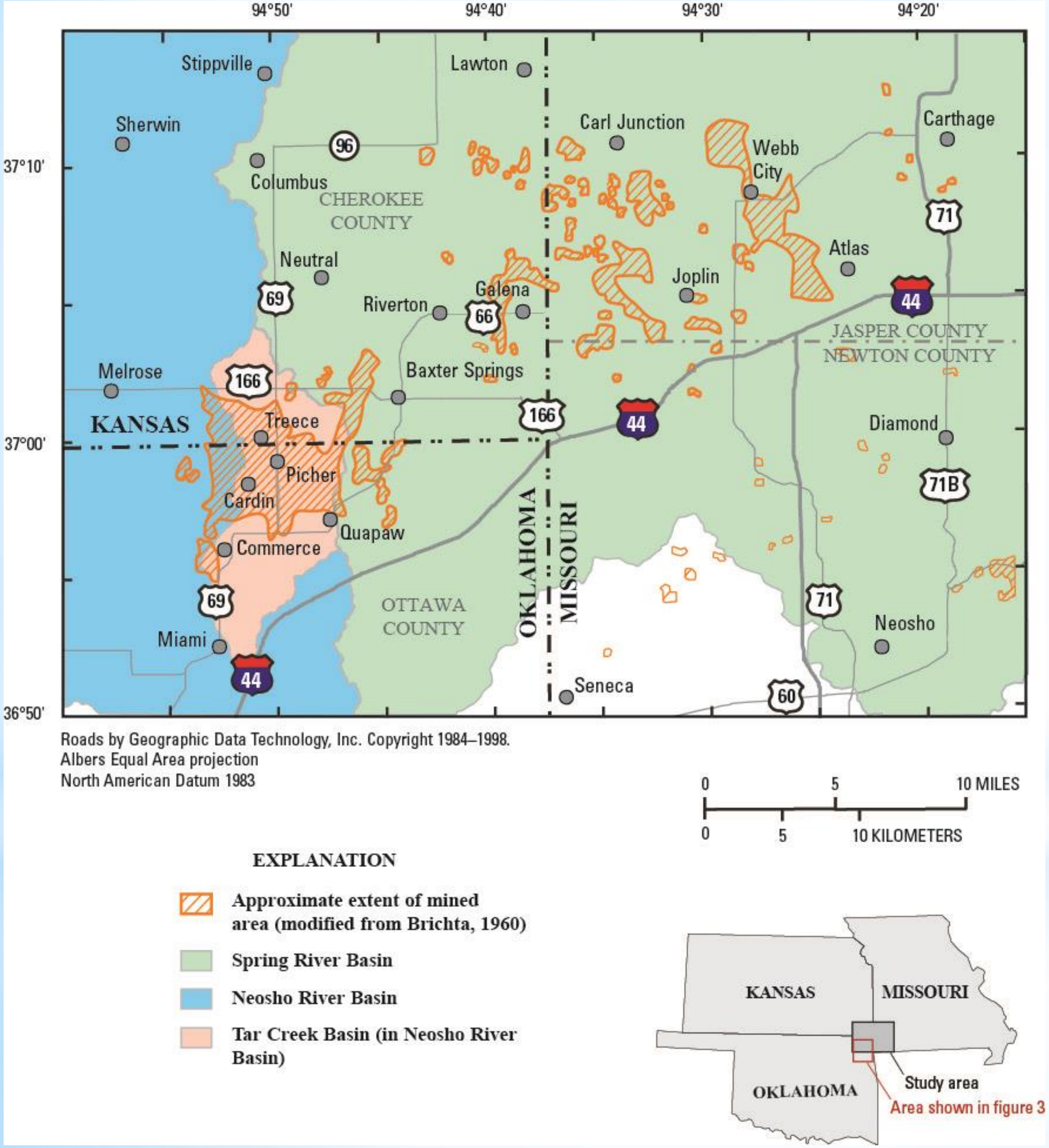
June 2014

USGS science for a changing world

Introduction

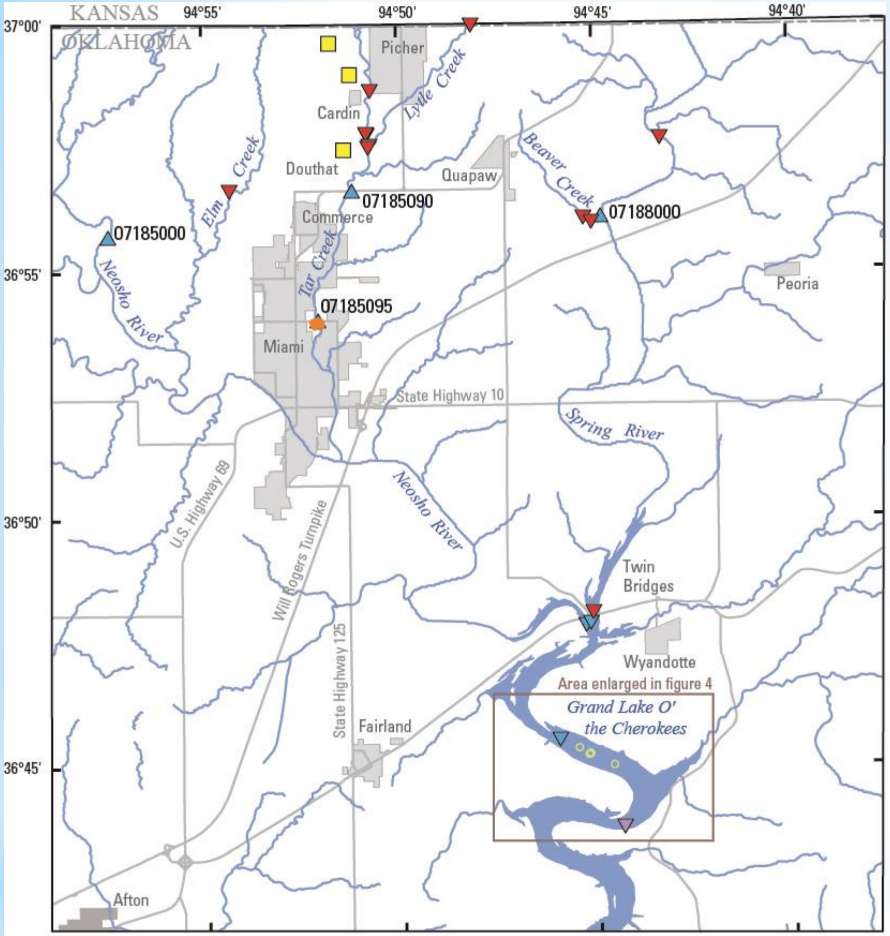
- The abandoned Tri-State mining district encompasses 1,188 sq. miles in northeast Oklahoma, southeast Kansas, and southwest Missouri.
- The 40-sq-mile part of the district in Oklahoma, known as the Picher mining district, was a primary producing area of lead and zinc from sulfide ores in the U.S. during the first half of the 20th century.
- Lead, zinc, and other metals in mine tailings, mine seeps, local soils, and streambed and lakebed sediments are ongoing sources of contamination for people and wildlife in and downstream of this abandoned mining district.
- The USGS Oklahoma Water Science Center summarized metals-concentration data collected from streams, sediments on streambeds, lakebeds, and floodplains to characterize occurrence and distribution of metals at selected sites in and downstream of this abandoned mining district collected by previous studies. Results were published in USGS Scientific Investigations Report 2009-5032.
- Though the last of these data were collected in 2006, metals concentrations in many parts of this mining district are unlikely to have changed substantially in the past several years.

Study area



Proportions of mined lands in these 3 basins were 40.2% (Tar Creek), 1.9% (Spring River), and 0.34% (Neosho River).

Sampling sites

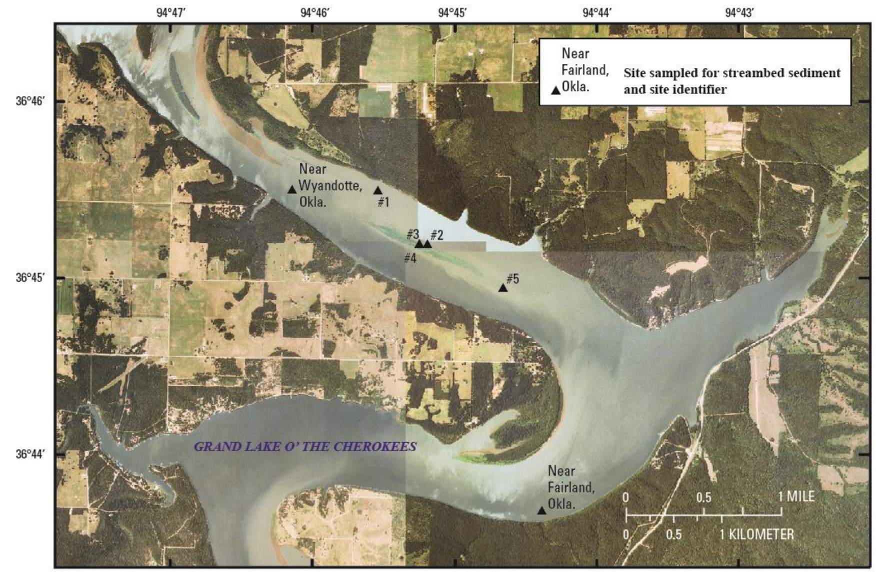


Hydrography, roads, and cities from Oklahoma Water Resources Board, Albers Equal Area Conic Projection, North American Datum 1983

0 5 MILES
0 5 KILOMETERS

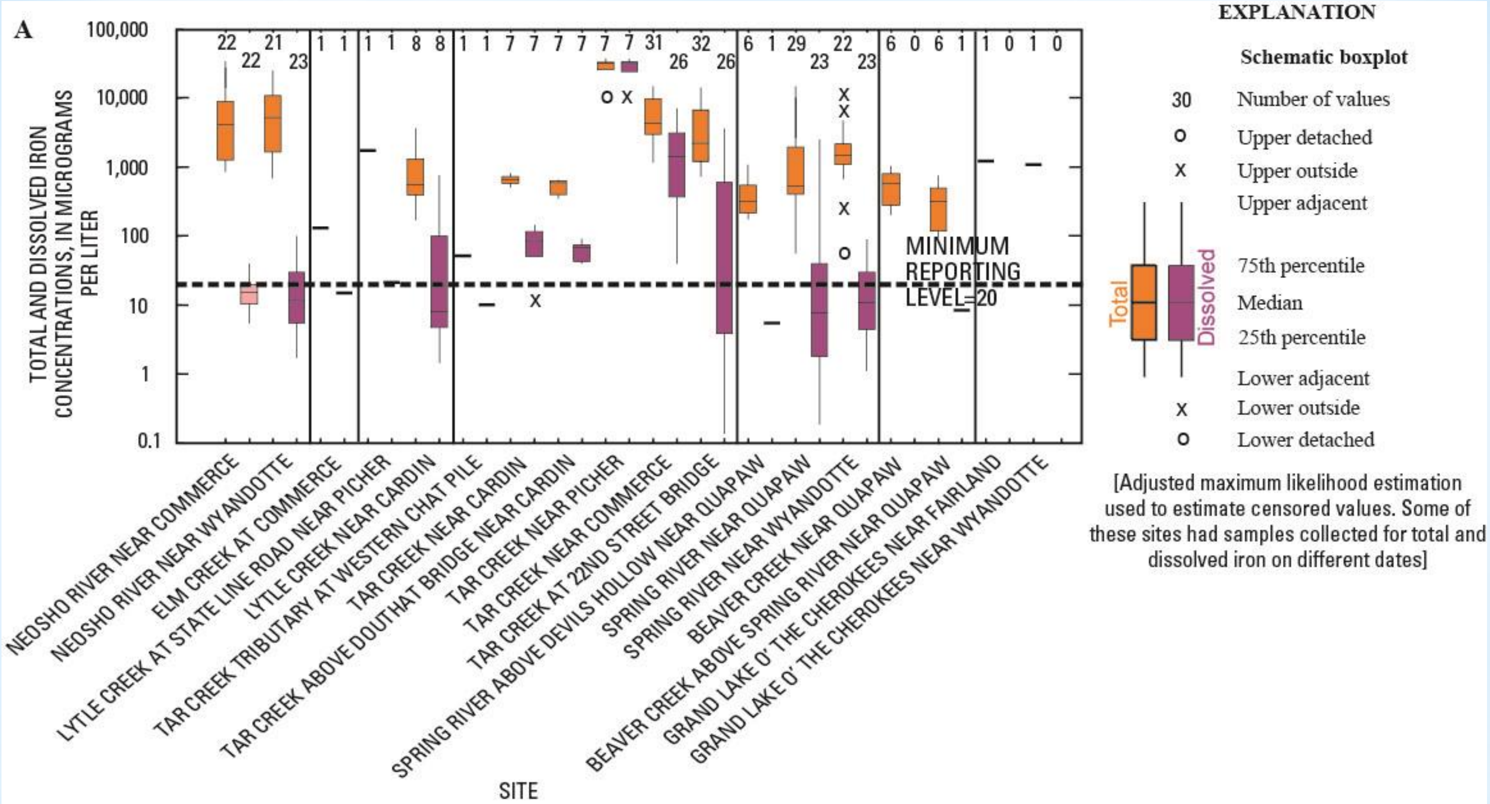
EXPLANATION

- Tailings sampling location
- Surface-water and dredge sample, ungaged site
- 07188000 Surface-water and dredge sample, gaged site and identifier
- Surface-water, dredge, and sediment core sample, ungaged site
- 07185095 Surface-water, dredge, and sediment core sample, gaged site and identifier
- Grand Lake O' the Cherokees sandbar sediment core sample
- Tar Creek floodplain sediment core sample
- Surface-water-quality sample, ungaged site



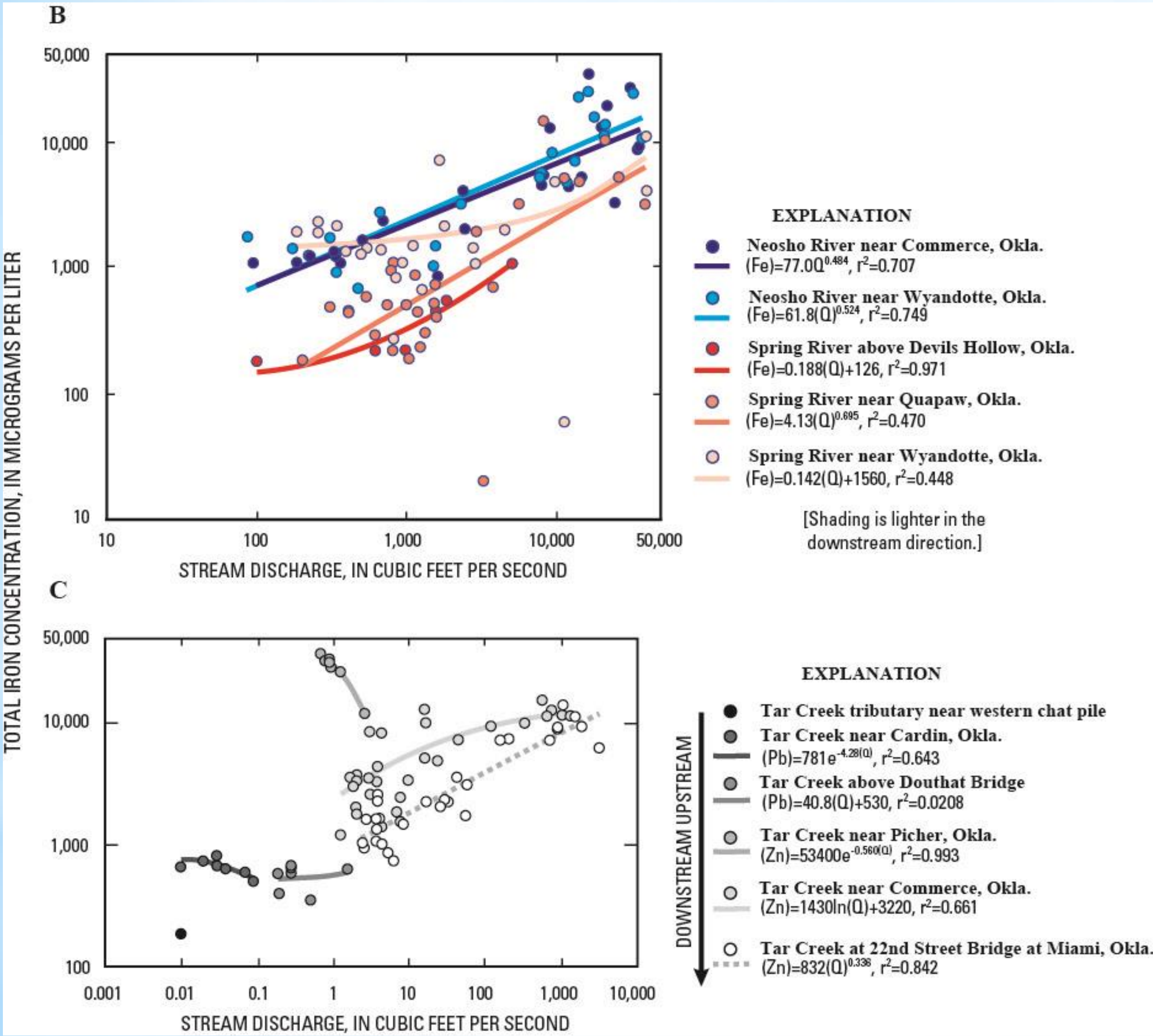
Aerial photo mosaic from
U.S. Department of Agriculture (2003)
Universal Transverse Mercator,
Zone 15N Projection
North American Datum 1983

Iron concentrations in water at selected stream sites



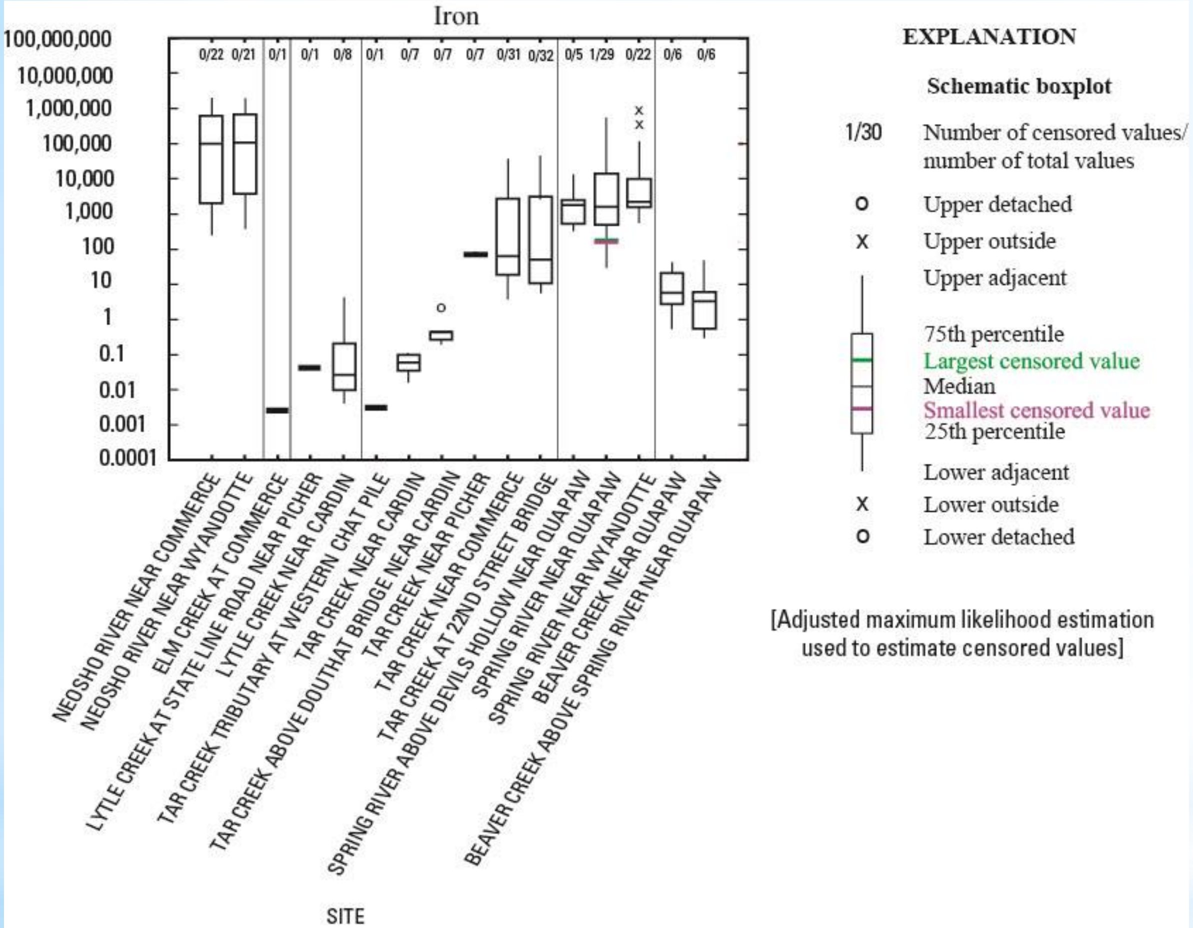
- Iron is one of the most “visible” metals in local streams due to oxidation into oxide, hydroxide, and oxyhydroxide mineral flocs.
- Iron concentrations generally were highest at the Tar Creek and Neosho River sites.

Iron concentration versus streamflow



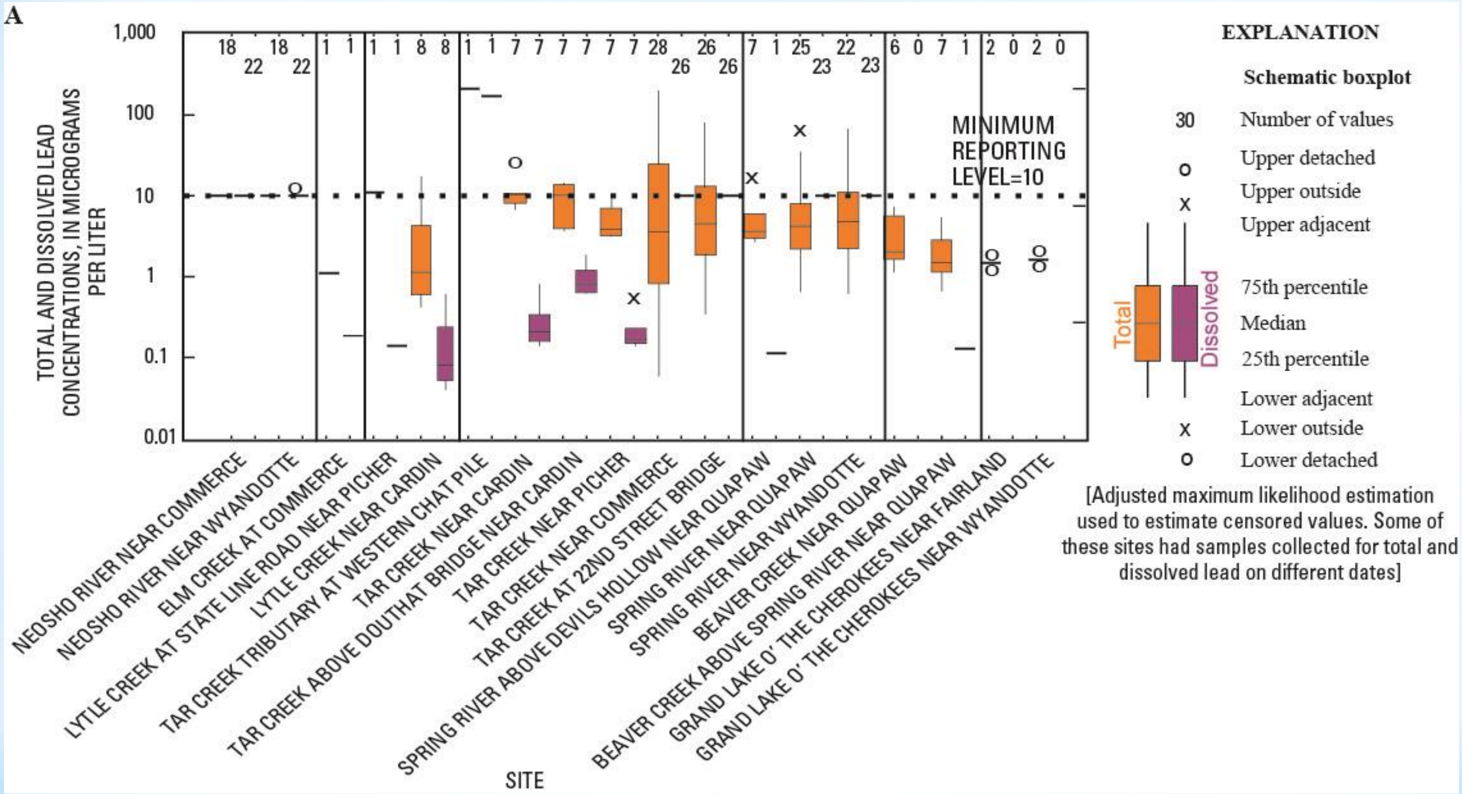
- Iron concentrations generally increased with streamflow, probably due to greater runoff and resuspension of streambed sediments at higher flows.
- At the Tar Creek site with the highest iron concentrations and the site near Cardin, the opposite relation was true, indicating dilution of nearby seeps (point sources) at higher flows.

Instantaneous iron loads



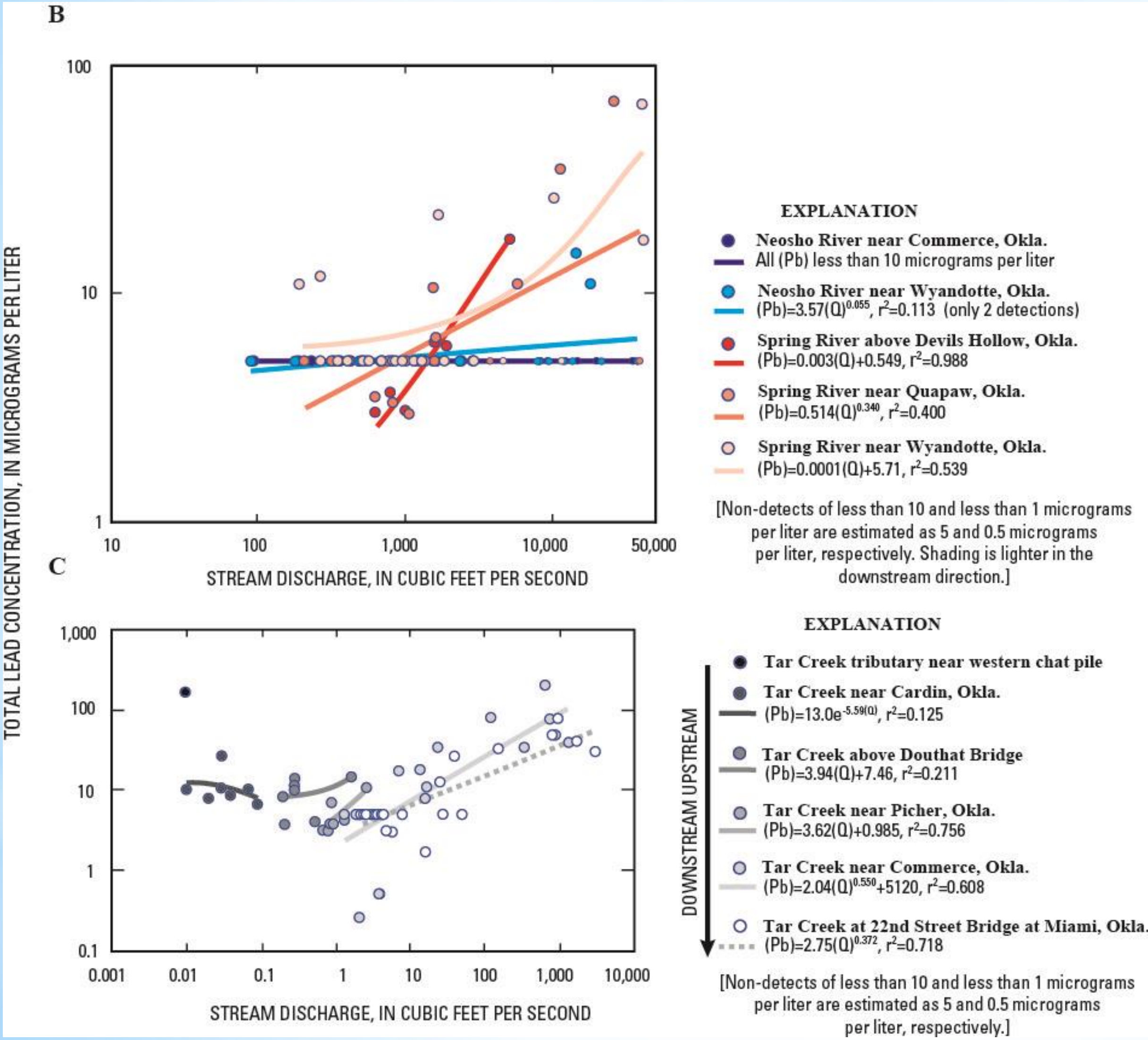
- Iron loads were greatest in the Neosho River.
- Iron loads increased in the downstream direction at the Tar Creek sites.

Lead concentrations in water at selected stream sites



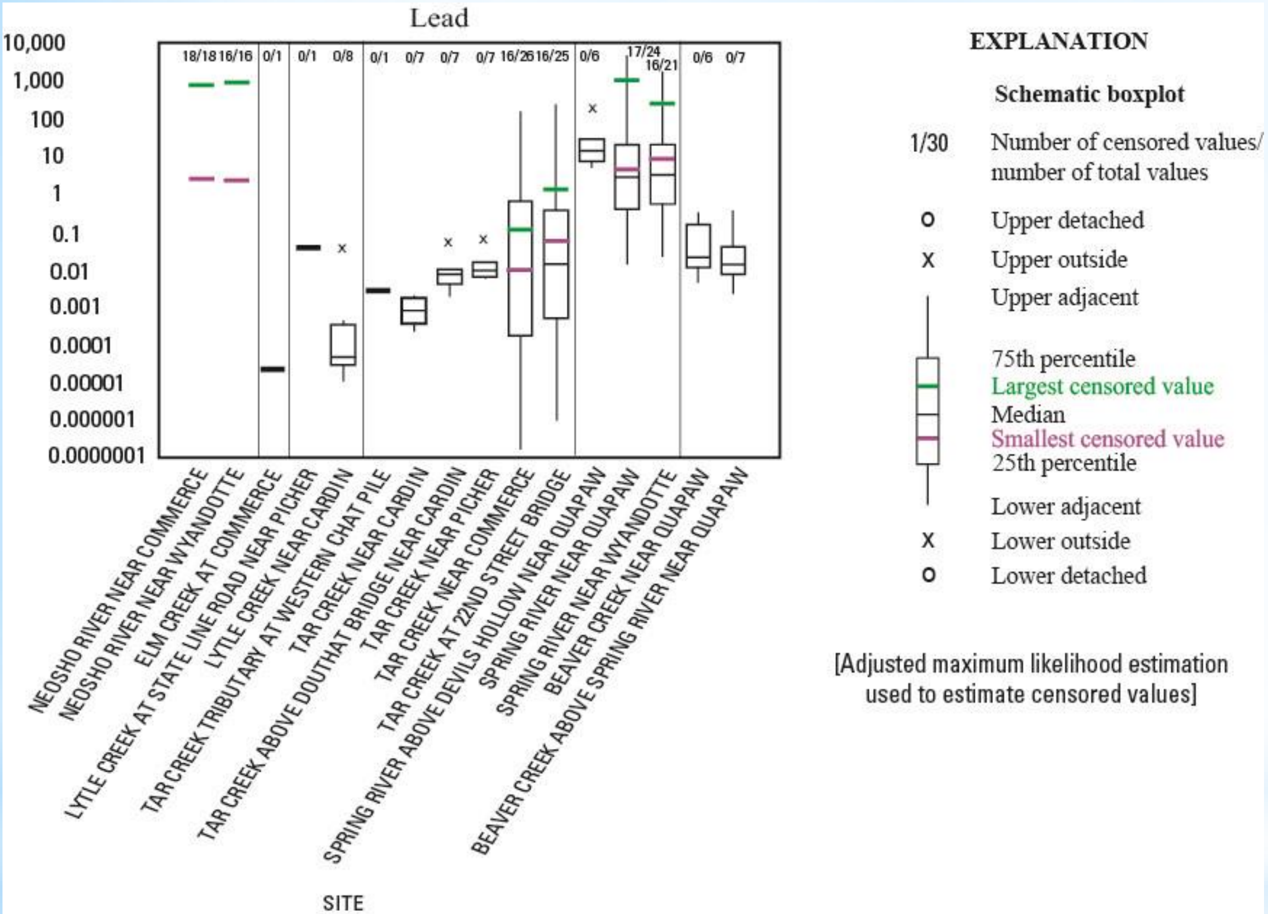
- Lead concentrations generally were less than reporting limits.
- The highest lead concentrations were in water samples collected from Tar Creek.

Lead concentration versus streamflow



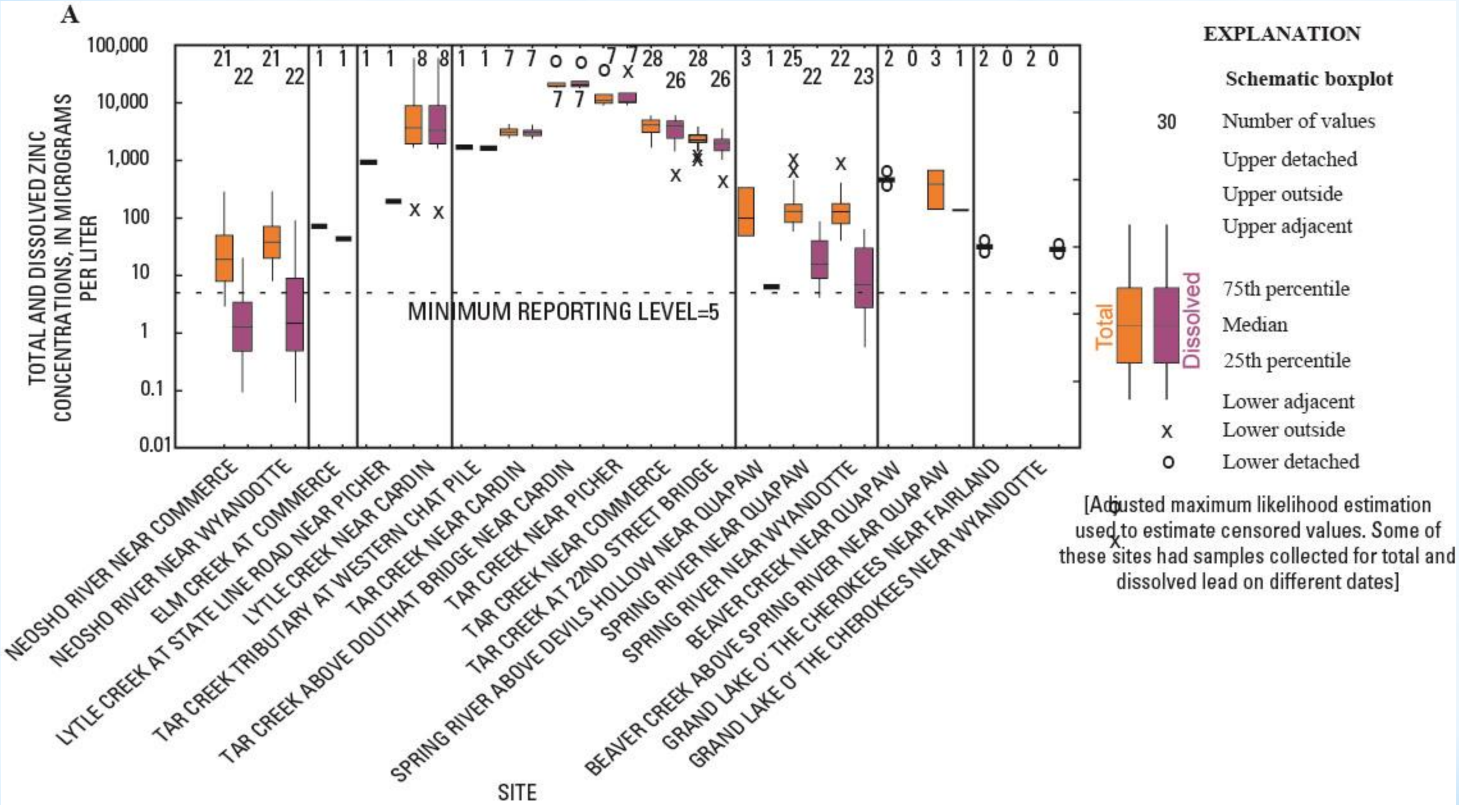
- Similar to iron, lead concentrations tended to increase with flow at many sites.
- Lead concentrations tended to be greater in the Spring River than in the Neosho River.
- As with iron, lead concentrations decreased slightly with increasing streamflow at the Cardin site.
- Unlike iron, the highest lead concentration was measured at the furthest upstream site on Tar Creek.

Instantaneous lead loads



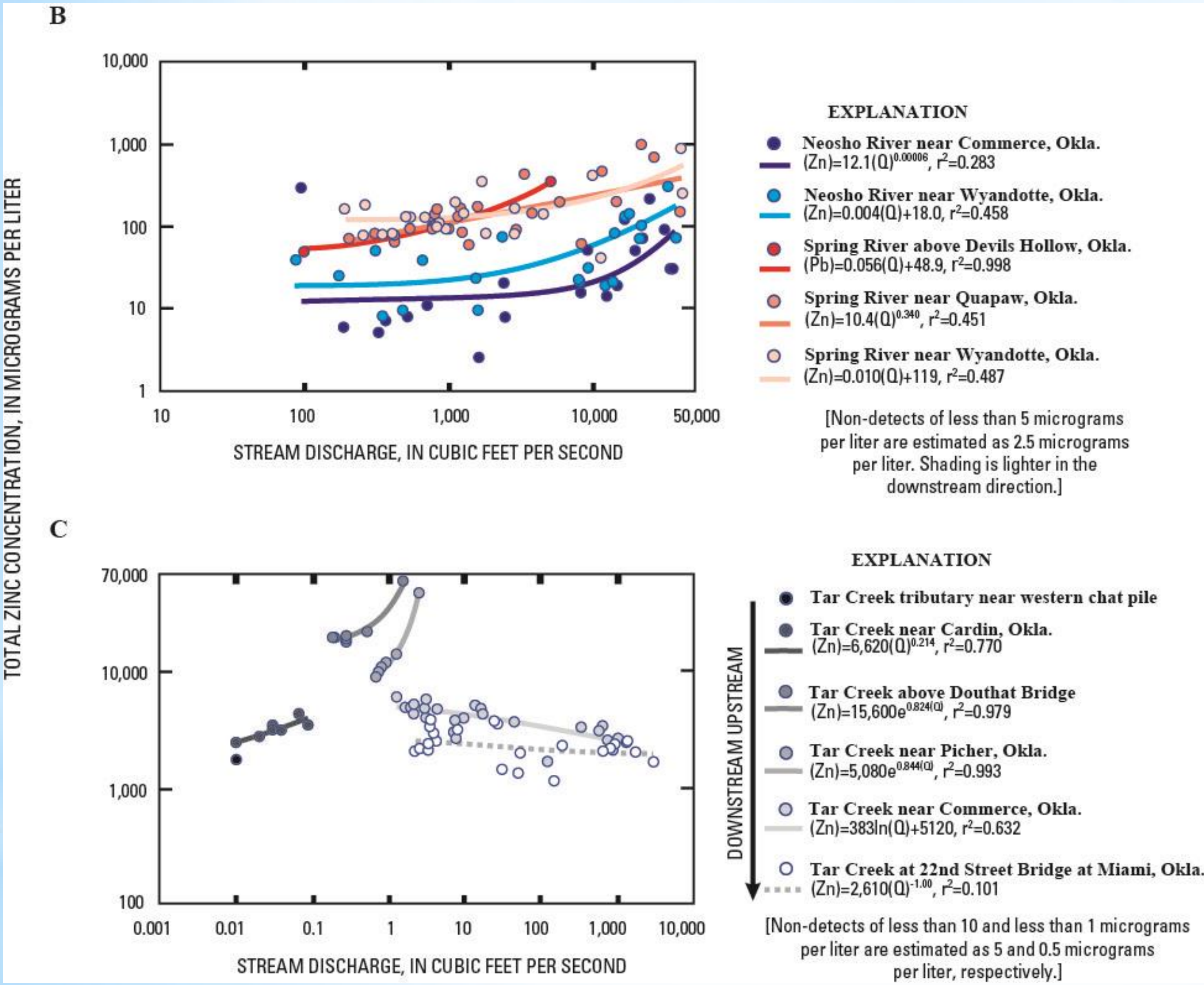
- Lead loads were highest at the Spring River Sites.
- Lead loads generally increased in the downstream direction at the Tar Creek sites.

Zinc concentrations in water at selected stream sites



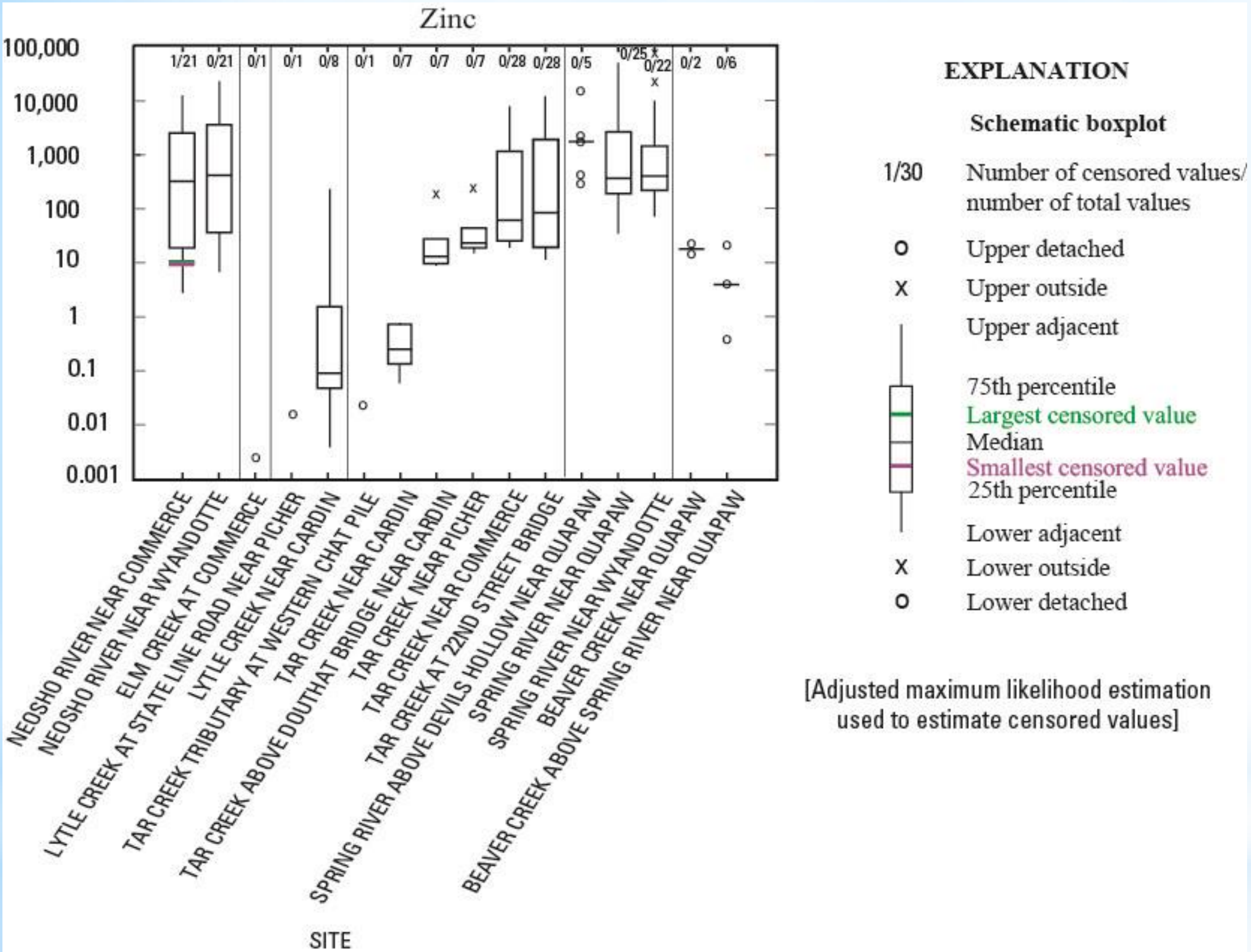
- Zinc concentrations were greatest at the sites on Tar Creek and Lytle Creek.
- Total zinc concentrations were higher at the Spring River sites than the Neosho River sites.

Zinc concentration versus streamflow

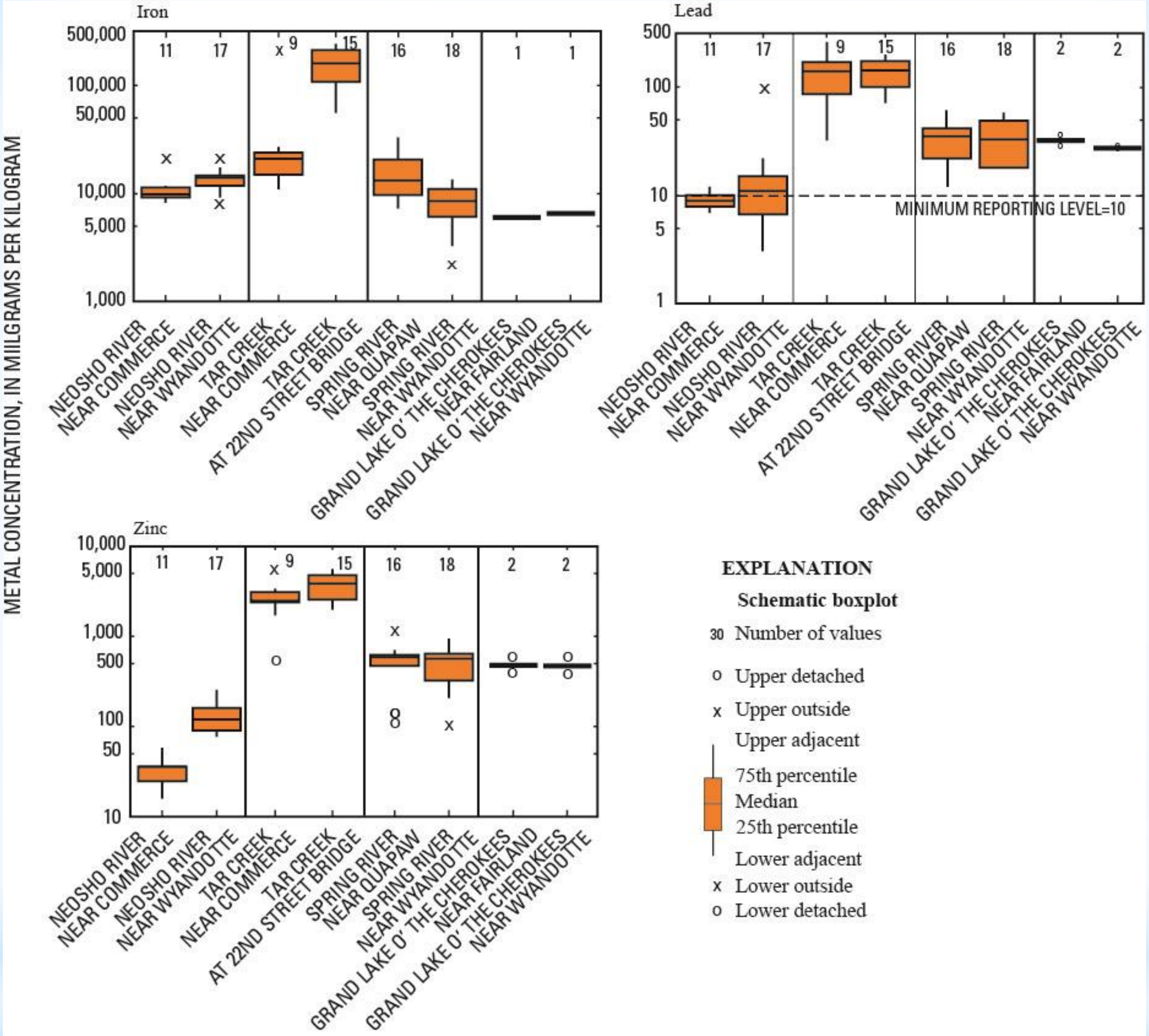


- Zinc concentrations generally increased with streamflow at the Spring and Neosho River sites.
- Zinc concentrations increased with streamflow at the upstream sites on Tar Creek, but slightly decreased with streamflow at the downstream sites, perhaps related to the distribution of metals in the district?

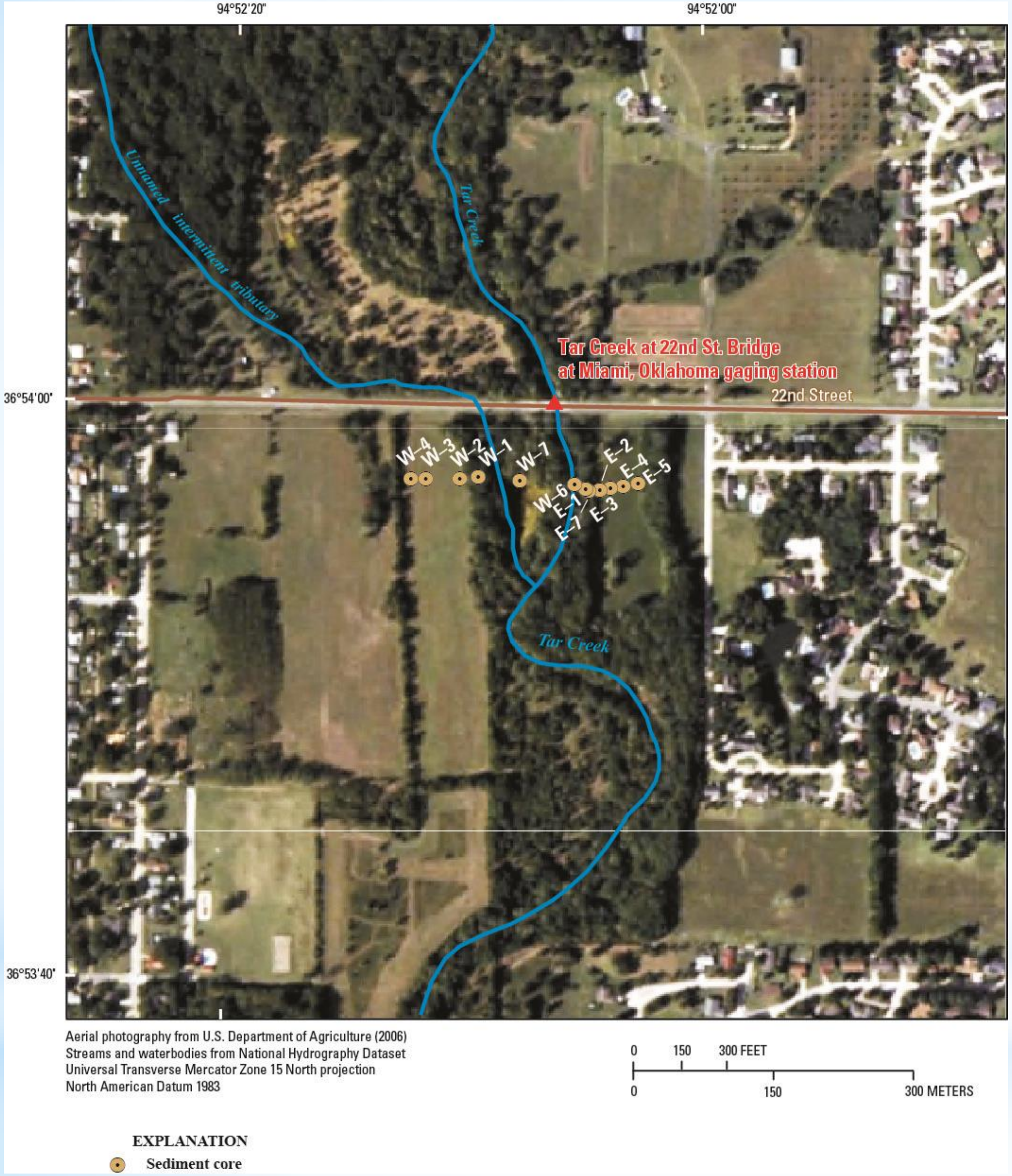
Instantaneous zinc loads



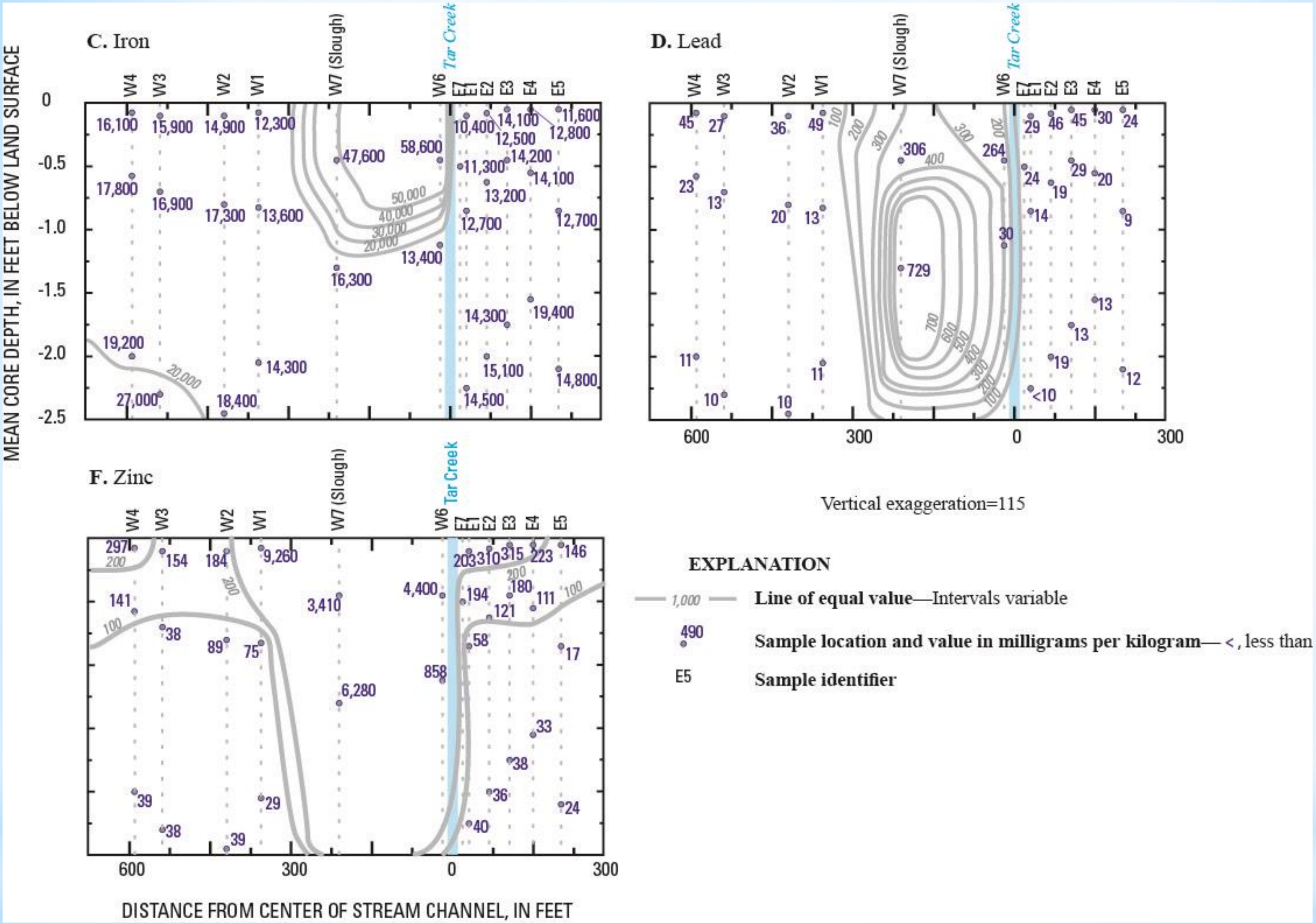
- The largest zinc loads were measured at sites in the Spring River Basin, which is a larger watershed, has larger flows and has a greater proportion of mined area.
- Like iron and lead, zinc loads increased substantially in the downstream direction at the Tar Creek sites.



- Streambed sediments were collected at eight sites upstream and in the upstream arm of Grand Lake O' The Cherokees.
- Iron, lead, and zinc concentrations generally were highest in sediment samples collected at the two Tar Creek sites.
- Lead and zinc concentrations were higher in sediment samples collected at the Spring River and Grand Lake sites than at the Neosho River sites.
- Most of these iron concentrations exceeded residential soil clean-up standards for iron (5,500 mg/Kg), few exceeded standards for lead (400 mg/Kg), and the sediment samples from Tar Creek exceeded standards for zinc (2,300 mg/Kg).



12 sediment cores were collected across a transect of the flood plain of Tar Creek to investigate metals distribution.

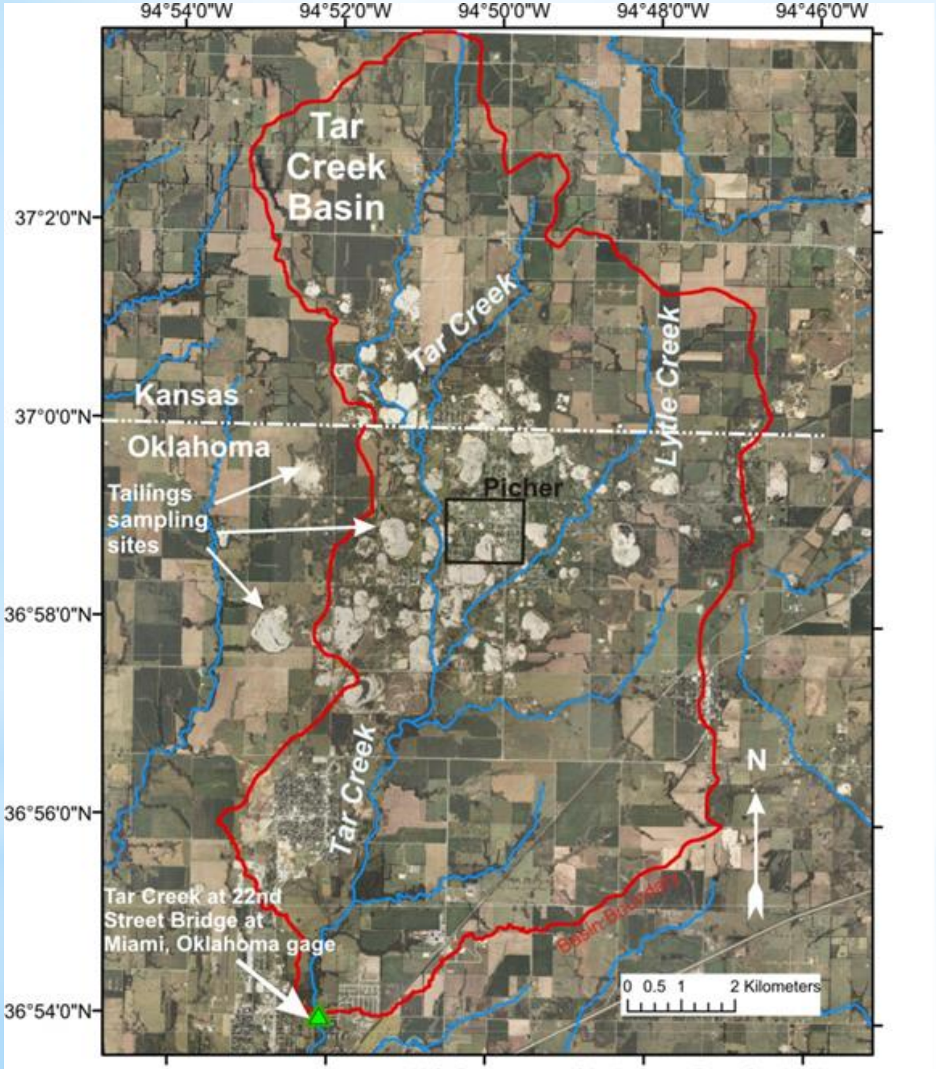


- The greatest concentrations of iron, lead, and zinc coincide with what appears to have been an earlier location of the meandering channel of this creek.
- Many of the measured concentrations of iron and zinc and one lead concentration in this old channel exceeded residential soil clean-up standards.

Summary

- Substantial amounts of iron, lead, and zinc remain in water and sediments in the Oklahoma part of the Tri-State mining district, a major source of lead and zinc for the U.S. in the first half of the 20th century.
- Water samples collected in the basins with the greatest proportion of mined lands generally contained the greatest concentrations of these metals.
- Water samples collected from the Neosho River generally contained the highest instantaneous loads of iron, whereas water samples collected from the Spring River generally had the highest instantaneous loads of lead and zinc.
- Iron, lead, and zinc concentrations generally were highest in streambed sediment samples collected at the two Tar Creek sites.
- Lead and zinc concentrations were higher in sediment samples collected at the Spring River and Grand Lake sites than at the Neosho River sites.
- Shallow sediment cores of the floodplain of Tar Creek indicated a former channel of that creek where iron, lead, and zinc concentrations exceeded residential soil cleanup standards.

Questions?



U.S. Department of Agriculture, Farm Service Agency
National Agriculture Imagery Program MrSID Mosaic (2006)
Projection: UTM Zone 14, Units: Meters, NAD 1983

USGS
science for a changing world