Modelled zinc and sediment transport of the Spring River watershed: An evaluation of best management practices for remediation

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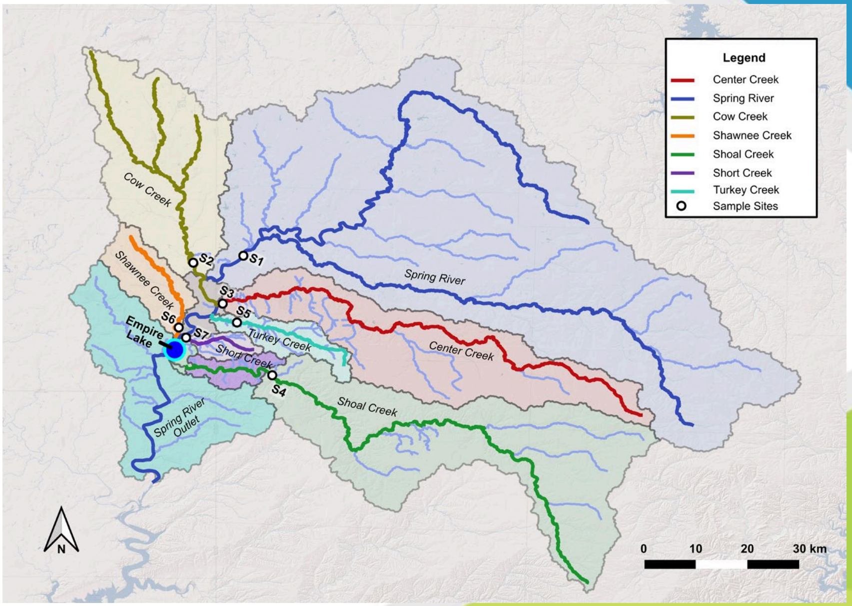
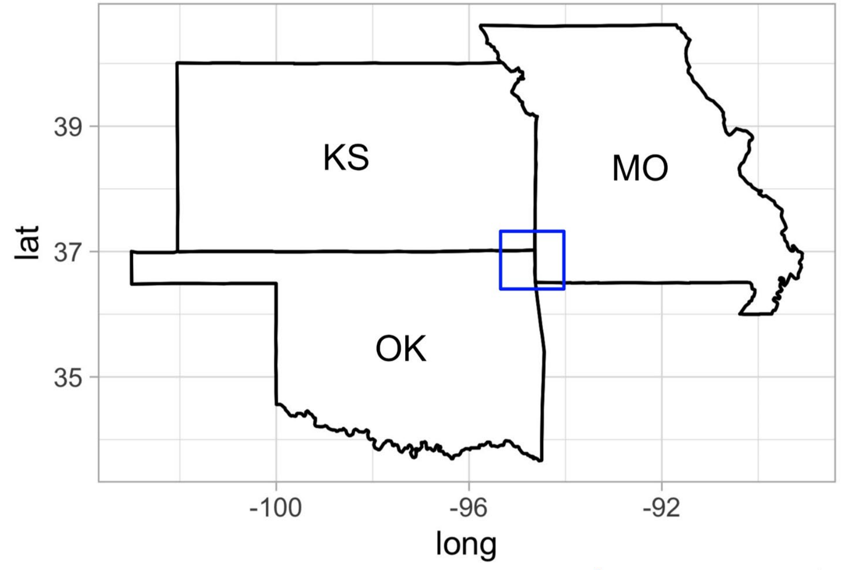


Introduction

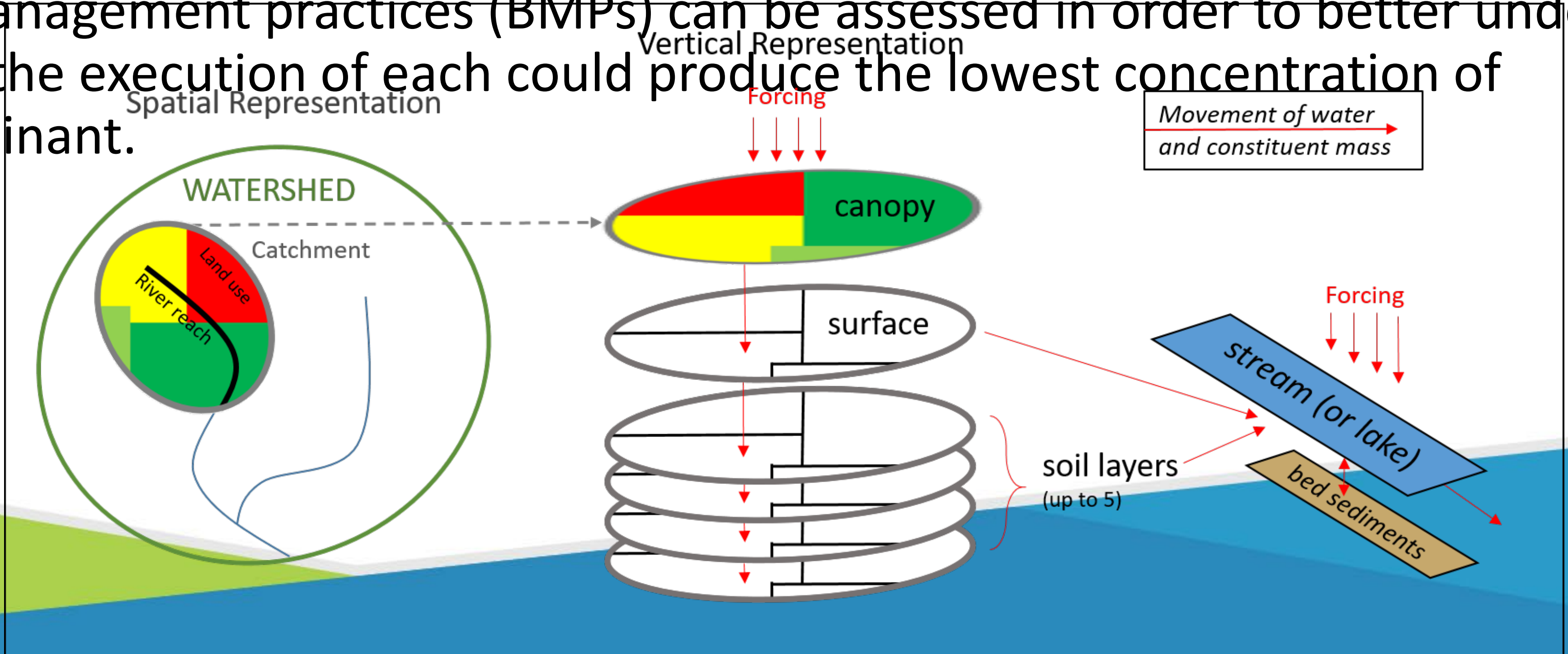
- The Spring River Watershed is located in the Tri-State mining region (Oklahoma, Kansas, and Missouri).
- This watershed has been the location of drastic remediation efforts due to devastating impacts from the lead and zinc mining operations from 1850 to 1970 in the region and their lasting impacts.

***Purpose of this study**: We evaluated different remediation techniques on a mining impacted watershed in the Tri-State region using the Watershed Analysis Risk Management Framework (WARMF) model to aid in ongoing remediation efforts in the region.



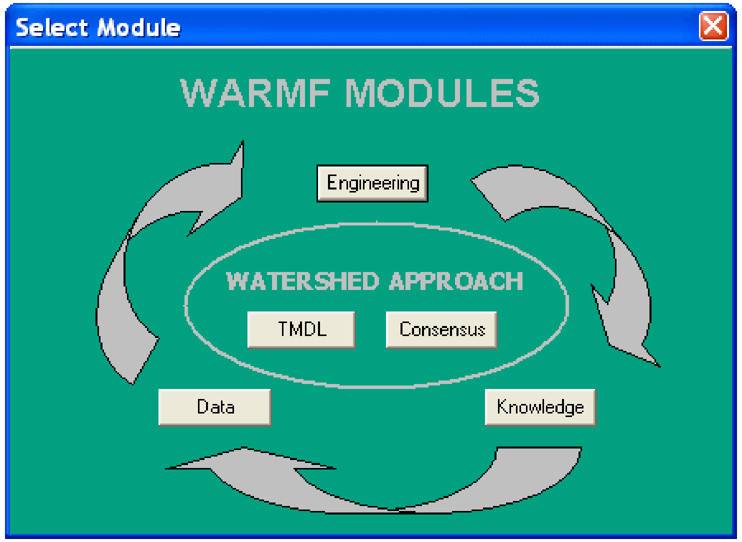
WARMF Model

- The Watershed Analysis Risk Management Framework (WARMF) model incorporates physical and chemical variables over a large spatial scale to assess and predict contamination movement and concentrations over both short- and long-term periods.
- Best management practices (BMPs) can be assessed in order to better understand where the execution of each could produce the lowest concentration of contaminant.



Major Advantages

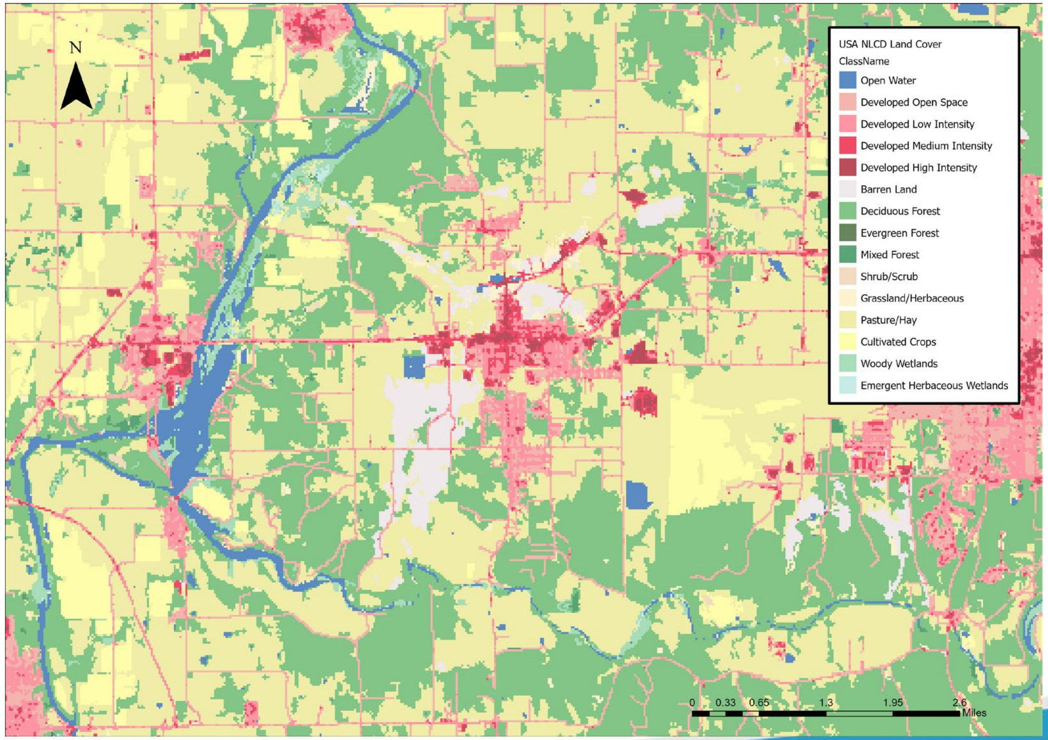
1. Can assess contaminated watersheds in a more cost-effective manner using a model compared to sustained field studies.
2. There is no coding language needed to run the scenarios allowing for potential use by both experts and non-experts alike.



WARMF Graphical User Interface (GUI)

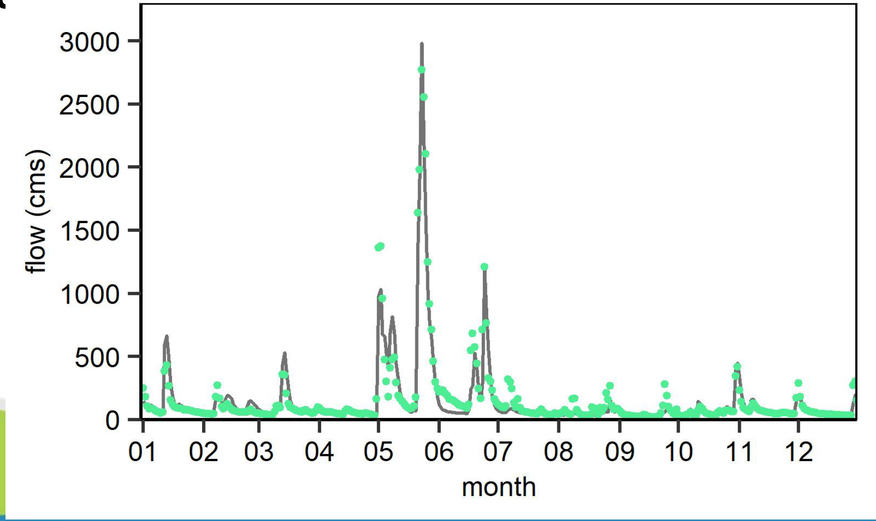
Model Inputs

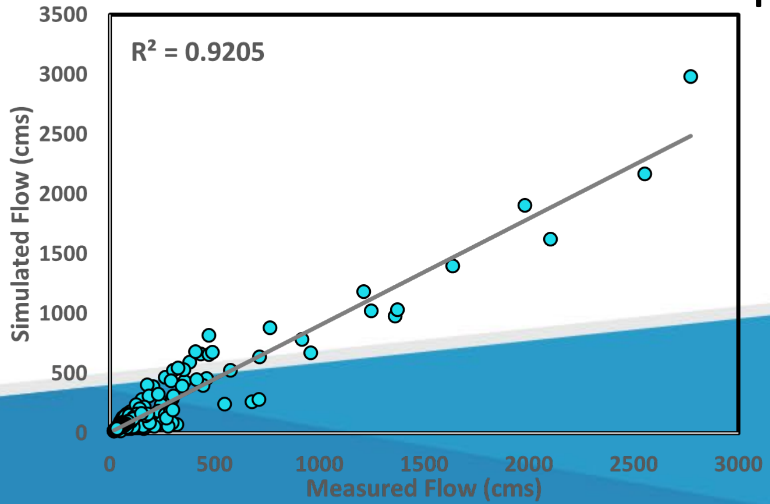
- Spatial variables:
  1. Topography - Digital elevation model (DEM)
  2. Catchment delineation – USGS StreamStats tool
  3. Land use cover – National land cover database
  4. Soil characteristics – Literature values
- Time series variables:
  1. Meteorology - PRISM
  2. Air quality – Atmospheric databases
  3. Flow – USGS monitors
  4. Observed Water Quality – Field Sampling



Calibrations

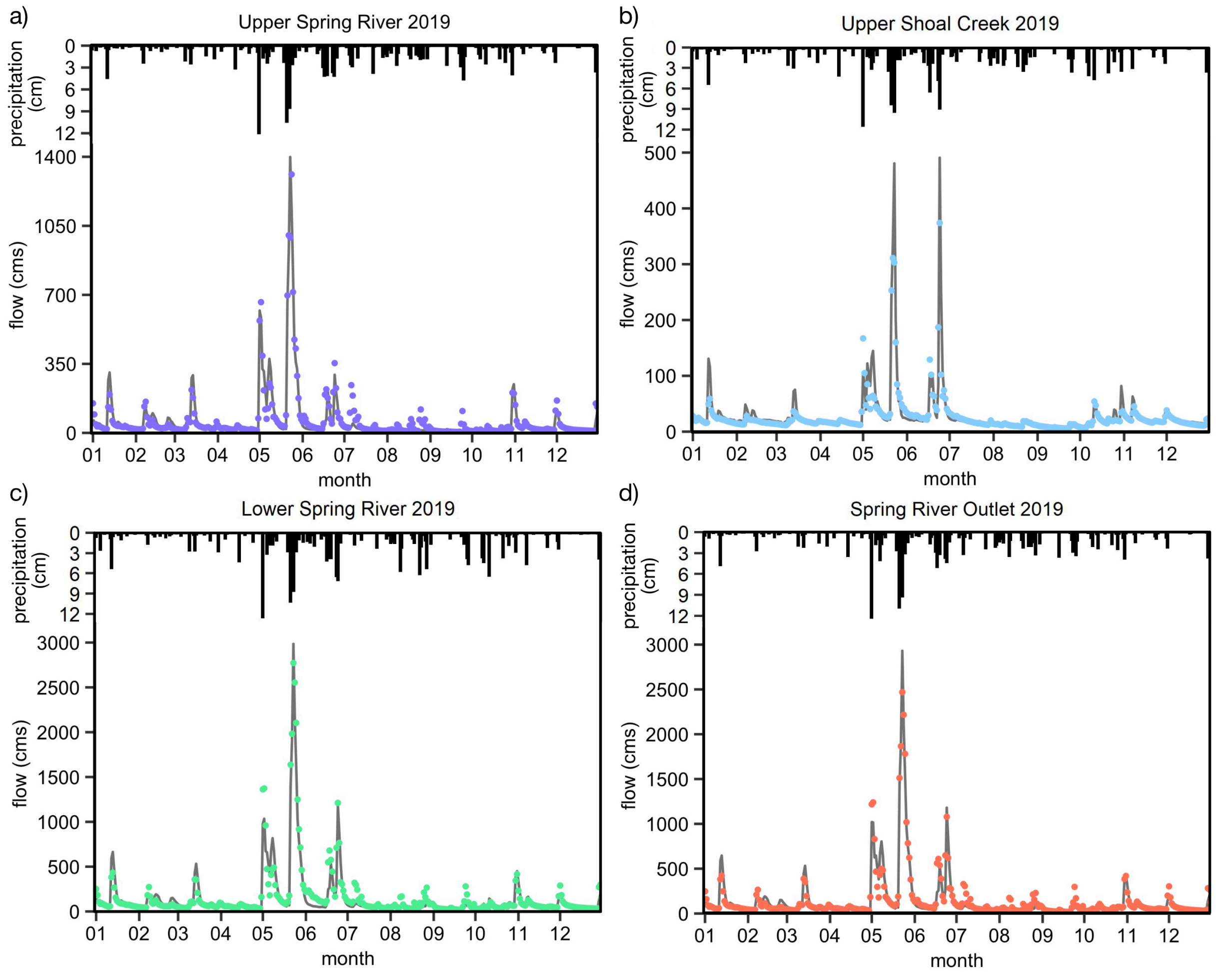
- Flow calibrations are performed for river segments delineated based on catchment boundaries. To produce modeled flow values similar to measured values, different coefficient values (e.g., soil layer thickness, moisture content, and hydraulic conductivity) are modified until results meet a statistical threshold.
- Parameters such as suspended sediment, nitrogen, phosphorus, pesticides, and heavy metal concentrations should be calibrated by adjusting coefficients for parameters such as adsorption and initial concentrations in the soil and compare them to





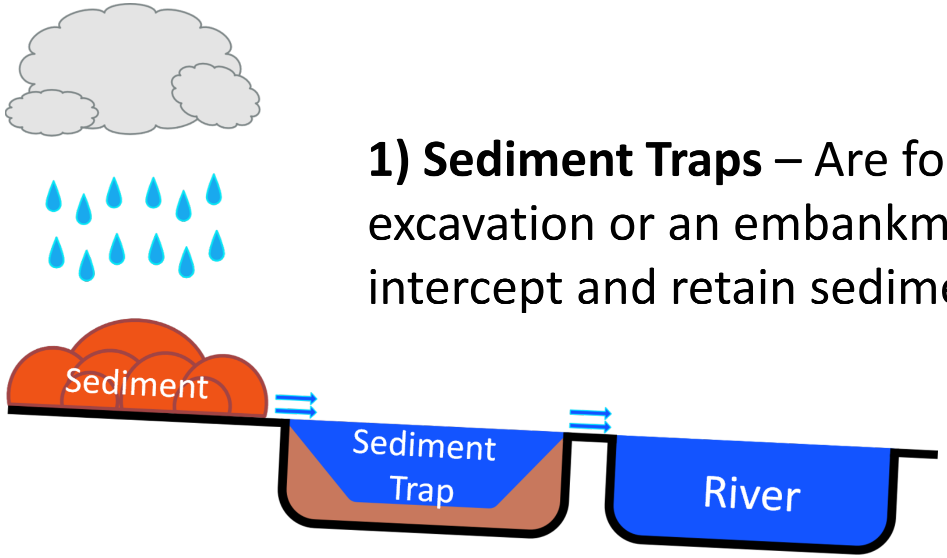
Simulated flow (gray line) and measured flow data (green points)

Precipitation and Flow

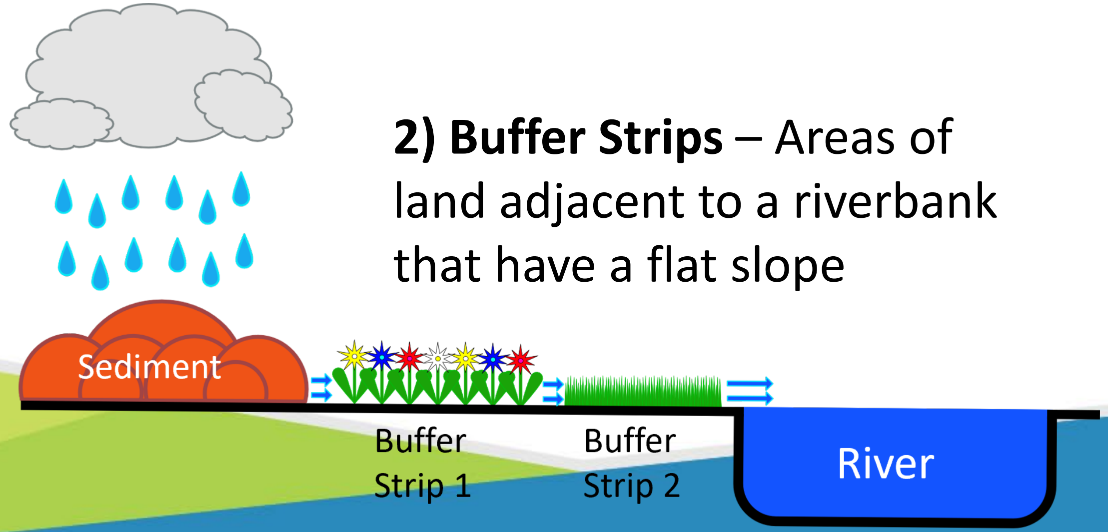


Best Management Practices (BMPs)

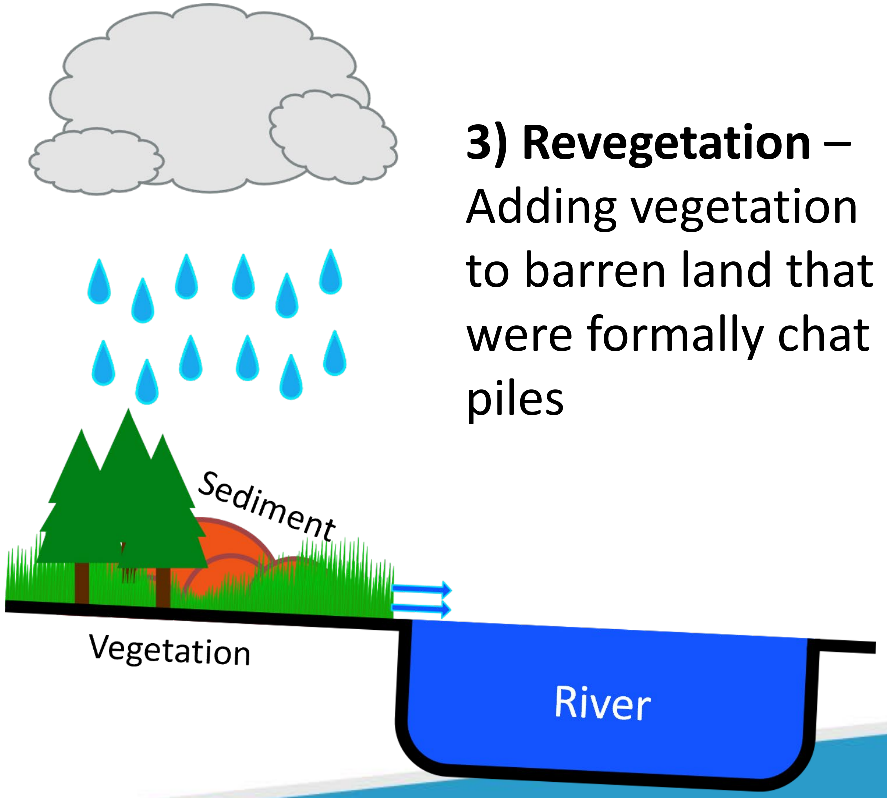
1) Sediment Traps – Are formed by excavation or an embankment to intercept and retain sediment runoff



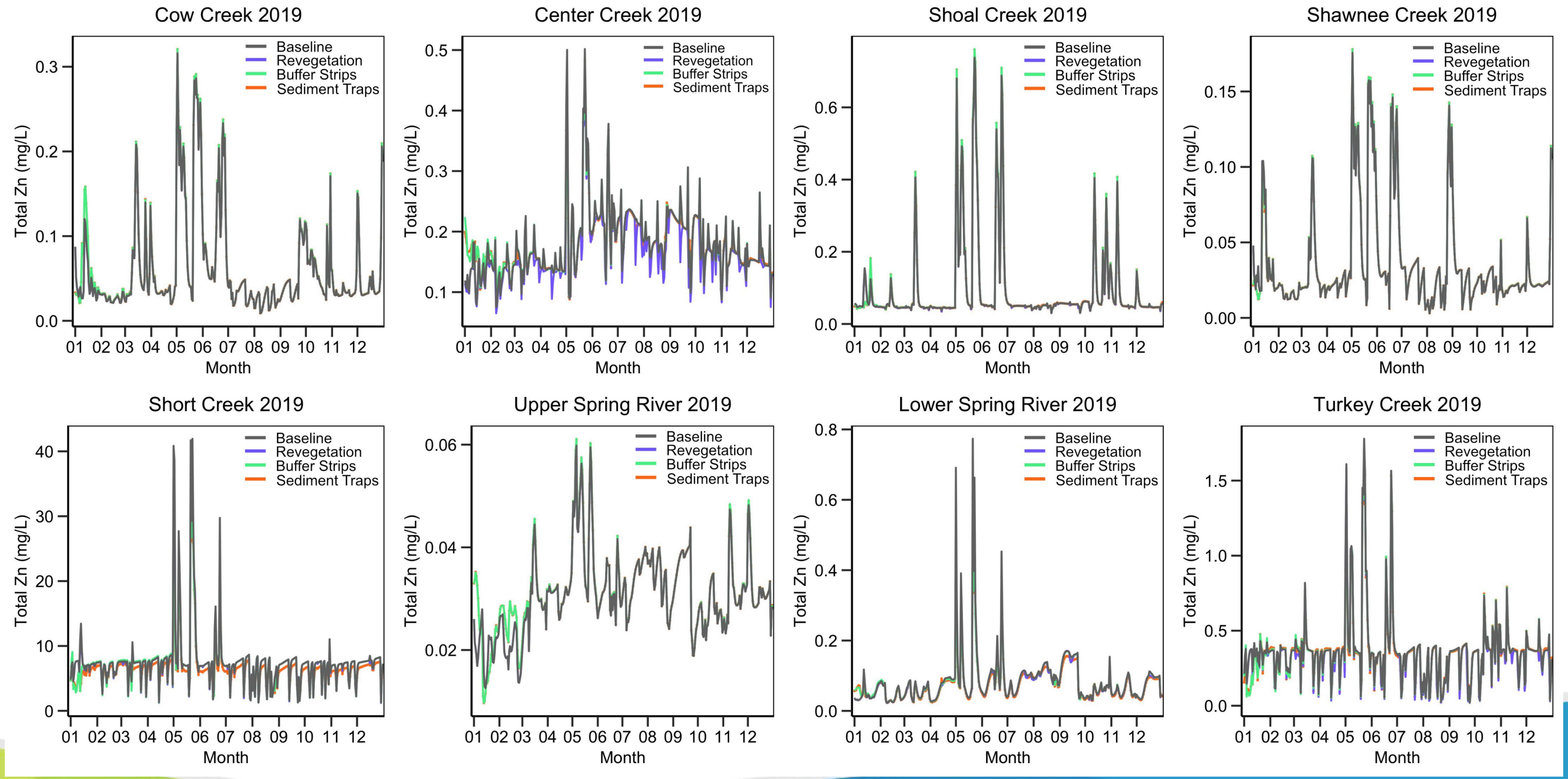
2) Buffer Strips – Areas of land adjacent to a riverbank that have a flat slope



3) Revegetation – Adding vegetation to barren land that were formally chat piles

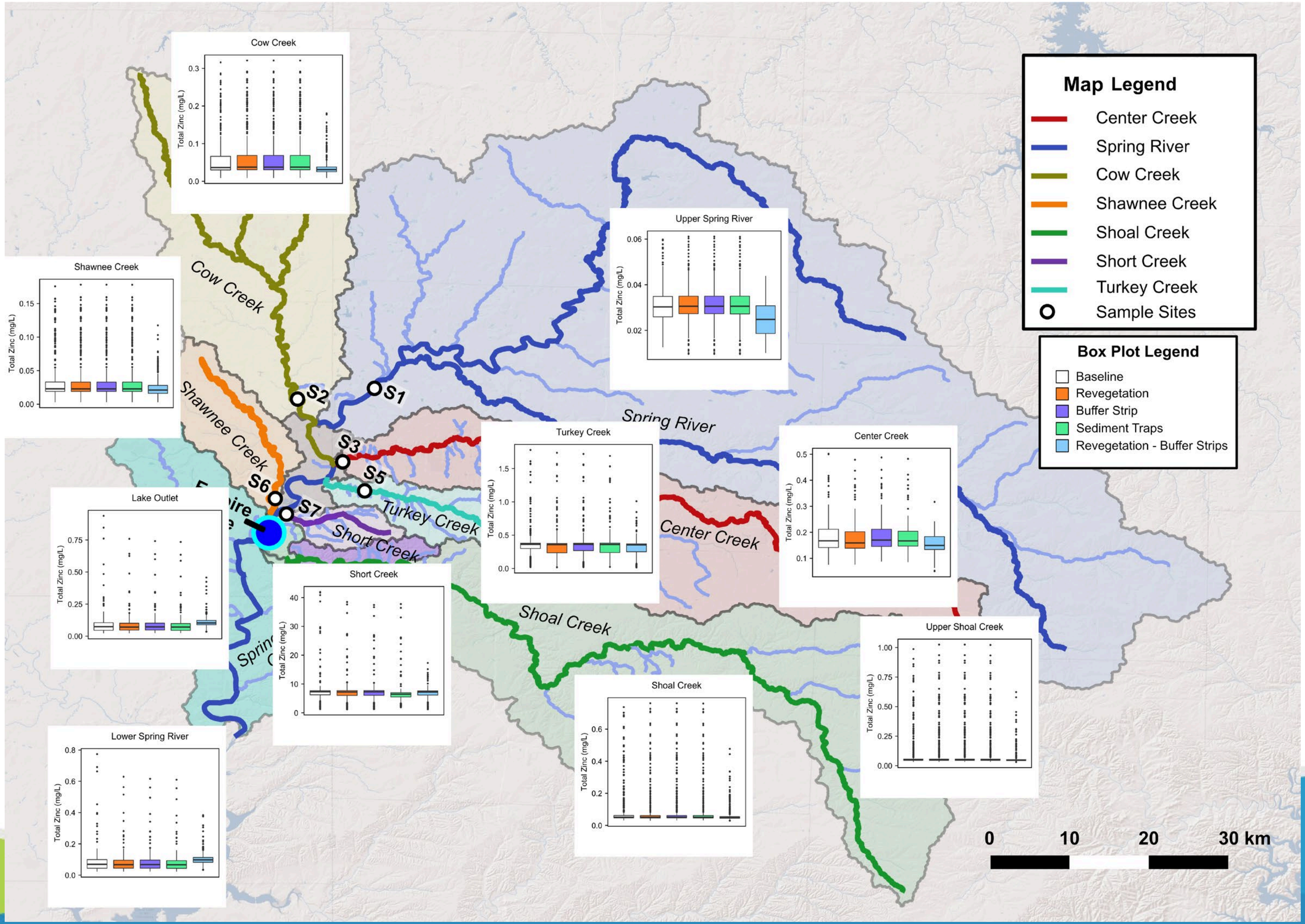


Total Zinc

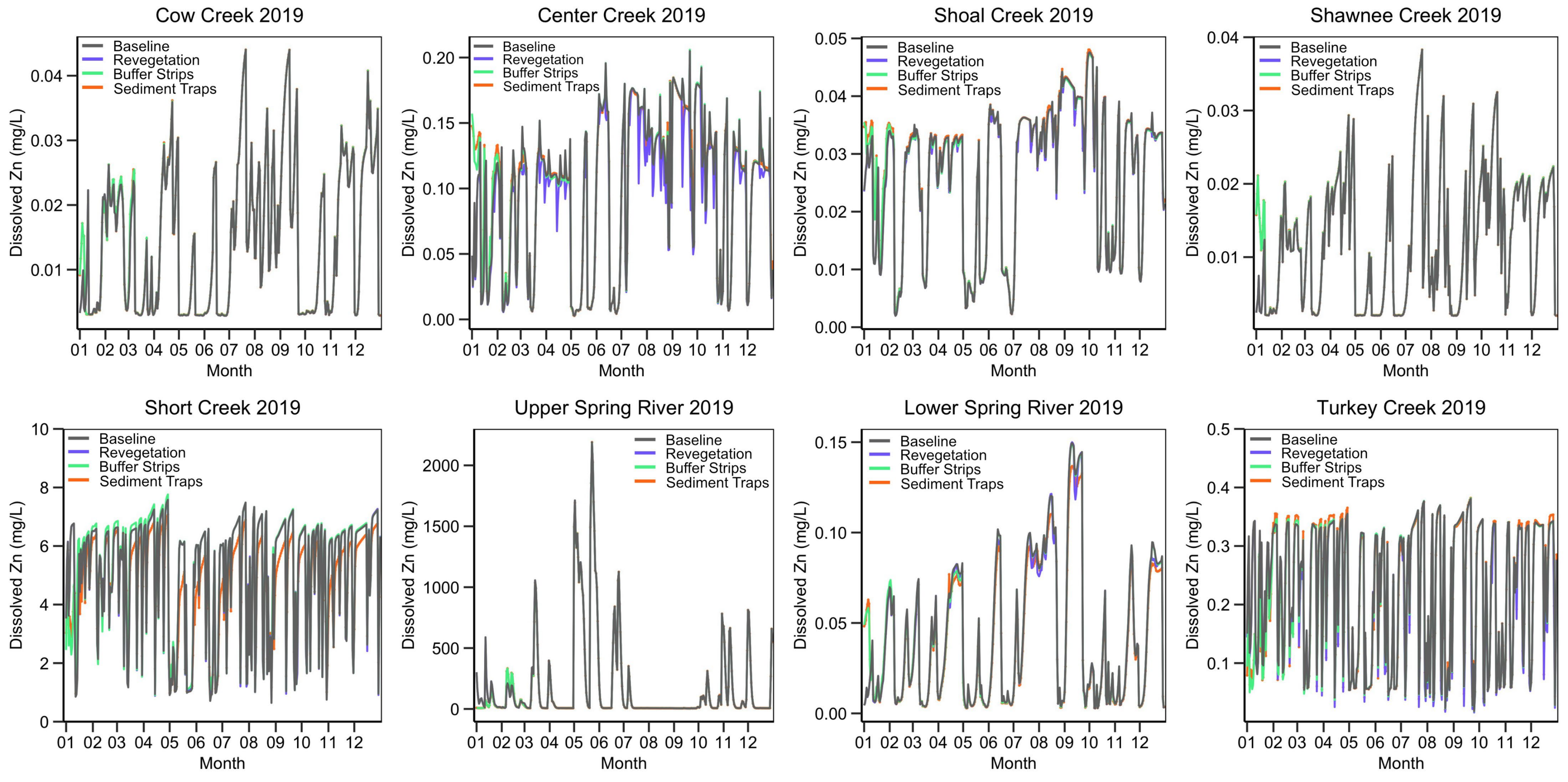


Cow Creek 2019
Center Creek 2019
Shoal Creek 2019
Shawnee Creek 2019
Short Creek 2019
Upper Spring River 2019
Lower Spring River 2019
Turkey Creek 2019
Baseline
Revegetation
Buffer Strips
Sediment Traps
Total Zn (mg/L)
Month
01 02 03 04 05 06 07 08 09 10 11 12

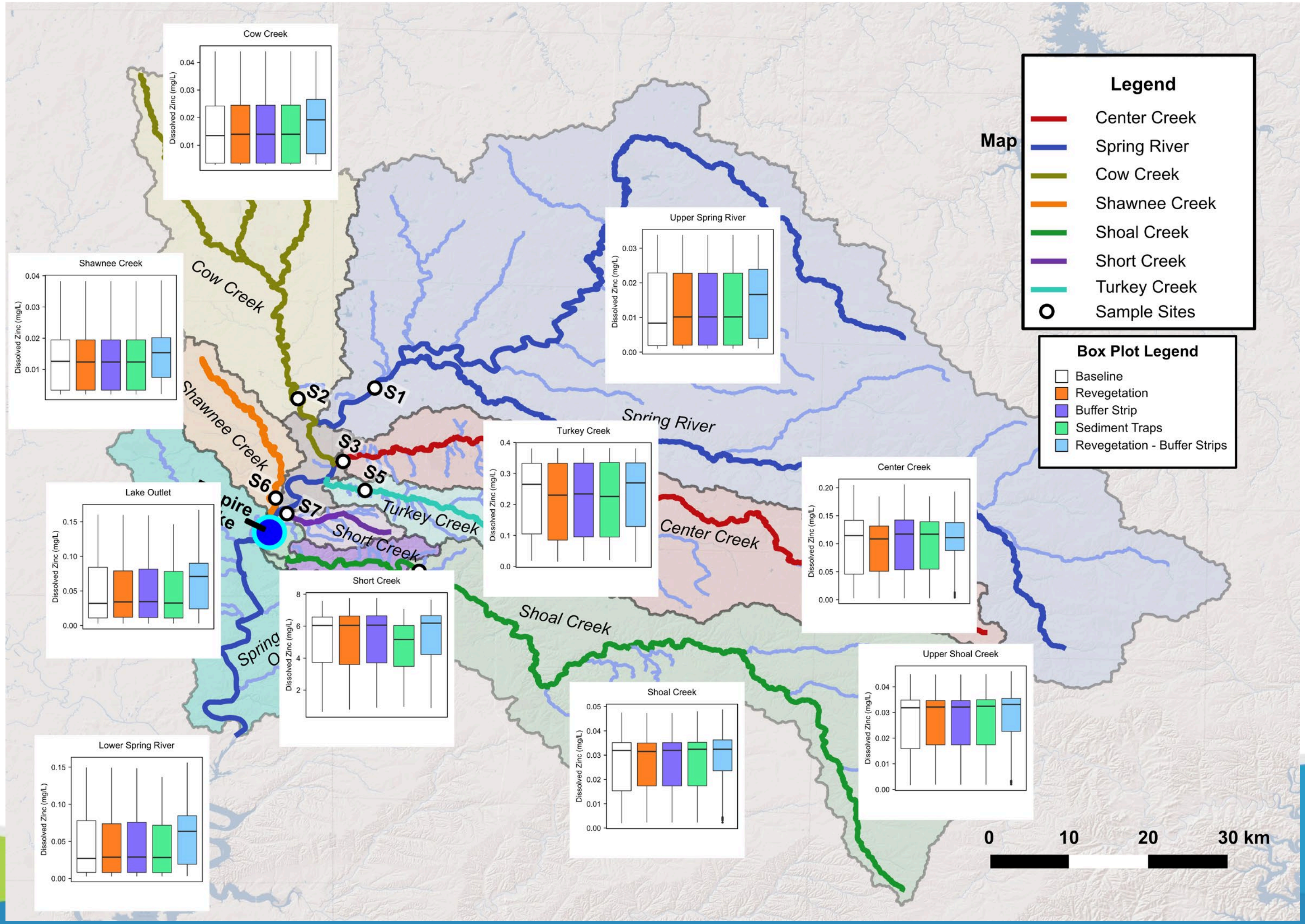
Total Zinc Continued



Dissolved Zinc



Dissolved Zinc Continued



Conclusions

- We found that a combination of revegetated former chat piles and introduced buffer strips caused the greatest removal of total suspended sediments and total zinc to the majority of the watershed.
- We attribute an increase in dissolved zinc to the improved removal of suspended sediments, which caused the system to lose surfaces for the dissolved zinc to adsorb to.
- Overall, we determined that a mixed implementation of BMPs across the watershed would yield the greatest improvement to water quality and further remediation efforts should be looked at for improved removal of dissolved zinc.

Thank you for your time!
Questions?