

**IMPACTS OF PRODUCED-WATER RELEASES ON GROUND WATER:
RESULTS FROM THE OSPER SITES, OSAGE COUNTY, OKLAHOMA**

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For the last five years, we have been investigating the transport, fate, natural attenuation and ecosystem impacts of inorganic and organic compounds in releases of produced water and associated hydrocarbons at the Osage-Skiatook Petroleum Environmental Research (OSPER) "A" and "B" sites, located in NE Oklahoma. Approximately 1.0 ha of land at both OSPER "A" (depleted lease) and "B" (active lease) sites, are visibly affected by salt scarring, tree kills, soil salinization, and brine and petroleum contamination from the leakages and accidental releases of produced water from brine pits, pipes and tank batteries. Geochemical data show that the produced water source is a Na-Ca-Cl brine (~150,000 mg/L TDS), with high Mg, but low SO₄ concentrations.

Groundwater impacts are being investigated using a variety of methodologies, including hydraulic slug tests, geophysical surveys of borehole and ground conductance, and detailed chemical analyses of water from repeated sampling of 85 boreholes, 1–71 m deep and of aqueous extracts of core samples. The most important results are: 1- A plume of high-salinity water (2,000–30,000 mg/L TDS) that extends beyond the visibly impacted areas is mapped at surface to intermediate depths of OSPER "A", indicating a large amount of salt remains after more than 65 years of natural attenuation; and, 2- produced-water brine and minor dissolved organics have penetrated the thick (3.5-6 m) shale units at OSPER