

Provide Support to Produced Water: Osage-Skiatook Petroleum Environmental Research Project

DE-IA26-01BC15238

Program

The project was funded under an Interagency Agreement. The goal was to provide a sound scientific study of the long-term effects of hydrocarbon waste on soil, water, and vegetation that could be used to model remediation efforts.

Project Goal

The project goal is to investigate the hydrology, geochemistry, microbiology, geology, and ecosystem dynamics of two oilfield sites impacted with produced water and associated oil and chemicals. The ultimate goal is to generate a credible analysis to understand the fate of trace hydrocarbons and the related ecosystem interaction.

Performers

*U.S. Geological Survey
Menlo Park, CA*

*Environmental Protection Agency
Washington D. C.*

*Bureau of Indian Affairs
Washington D. C.*

*Osage Environmental Office,
Osage Tribe
Pawhuska, OK*

Project Results

The project evaluated long-term and short-term effects of hydrocarbons and dissolved and suspended constituents of produced water on soil, groundwater, and surface water. Researchers examined mitigation effects of natural processes at older sites and active sites for comparing and evaluating the rate of soil recovery.

Benefits

Investigation of the hydrology, geochemistry, microbiology, geology, and ecosystem dynamics in oilfield site contamination will provide better remediation practices through an understanding of the fate and ecosystem interactions of organic and inorganic contaminants at these research sites and thus will apply to similar sites.



A tank battery showing produced water discharged to a holding pond in Osage County, OK. The fate of trace hydrocarbons, which leak from such holding ponds, was the focus of the research.

Background

Sound and unbiased studies are needed to evaluate the long- and short-term effects of hydrocarbons and the dissolved and suspended constituents of produced water on soil and ground and surface water and the natural processes that may be mitigating effects at older sites and at currently active ones. Two oil and gas production research sites have been selected adjacent Skiatook Lake in the southeastern Osage Reservation in northeastern Oklahoma. The Osage Nation holds the mineral rights, the BIA has trust responsibility, and the U.S. Army Corps of Engineers owns the surface at these sites.

The geologic and climatic settings of these two sites resemble that of much of the major southern Midcontinent oil- and gas-producing area of the U.S. Oil and gas production has occurred in this area for over 100 years. Thus the fields provide an opportunity for a study of the long-term effects of produced water on soils, water, and vegetation.

Project Summary

This is a multi-disciplinary, multi-agency investigation. Actual work includes the following detailed characterizations:

- Geochemistry of the contaminant sources (crude oil and hypersaline produced water).
- Weathering, microbial degradation, and dispersion of crude oil and its trace elements.

- Microbial ecology of disturbed and contaminant sites.
- Molecular biochemistry of microbial communities.
- Geochemistry and mineralogy of salt-impacted soils.
- Erosion mass transport.
- Geophysical signatures of disturbed and undisturbed sites.
- Geochemical impacts on oak species.
- Recovery of oak forest ecosystems.
- Modeling of solute transport of salts, trace elements, and soluble hydrocarbons.
- Interchange between the water and sediment column in the adjacent reservoir and contaminated surface and groundwater.
- Changes in soil hydrology with oil saturation.
- Trace element and radionuclide fate and transport.
- Stable and radioactive isotope geochemistry.
- Impacts on local fish species.

Reconnaissance examination of the two sites shows that local effects include soil salinization with resultant destruction of soil textures and deep erosion, death of proximal vegetation and stress on peripheral vegetation, salinization of surface water and groundwater, saturation of soils with

crude oil of varying age, and weathering and dispersal of crude oil components and trace elements.

Work included mapping and characterization of geologic, geophysical, vegetation, and soil resources and sampling and analysis of oil, gas, and produced water sources. Fifty sampling wells were drilled to delineate produced water and hydrocarbon sources, collect samples, and develop transport models for geochemical and microbial toxins. Additional samples were taken from the wells several months after the first collection to allow study of short-term changes and seasonal differences. The analysis was used to assess the signatures of disturbed and undisturbed sites, the geochemical impacts on oak trees, the recovery of oak forest ecosystems, and the interchange between the water and sediments in the reservoir and the contaminated surface water and groundwater. Researchers analyzed changes in the soil and water with respect to oil saturation and trace elements and the impact on local fish species.

Current Status (November 2005)

The project received a no-cost extension to September 30, 2006.

Project Start: October 1, 2001
Project End: September 30, 2006

Anticipated DOE Contribution: \$141,000
Performer Contribution: \$830,000 (85.4% of total)

Contact Information

NETL – Jesse Garcia (jesse.garcia@netl.doe.gov or 918-699-2036)
U.S. Geological Survey – Yousif K. Kharaka (ykaraka@usgs.gov or 650-329-4535)