



Examination of Brine Contamination Risk to Aquatic Resources from Petroleum Development in the Williston Basin

U.S. Geological Survey scientists and cooperating partners are examining the potential risk to aquatic resources (for example, wetlands, streams) by contamination from saline waters (brine) produced by petroleum development in the Williston Basin of Montana, North Dakota, and South Dakota. The primary goals of this study are to provide a science-based approach to assess potential risk of brine contamination to aquatic systems and to help focus limited monitoring and mitigation resources on the areas of greatest need. These goals will be accomplished through field investigations that quantify brine movement and risk assessments using remotely-sensed and other spatial datasets.

Background and Problem

The Williston Basin (fig. 1) has been a leading domestic oil and natural gas producing region for more than one-half a century (fig. 2), and there are ongoing efforts to develop oil and gas from deeper formations, such as the Bakken Formation, which is critical to meet our future energy needs. Estimates suggest that for older oil fields, at least 10 barrels (1 barrel = 42 U.S. gallons) of brine (greater than 35,000 milligrams per liter dissolved-solids concentration) are produced per barrel of extracted oil (Wanty, 1997), and brine from the Williston Basin has some of the highest levels of dissolved solids in the United States (Otton, 2006). These large volumes of brine have been primarily disposed through the years into deep geologic units by means of disposal wells. Historically, brine also was discharged directly into surface waters or earthen evaporation pits (McMillion, 1965; Gorman, 1999). Before regulations enacted in the 1970s, the evaporation pits were unlined and had great potential to leak, thereby contaminating nearby groundwater, surface water, and soil. Possible sources of brine contamination include leakage from unlined pits, transport pipelines, storage tanks, and tanker trucks.

In the United States, the Williston Basin and Bakken Formation cover 249,697 and 125,684 square kilometers (km²), respectively. Of the United States part of the Prairie Pothole Region (324,308 km²), 78,240 km² are within the Williston Basin or the Bakken Formation.

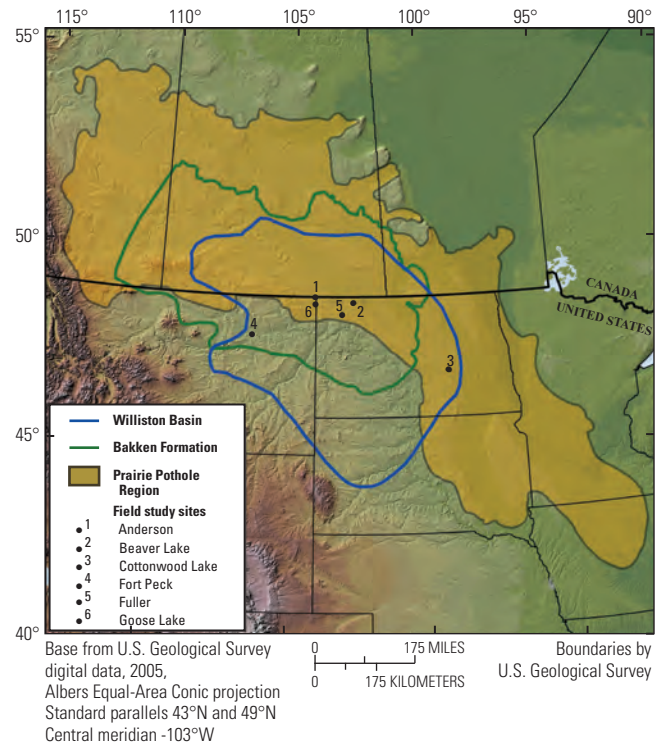


Figure 1. Location of the Williston Basin, Bakken Formation, and Prairie Pothole Region and field study sites.

A 2008 U.S. Geological Survey (USGS) assessment estimates that the Bakken Formation contains mean values of 3.65 billion barrels of technically recoverable oil, 1.85 trillion cubic feet of associated/dissolved natural gas, and 148 million barrels of liquid natural gas (Pollastro and others, 2008). Further, the Bakken Formation is one of the greatest potential gas reserves in the world (Durham, 2010), and government and industry personnel forecast significant increases in drilling and production in the coming years. As petroleum production increases, the potential environmental risk also increases.

