Assessment of Ground-Water Quality Impacts Caused by Land Spreading of Saline Oil & Gas Exploration and Production Solid Wastes

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There are more than 900 oil and gas drilling operations annually in the State of Ohio in addition to the approximately 65,000 producing oil and gas wells throughout the eastern and northwestern portion of the state. The increasing need for safe disposal methods for the waste byproducts from these operations is important to the protection and maintenance of ground-water and surface-water quality. The Ohio Non-Point Source Assessment reported oil & gas production as the most commonly reported category of non-point source pollution in the state. Specifically, this pollution comes from drilling pits, brine storage pits, or transport line leaks. This paper focuses on the results of a two-phase study performed in conjunction with the Ohio Department of Natural Resources, Division of Oil and Gas. The study was designed to evaluate ground-water quality changes resulting from land spreading of oil & gas field cuttings as an alternative to current disposal practices.

The selected field site is in Licking County, Ohio, approximately 1 mile north of the town of Newark, at a four acre plot along the western floodplain of the North Fork of the Licking River. This area overlies a buried bedrock valley filled with as much as 200 feet of glacial deposits. At the field site, there are two main units that comprise the uppermost 10 feet of material: an upper silty clay layer underlain by a heterogeneous loamy sand and gravel layer, which acts as the major shallow water bearing unit. These materials are underlain by a 40-foot thick continuous clay layer that acts as a confining layer for the overlying shallow unconfined aquifer. The predominant ground-water flow direction is westward, with a hydraulic gradient ranging from 0.0065 to 0.014 feet per foot. The site represents a "worst case" scenario in terms of ground-water contamination potential because of the high hydraulic conductivity, small saturated thickness, and rapid infiltration capacity of the shallow unconfined aquifer.

The field site consists of a network of 11 monitoring wells used to obtain ground-water samples for analysis of major ions and trace metals (Figure 1). Two sets of background samples were taken to serve as control. Piper diagrams were constructed using the concentrations of major cations and anions to illustrate the prevalent chemical character (PCC) of the waters. Based on these diagrams, the ambient ground-water quality is a calcium-bicarbonate water.

The first phase of the study involved spreading and mixing approximately 20 yd³ of non-solidified saturated drill cuttings over a 1,500 ft² area upgradient of 10 of the 11 monitoring wells (Figure 1). The cuttings were obtained from a drilling pit for a gas well penetrating the Trempeleau and Rose Run Formations. Resulting formation brines were tested and contained over 5,500 mg/l chloride, well over the regulatory limit of 250 mg/l.