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Aquifer Storage and Recovery, Horry County, South Carolina

Phase IV: Results of the Bay Road Well and Highway 501 Pottery Well Injection Tests

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ABSTRACT

An injection storage-recovery test of several months duration was completed in 1994 as part of a program to develop Aquifer Storage and Recovery sites in the Grand Strand area of Horry County, S.C. For this test, a former public-supply well on Bay Road was modified to permit injection of treated surface water into Coastal Plain sediments of Cretaceous age. More than 52 million gallons of treated surface water were injected, using the line pressure of the distribution system. After 2½ months of storage, the water was recovered. Significant quality changes were observed in the chemical composition of the recovered water.

An intensive monitoring program was implemented at the ASR site to explain the chemical evolution of the recovered water. The ratio of mixing between the treated water and the native ground water was estimated from measurements of two conservative tracers, chloride and tritium. Specific chemical reactions were identified from calculations of equilibrium speciation and mineral saturation, using WATEQ4F, and by mass-balance calculations using NETPATH. Both WATEQ4F and NETPATH are computer programs developed by the U.S. Geological Survey.

Although most changes in chemical composition of the recovered water were caused by the mixing of treated water with ground water, a small fraction was due to geochemical reactions. The four most important reactions (mass-wise) were pyrite and organic matter oxidation, calcium dissolution, and calcium-sodium exchange.

At the Bay Road well, extensive mixing of the treated water with the ground water is attributed to partial clogging of the well screens. Clogging probably was caused by chemical precipitation and/or by mechanical conditions such as air locking due to gas entrainment during injection. During the recovery period, continuous pumping probably caused progressive unclogging of the screens. This led to mixing of the treated water stored in the aquifer with native ground water. The native ground water came from the aquifers that had clogged screens, and therefore, did not accept treated water during the injection period.

At a well on Highway 501, seven short-term injection tests were completed. Chemical quality of the recovered water showed significant improvement with each successive test. This confirmed that flushing of the aquifer and appropriate management of the injected plume can significantly improve the recovery efficiency of the system.

During these tests and others in the region, the following field practices were found to be essential in developing and operating a successful ASR program: (1) Optimizing of injection rates to increase storage capacity without risking overflow and aquifer compaction or fracturing. Initial rates of approximately one-third of the well's pumping capacity are recommended; (2) Using of injection techniques that will minimize air entrainment, such as maintaining full pump columns with positive heads throughout the injection period; (3) Backflushing regularly to remove solids form the well screens and gravel pack; (4) Developing and maintaining of a buffer zone to improve the isolation of treated water from native ground water; (5) Monitoring water quality to assess mixing and chemical reactions during storage and recovery, information that can be used to improve the management of water quality; (6) Implementing of management practices appropriate to specific project objectives to ensure an optimum rate of recovery and also produce consistent quality in the recovered water.

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