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3:30 PM – 5:00 PM
SESSION 54: Groundwater II

Aquifer Storage and Recovery for Tualatin Valley Water District, Washington County, Oregon - Kenny Janssen, Golder Associates Inc., Lake Oswego, OR (co-authors: Mark Wirganowicz, Joel Cary)

The Tualatin Valley Water District (TVWD) recently began their second year of operations at its Grabhorn Road Aquifer Storage and Recovery (ASR) facility located on Cooper Mountain in Beaverton, Oregon. TVWD provides water to the second largest population base in Oregon and is using the Grabhorn ASR well to help meet summer water demands. The ASR facility uses the Grabhorn well to recharge, store and recover treated drinking water from the Joint Water Commission treatment plant in basalts of the Columbia River Basalt Group aquifer. An older well at a reservoir site (the Grabhorn Road facility) was reconstructed for ASR operations. Other facility modifications included a detention pond for onsite pump-to-waste operations, wellhouse, chlorination system, pumping system, and site piping and controls. After the engineering design, land-use permitting, ASR permitting, and construction phases were completed, TVWD began ASR testing in spring of 2008. The Year-1 ASR testing program consisted of two cycles, each consisting of a recharge, storage, and recovery phase. Cycle-1 was conducted over a short-term period in order to make preliminary assessments of system operations and the aquifer's response to recharge and storage before moving forward with Cycle-2 operations. Cycle-2 was conducted over a longer period to more closely approximate an operational-scale ASR system, and to evaluate long-term hydraulic aquifer response, well performance, and any potential changes in water quality. Results of the Year-1 program indicate that the storage and recovery of high-quality drinking water is feasible at this location. Analytical test results indicate that (1) the quality of the recovered water meets all primary and secondary drinking water standards for public water systems, (2) there is limited reactivity between the aquifer matrix and recharge water, and (3) no formation of TTHM or HAA-5 disinfection by-products is occurring during the storage periods. Year-2 operations for a full-scale ASR cycle with a target injection volume of 300 million gallons were initiated in December 2008, and recovery operations are expected to begin in summer 2009. This presentation will review results from Year-1 and Year-2 operations, and discuss some of the engineering and permitting challenges associated with project development.

Patterns of Ground Water Movement in a Portion of the Willamette River Floodplain, Oregon - Barton R. Faulkner, U.S. Environmental Protection Agency, ORD, Ada, OK (co-authors: Renee J. Brooks, Kenneth J. Forshay)

In reaches unconstrained by revetments, the Willamette River and its floodplain along its lowland mainstem is a continually evolving system. Several channel reconstruction and restoration projects have been implemented or planned in order to obtain beneficial services along the river system. In many cases, the aquatic habitat improvements expected from these efforts are strongly dependent upon flows between ground water and surface water, and the ground water component of these flows (hyporheic flow) is often more difficult to measure, quantify, and generalize in a geomorphic framework. In cooperation with the McKenzie River Trust, the U.S. EPA Office of Research and Development installed and instrumented 50 monitoring wells along a portion of the Willamette near its confluence with the McKenzie River. This is a region of high activity for restoration and channel reconstruction projects, and the McKenzie River Trust is implementing restoration projects on Green Island, near Coburg, Oregon, where the wells were installed. The area is representative of the Willamette system in its natural geomorphic condition. Instrumentation includes continuous monitoring of water elevation and temperature in the wells. Water level changes are significantly correlated with river stage, even in wells up to 1 km from the river, and preliminary stable isotope analyses indicate extensive hyporheic flow. Mapping of the potentiometric surface indicates ground water mounding during wet season in older forested floodplains, and the greatest potential for hyporheic flow in the younger bar sediments. These results have implications for nitrate retention and temperature buffering. Slug tests were conducted in 41 wells to

characterize the hydraulic conductivity. Study of historical aerial photographs showed the highest conductivities (up to 492 m/day) occur in remnant stream channels and young gravel bars, and the lowest (down to 18 m/day) occur in the interior, coalesced locations of the main island. Results of calibrating a ground water flow model are emerging as data is collected. This is an abstract of a proposed presentation and does not necessarily reflect EPA policy.

An Integrated Surface Water-Groundwater Modeling to Study the Basin Hydrology in the Snake River Basin, Idaho – Xin Jin, Boise State University, Boise, ID (co-author: Venkataramana Sridhar)

Observed climate change in the past decades have been a concern for many river basins around the world. including the Snake River Basin (SRB) in Idaho. SRB area has a strong interaction between the river and beneath aquifer that augments the water supply for irrigation, hydropower and minimal flows among others. Both precipitation and irrigation return flows recharge the groundwater via infiltration and percolation when the unsaturated soil zone becomes saturated and the groundwater supplements the baseflow during the non-rainy season and dry summer months.. The Variable Infiltration Capacity (VIC) model is a widely used macroscale hydrological model that assesses the hydrological impacts in the continental United States. The model solves the energy and water fluxes at hourly time step and the resulting fluxes are routed to generate runoff. MODFLOW is a popular groundwater model to calculate the groundwater flow. It was developed by U.S. Geological Survey to solve the three-dimensional groundwater flow in the porous medium. It also incorporates a package to solve the unsaturated zone. In this study, a dynamic interface will be developed between VIC and MODFLOW to predict the surface and groundwater exchanges in the SRB. The available long-term historical streamflow and recharge data will be used to calibrate the model. Our results will include the implementation of the coupled model to predict the streamflow under climate change scenarios and evaluation of its application to study the water resource management in the basin.

Henry Darcy's Public Fountains of the City of Dijon - Patricia Bobeck, Geotechnical Translations, Austin, TX

Henry Darcy, a young French engineer, built one of the earliest modern water supply systems in Dijon France in 1840. He described this project in his 1856 book “The Public Fountains of the City of Dijon,” which also contains an account of the water filtration experiments that led to Darcy’s Law. Darcy designed the system to solve the water shortages that had plagued Dijon for four centuries. The city obtained water from rooftops and from shallow alluvial wells, which were often contaminated. Darcy describes his calculations to determine the amount of water Dijon’s inhabitants required. He then researched local surface and groundwater to find a pure and plentiful water supply. He selected a spring located 12.7 km from Dijon, and built an aqueduct to bring the water to the city. Within Dijon, he built two reservoirs, a main artery to connect them, 10 distributor pipes along major streets and 118 street fountains where Dijon’s inhabitants could obtain pure free water day or night. Darcy placed the fountains no farther than 100 m apart, so no one, rich or poor, had to walk more than 50 m to obtain water. The system was operated by gravity due to the elevation difference between the springs and the city. After the water supply system was built, Dijon ranked second only to Rome in terms of water quality and quantity. Dijon, which had been visited by cholera in 1832, began to thrive. Darcy wrote the book near the end of his life as a legacy for young engineers charged with the construction of water supply systems. He had served as consultant to the Brussels water supply system and had retired to Dijon on disability when he conducted the sand filtration experiments that led to Darcy’s Law. The book is now a rare book in French, available in only a few historical libraries in France and the US. The translation makes Darcy’s genius accessible to modern hydrogeologists. The presentation covers Darcy's biography, the book, photos of modern day Dijon and the remains of Darcy's water system.