Water quality predication for a proposed brackish water RO facility in Florida

Weixing Guo, Thomas Missimer, Scott Manahan and Robert Maliva

Schlumberger Water Services USA Inc. 1567 Hayley Lane #202, Fort Myers, FL 33907

ABSTRACT

A new brackish water reverse osmosis (RO) facility is being developed to meet the future supply demands of water supply for the City of Hialeah, Florida. The new facility has a final design capacity of 66,245 m^3/day (17.5 MGD) and will treat brackish water from wells tapping the Upper Floridan Aquifer (UFA). The production zone occurs approximately 330 m (1080 ft) to 450 m (1480 ft) below the land surface.

A critical part of the design of brackish-water desalination facilities is predicting groundwater chemistry over long term (10 – 30 years) operation period. Density-dependant solute transport modeling is needed to evaluate potential salinity changes over time. A groundwater model was developed for the Hialeah RO facility that was derived from a regional SEAWAT model developed by South Florida Water management District (SFWMD), which was recalibrated and updated with data collected during a hydrogeological investigation conducted as part of this study.

The model has 14 layers representing the Floridan aquifer system. The Surfical aquifer and underlying Bolder Zone (Lower Floridan Aquifer) were modeled as constant head and constant concentration boundaries. Predictive simulations were run for 30 years, with a variable pumping rate increasing from 50,460 m^3/day (13.33 MGD) to 88,314 m^3/day (23.33 MGD) from 14 proposed wells tapping the UFA. The results of predictive simulation indicate that the average total dissolved solids (TDS) concentrations of mixed raw water would increase from the initial value of 3,500 mg/l to approximately 4,320 mg/l in 30 years.

A series of predictive simulations were performed to assess the uncertainty associated with the model input parameters including horizontal and vertical dispersivities, effective porosity and the vertical hydraulic conductivity of the semi-confining underlying the UFA. The results of uncertainty analysis indicate the model results are sensitive to the vertical hydraulic conductivity of the underlying confining unit since the upward migration of solute from deeper aquifers plays a key role in determining the quality of withdrawn raw water. If the vertical hydraulic conductivity of the underlying confining unit is doubled, then the TDS concentration of mixed raw water could reach as high as 6,420 mg/l at the end of 30 year simulation period. The results of the uncertainty analysis will be used in the treatment system design.