

Production aquifer water salinity change impacts on brackish-water reverse osmosis desalination facility process design and operation: the City of Clewiston, Florida

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Received 7 June 2021; Accepted 8 July 2021

ABSTRACT

The successful management of a brackish-water reverse osmosis (BWRO) desalination facility depends on understanding future expected water-quality changes and how these changes may affect the operational reliability of the water treatment plant. Because most production aquifers that supply feed water for BWRO facilities are leaky to some extent, long-term water quality changes are expected. To assess the rate of feed water quality changes, two commonly used approaches are groundwater solute transport modeling and various engineering and statistical assumptions. The design of a BWRO facility, RO membrane type, and operational pressure range must be robust enough to treat a range in projected feed water concentrations of total dissolved solids (TDS). The initial water quality and stability of the production aquifer are critical components that guide the design of all BWRO facilities. Inaccurate prediction of the wellfield future water-quality changes can result in major operational and financial consequences. The rate of salinity change in production wells is determined by the hydraulic characteristics of the aquifer (transmissivity, storativity, and leakance), well design, the configuration of the wellfield, and the rate of pumping. The City of Clewiston BWRO facility was designed to produce 11,356 m³/d of potable water from the upper Floridan aquifer. The membrane process was designed to treat feed water with a TDS maximum of 3,588 mg/L. The initial TDS concentration in 2008 was 2,786 mg/L. The observed 12-y historic average increase in dissolved chloride concentration was 301 mg/L (579 mg/L TDS) with the projected average 20-y increase being 611 mg/L (1,174 mg/L TDS) by the year 2040. The projected 20-y average TDS concentration is anticipated to reach 4,540 mg/L by the year 2040, exceeding the upper design limit. Treatment process design modifications, wellfield management alteration, and capacity expansion will likely be required for the facility to operate until the year 2040. Based on this analysis, groundwater solute-transport modeling is recommended before the design of even moderate-capacity BWRO facilities.

Keywords: Brackish-water reverse osmosis desalination; Groundwater quality; Aquifer characteristics; Feed water quality change; City of Clewiston, Florida

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