Static water level monitoring of the Devonian Aquifer

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Introduction

In 1991, the Iowa Geological Survey (IGS) constructed a three piezometer wellnest at the ISU NE Research Farm. All piezometers are completed in the Devonian's Cedar Valley Group. NP-1 is completed in the Bassett Member of the Little Cedar Formation (190 feet deep); NP-2 in the Eagle Center Member (130 feet deep); and NP-3in the Hinkle Member (110 feet deep). The Chickasaw Shale Member, a regional confining unit, separates NP-1 from the other wells. In 2022, the IGS began monitoring these piezometers to improve our understanding of spatial and temporal patterns of groundwater hydrology in the Devonian aquifer in North-Central Iowa.

Materials and Methods

In September 2022, the IGS installed pressure transducers into NP-1 and NP-2. A transducer wasn't installed in NP-3 because no water was expected in the well during the study. The transducers collected water level measurement every hour. Manual water level measurements using an e-line were made quarterly to verify the accuracy of the transducers.

Results and Discussion

The data confirms many observations noted in Simpkins and Weis (1994). Water level data suggest a potential downward flow from NP-2 and NP-3, going through the Chickasaw Shale, and into NP-1 (figure 1). Large flood events on the Cedar River are associated with rises in water levels in NP1, suggesting the Bassett Member opened in NP1 is connected to the Cedar River (figure 2). NP-3 was dry for most of the study, only having water in the fall, and was observed to blow air at times when dry.

The fluctuations in water level recorded in NP-2 were unexpected. The fluctuations do not correlate with precipitation or water usage at the farm and nearby irrigators. The IGS is continuing to investigate cause of these fluctuations.

Drought conditions may impact water levels in NP-1. Water levels recorded in NP-1 during this study are generally 5-10 feet lower than the lowest levels reported in Simpkins and Weis (1994). A nearby IGS well (FM3-3) in the same geologic unit with a longer monitoring records offers an opportunity to put current NP-1 measurements in context with historical data. FM3-3 is approximately 10.5 miles NW of NP-1, is completed in the Bassett Member, and has a water level record dating back to 1992. Drought conditions appear to have impacted water levels in FM3-3 this year. FM3-3 water level measurements in September and December were within the lowest 10^{th} percentile of measurements collected at the site. By relative association, the drought conditions may be similarly affecting the water levels in NP-1. Based on historic observations at FM3-3, the water-level in NP-1 is expected to rebound in the spring.

Reference

Simpkins, W. and Weis, M. (1994), "Hydrogeology and Water Quality Studies in the Devonian Aquifer", Iowa State University, Northeast Research Farm Annual Report, ORS94-13.

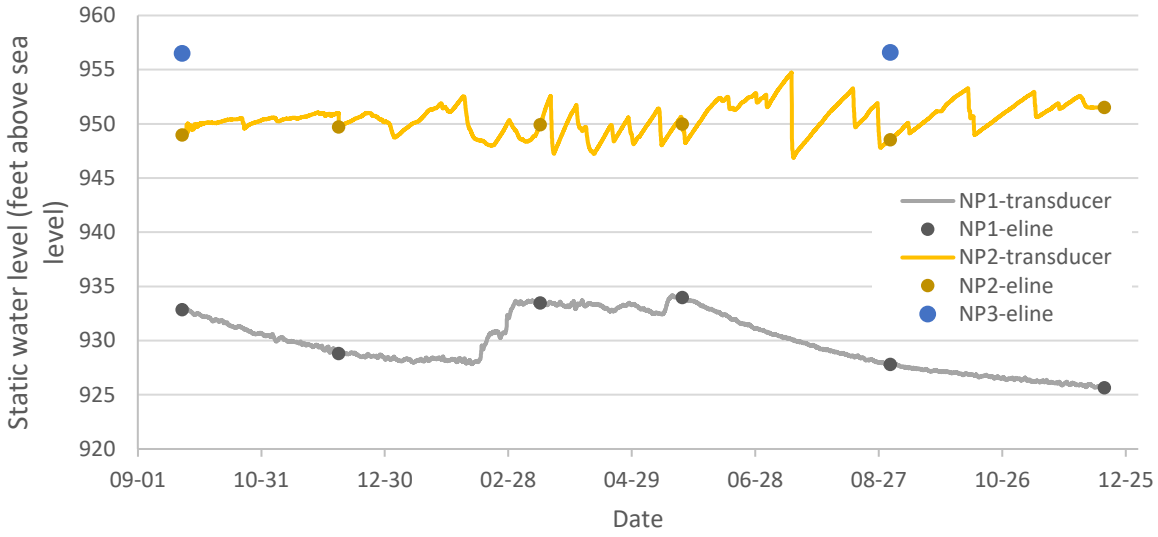

Figure 1: Water level measurements in the ISU NE Research Farm piezometers.

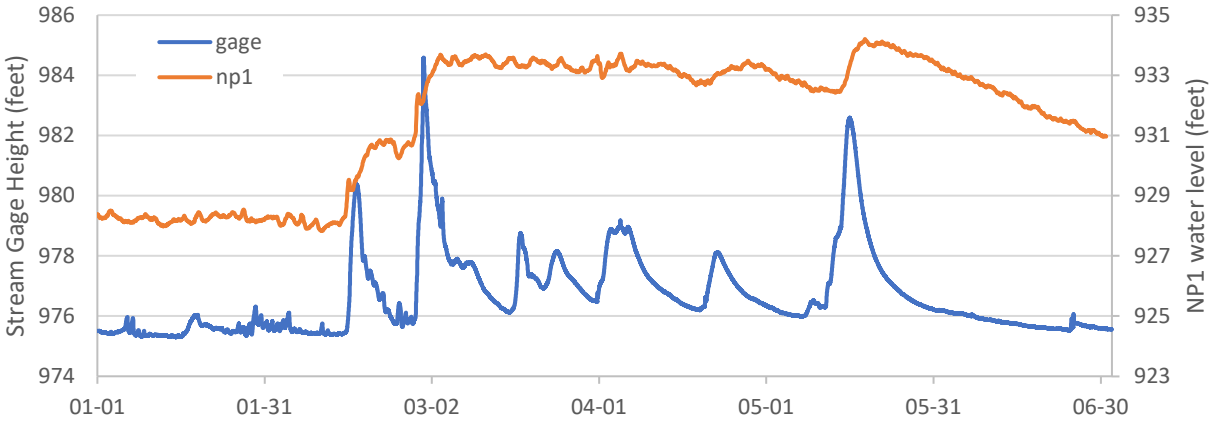

Figure 2: Comparison of the height of the Cedar River at Charles City (USGS site 05457700) to water levels in NP1.