ESTIMATING BAROMETRIC EFFICIENCY USING A GRAPHICAL METHOD ON NEARLY CONTINUOUS DATA

Gerard J. Gonthier

AUTHORS: Hydrologist, U.S. Geological Survey, 3039 Amwiler Road, Suite 130, Peachtree Business Center, Atlanta, Georgia 30360-2824.
REFERENCE: *Proceedings of the 2007 Georgia Water Resources Conference*, held March 27–29, 2007, at The University of Georgia, Athens, Georgia.

Abstract. Nearly continuous water-level and barometric-pressure data were collected at Air Force Plant 6, Marietta, Georgia, as part of ground-water characterization efforts (Fig. 1). The study site encompasses about 150 acres in the Piedmont physiographic province of northern Georgia, which is underlain by fractured, crystalline rock. An 889-hour (37-day) constant-discharge aquifer test was conducted for August through October 2003. Many wells responded measurably to barometric-pressure changes, including a barometric event that occurred during the start of the aquifer test. The barometric effects on water level had to be removed to better interpret the aquifer-test data. Water-level data from 45 wells and barometric-pressure data from two barometers were recorded every 15 minutes.

As part of the effort to remove barometric effects from water-level data, a graphical method was developed for estimating the barometric efficiency of a well using continuous water-level and barometric-pressure data. A plot of nearly continuous ground-water level on the y-axis as a function of nearly continuous barometric pressure on the x-axis will plot as a series of connected elliptical loops. Each loop (open or closed) represents a complete fluctuation in barometric pressure, in time series (Figs. 2 and 3). The slope of the preferred orientation of many elliptical loops is approximately the median slope of the major axes of the elliptical loops and is an estimate of the barometric efficiency.

The graphical method was compared to other methods using six control wells, known to have a barometric efficiency close to zero based on surface influences. Compared to all methods, the graphical method results had the least amount of error in the estimate of barometric efficiency. The ratio of the variance of barometric-pressure-independent water-level change to the variance of barometric-pressure change appeared to be a predictor of the amount of error in method estimates of barometric efficiency. A given plot can provide a range of possible values of the barometric efficiency using the graphical method because there is some subjectivity to the selection of the median slope. It is advisable that more than one person selects the preferred slope or that the same person fits the same data several times in order to minimize subjectivity.

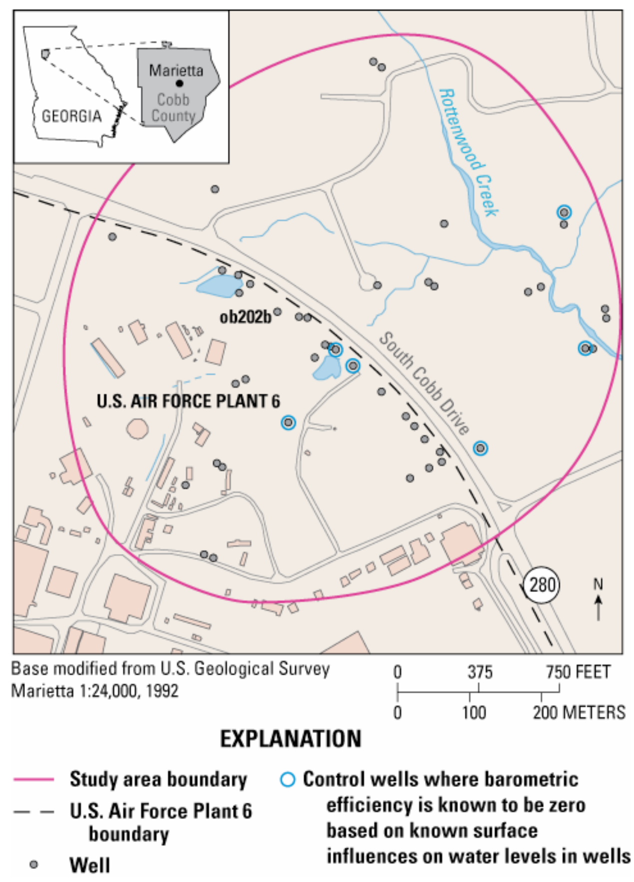

Figure 1. Monitoring wells in the study area, U.S. Air Force Plant 6, Marietta, Georgia.

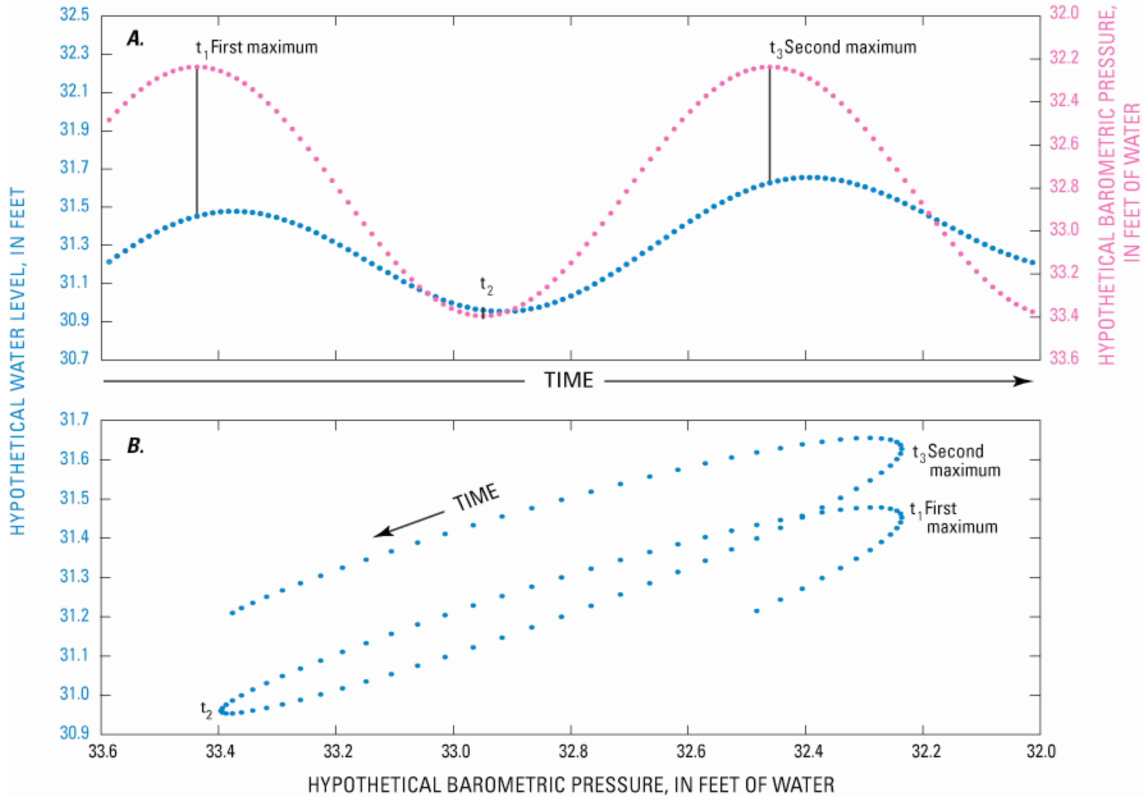

Figure 2. **Example of (*A*) time series of hypothetical water level and barometric pressure and (*B*) hypothetical water level as a function of barometric pressure. One fluctuation or loop equals t_1–t_3; barometric efficiency equals 0.50.**

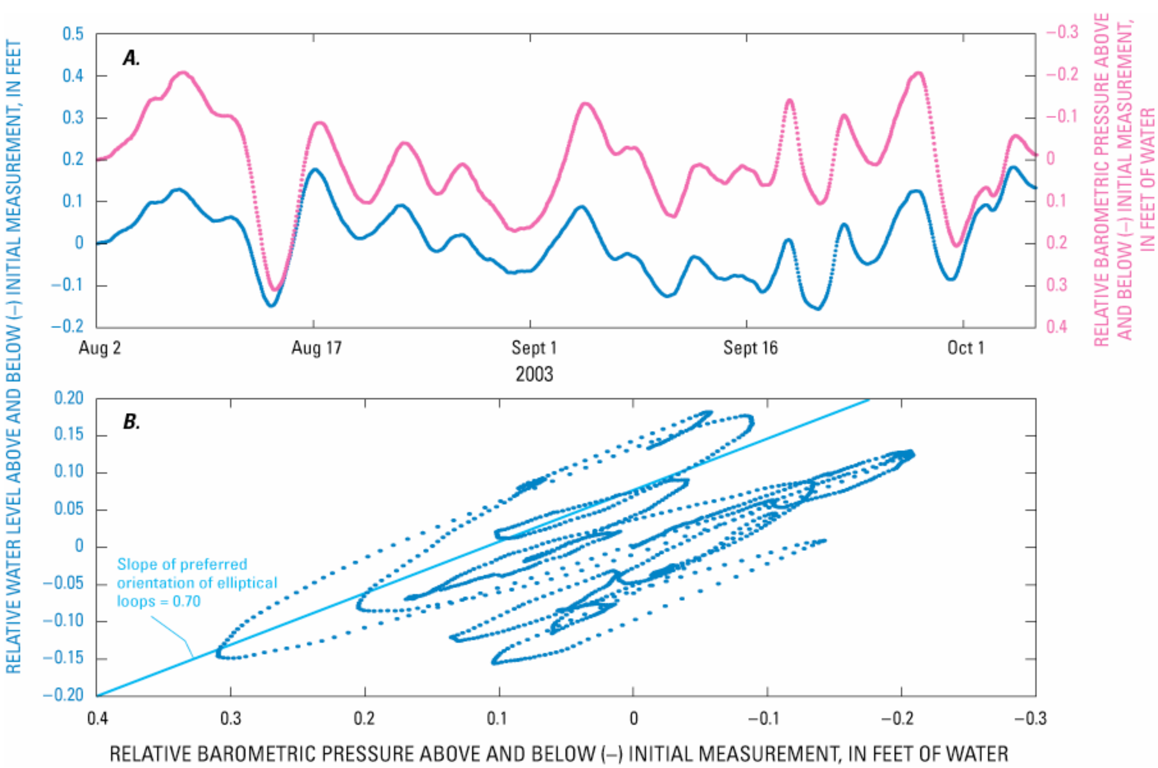

Figure 3. **(A) Time series of water level and barometric pressure and (B) water level as a function of barometric pressure for well ob202b, August 2–October 6, 2003. Barometric efficiency equals 0.70; initial water-level and barometric-pressure measurements are normalized to zero. See figure 1 for well location.**