

Christensen Farms Aquifer Test
Swine Finishing Facility; Well Use Impact Evaluation
Hand County, South Dakota
Summary Findings Report

1.0 INTRODUCTION

In February and March 2019, an aquifer test was conducted at two Christensen Farms (CF) swine finishing facilities located in Hand County, South Dakota to address the concern of potentially reducing the artesian flow rates at neighboring wells from the use of the respective production wells at the facilities. The wells and facilities are referred to as G005 and G006. The anticipated maximum daily use from each well is approximately 3,600 to 4,000 gallons which equates to an average flow rate of approximately 2 to 3 gallons per minutes (gpm). The neighboring wells are used for cattle watering purposes. Northwest AqwaTek Solutions (Wadena, Minnesota) was retained by Christensen Farms (Sleepy Eye, Minnesota) to conduct the aquifer test.

The CF and nearby wells are completed in the Dakota Sandstone aquifer at depths ranging from approximately 950 feet to 1,250 feet. The aquifer occurs under flowing artesian conditions in the vicinity of the CF facilities; therefore, the wells flow naturally at the surface at rates of approximately 5 gpm to 20 gpm.

1.1 Design

The monitoring network consisted of four wells; G006 and three cattle water supply wells. Well G005 already had been plumbed into the respective barn and therefore, the pressure probe that was wired to the Grundfos pump in the well maintained a constant pressure head within the respective piping. Consequently, no monitoring was conducted at this well.

Figure 1 provides a geographical distribution of the wells. The respective cattle wells are labelled as Rocky Oakley, Jim Becker, and Fortune 1. It's important to note that the Jeff Bust well shown in Figure 1 was intended to be part of the monitoring network. However, upon contacting Mr. Bust to acquire permission to access his well, he declined our request to include his well for the test. Table 1 provides the location coordinates, elevation, well screen intervals, and respective distances and directions of the wells from the wells.

Each well was equipped with a 5/8-inch x 3/4 inch *Badger E-Series* Ultrasonic flow meter attached to an *ORION* cellular fixed radio transmission endpoint antenna. The operating range of the meter is 0.1 gpm to 25.0 gpm. Flow rates were stored at 15-minutes intervals, transmitted electronically every four hours to a cloud-based network and then remotely downloaded to a laptop computer by NWATS personnel.

Wells G006 and Fortune 1 were equipped with an *In-Situ Level Troll 400* absolute pressure transducer to monitor the change in pressure head of the aquifer, compare change in flow rate to change in pressure head, and to calculate the barometric efficiency (i.e., atmospheric pressure effect on the fluctuation of pressure heads and flow rates) of the Dakota sandstone aquifer.

1.2 Implementation

The aquifer test consisted of four monitoring phases: 1) background, 2) pressure head (no flow) response, 3) pumping (flow) response, and 4) recovery. The effect of inversely stressing the aquifer by decreasing the total outflow from it was monitored during Phase 2, whereas the effect of directly stressing the aquifer by increasing the total discharge from it was monitored during Phase 3. The equivalent stress to the aquifer was approximately 2.5 times the maximum anticipated daily use of each production well.

Background monitoring of the pressure heads and flow rates occurred for a period of 8 days from February 10th to February 18th. The pressure response phase which consisted of shutting in and stopping the flow at well G006 occurred over a period of 13 days from February 18th to March 3rd. The pumping phase which consisted of discharging water from well G005 at a continuous rate of approximately 7 gpm occurred for a period 6 days from February 25th to March 3rd. And monitoring for “rebound” (recovery) of flow rates and pressure heads in the neighboring wells following the pumping of G005 occurred from March 3rd to March 22nd for a total of 20 days. Table 2 provides an operational timeline and manual flow rate verification of the wells.

2.0 FINDINGS

The findings from each of the monitoring phases are presented below as bullet items with reference to the subsequent figures. Data plots of the flow rates and hydrostatic pressure heads are provided in Figures 2 thru 5.

2.1 Well G006

- Background monitoring – The well was drilled November 2018 and allowed to free flow into a nearby ditch at a rate of approximately 7 gpm upon its completion. The rate was maintained with a gate valve that was installed at the top of the well. The flow remained steady at 7 gpm during background monitoring with minor fluctuations occurring as a result of variations in the barometric pressure (Figure 3).
- Pressure head monitoring - Flow from the well stopped upon shutting off the gate valve. The hydrostatic pressure was monitored at the well head at 15-minute intervals and the resultant data reveal a total fluctuation in pressure of approximately 1 psi (2.3 feet of water) and a fluctuating pattern similar to that which occurred at Fortune 1.