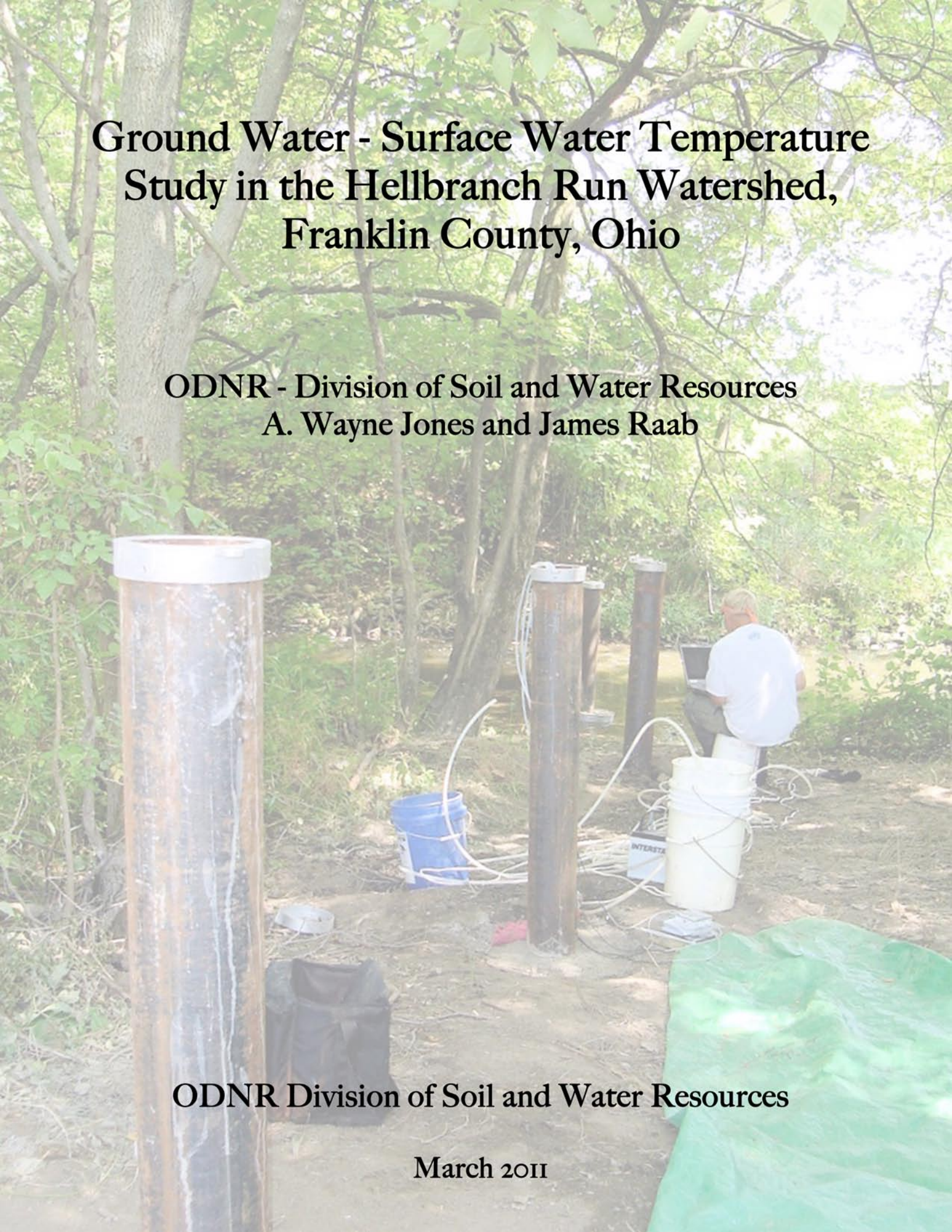
Ground Water - Surface Water Temperature Study in the Hellbranch Run Watershed, Franklin County, Ohio

ODNR - Division of Soil and Water Resources
A. Wayne Jones and James Raab



ODNR Division of Soil and Water Resources

March 2011

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Finally, thank you to the Ohio Water Resources Council for their financial support for this project.

Ground Water - Surface Water Temperature Study in the Hellbranch Run Watershed, Franklin County, Ohio

Introduction

In 2007 the Ohio Department of Natural Resources Division of Water (DOW) and the United States Geological Survey (USGS) joined efforts to study the ground water – surface water interactions along the Hellbranch Run located in western Franklin County. The DOW has completed a 2 year study of the ground water/surface water interaction of Hellbranch Run, a second-order stream in the Big Darby watershed, whose drainage is undergoing rapid urban development. The purpose of this study was to quantitatively determine gaining and losing reaches of Hellbranch Run and to determine spatial and temporal variations of shallow ground-water temperatures in selected gaining reaches of Hellbranch Run. On August 7, 2007 the USGS conducted a gain-loss study along the Hellbranch Run from Feder Road to Lambert Road.

During August and September 2007, the DOW installed monitor wells at three different sites (see Figure 1). At each site, one well was installed in the bed of Hellbranch Run and three wells were installed perpendicular to the Run. Four temperature probes were installed in each well at varying depths. Tidbit thermistors, single sensor thermistors and HOBO multiport data loggers were used to collect detailed temperature data. Temperature data was collected from each probe at 15-minute intervals. The temperature data was then used to model the interaction of surface water and ground water using VS2DHI software (Hsieh, et al., 2004).

Description of the Study Area

The Hellbranch Run watershed is located in western Franklin County and drains most of Prairie and Pleasant Townships. The Hellbranch Run flows into the Big Darby Creek near the Franklin County-Pickaway County line. This part of Franklin County is located in the Till Plains Section of the Interior Low Plains Province (Fenneman, 1938).

During August and September 2007 a total of 12 wells were installed at three different sites along Hellbranch Run. The northernmost site is located near 6370 Alkire Road. This site is referred to as site GA. The center site (referred to as site PA) is located at 5380 Lambert Road and the southernmost site (site MA) is at 6440 Lambert Road. Figure 1 is a location map of the study area showing the three sites.

The northernmost site (GA) is located 50 yards north of the intersection of Hellbranch Run and Alkire Road in Prairie Township. This site is buffered by 30 feet of dense tree cover with a shallow land slope from uplands to the stream bank. Low flow measurements were taken by the USGS at the Alkire Road bridge for sampling station 7 (Dumouchelle, 2007).

The intermediate site (PA) is located east of Lambert Road between Beatty Road and State Route 665. The elevation of the upland streambank is 10 feet above the base of the stream. The uplands are heavily wooded 30 feet on each side of Hellbranch Run. Low flow measurements were taken by the USGS at sampling station 10 located at the Beatty Road Bridge north of the PA site (Dumouchelle, 2007). South of the PA site the USGS has a gaging station (03230450) that was used for daily streamflow values (Dumouchelle, 2007).

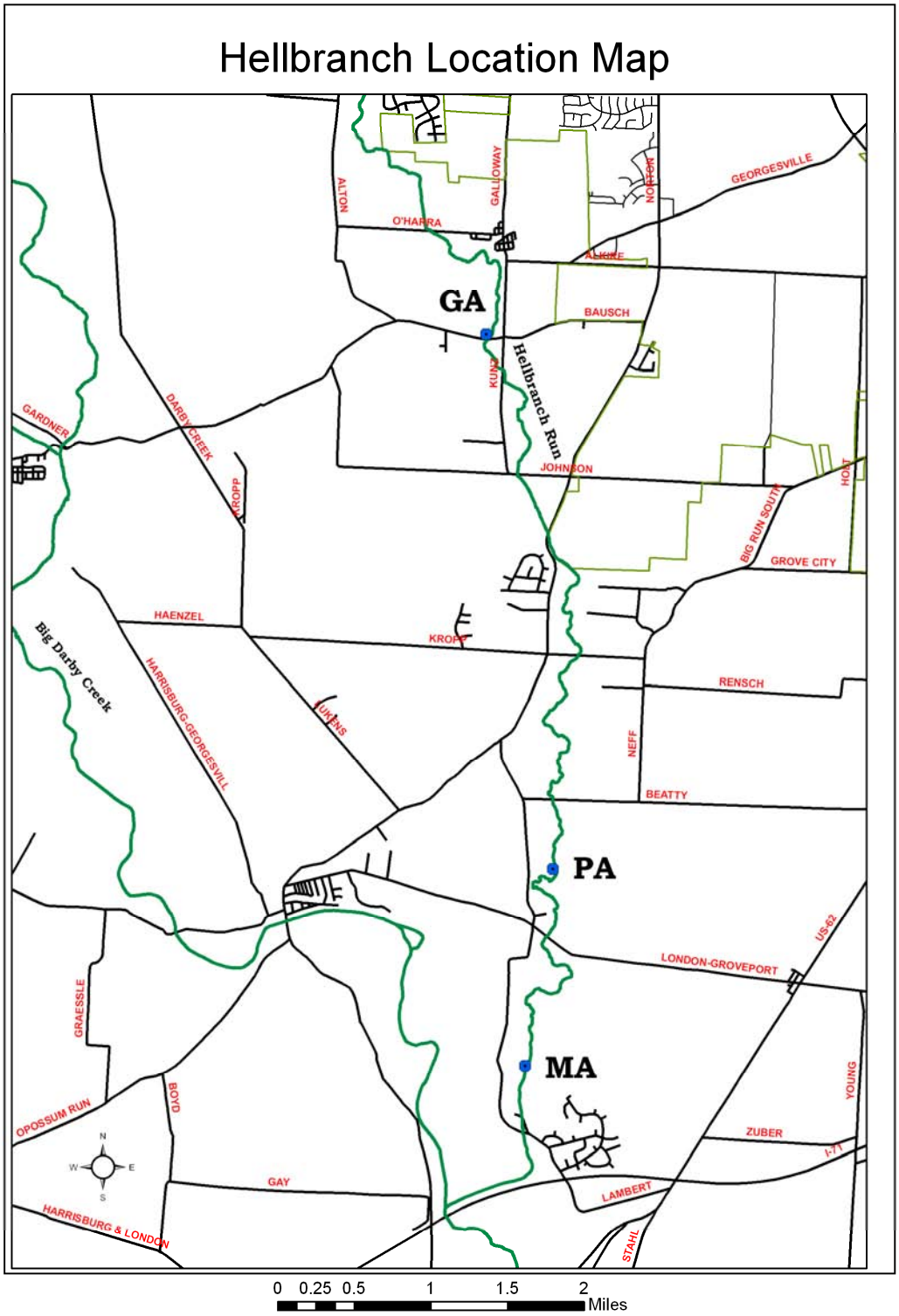

Figure 1 Location map of the study area

The southernmost site (MA) is located east of Lambert Road between State Route 665 and I-71. Farm land is on both sides of the MA site. The well sites are located close to a gravel access way that has been constructed across Hellbranch Run to move equipment between agricultural fields.

Geology and Hydrogeology

During the Pleistocene Epoch (2 million to 10,000 years before the present (Y.B.P.)), several episodes of ice advances occurred in central Ohio. The majority of the glacial deposits left behind are glacial till and outwash and, to a lesser extent, lacustrine and ice contact sand and gravel. Modern stream valleys contain alluvium or floodplain deposits. The thickness of the glacial deposits in the study area varies from 105 to 160 feet. According to the Pleistocene Geology of Ohio map (Pavey et al 1999), all three monitoring sites contain ground moraine that consists predominantly of silty loam till. Interspersed within the till are sand and gravel deposits. Water wells completed in these deposits typically yield up to 25-30 gallons per minute (gpm).

The limestone and dolomite bedrock is the principal aquifer within the entire study area (Schmidt, 1993). Yields of as much as 250 gpm can be developed at depths of less than 300 feet. Higher yields are available at greater depths but water quality is a concern.

GA Site

The soil type present at the GA site is the Westland silty clay loam. This very poorly drained soil is found on outwash plains and stream terraces. This soil is subject to ponding in the lower parts of depressions. Permeability is moderately slow in the subsoil and very rapid in the substratum (McLoda and Parkinson, 1980). Monitor wells drilled at this site encountered predominantly sandy to gravelly clay to a depth of 16 feet. The depth to water in these deposits varied from 4 to 9 feet. Most of the water supply wells in the surrounding area are completed in the sand and gravel deposits at depths ranging from 95 to 145 feet. Depth to the top of the limestone varies from 105 to 145 feet.

PA Site

The soil type present at the PA site is the Medway silt loam (McLoda and Parkinson, 1980). This soil is moderately well drained and commonly occurs adjacent to streams in small valleys. Permeability of this soil is moderate. Monitor wells at this site encountered sandy to gravelly clay to a depth of 26 feet. The depth to water in these wells varied from 7.5 to 19 feet. Domestic water supply wells in the area are completed in the sand and gravel deposits at depths ranging from 60 to 86 feet. Depth to the top of the limestone is approximately 160 feet.

MA Site

The soil type at the MA site is the Shoals silt loam. This soil is somewhat poorly drained and is found in narrow strips along high water channels on wide flood plains (McLoda and Parkinson, 1980). Permeability of these soils is moderate. Monitor wells drilled at this location encountered the most

permeable deposits of the three sites. Thin layers of sand and gravel were encountered in the sandy clay. The depth to water in these wells varied from 8 to 15 feet. Domestic wells in the area are completed in the sand and gravel deposits at depths ranging from 60 to 95 feet.

Well Installation

At each site a well was installed in the streambed. At the two northernmost sites the streambed well was installed by hand augering. Truck access to the streambed was available at the southernmost site; that well was installed by use of a truck-mounted auger. All of the other wells were installed using the truck-mounted auger. The other three wells at each site were installed in a line perpendicular to Hellbranch Run. Spacing between the wells was approximately 10 feet. Two-inch diameter PVC casing and screen were used. Each well was screened from the bottom of the well to within a few feet of the land surface. A sand pack was installed around the screened interval with the rest of the annular space grouted to the surface. A steel surface casing was cemented around the PVC pipe to house the data logger and protect the well. **Figure 2** shows pictures of typical well construction. Water well records for all 12 wells can be found in Appendix A.

Temperature Probes

Each of the 12 wells was equipped with four thermistors set at different intervals in the well. Most of the wells had a thermistor spacing of 2.5 to 4 feet. Table 1 lists the thermister depths for each well. The data logger was programmed to record temperatures at 15-minute intervals. A temperature probe was installed in Hellbranch Run at each site to record surface water temperatures.

Table 1 Depth of thermistors from land surface

Well ID	Thermister depths (feet from land surface)			
GA-1	10	13	16	19
GA-2	9	13	15	18
GA-3	6.25	10.25	14.25	18.25
GA-4	4	6.33	8.66	11
PA-1	18	21	24	27
PA-2	19	22	25	28
PA-3	18	21	24	27
PA-4	4	5.5	7	8.5
MA-1	19	22	25	28
MA-2	14	17	20	23
MA-3	14	17	20	23
MA-4	5	7.5	10	12.5

A

B

C

D

Figure 2 Pictures showing typical well design and set-up. A. Line of monitor wells perpendicular to Hellbranch Run; B. Wells with steel surface casing; C. Set of four thermistors going into monitor well; D. Datalogger used to collect temperature data

Concept of Heat as a Tracer

The interaction between ground water and surface water is among the most important concepts to understanding the movement of natural water systems. Ground water discharges into streams and become surface water throughout most hydrogeologic settings in Ohio. These gaining streams can acquire as much as 70 percent of their base flow from ground water discharge (Koltun, 1995). Losing streams mix surface water with ground water.

Chemical tracers are often used to identify subsurface flow; however, using the transfer of heat to understand ground water flow is gaining popularity. Heat is as an excellent natural tracer for ground water movement. For example, during the summer in Ohio as cool ground water flows into the warmer stream water, a cooling of the surface water occurs. During the winter, the warmer ground water flows into cooler surface water, raising the temperature of the stream. Tracking changes in water temperature in the sediments below the stream provides valuable information about water movement.

Temperature differences between ground water and surface water can be used as a tool to help understand surface water-ground water interaction. Near-surface ground water temperature remains nearly constant throughout the year (Driscoll, 1986). The temperature of ground water is usually equal to the average annual air temperature. Shallow ground water temperatures vary seasonally but are not as influenced by rapid fluctuations in air temperature. Surface water is predominately controlled by the diurnal heating and cooling cycle. Surface water temperature data in Ohio often has the highest values in July and lowest values in December.

A local flow system exists in the shallow subsurface where ground water and surface water mix. Local ground water flow systems are usually very small in size, dynamic in nature and have the most interaction with surface water through mixing. The hyporheic zone is the portion of the saturated zone underlying and beside a stream where mixing of surface water and ground water occurs. In this mixing zone, complex small scale changes in flow direction and gradient often occur. The way in which these waters mix is somewhat controlled by the morphology and structure of the stream.

The range of variability based on depth below the surface is evident when the data is plotted up for the four thermistors below the stream for GA-4. An envelope of temperature values clearly shows more variability in temperature the nearer the water is to land surface (Figure 3). This one-dimensional model shows that temperature is a function of depth and season. The deeper temperature sampling points show the influence of ground water producing a less variable temperature range. Shallow thermistors show the “flashy” influence of temperature flux found in surface water. Streambed temperatures at greater depths are cooler than the stream in the summer and warmer than the stream in the winter. The deepest temperature measurements taken show the least fluctuation from season to season.

Methodology

Tidbit thermistors were anchored to the base of the stream to collect surface water temperatures outside the confines of the well casing. Tidbit thermistors are accurate to 0 .1 degree Celsius (C) (Onset Inc, 2009). Figure 4 shows stream flow velocity in cubic feet per second and stream temperature in degrees Celsius for Hellbranch Run during the study period. This data was collected by the USGS at the State Route 665 Bridge. All in-well sensors were specially constructed and individually calibrated to have an accuracy of better than 0.1 degree C (Tom Quick, personal communication). Because the streambed is always saturated, the steel cased piezometers readily conduct heat, therefore the temperature of the water in each piezometer is assumed to be at thermal equilibrium with the streambed temperature. Temperature data was collected at 15 minute intervals from the time that well construction was complete. In-stream temperature data could not be collected during the cold winter months because of freezing. Once all wells were operational, a period of record from November 4 to December 22, 2007 was chosen for computer modeling.

Streamflow and Ground Water Modeling

Streams that exist in arid regions, such as the southwestern United States, have the water table at greater depth. The aquifer is not hydraulically connected to the base of the stream. The streams are recharging the aquifer system during storm events. The streambed seepage is in a downward direction. Rainfall or snowmelt flows from the river through a generally gravelly base into the unsaturated zone to recharge the aquifer. Modeling the transfer of heat through downward streambed seepage by using temperature change is a relatively simple process. Usually the storm flow is short term event and all of the flow of water between the aquifer and the streambed is in the same direction.

Ohio has a much more humid environment in which precipitation events occur year around. Most Ohio streams gain water from the ground water aquifers. Since water can move into and out of streams, modeling in these hydrogeologic settings is more challenging. Many aquifers have high water tables which are hydraulically connected to surficial streams. In the Hellbranch Run system, most of the flow is from ground water into Hellbranch Run.

In August of 2007, during low flow conditions, the USGS conducted a gain-loss study on Hellbranch Run (Dumouchelle, 2007). Measurements were made of the streamflow discharge and all of the inflows to a stream reach. The determination was made as to which reaches of the stream were gaining or losing. The reach just north of the GA-4 was a losing reach. The other reaches adjacent to the study sites were all slightly gaining or could not be determined.

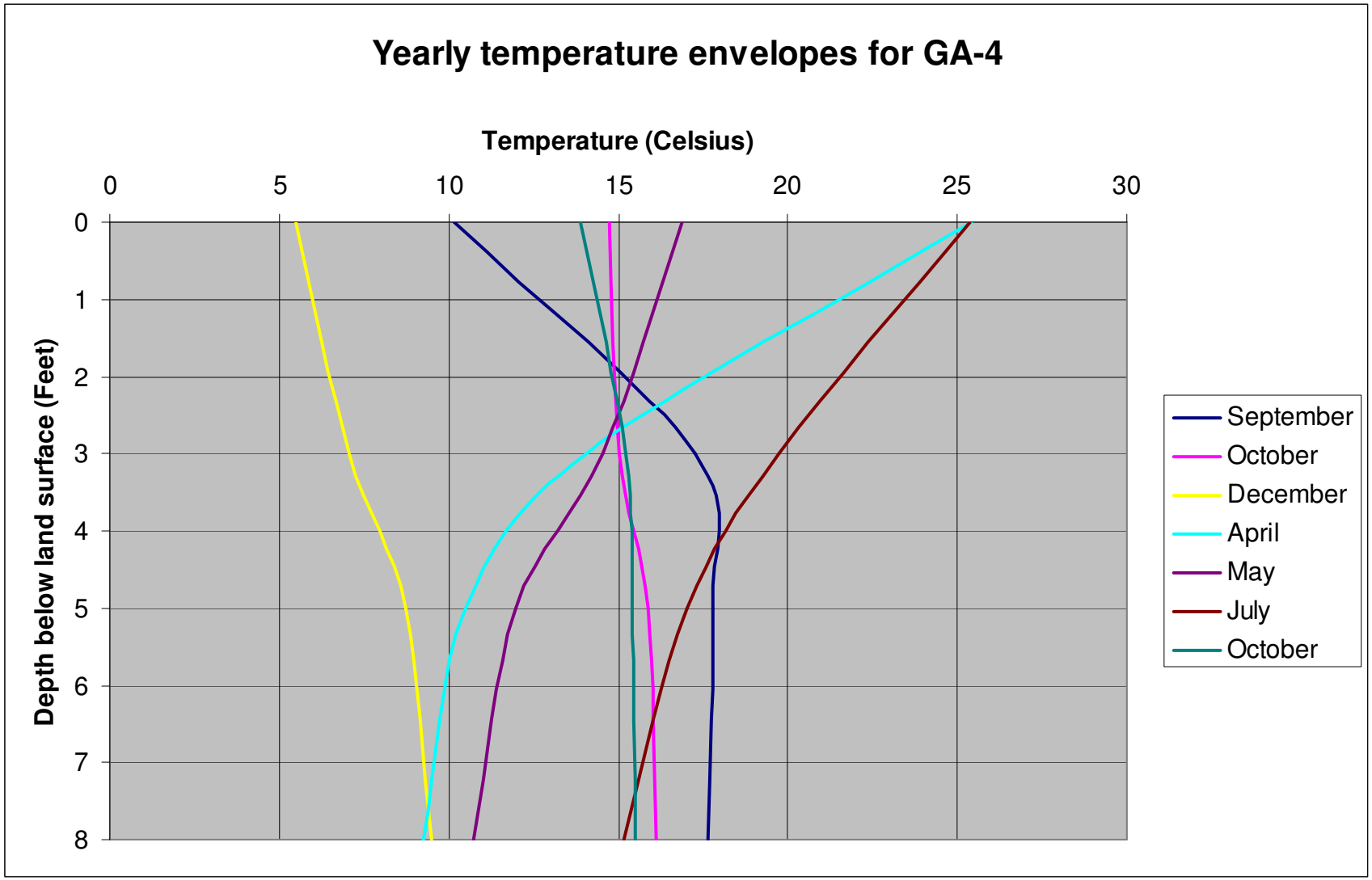

Figure 3 Temperature envelope

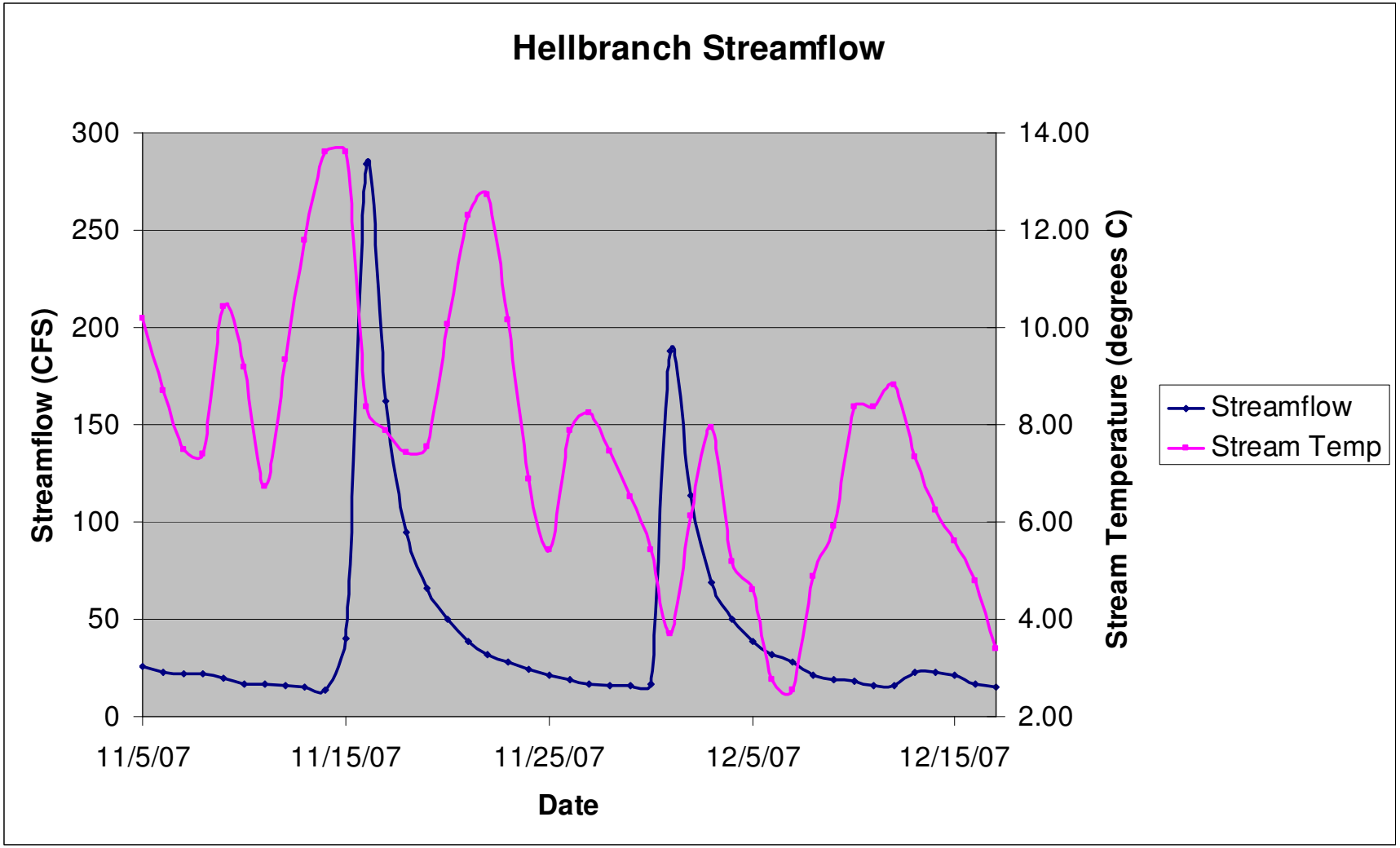

Figure 4 Hellbranch streamflow and water temperature

Models

A properly defined conceptual model of flow characteristics is necessary before the modeling process begins. The conceptual model used was a 2-dimensional flow system where flow is parallel to the stream and also downward. This model is used when ground water levels are near the top of the stream and the stream is losing in the upper reaches and gaining flow in the lower reaches (Constantz, 2003). The computer model also requires that all of the boundary conditions at the site are properly defined. The use of this conceptual model is consistent with the data collected during the USGS gain-loss study (Dumouchelle, 2007).

The software used to model the temperature data was VS2DI Version 1.2 (Hsieh et al., 2004). This software was used to simulate thermal and fluid transport in porous media. The graphical interface is designed to construct computer models of flow in a visual manner. A scaled sketch of the site was constructed for each location. All the geologic and hydrogeologic parameters were added to the model. A graphical model of the sediments was constructed based on well logs, and cross sections. Initial estimates of the hydraulic conductivity of the sediments were made.

Once the model construction was completed, a simulation of the model was run. The output file of temperature data was added to the graphs of temperature data collected at the sites. Adjustments were then made to the model input and the simulation was rerun to produce a simulation that most closely matched the real temperature data that was collected. Calibration of the VS2DHI model to the collected temperature data produced an accurate hydraulic conductivity value for aquifer materials and allowed for a reliable estimate of streambed seepage.

Results

GA-4

GA-4 is the northernmost location in the study area. The hydraulic gradient was calculated at 0.12 foot/foot. This means that the ground water table is dipping towards Hellbranch Run at approximately 1.44 inches for every foot in the horizontal direction. The upstream reach from GA-4 was the only reach that was losing during the gain-loss study (Dumouchelle, 2007). The downstream reach was gaining (Dumouchelle, 2007). The fit of the VS2DHI model was the best of the three sites (Figure 5). The model was calibrated to the deepest thermistor set at 6.30 feet below the stream channel. The stream depth at GA-4 was less that 1 foot at the well site. The GA-4 plot labeled Model is the modeled result for the deepest thermistor at the site. The results of the calibrated model show a hydraulic conductivity of 3.0×10^{-2} feet/day for the glacial till deposit and 3.0×10^{-1} feet/day for the sand and gravel deposits. The values are within the range that would be expected for these deposits.

PA-4

PA-4 is the central location in the study area. The hydraulic gradient was calculated at 0.146 feet per foot. This means that the ground water table is dipping towards Hellbranch Run at approximately 1.75 inches for every foot in the horizontal direction. It could not be determined if either the upstream or the downstream reaches from PA-4 were gaining or losing because of the high level of uncertainty in the measurements that were collected by the USGS (Dumouchelle, 2007). The fit of the VS2DHI model was good in the early time and late time data, but was less accurate during the middle time data (Figure 6). The model was calibrated to the deepest thermistor set at 4.2 feet below the stream channel. The stream depth at PA-4 was less that 1 foot at the well site. PA-4 is the modeled result which overlays the plot labeled Model, which is the deepest thermistor in well PA-4. The results of the calibrated model had a hydraulic conductivity of 6.0×10^{-3} feet/day for the glacial till deposit and 6.0×10^{-2} feet/day for the sand and gravel deposits. These values are greater than an order of magnitude less than the GA-4 site. The values are still well within the range that would be expected for these deposits.

MA-4

MA-4 is the southernmost location in the study area. It could not be determined if the upstream reach from MA-4 was gaining or losing because of the high level of uncertainty in the measurements that were collected (Dumouchelle, 2007). Downstream of MA-4 was at the intersection of Lambert Road and Hellbranch Run. At this location water was visible in the stream channel, but no measurement could be taken, therefore no gain-loss data was available downstream. The model was calibrated to the deepest thermistor set at 7.92 feet below the stream channel. Model runs for this site were not able to be accurately calibrated. The model data did not match the temperature data that was field collected. Temperature values collected by the stream Tidbit were of questionable accuracy. The expected temperature changes in this shallow reach of Hellbranch Run were not always present in the Tidbit data. This equipment malfunction contributed to difficulties in model calibration. Inaccurate understanding of the hydrology of the site is an additional probable cause for the difficulties with model calibration.

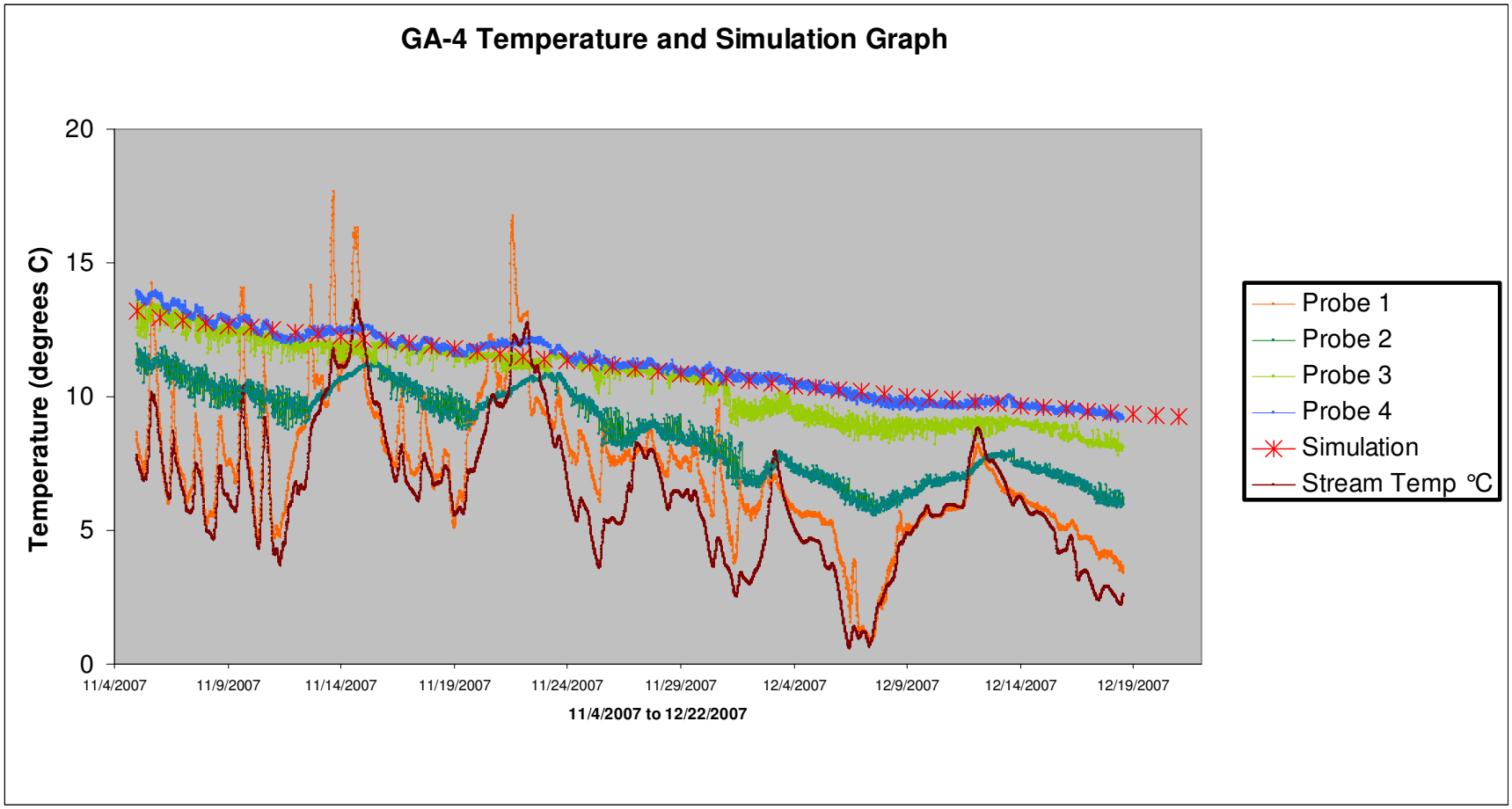

Figure 5 GA-4 Temperature and simulation graph

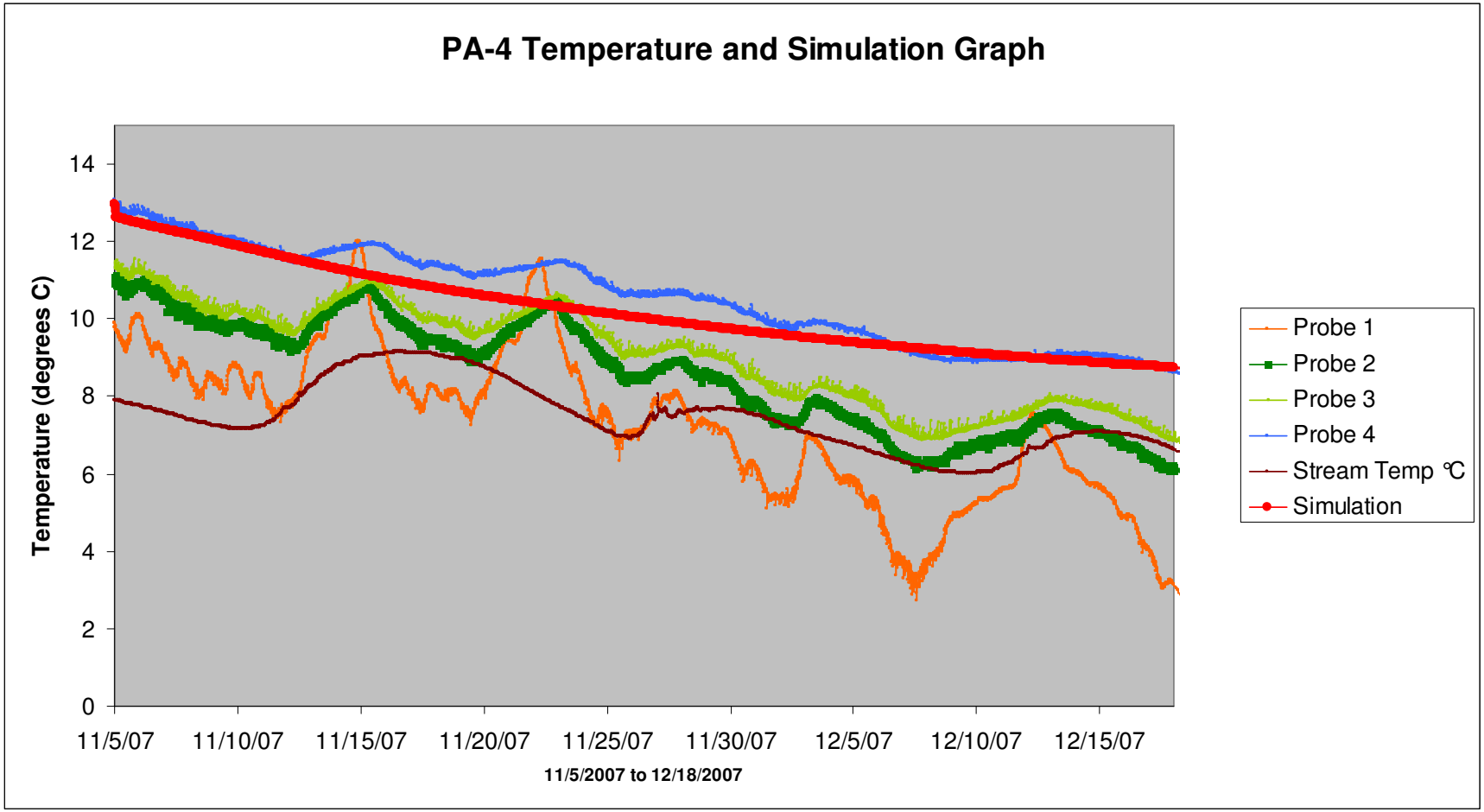

Figure 6 PA-4 Temperature and simulation graph

Hydrology

Using the values from the calibrated model for GA-4, a ground water flow rate, also known as seepage rate, was calculated. Using the hydraulic gradient and the hydraulic conductivity values for the calibrated model, the seepage rate can be calculated. The seepage rate in the glacial till is 6.15×10^{-4} feet/day. The seepage rate in the sand and gravel portion of the aquifer is 1.11×10^{-2} feet day.

Ground water seepage rates were calculated for PA-4 by using the values from the PA-4 calibrated model for hydraulic conductivity in feet/day times the hydraulic gradient in feet/foot. The value for the seepage rate in the glacial till is 8.76×10^{-4} feet/day. The value for the seepage rate in sand and gravel portion of the aquifer is 8.76×10^{-2} feet day.

Conclusions

The model worked the best at the northernmost site (GA), which had a losing reach of the Hellbranch Run upgradient of the site and a gaining reach downgradient of the site. The poorest fit for the model was the southernmost site MA-4. The reaches upgradient and downgradient were gaining according to the USGS gain-loss study. At this time, the VS2DHI software is not really designed to analyze this hydrogeologic setting in a 2-dimensional model (Constantz, 2003). Other software is available for 3-D analysis for these types of setting, but use of that software was beyond the scope of this project.

Using heat as a tool for determining the movement of water near rivers in Ohio shows much promise. The results of a calibrated model are values for hydraulic conductivity that in turn would be useful for water supply, contaminant transport and other modeling efforts. As with all modeling software, the user must understand the hydrology of the study area before modeling begins. Having a gain-loss study in place is helpful in defining areas that are appropriate for the use of this type of modeling.

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Appendix

Water Well Records

DNR 7802.05e

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Division of Water, 2045 Morse Road, Columbus, Ohio 43229-6605
Voice (614) 265-6740 Fax (614) 265-6767

Well Log Number: 2012737

Page 1 of 1 for this record.

WELL LOCATION

County: FRANKLIN Township: PRAIRIE

Owner/Builder: ODNR DIV OF WATER

Address of Well Location: 6370 ALKIRE RD

City: GALLOWAY Zip Code +4: 43119

Permit No. _____ Section; _____ and or Lot No. _____

Use of Well: MONITOR

Coordinates of Well (Use only one of the below coordinate systems)

State Plane Coordinates

N ☐ X _____ +/- _____ ft.

S ☐ Y _____ +/- _____ ft.

Latitude, Longitude Coordinates

Latitude: 39.90451 Longitude: -83.16489

Elevation of Well in feet: 873.15 +/- _____ ft.

Datum Plane: ☐ NAD27 ☐ NAD83 Elevation Source _____

Source of Coordinates: GPS

Well location written description:
FAR SOUTHEAST CORNER OF PROPERTY NEAR HELLBRANCH RUN

Comments on water quality/quantity and well construction:
WELL ID IS GA-1

WELL TEST *

Pre-Pumping Static Level 8.9 ft. Date 8/9/2007

Measured from TOP OF CASING

Pumping test method _____

Test Rate _____ gpm Duration of Test _____ hrs.

Feet of Drawdown _____ ft. Sustainable Yield _____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☒ No

PUMP/PITLESS

Type of pump _____ Capacity _____ gpm

Pump set at _____ ft. Pitless Type _____

Pump installed by _____

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm: ODNR DIVISION OF WATER

Address: 2045 MORSE RD

City, State, Zip: COLUMBUS OH 43229

Signed: JAMES RAAB (Filed Electronically) Date: 8/4/2009

ODH Registration Number _____

CONSTRUCTION DETAILS

Drilling Method: AUGER

BOREHOLE/CASING (Measured from ground surface)

1 Borehole Diameter 4 inches Depth 16 ft.
Casing Diameter 2 in. Length 5 ft. Thickness 0.154 in.

2 Borehole Diameter _____ inches Depth _____ ft.
Casing Diameter _____ in. Length _____ ft. Thickness _____ in.

Casing Height Above Ground 4.5 ft.

Type 1: PVC
2: _____

Joints 1: _____
2: _____

SCREEN

Diameter 2 in. Slot Size 0.02 in. Screen Length 15 ft.

Type MACHINE SLOTTED Material PVC

Set Between 16 ft. and 1 ft.

GRAVEL PACK (Filter Pack)

Material/Size #5 SAND Vol/Wt. Used 100 LBS

Method of Installation Tremie

Depth: Placed From: 16 ft. To: 1 ft.

GROUT

Material Bentonite pellets/chunks Vol/Wt. Used 5 LBS

Method of Installation Poured (gravity)

Depth: Placed From: 1 ft. To: 0 ft.

DRILLING LOG*

FORMATIONS INCLUDE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Color	Texture	Formation	From	To
BROWN		SOIL	0	2
GRAY-BROWN		CLAY & GRAVEL	2	6
GRAY	GRAVELLY	SAND AND CLAY	6	16
		Water Encountered At	6	16

Aquifer Type (Formation producing the most water.) SAND AND CLAY

Date of Well Completion 8/9/2007 Total Depth of Well 16 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.
Distribute copies of this record to Customer, and Local Health Deptartment.

DNR 7802.05e

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Division of Water, 2045 Morse Road, Columbus, Ohio 43229-6605
Voice (614) 265-6740 Fax (614) 265-6767

Well Log Number: 2012739

Page 1 of 1 for this record.

WELL LOCATION

County: FRANKLIN Township: PRAIRIE

Owner/Builder: ODNR DIVISION OF WATER

Address of Well Location: 6370 ALKIRE RD

City: GALLOWAY Zip Code +4: 43119

Permit No. _____ Section; _____ and or Lot No. _____

Use of Well: MONITOR

Coordinates of Well (Use only one of the below coordinate systems)

State Plane Coordinates

N ☐ X _____ +/- _____ ft.

S ☐ Y _____ +/- _____ ft.

Latitude, Longitude Coordinates

Latitude: 39.904517 Longitude: 83.16485

Elevation of Well in feet: _____ +/- _____ ft.

Datum Plane: ☐ NAD27 ☐ NAD83 Elevation Source _____

Source of Coordinates: GPS

Well location written description:

FAR COUTHEAST CORNER OF PROPERTY NEAR HELLBRANCH RUN MIDDLE OF THE 3 WELLS ON LAND

Comments on water quality/quantity and well construction:

WELL ID = GA-2

WELL TEST *

Pre-Pumping Static Level 8 ft. Date 8/9/2007

Measured from TOP OF CASING

Pumping test method _____

Test Rate _____ gpm Duration of Test _____ hrs.

Feet of Drawdown _____ ft. Sustainable Yield _____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☒ No

PUMP/PITLESS

Type of pump _____ Capacity _____ gpm

Pump set at _____ ft. Pitless Type _____

Pump installed by _____

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm: ODNR DIVISION OF WATER

Address: 2045 MORSE RD

City, State, Zip: COLUMBUS OH 43229

Signed: JAMES RAAB (Filed Electronically) Date: 10/1/2007

ODH Registration Number _____

CONSTRUCTION DETAILS

Drilling Method: AUGER

BOREHOLE/CASING (Measured from ground surface)

1 { Borehole Diameter 4 inches Depth 16.1 ft.
  { Casing Diameter 2 in. Length 15 ft. Thickness 0.154 in.

2 { Borehole Diameter _____ inches Depth _____ ft.
  { Casing Diameter _____ in. Length _____ ft. Thickness _____ in.

Casing Height Above Ground 4.3 ft.

Type { 1: PVC
     { 2: _____

Joints { 1: Threaded
       { 2: _____

SCREEN

Diameter 2 in. Slot Size 0.02 in. Screen Length 15 ft.

Type MACHINE SLOTTED Material PVC

Set Between 16.1 ft. and 1.1 ft.

GRAVEL PACK (Filter Pack)

Material/Size #5 SAND Vol/Wt. Used 100 LBS

Method of Installation Tremie

Depth: Placed From: 16.1 ft. To: 1 ft.

GROUT

Material Bentonite pellets/chunks Vol/Wt. Used 5

Method of Installation Poured (gravity)

Depth: Placed From: 1 ft. To: 0 ft.

DRILLING LOG*

FORMATIONS INCLUDE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Color	Texture	Formation	From	To
BROWN		SOIL	0	2
BROWN-GRAY	SANDY	CLAY	2	5
GRAY	GRAVELLY	SAND AND CLAY	5	6
GRAY	GRAVELLY	CLAY AND SAND	6	16.1
		Water Encountered At	6	16

Aquifer Type (Formation producing the most water.) SAND AND CLAY

Date of Well Completion 8/9/2007 Total Depth of Well 16.1 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.
Distribute copies of this record to Customer, and Local Health Deptartment.

DNR 7802.05e

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Division of Water, 2045 Morse Road, Columbus, Ohio 43229-6605
Voice (614) 265-6740 Fax (614) 265-6767

Well Log Number: 2012740

Page 1 of 1 for this record.

WELL LOCATION

County: FRANKLIN Township: PRAIRIE

Owner/Builder: ODNR-DIVISION OF WATER

Address of Well Location: 6370 ALKIRE RD

City: GALLOWAY Zip Code +4: 43119

Permit No. _____ Section; _____ and or Lot No. _____

Use of Well: MONITOR

Coordinates of Well (Use only one of the below coordinate systems)

State Plane Coordinates

N ☐ X _____ +/- _____ ft.

S ☐ Y _____ +/- _____ ft.

Latitude, Longitude Coordinates

Latitude: 39.904483 Longitude: 83.164867

Elevation of Well in feet: _____ +/- _____ ft.

Datum Plane: ☐ NAD27 ☐ NAD83 Elevation Source _____

Source of Coordinates: GPS

Well location written description:

FAR SOUTHEAST CORNER OF PROPERTY NEAR HELLBRANCH RUN, WELL NEAREST TO THE RUN

Comments on water quality/quantity and well construction:

WELL ID = GA-3

WELL TEST *

Pre-Pumping Static Level 6.6 ft. Date 8/9/2007

Measured from TOP OF CASING

Pumping test method _____

Test Rate _____ gpm Duration of Test _____ hrs.

Feet of Drawdown _____ ft. Sustainable Yield _____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☒ No

PUMP/PITLESS

Type of pump _____ Capacity _____ gpm

Pump set at _____ ft. Pitless Type _____

Pump installed by _____

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm: ODNR DIVISION OF WATER

Address: 2045 MORSE RD

City, State, Zip: COLUMBUS OH 43229

Signed: JAMES RAAB (Filed Electronically) Date: 10/1/2007

ODH Registration Number _____

CONSTRUCTION DETAILS

Drilling Method: AUGER

BOREHOLE/CASING (Measured from ground surface)

1 Borehole Diameter 4 inches Depth 16.5 ft.
Casing Diameter 2 in. Length 5 ft. Thickness 0.154 in.

2 Borehole Diameter _____ inches Depth _____ ft.
Casing Diameter _____ in. Length _____ ft. Thickness _____ in.

Casing Height Above Ground 4 ft.

Type 1: PVC
2: _____

Joints 1: Threaded
2: _____

SCREEN

Diameter 2 in. Slot Size 0.02 in. Screen Length 10 ft.

Type MACHINE SLOTTED Material PVC

Set Between 16.5 ft. and 1.5 ft.

GRAVEL PACK (Filter Pack)

Material/Size #5 SAND Vol/Wt. Used 80 LBS

Method of Installation Tremie

Depth: Placed From: 16.5 ft. To: 1 ft.

GROUT

Material Bentonite pellets/chunks Vol/Wt. Used 5 LBS

Method of Installation Poured (gravity)

Depth: Placed From: 1 ft. To: 0 ft.

DRILLING LOG*

FORMATIONS INCLUDE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Color	Texture	Formation	From	To
BROWN		SOIL	0	2
BROWN-GRAY		CLAY	2	6
GRAY		CLAY AND SILT	6	16.5

Aquifer Type (Formation producing the most water.) CLAY & SILT

Date of Well Completion 8/9/2007 Total Depth of Well 16.5 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.
Distribute copies of this record to Customer, and Local Health Deptartment.

DNR 7802.05e

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Division of Water, 2045 Morse Road, Columbus, Ohio 43229-6605
Voice (614) 265-6740 Fax (614) 265-6767

Well Log Number: 2012742

Page 1 of 1 for this record.

WELL LOCATION

County: FRANKLIN Township: PRAIRIE

Owner/Builder: ODNR-DIVISION OF WATER

Address of Well Location: 6370 ALKIRE RD

City: GALLOWAY Zip Code +4: 43119

Permit No. _____ Section; _____ and or Lot No. _____

Use of Well: MONITOR

Coordinates of Well (Use only one of the below coordinate systems)

State Plane Coordinates

N ☐ X _____ +/- _____ ft.

S ☐ Y _____ +/- _____ ft.

Latitude, Longitude Coordinates

Latitude: 39.90445 Longitude: 83.16485

Elevation of Well in feet: _____ +/- _____ ft.

Datum Plane: ☐ NAD27 ☐ NAD83 Elevation Source _____

Source of Coordinates: GPS

Well location written description:

FAR SOUTHEAST CORNER OF PROPERTY NEAR HELLBRANCH RUN, WELL IS LOCATED IN HELLBRANCH RUN

Comments on water quality/quantity and well construction:

WELL ID = GA-4

WELL TEST *

Pre-Pumping Static Level 3.5 ft. Date 8/9/2007

Measured from TOP OF CASING

Pumping test method _____

Test Rate _____ gpm Duration of Test _____ hrs.

Feet of Drawdown _____ ft. Sustainable Yield _____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☒ No

PUMP/PITLESS

Type of pump _____ Capacity _____ gpm

Pump set at _____ ft. Pitless Type _____

Pump installed by _____

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm: ODNR DIVISION OF WATER

Address: 2045 MORSE RD

City, State, Zip: COLUMBUS OH 43229

Signed: JAMES RAAB (Filed Electronically) Date: 10/1/2007

ODH Registration Number _____

CONSTRUCTION DETAILS

Drilling Method: AUGER

BOREHOLE/CASING (Measured from ground surface)

1 Borehole Diameter 1.25 inches Depth 7.1 ft.
Casing Diameter 1.25 in. Length 10 ft. Thickness 0.144 in.

2 Borehole Diameter _____ inches Depth _____ ft.
Casing Diameter _____ in. Length _____ ft. Thickness _____ in.

Casing Height Above Ground 4.7 ft.

Type 1: Galvanized
2: _____

Joints 1: Threaded
2: _____

SCREEN

Diameter 1.25 in. Slot Size 0.02 in. Screen Length 3 ft.

Type PERFORATED (DRILLED) Material GALVANIZED STEEL

Set Between 7.1 ft. and 4 ft.

GRAVEL PACK (Filter Pack)

Material/Size _____ Vol/Wt. Used _____

Method of Installation _____

Depth: Placed From: _____ ft. To: _____ ft.

GROUT

Material _____ Vol/Wt. Used _____

Method of Installation _____

Depth: Placed From: _____ ft. To: _____ ft.

DRILLING LOG*

FORMATIONS INCLUDE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Color	Texture	Formation	From	To
		GRAVEL AND BOULDERS	0	1
GRAY	SANDY	CLAY	1	7.1
		Water Encountered At	1	7

Aquifer Type (Formation producing the most water.) CLAY

Date of Well Completion 8/9/2007 Total Depth of Well 7.1 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.
Distribute copies of this record to Customer, and Local Health Deptartment.

DNR 7802.05e

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Division of Water, 2045 Morse Road, Columbus, Ohio 43229-6605
Voice (614) 265-6740 Fax (614) 265-6767

Well Log Number: 2012751

Page 1 of 1 for this record.

WELL LOCATION

County: FRANKLIN Township: PLEASANT

Owner/Builder: ODNR-DIVISION OF WATER

Address of Well Location: 5380 LAMBERT RD

City: GROVE CITY Zip Code +4: 43123

Permit No. _____ Section; _____ and or Lot No. _____

Use of Well: MONITOR

Coordinates of Well (Use only one of the below coordinate systems)

State Plane Coordinates

N ☐ X _____ +/- _____ ft.

S ☐ Y _____ +/- _____ ft.

Latitude, Longitude Coordinates

Latitude: 39.85415 Longitude: 83.156317

Elevation of Well in feet: _____ +/- _____ ft.

Datum Plane: ☐ NAD27 ☐ NAD83 Elevation Source _____

Source of Coordinates: GPS

Well location written description:

WELL DRILLED AT FAR SOUTHEAST CORNER OF PROPERTY APPROXIMATELY 25 FEET FROM HELLBRANCH RUN

Comments on water quality/quantity and well construction:

WELL ID = PA-1

WELL TEST *

Pre-Pumping Static Level 25.3 ft. Date 9/28/2007

Measured from TOP OF CASING

Pumping test method _____

Test Rate _____ gpm Duration of Test _____ hrs.

Feet of Drawdown _____ ft. Sustainable Yield _____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☒ No

PUMP/PITLESS

Type of pump _____ Capacity _____ gpm

Pump set at _____ ft. Pitless Type _____

Pump installed by _____

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm: ODNR DIVISION OF WATER

Address: 2045 MORSE RD

City, State, Zip: COLUMBUS OH 43229

Signed: JAMES RAAB (Filed Electronically) Date: 10/1/2007

ODH Registration Number _____

CONSTRUCTION DETAILS

Drilling Method: AUGER

BOREHOLE/CASING (Measured from ground surface)

1 Borehole Diameter 4 inches Depth 26 ft.
Casing Diameter 2 in. Length 10 ft. Thickness 0.154 in.

2 Borehole Diameter _____ inches Depth _____ ft.
Casing Diameter _____ in. Length _____ ft. Thickness _____ in.

Casing Height Above Ground 4 ft.

Type 1: PVC
2: _____

Joints 1: Threaded
2: _____

SCREEN

Diameter 2 in. Slot Size 0.01 in. Screen Length 20 ft.

Type MACHINE SLOTTED Material PVC

Set Between 26 ft. and 6 ft.

GRAVEL PACK (Filter Pack)

Material/Size #5 SAND Vol/Wt. Used 100 LBS

Method of Installation Tremie

Depth: Placed From: 26 ft. To: 5 ft.

GROUT

Material Bentonite pellets/chunks Vol/Wt. Used 20 LBS

Method of Installation Poured (gravity)

Depth: Placed From: 5 ft. To: 1 ft.

DRILLING LOG*

FORMATIONS INCLUDE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Color	Texture	Formation	From	To
DARK BROWN	SANDY	SOIL	0	3
BROWN	SANDY	CLAY	3	26

Aquifer Type (Formation producing the most water.) CLAY

Date of Well Completion 9/28/2007 Total Depth of Well 26 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.
Distribute copies of this record to Customer, and Local Health Deptartment.

DNR 7802.05e

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Division of Water, 2045 Morse Road, Columbus, Ohio 43229-6605
Voice (614) 265-6740 Fax (614) 265-6767

Well Log Number: 2012752

Page 1 of 1 for this record.

WELL LOCATION

County: FRANKLIN Township: PLEASANT

Owner/Builder: ODNR-DIVISION OF WATER

Address of Well Location: 5380 LAMBERT RD

City: GROVE CITY Zip Code +4: 43123

Permit No. _____ Section; _____ and or Lot No. _____

Use of Well: MONITOR

Coordinates of Well (Use only one of the below coordinate systems)

State Plane Coordinates

N ☐ X _____ +/- _____ ft.

S ☐ Y _____ +/- _____ ft.

Latitude, Longitude Coordinates

Latitude: 39.854117 Longitude: 83.15625

Elevation of Well in feet: _____ +/- _____ ft.

Datum Plane: ☐ NAD27 ☐ NAD83 Elevation Source _____

Source of Coordinates: GPS

Well location written description:

WELL DRILLED NEAR SOUTHEAST CORNER OF PROPERTY APPROXIMATELY 15 FEET WEST OF HELLBRANCH RUN

Comments on water quality/quantity and well construction:

WELL ID = PA-2

WELL TEST *

Pre-Pumping Static Level 14.7 ft. Date 9/24/2007

Measured from TOP OF CASING

Pumping test method _____

Test Rate _____ gpm Duration of Test _____ hrs.

Feet of Drawdown _____ ft. Sustainable Yield _____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☒ No

PUMP/PITLESS

Type of pump _____ Capacity _____ gpm

Pump set at _____ ft. Pitless Type _____

Pump installed by _____

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm: ODNR DIVISION OF WATER

Address: 2045 MORSE RD

City, State, Zip: COLUMBUS OH 43229

Signed: JAMES RAAB (Filed Electronically) Date: 10/1/2007

ODH Registration Number _____

CONSTRUCTION DETAILS

Drilling Method: AUGER

BOREHOLE/CASING (Measured from ground surface)

1 Borehole Diameter 4 inches Depth 27 ft.
Casing Diameter 2 in. Length 10 ft. Thickness 0.154 in.

2 Borehole Diameter _____ inches Depth _____ ft.
Casing Diameter _____ in. Length _____ ft. Thickness _____ in.

Casing Height Above Ground 4.5 ft.

Type 1: PVC
2: _____

Joints 1: Threaded
2: _____

SCREEN

Diameter 2 in. Slot Size 0.01 in. Screen Length 20 ft.

Type MACHINE SLOTTED Material PVC

Set Between 26 ft. and 6 ft.

GRAVEL PACK (Filter Pack)

Material/Size #5 SAND Vol/Wt. Used 150 LBS

Method of Installation Tremie

Depth: Placed From: 26 ft. To: 5 ft.

GROUT

Material Bentonite pellets/chunks Vol/Wt. Used 20 LBS

Method of Installation Poured (gravity)

Depth: Placed From: 5 ft. To: 0 ft.

DRILLING LOG*

FORMATIONS INCLUDE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Color	Texture	Formation	From	To
DARK BROWN	SANDY	SOIL	0	2
BROWN	GRAVELLY	CLAY	2	11
GRAY-BROWN	SILTY	CLAY & GRAVEL	11	13
GRAY	SILTY	CLAY & GRAVEL	13	26
GRAY	PLASTIC	CLAY	26	27

Aquifer Type (Formation producing the most water.) CLAY

Date of Well Completion 9/24/2007 Total Depth of Well 26 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.
Distribute copies of this record to Customer, and Local Health Deptartment.

DNR 7802.05e

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Division of Water, 2045 Morse Road, Columbus, Ohio 43229-6605
Voice (614) 265-6740 Fax (614) 265-6767

Well Log Number: 2012754

Page 1 of 1 for this record.

WELL LOCATION

County: FRANKLIN Township: PLEASANT

Owner/Builder: ODNR-DIVISION OF WATER

Address of Well Location: 5380 LAMBERT RD

City: GROVE CITY Zip Code +4: 43123

Permit No. _____ Section; _____ and or Lot No. _____

Use of Well: MONITOR

Coordinates of Well (Use only one of the below coordinate systems)

State Plane Coordinates

N ☐ X _____ +/- _____ ft.

S ☐ Y _____ +/- _____ ft.

Latitude, Longitude Coordinates

Latitude: 39.854133 Longitude: 83.156183

Elevation of Well in feet: _____ +/- _____ ft.

Datum Plane: ☐ NAD27 ☐ NAD83 Elevation Source _____

Source of Coordinates: GPS

Well location written description:

WELL DRILLED AT FAR SOUTHEAST CORNER OF PROPERTY APPROXIMATELY 5 FEET FROM THE BANK OF HELLBRANCH RUN

Comments on water quality/quantity and well construction:

WELL ID = PA-3

WELL TEST *

Pre-Pumping Static Level 12.9 ft. Date 9/24/2007

Measured from TOP OF CASING

Pumping test method _____

Test Rate _____ gpm Duration of Test _____ hrs.

Feet of Drawdown _____ ft. Sustainable Yield _____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☒ No

PUMP/PITLESS

Type of pump _____ Capacity _____ gpm

Pump set at _____ ft. Pitless Type _____

Pump installed by _____

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm: ODNR DIVISION OF WATER

Address: 2045 MORSE RD

City, State, Zip: COLUMBUS OH 43229

Signed: JAMES RAAB (Filed Electronically) Date: 10/1/2007

ODH Registration Number _____

CONSTRUCTION DETAILS

Drilling Method: AUGER

BOREHOLE/CASING (Measured from ground surface)

1 Borehole Diameter 4 inches Depth 27 ft.
Casing Diameter 2 in. Length 10 ft. Thickness 0.154 in.

2 Borehole Diameter _____ inches Depth _____ ft.
Casing Diameter _____ in. Length _____ ft. Thickness _____ in.

Casing Height Above Ground 4.1 ft.

Type 1: PVC
2: _____

Joints 1: Threaded
2: _____

SCREEN

Diameter 2 in. Slot Size 0.01 in. Screen Length 20 ft.

Type MACHINE SLOTTED Material PVC

Set Between 26 ft. and 6 ft.

GRAVEL PACK (Filter Pack)

Material/Size #5 SAND Vol/Wt. Used 125 LBS

Method of Installation Tremie

Depth: Placed From: 26 ft. To: 5 ft.

GROUT

Material Bentonite pellets/chunks Vol/Wt. Used 20 LBS

Method of Installation Poured (gravity)

Depth: Placed From: 5 ft. To: 0 ft.

DRILLING LOG*

FORMATIONS INCLUDE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Color	Texture	Formation	From	To
DARK BROWN		SOIL	0	2
BROWN		SAND AND SILT	2	7
BROWN		CLAY AND SILT	7	11
BROWN-GRAY		CLAY AND SILT	11	14
GRAY	DAMP	CLAY & GRAVEL	14	27

Aquifer Type (Formation producing the most water.) CLAY & SILT

Date of Well Completion 9/24/2007 Total Depth of Well 26 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.
Distribute copies of this record to Customer, and Local Health Deptartment.

DNR 7802.05e

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Division of Water, 2045 Morse Road, Columbus, Ohio 43229-6605
Voice (614) 265-6740 Fax (614) 265-6767

Well Log Number: 2012755

Page 1 of 1 for this record.

WELL LOCATION

County: FRANKLIN Township: PLEASANT

Owner/Builder: ODNR-DIVISION OF WATER

Address of Well Location: 5380 LAMBERT RD

City: GROVE CITY Zip Code +4: 43123

Permit No. _____ Section; _____ and or Lot No. _____

Use of Well: MONITOR

Coordinates of Well (Use only one of the below coordinate systems)

State Plane Coordinates

N ☐ X _____ +/- _____ ft.

S ☐ Y _____ +/- _____ ft.

Latitude, Longitude Coordinates

Latitude: 39.854183 Longitude: 83.156083

Elevation of Well in feet: _____ +/- _____ ft.

Datum Plane: ☐ NAD27 ☐ NAD83 Elevation Source _____

Source of Coordinates: GPS

Well location written description:

WELL DRILLED AT FAR SOUTHEAST CORNER OF PROPERTY IN THE HELLBRANCH RUN

Comments on water quality/quantity and well construction:

WELL ID = PA-4

WELL TEST *

Pre-Pumping Static Level 3.6 ft. Date 9/24/2007

Measured from TOP OF CASING

Pumping test method _____

Test Rate _____ gpm Duration of Test _____ hrs.

Feet of Drawdown _____ ft. Sustainable Yield _____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☒ No

PUMP/PITLESS

Type of pump _____ Capacity _____ gpm

Pump set at _____ ft. Pitless Type _____

Pump installed by _____

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm: ODNR DIVISION OF WATER

Address: 2045 MORSE RD

City, State, Zip: COLUMBUS OH 43229

Signed: JAMES RAAB (Filed Electronically) Date: 10/1/2007

ODH Registration Number _____

CONSTRUCTION DETAILS

Drilling Method: DRIVEN

BOREHOLE/CASING (Measured from ground surface)

1 Borehole Diameter 1.25 inches Depth 7.5 ft.
Casing Diameter 1.25 in. Length 10 ft. Thickness 0.144 in.

2 Borehole Diameter _____ inches Depth _____ ft.
Casing Diameter _____ in. Length _____ ft. Thickness _____ in.

Casing Height Above Ground 4.2 ft.

Type 1: Galvanized
2: _____

Joints 1: Threaded
2: _____

SCREEN

Diameter 1.25 in. Slot Size 0.02 in. Screen Length 1 ft.

Type PERFORATED (DRILLED) Material GALVANIZED STEEL

Set Between 7.5 ft. and 6.5 ft.

GRAVEL PACK (Filter Pack)

Material/Size _____ Vol/Wt. Used _____

Method of Installation _____

Depth: Placed From: _____ ft. To: _____ ft.

GROUT

Material _____ Vol/Wt. Used _____

Method of Installation _____

Depth: Placed From: _____ ft. To: _____ ft.

DRILLING LOG*

FORMATIONS INCLUDE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Color	Texture	Formation	From	To
		SAND AND BOULDERS	0	1
	SILTY	CLAY & GRAVEL	1	7.5

Aquifer Type (Formation producing the most water.) SAND AND BOULDERS

Date of Well Completion 9/24/2007 Total Depth of Well 7.5 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.
Distribute copies of this record to Customer, and Local Health Deptartment.

DNR 7802.05e

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Division of Water, 2045 Morse Road, Columbus, Ohio 43229-6605
Voice (614) 265-6740 Fax (614) 265-6767

Well Log Number: 2012743

Page 1 of 1 for this record.

WELL LOCATION

County: FRANKLIN Township: PLEASANT

Owner/Builder: ODNR-DIVISION OF WATER

Address of Well Location: 6440 LAMBERT RD

City: ORIENT Zip Code +4: 43146

Permit No. _____ Section; _____ and or Lot No. _____

Use of Well: MONITOR

Coordinates of Well (Use only one of the below coordinate systems)

State Plane Coordinates

N ☐ X _____ +/- _____ ft.

S ☐ Y _____ +/- _____ ft.

Latitude, Longitude Coordinates

Latitude: 39.835483 Longitude: 83.1597

Elevation of Well in feet: _____ +/- _____ ft.

Datum Plane: ☐ NAD27 ☐ NAD83 Elevation Source _____

Source of Coordinates: GPS

Well location written description:

WELL DRILLED BACK BY STREAM CROSSING APPROXIMATELY 35 FEET FROM HELLBRANCH RUN

Comments on water quality/quantity and well construction:

WELL ID = MA-1

WELL TEST *

Pre-Pumping Static Level 14.9 ft. Date 9/28/2007

Measured from TOP OF CASING

Pumping test method _____

Test Rate _____ gpm Duration of Test _____ hrs.

Feet of Drawdown _____ ft. Sustainable Yield _____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☒ No

PUMP/PITLESS

Type of pump _____ Capacity _____ gpm

Pump set at _____ ft. Pitless Type _____

Pump installed by _____

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm: ODNR DIVISION OF WATER

Address: 2045 MORSE RD

City, State, Zip: COLUMBUS OH 43229

Signed: JAMES RAAB (Filed Electronically) Date: 10/1/2007

ODH Registration Number _____

CONSTRUCTION DETAILS

Drilling Method: AUGER

BOREHOLE/CASING (Measured from ground surface)

1 Borehole Diameter 4 inches Depth 27 ft.
Casing Diameter 2 in. Length 10 ft. Thickness 0.154 in.

2 Borehole Diameter _____ inches Depth _____ ft.
Casing Diameter _____ in. Length _____ ft. Thickness _____ in.

Casing Height Above Ground 4.3 ft.

Type 1: PVC
2: _____

Joints 1: Threaded
2: _____

SCREEN

Diameter 2 in. Slot Size 0.01 in. Screen Length 20 ft.

Type MACHINE SLOTTED Material PVC

Set Between 27 ft. and 7 ft.

GRAVEL PACK (Filter Pack)

Material/Size #5 SAND Vol/Wt. Used 125 LBS

Method of Installation Tremie

Depth: Placed From: 27 ft. To: 5 ft.

GROUT

Material Bentonite pellets/chunks Vol/Wt. Used 20 LBS

Method of Installation Poured (gravity)

Depth: Placed From: 5 ft. To: 0 ft.

DRILLING LOG*

FORMATIONS INCLUDE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Color	Texture	Formation	From	To
BROWN	SANDY	SOIL	0	4
GRAY-BROWN	GRAVELLY	CLAY	4	12
GRAY	CLAYEY	SAND AND GRAVEL	12	13
GRAY	GRAVELLY	CLAY	13	19
DARK BROWN		SAND	19	20
GRAY	GRAVELLY	CLAY	20	27
		Water Encountered At	12	26

Aquifer Type (Formation producing the most water.) SAND AND GRAVEL

Date of Well Completion 9/28/2007 Total Depth of Well 26 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.
Distribute copies of this record to Customer, and Local Health Deptartment.

DNR 7802.05e

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Division of Water, 2045 Morse Road, Columbus, Ohio 43229-6605
Voice (614) 265-6740 Fax (614) 265-6767

Well Log Number: 2012745

Page 1 of 1 for this record.

WELL LOCATION

County: FRANKLIN Township: PLEASANT

Owner/Builder: ODNR-DIVISION OF WATER

Address of Well Location: 6440 LAMBERT RD

City: ORIENT Zip Code +4: 43146

Permit No. _____ Section; _____ and or Lot No. _____

Use of Well: MONITOR

Coordinates of Well (Use only one of the below coordinate systems)

State Plane Coordinates

N ☐ X _____ +/- _____ ft.

S ☐ Y _____ +/- _____ ft.

Latitude, Longitude Coordinates

Latitude: 39.8355 Longitude: 83.159633

Elevation of Well in feet: _____ +/- _____ ft.

Datum Plane: ☐ NAD27 ☐ NAD83 Elevation Source _____

Source of Coordinates: GPS

Well location written description:

WELL DRILLED BACK BY STREAM CROSSING APPROXIMATELY 25 FEET FROM HELLBRANCH RUN

Comments on water quality/quantity and well construction:

WELL ID = MA-2

WELL TEST *

Pre-Pumping Static Level 13 ft. Date 9/24/2007

Measured from TOP OF CASING

Pumping test method _____

Test Rate _____ gpm Duration of Test _____ hrs.

Feet of Drawdown _____ ft. Sustainable Yield _____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☒ No

PUMP/PITLESS

Type of pump _____ Capacity _____ gpm

Pump set at _____ ft. Pitless Type _____

Pump installed by _____

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm: ODNR DIVISION OF WATER

Address: 2045 MORSE RD

City, State, Zip: COLUMBUS OH 43229

Signed: JAMES RAAB (Filed Electronically) Date: 10/1/2007

ODH Registration Number _____

CONSTRUCTION DETAILS

Drilling Method: AUGER

BOREHOLE/CASING (Measured from ground surface)

1 Borehole Diameter 4 inches Depth 26 ft.
Casing Diameter 2 in. Length 10 ft. Thickness 0.154 in.

2 Borehole Diameter _____ inches Depth _____ ft.
Casing Diameter _____ in. Length _____ ft. Thickness _____ in.

Casing Height Above Ground 4.4 ft.

Type 1: PVC
2: _____

Joints 1: Threaded
2: _____

SCREEN

Diameter 2 in. Slot Size 0.01 in. Screen Length 20 ft.

Type MACHINE SLOTTED Material PVC

Set Between 26 ft. and 6 ft.

GRAVEL PACK (Filter Pack)

Material/Size #5 SAND Vol/Wt. Used 200 LBS

Method of Installation Tremie

Depth: Placed From: 26 ft. To: 5 ft.

GROUT

Material Bentonite pellets/chunks Vol/Wt. Used 20 LBS

Method of Installation Poured (gravity)

Depth: Placed From: 5 ft. To: 0 ft.

DRILLING LOG*

FORMATIONS INCLUDE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Color	Texture	Formation	From	To
BROWN	SANDY	SILT	0	4
BROWN	DRY	SAND AND GRAVEL	4	9
GRAY	CLAYEY	SAND	9	17
GRAY	DIRTY	GRAVEL	17	19
GRAY	CLAYEY	SAND	19	26
		Water Encountered At	12	26

Aquifer Type (Formation producing the most water.) SAND AND GRAVEL

Date of Well Completion 9/24/2007 Total Depth of Well 26 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.
Distribute copies of this record to Customer, and Local Health Deptartment.

DNR 7802.05e

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Division of Water, 2045 Morse Road, Columbus, Ohio 43229-6605
Voice (614) 265-6740 Fax (614) 265-6767

Well Log Number: 2012746

Page 1 of 1 for this record.

WELL LOCATION

County: FRANKLIN Township: PLEASANT

Owner/Builder: ODNR-DIVISION OF WATER

Address of Well Location: 6440 LAMBERT RD

City: ORIENT Zip Code +4: 43146

Permit No. _____ Section; _____ and or Lot No. _____

Use of Well: MONITOR

Coordinates of Well (Use only one of the below coordinate systems)

State Plane Coordinates

N ☐ X _____ +/- _____ ft.

S ☐ Y _____ +/- _____ ft.

Latitude, Longitude Coordinates

Latitude: 39.835483 Longitude: 83.159583

Elevation of Well in feet: _____ +/- _____ ft.

Datum Plane: ☐ NAD27 ☐ NAD83 Elevation Source _____

Source of Coordinates: GPS

Well location written description:

WELL DRILLED BACK BY STREAM CROSSING APPROXIMATELY 10 FEET FROM HELLBRANCH RUN

Comments on water quality/quantity and well construction:

WELL ID = MA-3

WELL TEST *

Pre-Pumping Static Level 13.2 ft. Date 9/28/2007

Measured from TOP OF CASING

Pumping test method _____

Test Rate _____ gpm Duration of Test _____ hrs.

Feet of Drawdown _____ ft. Sustainable Yield _____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☒ No

PUMP/PITLESS

Type of pump _____ Capacity _____ gpm

Pump set at _____ ft. Pitless Type _____

Pump installed by _____

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm: ODNR DIVISION OF WATER

Address: 2045 MORSE RD

City, State, Zip: COLUMBUS OH 43229

Signed: JAMES RAAB (Filed Electronically) Date: 10/1/2007

ODH Registration Number _____

CONSTRUCTION DETAILS

Drilling Method: AUGER

BOREHOLE/CASING (Measured from ground surface)

1 Borehole Diameter 4 inches Depth 23 ft.
Casing Diameter 2 in. Length 10 ft. Thickness 0.154 in.

2 Borehole Diameter _____ inches Depth _____ ft.
Casing Diameter _____ in. Length _____ ft. Thickness _____ in.

Casing Height Above Ground 4.5 ft.

Type 1: PVC
2: _____

Joints 1: Threaded
2: _____

SCREEN

Diameter 2 in. Slot Size 0.01 in. Screen Length 20 ft.

Type MACHINE SLOTTED Material PVC

Set Between 23 ft. and 3 ft.

GRAVEL PACK (Filter Pack)

Material/Size #5 SAND Vol/Wt. Used 150 LBS

Method of Installation Tremie

Depth: Placed From: 23 ft. To: 2 ft.

GROUT

Material Bentonite pellets/chunks Vol/Wt. Used 10 LBS

Method of Installation Poured (gravity)

Depth: Placed From: 2 ft. To: 0 ft.

DRILLING LOG*

FORMATIONS INCLUDE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Color	Texture	Formation	From	To
BROWN	SANDY	SILT	0	5
BROWN-GRAY	GRAVELLY	CLAY	5	26

Aquifer Type (Formation producing the most water.) CLAY

Date of Well Completion 9/28/2007 Total Depth of Well 23 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.
Distribute copies of this record to Customer, and Local Health Deptartment.

DNR 7802.05e

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Division of Water, 2045 Morse Road, Columbus, Ohio 43229-6605
Voice (614) 265-6740 Fax (614) 265-6767

Well Log Number: 2012747

Page 1 of 1 for this record.

WELL LOCATION

County: FRANKLIN Township: PLEASANT

Owner/Builder: ODNR-DIVISION OF WATER

Address of Well Location: 6440 LAMBERT RD

City: ORIENT Zip Code +4: 43146

Permit No. _____ Section; _____ and or Lot No. _____

Use of Well: MONITOR

Coordinates of Well (Use only one of the below coordinate systems)

State Plane Coordinates

N ☐ X _____ +/- _____ ft.

S ☐ Y _____ +/- _____ ft.

Latitude, Longitude Coordinates

Latitude: 39.835483 Longitude: 83.159533

Elevation of Well in feet: _____ +/- _____ ft.

Datum Plane: ☐ NAD27 ☐ NAD83 Elevation Source _____

Source of Coordinates: GPS

Well location written description:

WELL DRILLED BACK SOUTH OF STREAM CROSSING IN HELLBRANCH RUN

Comments on water quality/quantity and well construction:

WELL ID = MA-4

WELL TEST *

Pre-Pumping Static Level 4 ft. Date 9/28/2007

Measured from TOP OF CASING

Pumping test method _____

Test Rate _____ gpm Duration of Test _____ hrs.

Feet of Drawdown _____ ft. Sustainable Yield _____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☒ No

PUMP/PITLESS

Type of pump _____ Capacity _____ gpm

Pump set at _____ ft. Pitless Type _____

Pump installed by _____

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm: ODNR DIVISION OF WATER

Address: 2045 MORSE RD

City, State, Zip: COLUMBUS OH 43229

Signed: JAMES RAAB (Filed Electronically) Date: 10/1/2007

ODH Registration Number _____

CONSTRUCTION DETAILS

Drilling Method: AUGER

BOREHOLE/CASING (Measured from ground surface)

1 Borehole Diameter 4 inches Depth 13 ft.
Casing Diameter 2 in. Length 5 ft. Thickness 0.154 in.

2 Borehole Diameter _____ inches Depth _____ ft.
Casing Diameter _____ in. Length _____ ft. Thickness _____ in.

Casing Height Above Ground 4.6 ft.

Type 1: PVC
2: _____

Joints 1: Threaded
2: _____

SCREEN

Diameter 2 in. Slot Size 0.01 in. Screen Length 10 ft.

Type MACHINE SLOTTED Material PVC

Set Between 13 ft. and 3 ft.

GRAVEL PACK (Filter Pack)

Material/Size #5 SAND Vol/Wt. Used 50 LBS

Method of Installation Poured (gravity)

Depth: Placed From: 13 ft. To: 2 ft.

GROUT

Material Bentonite pellets/chunks Vol/Wt. Used 5 LBS

Method of Installation Poured (gravity)

Depth: Placed From: 2 ft. To: 0 ft.

DRILLING LOG*

FORMATIONS INCLUDE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Color	Texture	Formation	From	To
		SANDGRAVELBOULDERS	0	1
BROWN-GRAY	GRAVELLY	CLAY	1	9
GRAY	SANDY	CLAY	9	10
GRAY	GRAVELLY	CLAY	10	13

Aquifer Type (Formation producing the most water.) CLAY

Date of Well Completion 9/28/2007 Total Depth of Well 13 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.
Distribute copies of this record to Customer, and Local Health Deptartment.