University of Minnesota
MINNESOTA GEOLOGICAL SURVEY
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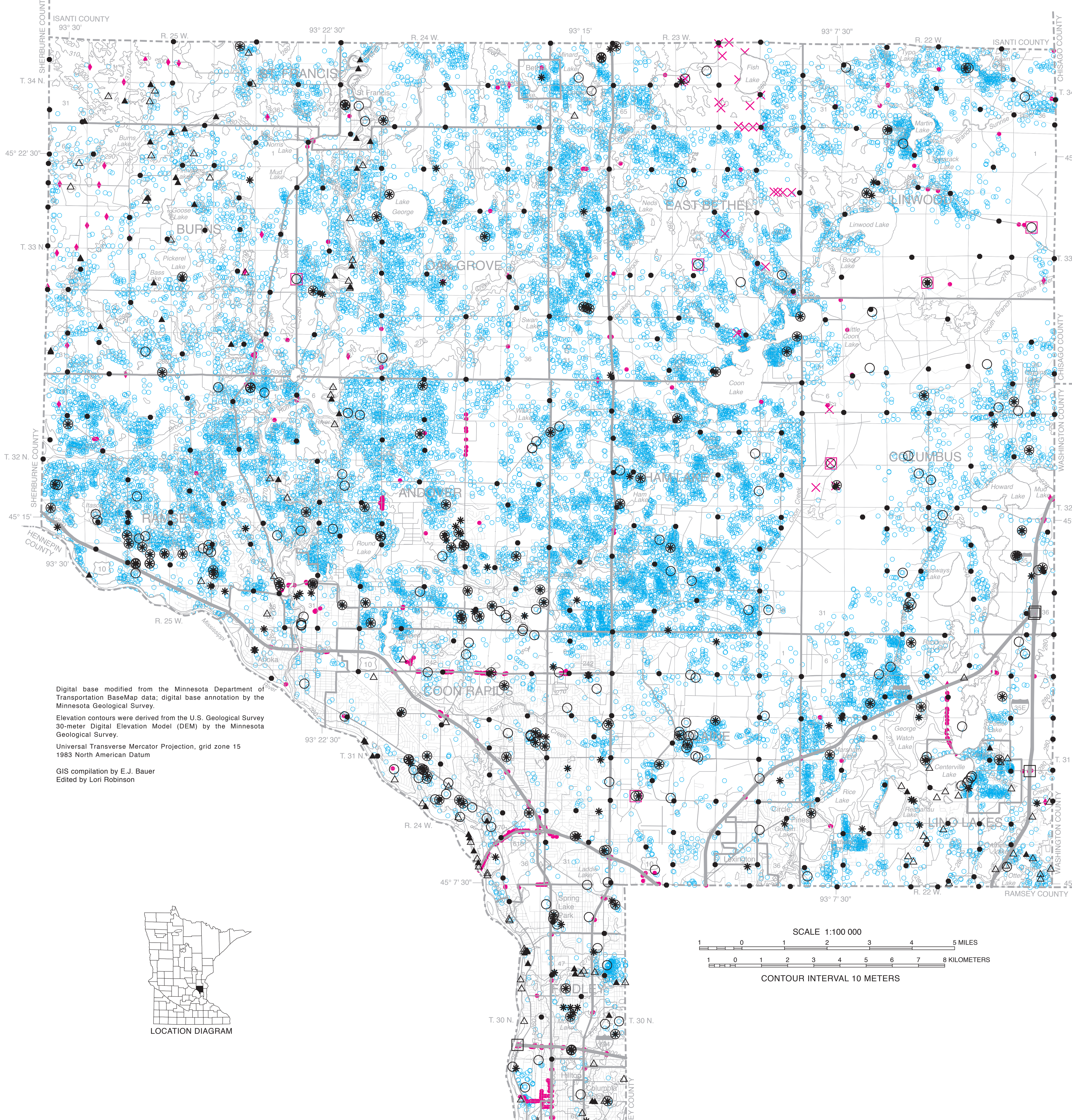


Digital base modified from the Minnesota Department of Transportation BaseMap data; digital base annotation by the Minnesota Geological Survey.

Elevation contours were derived from the U.S. Geological Survey 30-meter Digital Elevation Model (DEM) by the Minnesota Geological Survey.

Universal Transverse Mercator Projection, grid zone 15
1983 North American Datum

GIS compilation by E.J. Bauer
Edited by Lori Robinson

LOCATION DIAGRAM

DATA-BASE MAP

By

Emily J. Bauer

2012

THE DATA-BASE MAP

The types, locations, and density of information used to prepare the Anoka County atlas are shown on this map. The data are described below to aid the user in assessing what types may be useful for a particular information need. The Data-Base Map serves as a guide to the precision of the other maps in the atlas. It shows where data are sparse or lacking and interpretation and extrapolation were required to prepare the maps. All data were collected by Minnesota Geological Survey staff unless otherwise specified.

DRILL-HOLE INFORMATION

A **record of water-well construction (well driller's log)** is a water-well contractor's description of the geologic materials penetrated during drilling and the construction materials used to complete the well. Not all wells extend to bedrock. In areas of thick, unconsolidated Quaternary deposits, drillers commonly do not need to drill through the entire thickness of overburden to find sufficient ground water. Hydrologic data, such as the static water level and test-pumping results, are commonly included. Before any driller's log can be used, the location of the well must be verified, and a geologist must interpret the log. Driller's logs are the primary source of subsurface geologic and hydrologic data for Anoka County; about 24,000 logs were used for this atlas; they can be found in the County Well Index (CWI).

Core samples were collected at various sites throughout Anoka County as a means to establish the nature of the subsurface material. Four core samples were collected by the Minnesota Department of Transportation using diamond core drilling. This method uses a diamond bit rotating at the end of a drill rod. A column of rock moves up the drill pipe and is recovered at the surface for study. Rotary-sonic cores were collected by the Minnesota Geological Survey from six sites in the county to aid the interpretation of the Quaternary deposits. The coring technique enables recovery of a continuous core, 3.5 inches (8.9 centimeters) in diameter, from glacial deposits and bedrock (if intersected). It provides excellent subsurface samples for detailed study and comparison with cuttings, geophysical logs, and driller's logs from surrounding sites. A detailed geologist's log is entered into the County Well Index (CWI) and any sampling results are entered into the Quaternary Samples Data Base (QBASE). The core is available for inspection at the Minnesota Department of Natural Resources, Division of Lands and Minerals offices.

Cutting samples collected during drilling provide physical evidence of subsurface geologic materials. Cuttings are the samples generated as the drill bit cuts through the subsurface material and are used to interpret and verify driller's logs. They are logged and stored at the Minnesota Geological Survey.

Borehole geophysical logs are created by lowering instruments down a well or drill hole and measuring the physical and chemical properties of the geologic materials through which the hole passes. Different logging techniques measure naturally occurring gamma radiation, spontaneous potential, and resistivity. Gamma logs characterize in graphic form the geologic formations penetrated. Spontaneous potential and resistivity are mainly used to locate water levels in wells and the depth of the well casing. An interpretive log is prepared from the geophysical log and correlated with drilling samples from the same hole, information obtained from nearby outcrops, or a geophysical log from a nearby drill hole. Geophysical logs can provide high-quality subsurface geologic and hydrologic information for wells that have little or no other information available. The information obtained from a geophysical log is added to the County Well Index (CWI) and the paper log is on file at the Minnesota Geological Survey.

Soil borings are test holes drilled to obtain information about the physical properties of subsurface materials for engineering, mapping, or exploration purposes. They are logged by an engineer or a geologist using a variety of classification schemes based on particle sizes, penetration rate, moisture content, and color. Soil-boring data were collected by the Minnesota Department of Transportation, the U.S. Geological Survey, and the Anoka County Highway Department. They are limited in distribution; in Anoka County they are concentrated along the U.S. Highway 10, U.S. Interstate 35, U.S. Interstate 694, and State Highway 610 corridors. These data are most useful in determining the composition of unconsolidated deposits. The geologic materials penetrated are entered into the Quaternary Samples Data Base (QBASE); all other information collected is contained in paper files.

Giddings probe holes are continuous cores of glacial materials, 2 inches (5.1 centimeters) in diameter, collected by a truck-mounted hydraulic auger. A description was generated at every site and samples were taken for textural analyses at most locations. Samples were generally taken about every 5 feet (1.5 meters), at unit contacts, or where the geologist believed it was important.

OTHER INFORMATION

Field sites are natural and artificial exposures of unconsolidated Quaternary deposits that were described in detail; samples from many sites were texturally analyzed. Field sites include stream and river cuts, gravel pits, and road cuts.

Textural analyses express the proportion of sand-, silt-, and clay-size particles that make up a sample. The samples analyzed were taken from natural and artificial exposures, Giddings holes, and the rotary-sonic cores. They are helpful in determining the origin, correlation, and hydrologic properties of unconsolidated sediments.

Gravity data can be used to help map the thickness of overlying glacial deposits. The application of this method relies primarily on the strong density contrasts that exist between bedrock and unconsolidated deposits. The method also relies on the ability to separate the gravity effect associated with the bedrock topography and glacial fill from that of density variations occurring within the underlying Precambrian bedrock. Unfortunately, no suitable means of isolating the two effects could be achieved in Anoka County; the Precambrian bedrock signature is too strong, and it overlaps the wavelength characteristics of that associated with bedrock topography and glacial fill. Thus, the gravity data in Anoka County were primarily used to help map structures within the Precambrian bedrock.

Passive seismic depth to bedrock soundings provide information based on measurement and analysis of shear and surface wave energy in the ground that allow a calculation of the depth to bedrock beneath that point. The measurements employ a recording geophone system that is implanted into the ground surface and records ambient ground vibrations in 2 horizontal and 1 vertical directions over a 16-minute interval. The method is called passive because no energy is directly input into the ground at the time of measurement; the unit measures background (ambient) vibrations from a variety of natural and artificial sources such as wind or traffic. Calculations of depth to bedrock are made after the major resonant frequency peak is calculated by taking the combined horizontal components and dividing by the vertical component. This peak frequency is fitted to a calibration curve of frequency (H/V) versus depth to determine the depth to bedrock at the location of measurement. The calibration curve is constructed experimentally by making at least 30 measurements of H/V frequency at wells with known depths, plotting the results, and fitting a curve to the data. In general, depth to bedrock calculated by this method can have errors up to 25 percent of the depth; however, in areas with little to no other data, this is still useful information and many soundings can be inexpensively collected over a short period of time with one or two operators.

Bedrock outcrops are exposures of solid rock at the land surface. Most are natural outcrops; however, some may be exposures created during construction. They serve as reference points for mapping and for checking the accuracy of subsurface data. Bedrock at or near the surface must be considered in land-use planning decisions such as pipeline routing, sewage-system design, and excavation.

INTRODUCTION

The public health and economic development of Anoka County are directly dependent on the wise use and management of its land and water resources. Geologic and hydrologic information are essential before decisions are made that affect natural resources. Although the amount of geologic information required for making specific decisions can vary, the information will not be used if it is unavailable when needed, or if it is available only in a highly technical form, or scattered in many different maps and reports.

County atlases, prepared jointly by the Minnesota Geological Survey and the Minnesota Department of Natural Resources, Division of Waters, present detailed geologic and hydrologic information in an interpretive as well as descriptive form. Maps and texts either summarize basic geologic and hydrologic conditions at a county scale, or interpret these conditions in terms of the impacts of possible land- and water-use decisions. Site-specific information is available in some areas at a greater level of technical detail than shown on the maps of this atlas. The data are too voluminous to present at the scale of this atlas, but have been incorporated into readily accessible files housed at the Minnesota Geological Survey.

Several sources commonly provide information about an area or an individual property, but they may use different classification schemes to describe the same geologic materials. As a result, discrepancies in interpreting the data may arise or the different sources may appear to contradict each other. For example, water-well drillers may describe glacial till as "clay," but engineering records will describe it as "clayey sand." Both descriptions are acceptable for their original purpose of describing the physical attributes of the material. "Clay," the term used by well drillers, defines the general inability of the till to yield ground water to a well. "Clayey sand," the term from the engineering record, defines the physical composition of the till relative to particle size and engineering properties. The geologist must take the analysis one step further and define the material in terms of how it formed rather than how it is to be used. In this example, till consists of an unsorted mixture of rock fragments ranging in size from clay to cobbles and boulders, and it is interpreted by the geologist as having been deposited directly by glacial ice. Understanding the process by which the material formed allows geologists to make predictions about what lies between and beyond data points.

All of the types of data described on this plate had to be interpreted by geologists or hydrogeologists before they were meaningful for mapping purposes. The 1:100,000 scale of the maps in this atlas was chosen because it can show the geologic and topical studies of the county while keeping the physical size of each plate to a manageable level. As a result, some detailed information that was gained by data interpretation and mapping cannot be shown on these maps or discussed in the texts.

Whether to use the atlas alone, or in combination with the data bases, depends on the amount of detail needed. Generally, data-base information must be used to evaluate site-specific conditions.

DATA-BASE MANAGEMENT

All of the data shown on the maps were plotted on 7.5-minute topographic quadrangle maps or highway alignment maps and assigned inventory numbers. Automated data bases and a few manual files were developed to provide easy access and rapid retrieval of these site-specific data. The data may be obtained from the Minnesota Geological Survey.

Computer storage and retrieval systems are better than manual files for manipulating large amounts of data because automated geologic data bases can be designed to interact with other computer files, such as land-use data. Such interaction permits more efficient assessment of cause-and-effect relationships concerning natural resources than is commonly possible with manual files.

ANOKA COUNTY DATA BASES

Computerized files were developed for point-source data such as wells and borings in Anoka County. They use Public Land Survey descriptions, Universal Transverse Mercator (UTM), and latitude-longitude coordinates as location criteria; thus, they are compatible with the natural-resource data bases housed at the Minnesota Land Management Information Center (LMIC). The computerized data bases developed for Anoka County by the Minnesota Geological Survey are County Well Index (CWI) and Quaternary Samples Data Base (QBASE).

County Well Index (CWI)—Information from water-well records is continuously being entered into this statewide data base as the records are received from contractors. Each well log is assigned a six-digit unique number. These reference numbers are also used by state agencies and the Water Resources Division of the U.S. Geological Survey. Elevations, expressed in feet above sea level, were determined from topographic maps (see the index to 7.5-minute quadrangles) and are generally accurate to plus or minus five feet. The street address of each well is also included wherever possible to provide data users with a well-location system that is compatible with local regulatory programs. Software at the Minnesota Geological Survey is used to display and tabulate many of the data elements contained on the original well log.

The County Well Index is currently stored in a data base that consists of nine related tables. These tables contain information such as well depths, well construction, addresses, aquifers, dates drilled, static water levels, and pumping test data. They also contain alternate well identifiers such as permit numbers or emergency-service numbers, and the well stratigraphy (the geologic materials encountered during drilling).

CWI application software developed by the Minnesota Department of Health provides two types of reports:

- WELL LOG contains all the information about the well as it was reported by the contractor (Fig. 1). There may also be additional location information, land-surface elevation, aquifer designation, and remarks about the drill holes.
- WELL STRATIGRAPHY contains the geologic log with a geologist's stratigraphic interpretations, which are based on her or his knowledge and understanding of the geology of Anoka County (Fig. 2). Only those drill holes with verified locations have stratigraphy assigned to them.

Quaternary Samples Data Base (QBASE)—Information from Quaternary samples collected and analyzed is entered into this data base. QBASE contains locations, the name of the sample collector, elevations, depths from where the samples were collected, proportions of sand, silt, and clay, and proportions of crystalline, carbonate, and shale fragments. Information pertaining to borings obtained from the Minnesota Department of Transportation and the U.S. Geological Survey also can be found in this database.

FUTURE DATA COLLECTION

Additional geologic information is generated continuously as new water wells are drilled, construction activities expose more bedrock, or additional wells are tested for water quality. To address this, the library of information prepared for Anoka County is flexible so that old data can be reevaluated in light of new information, and new forms of data can be added if required. The need to manage ground water and other natural resources wisely will never become outdated. Future demands on these resources will require current data to assess the impacts.

ACKNOWLEDGEMENTS

The staff from the Anoka Conservation District contributed greatly to the development of the County Well Index (CWI) data base. We thank local water-well contractors and landowners for their valuable assistance.

MAP SYMBOLS

- Record of water-well construction (well driller's log)
- Diamond drill core sample
- Rotary-sonic core sample
- Cutting sample
- Borehole geophysical log
- Soil boring
- Giddings probe hole
- Field site
- Field site with textural analysis
- Gravity reading
- Passive seismic sounding
- Bedrock outcrop

Note: More than one symbol can occur at the same location

Unique Well Number **593632** | County Anoka | Quad Cedar | Quad Id 136D

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
MINNESOTA STATUTES CHAPTER 1031

Entry Date 2000/02/09 | Update Date 2007/01/22 | Received Date

Well Name ANDOVER TW-8A
Township 32 | Range 24 | Dir W | Section 22 | Subsection AABBBD | Field Located Elevation MGS 897.00 ft.

Well Address ANDOVER TW-8A
156TH LA W
ANDOVER MN 55304 Changed

Contact Address CITY OF ANDOVER
1685 CROSSTOWN BL NW
ANDOVER MN 55304 Changed

Well Depth 360.00 ft | Depth Completed 360.00 ft | Date Well Completed 1999/09/18

Drilling Method Non-specified Rotary

Drilling Fluid Bentonite | Well Hydrofractured? ☐ YES ☐ NO From ft. to

Use Abandoned

Casing Type Steel (black or low | Drive Shoe? ☒ YES ☐ NO | Hole Diameter (in.)
Diameter 4 | Depth 184
4.00 in. from 0.00 to 184.00 ft. 10.97 lbs/ft | 9.00 To 184.0 | 4.00 To 360.0

Description	Color	Hardness	From	To (ft.)
SAND	YELLOW	SOFT	0	15
SAND	GRAY	SOFT	15	38
CLAY & ROCKS	GRAY	SOFT	38	73
SAND	RED/BRN	SOFT	73	77
CLAY/ROCKS	GRAY	SOFT	77	105
SAND (MEDIUM)	BROWN	SOFT	105	115
CLAY	GRAY	MEDIUM	115	170
FRANCONIA	GRN/TAN	MEDIUM	170	177
FRANCONIA	GRN/TAN	MEDIUM	177	280
IRONTON-GALESVILLE	WHITE	SOFT	285	345
EAU CLAIRE	PINK	MEDIUM	345	360

Screen No | Open Hole(ft.) From 184.0 to 360.0
Make | Type
Diamter Slot Length Set

Static Water Level
25.80 ft. Top of casing above L Date measured 1999/09/15

Pumping Level (below land surface)
26.50 ft. after 4.00 hrs. pumping 30.00 g.p.m.

Wellhead Completion
Pitless adapter manufacturer ______ Model ______
☐ Casing Protection ☒ 12 in. above grade
☐ At-grate (Environmental Wells and Borings ONLY) ☐ Basement offset

Grouting Information Well grouted? ☒ YES ☐ NO
Material Neat Cement From 0.0 To 184.0 ft. 160.00 Sacks

Nearest Known Source of Contamination
______ feet ______ Direction ______ Type
Well disinfected upon completion? ☒ YES ☐ NO

Pump
☒ Not Installed Date Installed ______
Manufacture's name ______
Model number ______ HP ______ Volts ______
Length of drop pipe ______ Material ______ Capacity ______ g.p.m
Type

Abandoned Wells
Does property have any not in use and not sealed well(s)? ☐ YES ☒ NO

Variance
Was a variance granted from the MDH for this well? ☐ YES ☒ NO

Well Contractor Cerfication
Renner E.H. Well 71015
License Business Name | Lic. or Reg No.
PRAUGHT, V.

Remarks
GAMMA LOGGED 9-21-1999. M.G.S. NO. 3976. WELL SEALED 09-27-2002 BY 71015. ORIGINAL USE TW - TEST WELL.

First Bedrock CFRN | Aquifer Franconia-Eau Claire
Last Strat CECR | Depth to Bedrock 177.00 ft.

County Well Index v.5 | **REPORT** | Printed on 11/15/2011 | Name of Driller | Date | HE-01205-07 (Rev. 2/99)

Figure 1. An example of a WELL LOG record, showing all the information about the well as reported by the well driller.

Unique Well Number **593632** | County Anoka | Quad Cedar | Quad Id 136D

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
MINNESOTA STATUTES CHAPTER 1031

Entry Date 2000/02/09 | Update Date 2012/02/09 | Received Date

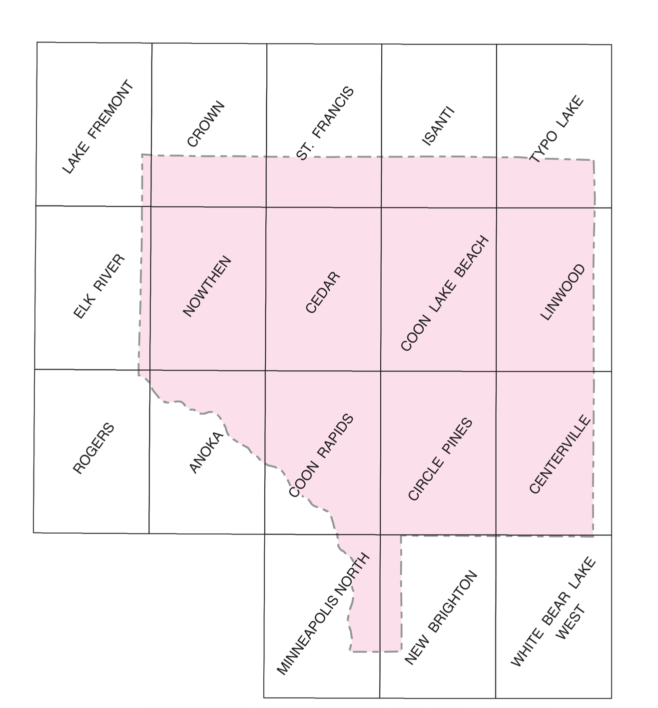
Well Name	Township	Range	Dir	Section	Subsection	Depth Drilled	Depth Completed	Date Completed	Lic/Reg. No.	Driller Name
ANDOVER TW-8A	32	24	W	22	AABBBD	360 ft	360 ft	1999/09/18	71015	PRAUGHT, V.

Elevation 897.00 ft. | Method 7.5 minute topographic | Aquifer Franconia-Eau Claire | Depth to Bedrock 177 ft. | Open Hole 184-360 | SWL 25.8

Field Located Program Minnesota Geological Survey | Location Method Digitization (Screen) - Map (1:2 | Universal Transverse Mercator(UTM) - NAD83 - Zone 15 - Meters
Input Source | UTM Easting (X) 475228 | UTM Northing (Y) 5011327
Uni No.Verified Tag on well | Input Date 2002/07/29
Geologic Interpretation John Mossler | Agency MGS | Interpretation Method Cuttings + geophysical log

Geological Material	Color	Hardness	DEPTH From	DEPTH To	Thick	ELEVATION From	ELEVATION To	Stratigraphy	LITHOLOGY Primary	LITHOLOGY Secondary	LITHOLOGY Minor
SAND	YELLOW	SOFT	0	15	15	897	882	sand-yellow	Sand		
SAND	GRAY	SOFT	15	38	23	882	859	sand-gray	Sand		
CLAY & ROCKS	GRAY	SOFT	38	73	35	859	824	pebbly sand/silt/clay-gray	Clay	Cobble	
SAND	RED/BRN	SOFT	73	77	4	824	820	sand	Sand		
CLAY/ROCKS	GRAY	SOFT	77	105	28	820	792	pebbly sand/silt/clay-gray	Clay	Cobble	
SAND (MEDIUM)	BROWN	SOFT	105	115	10	792	782	sand-brown	Sand		
CLAY	GRAY	MEDIUM	115	170	55	782	727	clay-gray	Clay		
FRANCONIA	GRN/TAN	MEDIUM	170	177	7	727	720	Quat. deposit-brown	Drift		
FRANCONIA	GRN/TAN	MEDIUM	177	280	103	720	617	Franconia	Sandstone	Shale	Dolomite
IRONTON-GALESVILLE	WHITE	SOFT	285	345	60	612	552	Ironton-Galesville	Sandstone		
EAU CLAIRE	PINK	MEDIUM	345	360	15	552	537	Eau Claire	Shale	Sandstone	

Figure 2. Example of a WELL STRATIGRAPHY record, which contains a geologist's interpretation of the geologic materials listed by the driller in the WELL LOG record (Fig. 1). Additional downhole information for this well (as noted in the Interpretation Method) informed the geologist's interpretation, which may not match the driller's description of the geologic material penetrated.



INDEX TO 7.5-MINUTE QUADRANGLES