

DATA-BASE MAP

By  
Emily J. Bauer and V.W. Chandler

2016

INTRODUCTION

The public health and economic development of Washington 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. The data bases described here address this need.

County atlases, prepared jointly by the Minnesota Geological Survey and the Minnesota Department of Natural Resources, Division of Ecological and Water Resources, present detailed geologic and hydrologic information in an interpretive as well as descriptive form. Maps and texts summarize the current basic geologic and hydrologic conditions at a county scale, and interpret these conditions in terms of the impacts of possible land- and water-use decisions at the time they were created. The maps and texts in this current set of county geologic atlas plates are a reworking of the original maps that were created for the 1990 Washington County geologic atlas. The amount of data available for Washington County has more than tripled in the intervening 25 years since the original maps were published and our understanding of some of the geologic processes governing geologic features seen in the county has grown; thus it was necessary to update the maps to reflect these new data. 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 liability of the till to yield groundwater 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 to have been deposited directly by glacial ice. Understanding the process by which the material formed allows geologists to make predictions about what lies beneath and beyond data points.

All of the types of data described on this plate are interpreted by geologists or hydrogeologists to make them meaningful for mapping purposes. The 1:100,000 scale of the maps in this atlas was chosen because it shows the geologic and topographic 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. Some of this information is available in digital files that accompany the atlas.

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.

WASHINGTON COUNTY DATA BASES

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

**County Well Index (CWI)**—Information from water-well records and exploration holes is entered into this statewide data base. Each well log is assigned a six-digit unique number and each exploration drill hole is assigned either a five- or six-digit unique number. These reference numbers are also used by state agencies such as the Water Resources Division of the U.S. Geological Survey. Elevations are expressed in feet above sea level and were determined either from topographic maps (see the index to 7.5-minute quadrangles) or Minnesota's lidar high-resolution elevation data set. Elevations from the topographic maps are generally accurate to plus or minus 5 feet (1.5 meters) and the lidar elevations are generally accurate to within 3 feet (1 meter). 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 text-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, the well stratigraphy (the geologic materials encountered during drilling), and the azimuth and inclination of angled exploration holes.

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 hole.

**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 Washington County and augmented in some cases by additional data sources, such as cuttings, borehole geophysical logs, or core (Fig. 2). Only those drill holes with verified locations have stratigraphy assigned to them.

**File data of the Minnesota Geological Survey**—Details about other types of data shown on this plate are available from digital (including the Quaternary Data Index, an internal working data base) and paper files at the Minnesota Geological Survey. These include descriptions of cutting samples, soil borings, Giddings probe holes, field sites, soil auger holes, textual analyses, gravel and aeromagnetic data, passive seismic sites, and aggregate resources sites.

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 Washington 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 future to manage groundwater and other natural resources wisely will never become outdated. Future demands on these resources will require current data to assess the impacts.

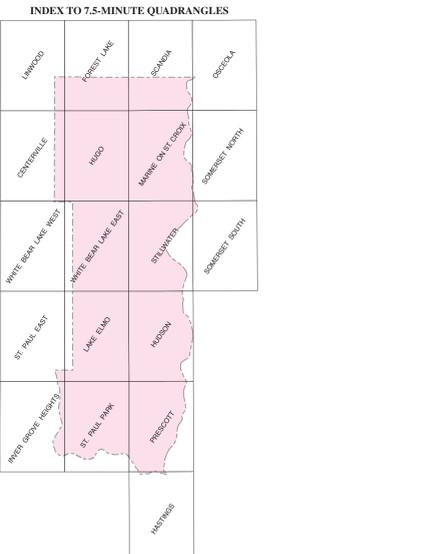
ACKNOWLEDGEMENTS

The staff from the Washington County Public Health and Environment Office contributed greatly to the development of the County Well Index (CWI) data base for this update of the county geologic atlas. We thank local water-well contractors and landowners for their valuable assistance.

MAP SYMBOLS

- Record of water-well construction (well driller's log)
- Rotary-sonic core sample
- Cutting sample
- Borehole geophysical log
- Soil boring
- Giddings probe hole
- △ Field site
- Soil auger hole
- Textual analysis
- Passive seismic sounding
- Seismic refraction sounding
- Bedrock outcrop

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



Unique Well Number	County	Washington	MINNESOTA DEPARTMENT OF HEALTH	Entry Date
761628	Washington	Prescott	WELL AND BORING RECORD	2008/07/11
Quadrant	1000	1000	MINNESOTA STATUTES CHAPTER 1037	Update Date
				2014/09/18
				Received Date
				2008/08/26
Well Name	AFTON ALPS LW	Township Range	27 20 W 2	Section Subsection
Field Located	Minnesota Geological Survey	Depth Drilled	285 ft	Date Completed
Well and Contact Address	AFTON ALPS 6600 PELLER AV S HASTINGS	Elevation	702.00 ft	LiDAR No.
State	MINN	County	55033	Driller Name
			Changed	BAUER, A
				1540
				Received Date
				2008/08/26
Well Depth	285.00 ft	Depth Completed	285.00 ft	Date Well Completed
Drilling Method	Rotary	Well Hydrofractured?	Yes	Yes
Drilling Fluid	Water	Well Hydrofractured?	No	No
Drillhole Angle	Vertical	Well Hydrofractured?	Yes	Yes
Use	Irrigation	Well Hydrofractured?	No	No
Casing Type	Steel (Black or Low/High Sulfur)	Well Hydrofractured?	Yes	Yes
Outer	12.00 in. 10.00 in. 8.00 in.	Well Hydrofractured?	No	No
Inner	16.00 in. 14.00 in. 12.00 in.	Well Hydrofractured?	Yes	Yes
Wellhead Completion	None	Well Hydrofractured?	No	No
Static Water Level (Multiple SWSL)	10.00 ft	Well Hydrofractured?	Yes	Yes
Land Surface	702.00 ft	Well Hydrofractured?	No	No
Date measured	2008/08/15	Well Hydrofractured?	Yes	Yes
Pumping Level (below land surface)	10.00 ft	Well Hydrofractured?	No	No
Flow	4.00 gpm	Well Hydrofractured?	Yes	Yes
Pressure	700.00 psi	Well Hydrofractured?	No	No
Pressure at 100 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 200 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 300 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 400 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 500 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 600 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 700 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 800 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 900 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 1000 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 1100 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 1200 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 1300 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 1400 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 1500 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 1600 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 1700 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 1800 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 1900 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 2000 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 2100 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 2200 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 2300 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 2400 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 2500 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 2600 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 2700 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 2800 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 2900 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 3000 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 3100 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 3200 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 3300 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 3400 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 3500 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 3600 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 3700 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 3800 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 3900 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 4000 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 4100 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 4200 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 4300 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 4400 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 4500 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 4600 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 4700 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 4800 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 4900 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 5000 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 5100 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 5200 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 5300 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 5400 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 5500 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 5600 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 5700 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 5800 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 5900 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 6000 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 6100 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 6200 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 6300 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 6400 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 6500 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 6600 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 6700 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 6800 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 6900 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 7000 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 7100 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 7200 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 7300 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 7400 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 7500 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 7600 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 7700 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 7800 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 7900 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 8000 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 8100 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 8200 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 8300 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 8400 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 8500 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 8600 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 8700 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 8800 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 8900 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 9000 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 9100 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 9200 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 9300 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 9400 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 9500 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 9600 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 9700 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 9800 ft	700.00 psi	Well Hydrofractured?	No	No
Pressure at 9900 ft	700.00 psi	Well Hydrofractured?	Yes	Yes
Pressure at 10000 ft	700.00 psi	Well Hydrofractured?	No	No

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

THE DATA-BASE MAP

The types, locations, and density of information used to prepare the Washington 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 groundwater. 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 Washington County; about 14,200 logs were used for this atlas; they can be found in the County Well Index (CWI).

Core samples were collected at various sites throughout Washington County as a means to establish the nature of the subsurface material. Rotary-sonic cores were collected by the Minnesota Geological Survey from 12 sites in the county (labeled WR-1 through WR-3 and WS-1 through WS-3) to aid both the interpretation of the Quaternary deposits and in determining bedrock depth and nature (where encountered). The coring technique enables recovery of a continuous core, 3.5 inches (8.9 centimeters) in diameter, from glacial deposits and bedrock (where intersected). It provides excellent subsurface samples for detailed study and comparison with cuttings, geophysical logs, and driller's logs from surrounding sites. Detailed geologist's logs for some of the cores are shown on Plate 4, *Quaternary Stratigraphy*. These logs are entered into the County Well Index (CWI) and two sampling results are available in the Minnesota Geological Survey file data. There were an additional two rotary-sonic cores collected on the 3M site in Cottage Grove where two monitor wells were installed. The cores are available for inspection at the Minnesota Department of Natural Resources, Division of Lands and Minerals offices in Hibbing.

Cuttings 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 are shown in graphic form on 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 by a geologist from the geophysical log and correlated with drilling samples from the same hole; information obtained from nearby exposures, 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 and Washington County Public Works. They are somewhat limited in distribution in that they are concentrated along major roads such as U.S. Highway 10 and County Highway 19. These data are most useful in determining the composition of unconsolidated deposits. Descriptions of the geologic materials penetrated can be accessed in digital and paper files at the Minnesota Geological Survey; all other information collected is contained in paper files. The data are available from the Minnesota Department of Transportation, Foundations Unit webpage ([http://www.mnr.dot.state.mn.us/geotechnical/foundations/Gis/g15\\_splsh.htm](http://www.mnr.dot.state.mn.us/geotechnical/foundations/Gis/g15_splsh.htm)) and Washington County Public Works.

Giddings probe holes are borings 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 at most locations a sample or samples were taken for textual analyses. Samples were generally taken 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 textually analyzed. Field sites include stream and river cuts, gravel pits, excavations, and road cuts. Data from the field sites can be found in Minnesota Geological Survey files. Additional gravel pit data may be found at the Minnesota Department of Transportation, Aggregate Source Information System webpage ([http](http://www.dot.state.mn.us/materials/assmap.htm)