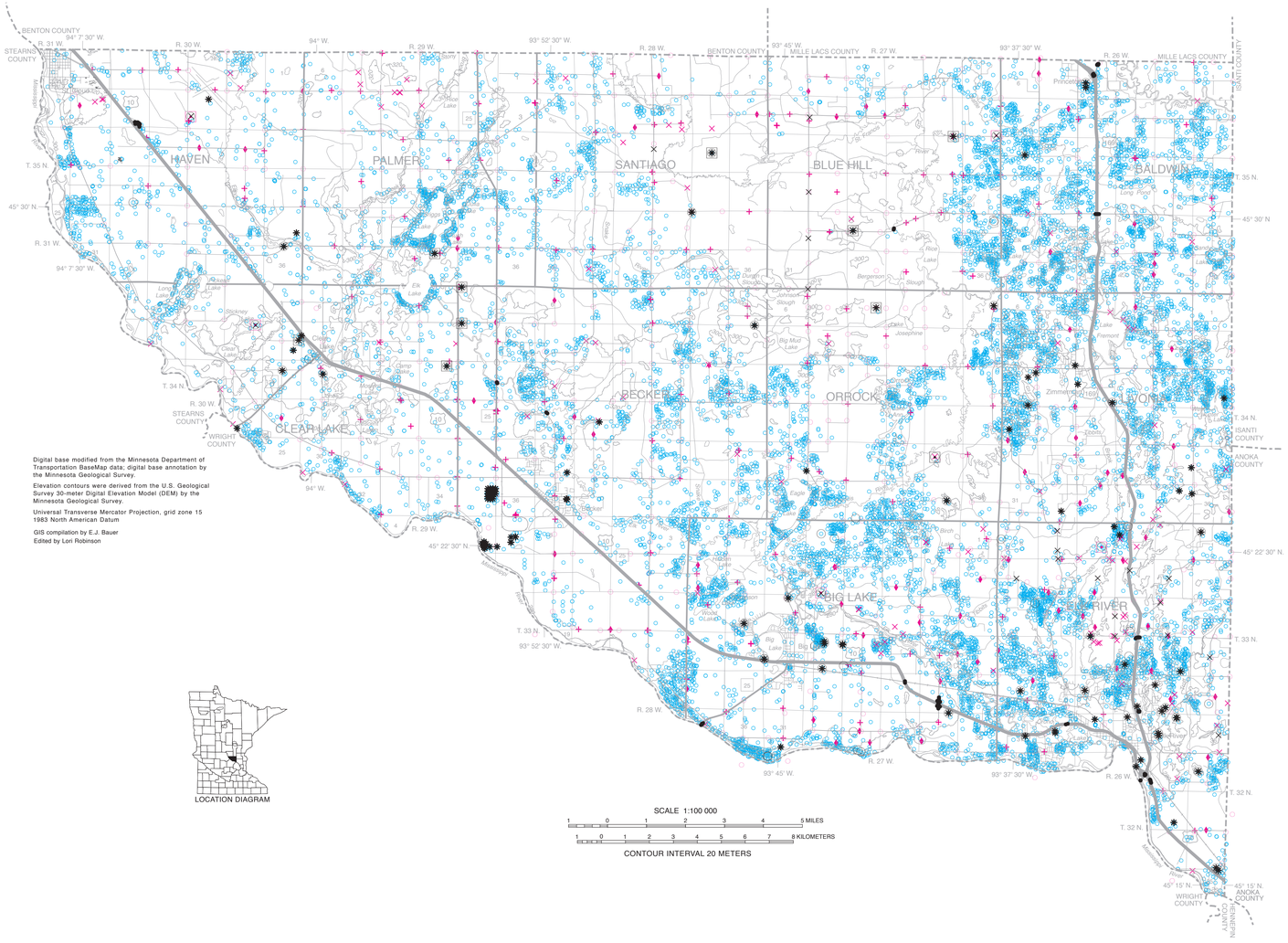
UNIVERSITY OF MINNESOTA
MINNESOTA GEOLOGICAL SURVEY
Harvey Thorleifson, Director

Prepared and Published with the Support of
THE SHERBURNE COUNTY BOARD OF COMMISSIONERS, AND
THE MINNESOTA ENVIRONMENT AND NATURAL RESOURCES TRUST FUND
AS RECOMMENDED BY THE LEGISLATIVE-CITIZEN COMMISSION ON MINNESOTA RESOURCES

COUNTY ATLAS SERIES
ATLAS C-32, PART A
Sherburne County
Plate 1—Data-Base Map



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.

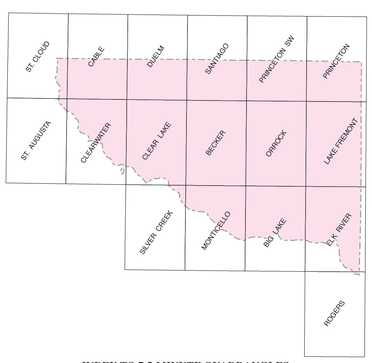
Universal Transverse Mercator Projection, grid zone 15
1983 North American Datum

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

SCALE 1:100 000

1 0 1 2 3 4 5 MILES
1 0 1 2 3 4 5 6 7 8 KILOMETERS

CONTOUR INTERVAL 20 METERS



INDEX TO 7.5-MINUTE QUADRANGLES

MAP SYMBOLS

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

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

DATA-BASE MAP

By

Emily J. Bauer and V.W. Chandler

2013

INTRODUCTION

The public health and economic development of Sherburne 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 summarize 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. Site-specific information is available in some locations 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 and 1:200,000 scales of the maps in this atlas were chosen because they 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.

SHERBURNE COUNTY DATA BASES

Computerized files were developed for point-source data such as wells and borings in Sherburne 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 Sherburne County by the Minnesota Geological Survey are County Well Index (CWI) and Quaternary Data Index (QDI).

County Well Index (CWI)—Information from water-well records is entered into this statewide data base. 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 (1.5 meters). 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 Sherburne County (Fig. 2). Only those drill holes with verified locations have stratigraphy assigned to them.

Quaternary Data Index (QDI)—Information from Quaternary samples collected and analyzed and from site descriptions is entered into this data base. QDI 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 can also 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 Sherburne 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 Sherburne County Zoning Administration 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.

THE DATA-BASE MAP

The types, locations, and density of information used to prepare the Sherburne 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 Sherburne County; about 14,450 logs were used for this atlas; they can be found in the County Well Index (CWI).

Core samples were collected at various sites throughout Sherburne County as a means to establish the nature of the subsurface material. Ten bedrock core samples were collected 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 from five 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 Data Index (QDI). 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 by a geologist 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 and the Sherburne County Highway Department. They are limited in distribution; in Sherburne County they are concentrated along the U.S. Highway 10 and U.S. Highway 169 corridors. These data are most useful in determining the composition of unconsolidated deposits. The geologic materials penetrated are entered into the Quaternary Data Index (QDI); 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 help determine origin, correlation, and hydrologic properties of unconsolidated materials.

Soil auger holes are borings created by the U.S. Geological Survey to generate a description of the subsurface material. The geologic materials penetrated are entered into the Quaternary Data Index (QDI).

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 sediment from that of density variations occurring within the underlying Precambrian bedrock. Unfortunately, no suitable means of isolating the two effects could be achieved in Sherburne County; the Precambrian bedrock signature is too strong, and it overlaps the wavelength characteristics of that associated with bedrock topography and glacial sediment. Thus, the gravity data in Sherburne County were primarily used to help map structures within the Precambrian bedrock (Plate 2, *Bedrock Geology*).

Passive seismic depth to bedrock soundings provide information based on measurement and analysis of ambient shear and surface wave energy in the ground that allow a calculation of the depth to bedrock (thickness of glacial deposits) beneath that point. The measurements employ a recording seismograph system that is implanted into the ground surface and records ambient ground vibrations in three orthogonal directions (2 horizontal and 1 vertical) during a 16-minute interval. The method is called passive because no energy is directly input into the ground at the time of measurement, such as is the case for conventional seismic sounding. Instead, the unit measures background vibrations from a variety of natural and artificial sources that include machinery, traffic, and wind. The averaged horizontal spectra of the seismic noise is divided by the corresponding vertical spectrum, and the resulting Horizontal to Vertical Spectral Ratio (HVSR) should display a prominent peak that closely approximates the resonant frequency (shear-wave) of the unconsolidated sequence overlying the bedrock surface. The resonant frequency of unconsolidated overburden is a useful parameter for seismic risk investigations, but here it is used to estimate the thickness of the overburden itself, which is the glacial sequence. In this application the HVSR method is calibrated by taking measurements at 30 or so locations (control points) where the thicknesses of glacial deposits are known from either well data or from conventional seismic sounding. The control points are selected to approximately span the expected range of bedrock depths for the region, and the calibration curve that is fitted to these data can be used to estimate bedrock depth in areas lacking either drill hole or seismic control. Most bedrock depths from the HVSR method are estimated to be accurate to within 15 to 25 percent error, which is somewhat more than the 5 to 15 percent error that is generally expected with conventional seismic methods. Nonetheless, HVSR depth estimates are adequate for many County Geologic Atlas applications, and the HVSR method is considerably faster and cheaper, assuring that many soundings over a large area can be inexpensively acquired by one or two operators.

Bedrock outcrops are exposures of solid rock at the land surface. Most are natural outcrops that can be found in Haven Township; however, some are 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.

Every reasonable effort has been made to ensure the accuracy of the factual data on which this map interpretation is based; however, the Minnesota Geological Survey does not warrant or guarantee that there are no errors. Users may wish to verify critical information; sources include both the references listed here and information on file at the offices of the Minnesota Geological Survey in St. Paul. In addition, effort has been made to ensure that the interpretation conforms to sound geologic and cartographic principles. No claim is made that the interpretation shown is rigorously correct, however, and it should not be used to guide engineering-scale decisions without site-specific verification.

Unique Well Number 659438

County Sherburne
Quad Monticello
Quad Id 138D

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

Entry Date 2001/11/15
Update Date 2011/06/15
Received Date

Well Name BIG LAKE TW-5
Township 33 Range 28 Dir W Section 13 Subsection CDAAAC Field Located Elevation MGS 947.00 ft.

Contact Address 160 LAKE ST N — CITY OF BIG LAKE
BIG LAKE MN 55309 Changed
Well Address BIG LAKE TW-5
BIG LAKE MN 55309 Changed

Well Depth 300.00 ft — Depth Completed 300.00 ft — Date Well Completed 2001/04/20
Drilling Method Non-specified Rotary
Drilling Fluid Bentonite — Well Hydrofractured? ☐ YES ☒ NO — From ft. to
Use Abandoned
Casing Type Plastic — Drive Shoe? ☐ YES ☒ NO — Depth 93 — Hole Diameter (in.) 8.00 To 300.0
Diameter 4 in. from 0.00 to 93.00 ft. lbs/ft
Screen No — Open Hole(ft.) From 93.0 to 300.0
Make — Diamter — Slot — Length — Set — Type
Static Water Level 21.00 ft. Land surface — Date measured 2001/04/20
Pumping Level (below land surface) 250.00 ft. after 7.00 hrs. pumping 150.00 g.p.m.
Wellhead Completion — Pitless adapter manufacturer — Model — ☒ 12 in. above grade — ☐ Casing Protection — ☐ At-grade (Environmental Wells and Borings ONLY) — ☐ Basement offset
Grouting Information — Well grouted? ☒ YES ☐ NO — Material Neat Cement — From 0.0 To 93.0 ft. 25.00 Sacks
Nearest Known Source of Contamination — 60 feet — E Direction — SDF 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 — Traut M.J. Well Co. 71536
License Business Name — Lic. or Reg No. — ROBBIE/RYAN
Name of Driller — Date

Description	Color	Hardness	From	To (ft.)
SAND/GRAVEL	BROWN	SOFT	0	25
CLAY	GRAY	MEDIUM	25	48
SAND/GRAVEL	BROWN	SOFT	48	57
CLAY	BROWN	MEDIUM	57	65
SAND/GRAVEL	BROWN	SOFT	65	67
SAND/GRAVEL	BROWN	SOFT	67	70
CLAY	BROWN	MEDIUM	70	72
SANDSTONE	TAN	MEDIUM	72	80
SANDSTONE	TAN	HARD	80	132
SHALE	RED	MEDIUM	132	133
SANDSTONE	PINK	HARD	133	147
SHALE	WHITE	HARD	147	149
SHALE	BROWN	MEDIUM	149	150
SHALE	RED	HARD	150	154
SANDSTONE/SHALE	RED	HARD	154	178
SANDSTONE/SHALE	RED	HARD	178	280
SHALE	RED	HARD	280	300

Remarks
SEALED 6-15-2001 BY MARK J. TRAUT WELLS INC. H-179661. WELL ADDRESS: INTERSECTION 196TH ST & MANITOU ST. GAMMA LOGGED 4-18-2001. M.G.S. NO. 4088. WELL SEALED 06-14-2001 BY 71536 ORIGINAL USE TW - TEST WELL

First Bedrock CMTS — Aquifer Multiple
Last Strat PMSC — Depth to Bedrock 67.00 ft.

C:\county Well Index v.3 — REPORT — Printed on 10/17/2012 — 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 659438

County Sherburne
Quad Monticello
Quad Id 138D

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

Entry Date 2001/11/15
Update Date 2011/06/15
Received Date

Well Name BIG LAKE TW-5 — Township 33 Range 28 Dir W Section 13 Subsection CDAAAC — Depth Drilled 300 ft — Depth Completed 300 ft — Date Completed 2001/04/20 — Lic/Reg. No. 71536 — Driller Name ROBBIE/RYAN

Elevation 947.00 ft. — **Method** 7.5 minute topographic — **Aquifer** Multiple — **Depth to Bedrock** 67 ft. — **Open Hole** 93-300 — **SWL** 21

Field Located Minnesota Geological Survey — **Location Method** Digitization (Screen) - Map (1:2 — **Universal Transverse Mercator(UTM) - NAD83 - Zone 15 - Meters**
Program — **Input Source** — **UTM Easting (X)** 439748 — **UTM Northing (Y)** 5021766
Uni No.Verified Information from owner — **Input Date** 2011/06/02
Geologic Interpretation John Mossler — **Agency** MGS — **Interpretation Method** Geologic study 1:24k to 1:100k

Geological Material	Color	Hardness	DEPTH From	DEPTH To	DEPTH Thick	ELEVATION From	ELEVATION To	Stratigraphy	LITHOLOGY Primary	LITHOLOGY Secondary	LITHOLOGY Minor
SAND/GRAVEL	BROWN	SOFT	0	25	25	947	922	sand +larger-brown	Sand	Gravel	
CLAY	GRAY	MEDIUM	25	48	23	922	899	clay-gray	Clay		
SAND/GRAVEL	BROWN	SOFT	48	57	9	899	890	sand +larger-brown	Sand	Gravel	
CLAY	BROWN	MEDIUM	57	65	8	890	882	clay-brown	Clay		
SAND/GRAVEL	BROWN	SOFT	65	67	2	882	880	sand +larger-brown	Sand	Gravel	
SAND/GRAVEL	BROWN	SOFT	67	70	3	880	877	Mt.Simon Sandstone	Sandstone		
CLAY	BROWN	MEDIUM	70	72	2	877	875	Mt.Simon Sandstone	Sandstone		
SANDSTONE	TAN	MEDIUM	72	80	8	875	867	Mt.Simon Sandstone	Sandstone		
SANDSTONE	TAN	HARD	80	132	52	867	815	Mt.Simon Sandstone	Sandstone		
SHALE	RED	MEDIUM	132	133	1	815	814	Fond Du Lac Formation	Shale	Sandstone	
SANDSTONE	PINK	HARD	133	147	14	814	800	Fond Du Lac Formation	Sandstone		
SHALE	WHITE	HARD	147	149	2	800	798	Fond Du Lac Formation	Shale	Sandstone	
SHALE	BROWN	MEDIUM	149	150	1	798	797	Fond Du Lac Formation	Shale	Sandstone	
SHALE	RED	HARD	150	154	4	797	793	Fond Du Lac Formation	Shale	Sandstone	
SANDSTONE/SHALE	RED	HARD	154	178	24	793	769	Fond Du Lac Formation	Shale	Sandstone	
SANDSTONE/SHALE	RED	HARD	178	280	102	769	667	Solor Church Formation	Shale	Sandstone	
SHALE	RED	HARD	280	300	20	667	647	Solor Church Formation	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.