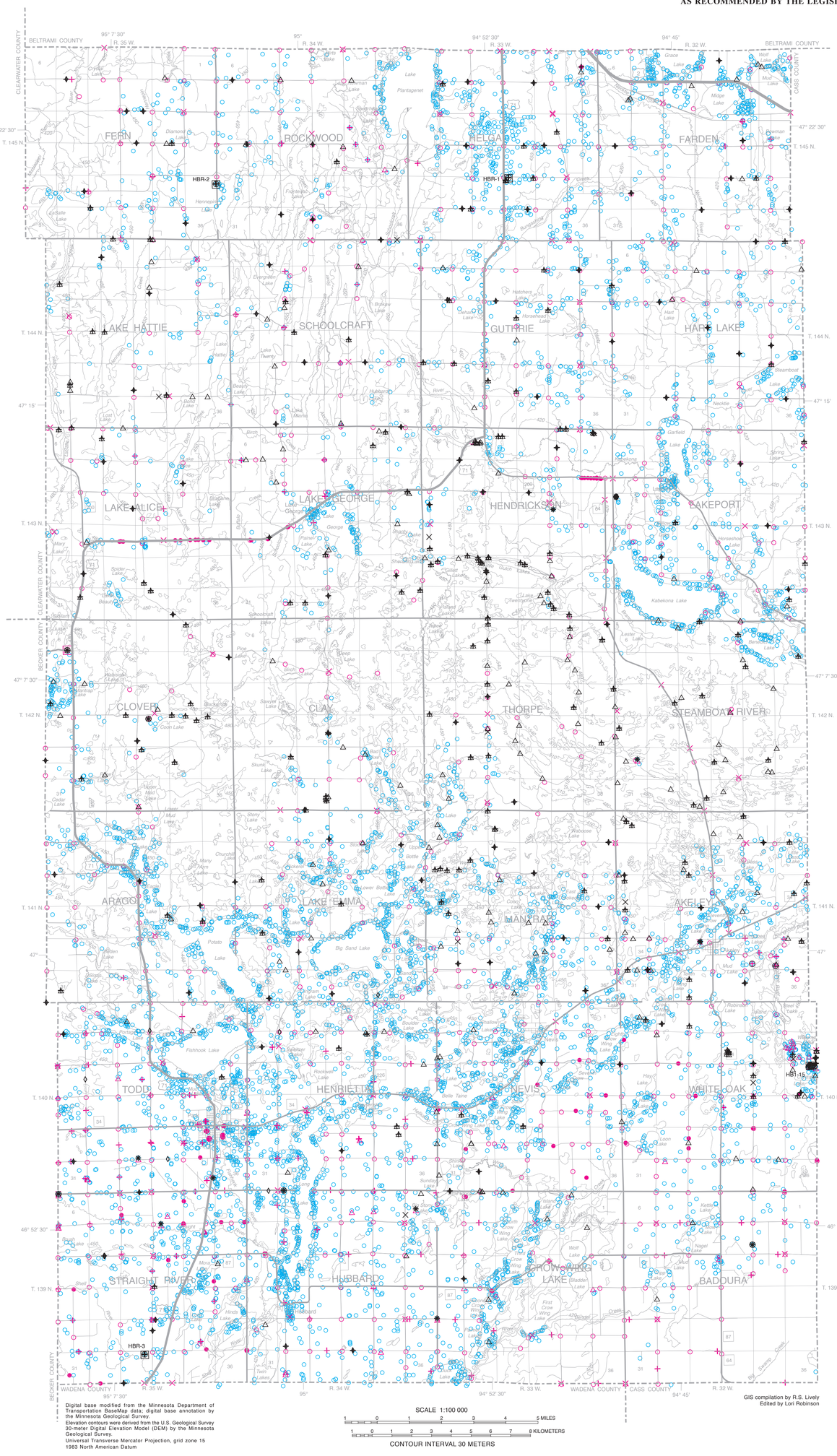
UNIVERSITY OF MINNESOTA
MINNESOTA GEOLOGICAL SURVEY
Harvey Thorleifson, Director

Prepared and Published with the Support of
THE HUBBARD 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-41, PART A
Hubbard County
Plate 1—Data-Base Map



DATA-BASE MAP

By

Bruce A. Bloomgren and V.W. Chandler

2018

INTRODUCTION

The public health and economic development of Hubbard 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, 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 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 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 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 were interpreted by geologists or hydrogeologists to make them meaningful for mapping purposes. The 1:100,000 and 1:200,000 scales of the maps in this atlas were chosen because they 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. 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 map 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.

HUBBARD COUNTY DATA BASES

Computerized files were developed for point-source data such as wells and borings in Hubbard 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 base developed for Hubbard 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 and the U.S. Geological Survey, Water Resources Division. Elevations are expressed in feet above sea level and were determined from either 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 ten 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 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 Hubbard County (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, soil auger holes, textural analyses, gravity and aeromagnetic data, and passive seismic 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 Hubbard 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 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 Hubbard County Soil and Water 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.

THE DATA-BASE MAP

The types, locations, and density of information used to prepare the Hubbard 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 Hubbard County; about 7,530 logs were used for this atlas; they can be found in the County Well Index (CWI). A small number of exploratory boring records that provide a description of geologic materials penetrated during mineral exploration can also be found in the County Well Index.

Scientific investigation holes are soil auger holes, test wells, and observation wells drilled by the U.S. Geological Survey, Water Resources Division, to determine the hydrologic properties of local and regional aquifers. Geologic logs were generated for each hole and entered into the County Well Index (CWI). Study results and conclusions may be found in U.S. Geological Survey published reports. The file data of the Minnesota Geological Survey has similar information available from digital and paper files.

Diamond drill and rotary-sonic core samples were collected at various sites throughout Hubbard County as a means to establish the nature of the subsurface material. The Minnesota Geological Survey collected one bedrock core sample in Clover Township 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 three sites in the county (labelled HBR-1, HBR-2, and HBR-3) and by the Minnesota Department of Natural Resources from one site in the county (labelled HB1-15) 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. A detailed geologist's log for three of the cores are shown on Plate 4, *Quaternary Stratigraphy*. These logs are entered into the County Well Index (CWI) and any sampling results are available in Minnesota Geological Survey file data. The core is available for inspection at the Minnesota Department of Natural Resources Drill Core Library in Hibbing.

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 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.

An **observation well** is used to observe change in water levels over a period of time. Observation wells can track water level changes during pumping from a nearby well, or track changes in groundwater levels seasonally or over longer periods of time. Observation wells typically have small diameters (2 inches [5 centimeters] or less) and are not used for pumping. Hubbard County has 53 observation wells located mainly in the southern one-third of the county. There is a large concentration in White Oak Township around Williams Lake, where the U.S. Geological Survey has a long-term study site researching groundwater/lake interaction. The University of Minnesota, Department of Earth Sciences conducts its annual Hydrogeology Field Camp in this area (https://sites.google.com/a/umn.edu/hydrogeology-field-camp/). Students have the opportunity to observe well construction, describe materials collected during the drilling process, and use the well as part of a network to investigate the impact of prolonged pumping on groundwater levels in the area. Additional information can be obtained from the Minnesota Department of Natural Resources (http://www.dnr.state.mn.us/waters/cgm/index.html).

An **exploratory boring (exploration hole)** is an exploration ist's description of the geologic materials penetrated during mineral exploration. Exploratory work may include the collection of core or cutting samples of the bedrock encountered for descriptive and analytical purposes. These core or cuttings are transferred to the Minnesota Department of Natural Resources and are available for public inspection at their Drill Core Library in Hibbing.

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. In Hubbard County, they are limited in distribution to stream and river crossings on major highways. 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. Minnesota Department of Transportation data are available from the Foundations Unit web page (http://www.dot.state.mn.us/materials/foundations.html).

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 samples were taken for textural analyses at most locations. Samples generally were taken about every 5 feet (1.5 meters), at unit contacts, or where the geologist believed it was important.

OTHER INFORMATION

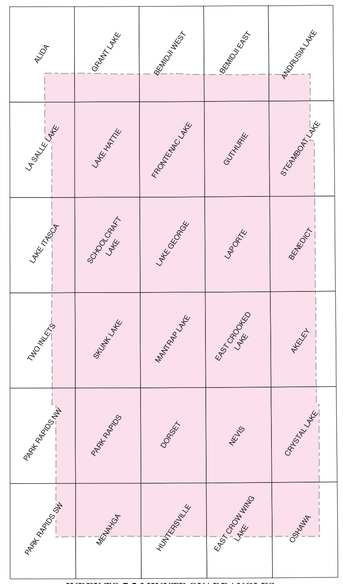
Field sites are natural and artificial exposures of unconsolidated Quaternary deposits that were described in detail; samples from many sites were texturally analyzed. Field sites include stream and river cuts, gravel pits, excavations, and road cuts. Data from field sites can be found in Minnesota Geological Survey files.

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. The data are available in Minnesota Geological Survey files.

Gravity and aeromagnetic (airborne-magnetic) data that are available at the Minnesota Geological Survey are used to assist mapping Precambrian geology. The utility of these two data sets relies on the strong contrasts in density and magnetization that commonly exist between various Precambrian rocks. The aeromagnetic data in Hubbard County were acquired 500 feet (152 meters) above ground along flight lines spaced 0.25 mile (402 meters) apart, and are compiled into a 328-foot (100-meter) grid (line and grid data are not indicated on the map due to high density). The gravity data are derived from ground-based stations that are spaced about a mile (1.6 kilometers) apart along roads. Precambrian rocks form most of the bedrock surface in Hubbard County, and because these rocks are unexposed and poorly sampled by drilling, gravity and magnetic data are of primary importance for bedrock mapping.

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 Quaternary 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 Quaternary sediments. In this application, the HVSR method is calibrated by taking measurements at locations where the thicknesses of Quaternary 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. 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. A total of 107 passive seismic stations were acquired as part of the Hubbard County Geologic Atlas.

Seismic refraction soundings measure the time required for sound or pressure waves to travel from a source through the subsurface and be refracted back to a receiver. Travel time can be correlated with the density and rigidity of the geologic material. Precambrian and Paleozoic rocks commonly exhibit pressure-wave velocities that are 1.5 to 2.5 times those of unconsolidated Quaternary sediments below the water tables. The spacing of the receivers (geophones) and the arrival times (measured in milliseconds) are used to calculate the depth to bedrock. Seismic refraction soundings are more labor intensive than passive seismic sounding, but can provide velocity information and higher-quality depth estimates. Eleven seismic refraction soundings have been acquired in Hubbard County by the Minnesota Department of Natural Resources. Of these soundings, two were acquired as part of earlier projects and nine were acquired as part of this geologic atlas.



INDEX TO 7.5-MINUTE QUADRANGLES

MAP SYMBOLS

- Record of water-well construction (well driller's log)
- Scientific investigation hole
- Diamond drill core sample
- Rotary-sonic core sample
- Cutting sample
- Borehole geophysical log
- Observation well
- Exploratory boring
- Soil boring
- Giddings probe hole
- Field site
- Textural analysis
- Gravity data
- Passive seismic sounding
- Seismic refraction sounding

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

Unique Well Number: 809697
County Hubbard; Quad Crystal Lake; Quad Id 254B
MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
MINNESOTA STATUTES CHAPTER 1031
Entry Date 2015/03/18; Update Date 2016/12/13; Received Date

Well Name HB1-15 (DNR) DNR OB 29060; Township 140; Range 32; Dir W; Section 13; Subsection AABBDB; Field Located Elevation MNDNR 1451.80 ft.
Well Depth 490.00 ft; Depth Completed 230.00 ft; Date Well Completed 2014/12/19
contact address U OF MN; MINNEAPOLIS MN 55455 Changed
Drillhole Angle
Drilling Method Vibracore/rotasonic
Drilling Fluid Water; Well Hydrofractured? YES NO; From ft. to
Use domestic
Casing Type Steel (black or low; Drive Shoe? YES NO; Diameter 4; Depth 210; 4.00 in. from 0.00 to 210.00 ft. 7.10 lbs/ft; Hole Diameter (in.) 9.00 To 230.0; 7.00 To 490.0
Screen Yes; Open Hole(ft.) From to; Make JOHNSON; Type stainless steel; Diameter Slot Length Set; 4.00 10 20 210 ft. to 230 ft.
Static Water Level 56.00 ft. land surface; Date measured 2014/12/18
Pumping Level (below land surface) 230.00 ft. after 3.00 hrs. pumping 40.00 g.p.m.
Wellhead Completion; Pitless adapter manufacturer; Model; Casing Protection; 12 in. above grade; At-grade (Environmental Wells and Borings ONLY); Basement offset
Grouting Information Well grouted? YES NO NOT SPECIFIED
Material neat cement From To 4.0 ft. 2.00 Sacks
Material high solids bentonite From 4.0 To 200.0 ft. 29.00 Sacks
Material high solids bentonite From 235.0 To 460.0 ft. 18.00 Sacks
Nearest Known Source of Contamination 1800 feet SW 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 Mark J Traut Wells, Inc. 1404
License Business Name Lic. or Reg No. KARASCH, D.
Name of Driller Date HE-01205-07 (Rev. 2/99)

Description	Color	Hardness	From	To (ft.)
TOP SOIL	BROWN	SOFT	0	1
SAND & GRAVEL, ROCK	BROWN	SOFT	1	6
SAND & GRAVEL	BROWN	SOFT	6	60
SAND	BROWN	SOFT	60	86
SAND	GRAY	SOFT	86	105
CLAY W/SAND	GRAY	MEDIUM	105	143
SAND W/CLAY	BROWN	MEDIUM	143	156
NO RECOVERY		SOFT	156	160
CLAY WITH SAND	BROWN	MEDIUM	160	207
CLAY WITH SAND	GRAY	MEDIUM	207	212
SAND	GRAY	SOFT	212	229
CLAY	GRAY	MEDIUM	229	267
SILT	GRAY	MEDIUM	267	272
SAND LITTLE GRAVEL	GRAY	SOFT	272	285
CLAY	GRAY	MEDIUM	285	325
SILTY CLAY	BROWN	MEDIUM	325	330
CLAY WITH SAND	GRAY	MEDIUM	330	360
CLAY WITH SAND	BROWN	MEDIUM	360	389
SILTY SAND	GRAY	MEDIUM	389	404
SILT	GRAY	SOFT	404	411
CLAY	GRAY	MEDIUM	411	479
MARL	GREEN	HARD	479	490

Remarks
ADDRESS: 39TH ST. NW & 72ND AVE. NW. DRILLERS: DARYL KARSCH AND TWO HELPERS. CORE TAKEN BY DNR-NICK BORCHERT AND U OF MN-SCOTT ALEXANDER. GAMMA LOGGED 12-16-2014. LOGGED FOR THE COUNTY ATLAS. LOGGED INSIDE THE 6 INCH DIAMETER CASING. CORE TAKEN FROM 0-490 FEET. DNR OB 29060.

First Bedrock UREG; Last Strat UREG; Aquifer Quat. buried artes. aquifer; Depth to Bedrock 479.00 ft.
County Well Index v.5 REPORT Printed on 12/21/2016

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

Unique Well Number: 809697
County Hubbard; Quad Crystal Lake; Quad Id 254B
MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
MINNESOTA STATUTES CHAPTER 1031
Entry Date 2015/03/18; Update Date 2016/12/13; Received Date

Well Name HB1-15 (DNR) DNR OB 29060; Township 140; Range 32; Dir W; Section 13; Subsection AABBDB; Depth Drilled 490 ft; Depth Completed 230 ft; Date Completed 2014/12/19; Lic/Reg. No. 1404; Driller Name KARASCH, D.
Elevation 1451.80 ft. Method LiDAR 1m DEM (MNDN; Aquifer Quat. buried artes. aquif; Depth to Bedrock 479 ft.; Screen 210-230; SWL 56
Field Located Program Mn Department of Natural Resources; Uni No.Verified Info/GPS from data source; Geologic Interpretation Bruce Bloomgren
Location Method Digitization (Screen) - Map (1:24 000); Input Source Minnesota Geological Survey; Input Date 2015/03/25; Agency MGS
Universal Transverse Mercator(UTM) - NAD83 - Zone 15 - Meters; UTM Easting (X) 373426; UTM Northing (Y) 5200735; Interpretation Method Interpreted from core+geophysical log

Geological Material	Color	Hardness	DEPTH From	DEPTH To	Thick	ELEVATION From	ELEVATION To	Stratigraphy	LITHOLOGY Primary	LITHOLOGY Secondary	LITHOLOGY Minor
TOP SOIL	BROWN	SOFT	0	1	1	1451.	1450.	Recent deposit-brown	soil	organic deposits	
SAND & GRAVEL, ROCK	BROWN	SOFT	1	6	5	1450.	1445.	sand +larger-brown	sand	gravel	cobble
SAND & GRAVEL	BROWN	SOFT	6	60	54	1445.	1391.	sand +larger-brown	sand	gravel	
SAND	BROWN	SOFT	60	86	26	1391.	1365.	sand-brown	sand		
SAND	GRAY	SOFT	86	105	19	1365.	1346.	sand-gray	sand		
CLAY W/SAND	GRAY	MEDIUM	105	143	38	1346.	1308.	clay+sand-gray	clay	sand	
SAND W/CLAY	BROWN	MEDIUM	143	156	13	1308.	1295.	clay+sand-brown	sand	clay	
NO RECOVERY		SOFT	156	160	4	1295.	1291.	Quaternary deposit	drift		
CLAY WITH SAND	BROWN	MEDIUM	160	207	47	1291.	1244.	clay+sand-brown	clay	sand	
CLAY WITH SAND	GRAY	MEDIUM	207	212	5	1244.	1239.	clay+sand-gray	clay	sand	
SAND	GRAY	SOFT	212	229	17	1239.	1222.	sand-gray	sand		
CLAY	GRAY	MEDIUM	229	267	38	1222.	1184.	clay-gray	clay		
SILT	GRAY	MEDIUM	267	272	5	1184.	1179.	silt-gray	silt		
SAND LITTLE GRAVEL	GRAY	SOFT	272	285	13	1179.	1166.	sand +larger-gray	sand	gravel	
CLAY	GRAY	MEDIUM	285	325	40	1166.	1126.	clay-gray	clay		
SILTY CLAY	BROWN	MEDIUM	325	330	5	1126.	1121.	silt+clay-brown	clay	silt	
CLAY WITH SAND	GRAY	MEDIUM	330	360	30	1121.	1091.	clay+sand-gray	clay	sand	
CLAY WITH SAND	BROWN	MEDIUM	360	389	29	1091.	1062.	clay+sand-brown	clay	sand	
SILTY SAND	GRAY	MEDIUM	389	404	15	1062.	1047.	sand+silt-gray	sand	silt	
SILT	GRAY	SOFT	404	411	7	1047.	1040.	silt-gray	silt		
CLAY	GRAY	MEDIUM	411	479	68	1040.	972.8	clay-gray	clay		
MARL	GREEN	HARD	479	490	11	972.8	961.8	weathering residuum unc.age	marl		

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 on the record above) controls the geologist's interpretation, which may not match the driller's description of the geologic material penetrated.

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND