MAP SYMBOLS

+ Exploratory boring (exploration hole)

Scientific investigation hole

Borehole geophysical log

X Passive seismic sounding

× Seismic refraction sounding

♦ Giddings probe hole

+ Textural analysis

Core sample

Soil boring

△ Field site

Gravity data

Bedrock outcrop

Unmapped tribal land

* Cutting sample

Record of water-well construction (well driller's log)

1 CRANBERRY BAY

3. CRANBERRY BAY

2. SOLDIER POINT

4. SOLDIER POINT

5. KEMPTON BAY

6. KETTLE FALLS

7. KABETOGEMA

9. ASH RIVER NE

10. NAMAKAN ISLAND

15. ASH RIVER SE

17. JOHNSON LAKE

20. TAKUCMICH LAKE

16. MARION LAKE

18. CRANE LAKE

19. SNOW BAY

22. IRON LAKE

24. ASH LAKE

30. SHELL LAKE

32. IRON LAKE

34. NETT LAKE

35. ORR SW

40. ASTRID LAKE

42. LAPOND LAKE

45. SILVERDALE

48. HALEY

44. FOURTOWN LAKE

49. NORWEGIAN BAY

50. VERMILION DAM

52. CHAD LAKE

INDEX TO 7.5-MINUTE QUADRANGLES

51. SIOUX PINE ISLAND

17 | 118 | 119 | 120 | 121 | 41 BOOTLEGIAKE

Unique Well Number | County St. Louis

well address

CHISHOLM

73 HY N

HARDPAN

SAND & BOULDER

CHISHOLM

1002 3RD AV NW

contact address

Well Name VOYAGEURS SERVICE CENTER

Township Range Dir Section Subsection Field Located MGS

58 20 W 16 CDDBAC **Elevation** 1501.00 ft.

NOLSON, MARK

RED/BLK

COURT CASE-CUSTOMER WILL NO PAY FOR WELL. WELL SEALED

Aquifer Farm Lake facies of GRB

Printed on 4/1/2021

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

10-15-1998 BY 69183. SEALED 10-15-1998 BY 69183

VOYAGEURS SERVICE CENTER

Hardness From To (ft.)

87 230

MN 55719

31. LAKE AGNES

33. FRIDAY BAY

25. ORR NE

23. NETT LAKE NE

26. ELEPHANT LAKE

27. KABUSTASA LAKE

29. LAKE JEANETTE

DALEY BAY

Note: More than one

symbol can occur at

105. CENTRAL LAKES

111 FLOODWOOD LAKE

114. MEADOWLANDS NW

112. UPSTEAD LAKE

108. HARRIS LAKE

109. FAIRBANKS

110. BRIMSON

115. KELSEY 116. COTTON

117. WHITEFACE

121. KING LAKE

124. ELMER

126. PAYNE

127, CANYON

133. ISLAND

137. ALBORN

141. ARNOLD

146. GOWAN

149. SAGINAW

150. ADOLPH

152. DULUTH

153. LAKEWOOD

155. WEST DULUTH

Entry Date

Depth Completed

Air Rotary

6.00 in. from 0.00 to 87.00 ft. 20.00 lbs/ft

24.00 ft. land surface

Pumping Level (below land surface)

At-grate (Environmental Wells and Borings ONLY)

Nearest Known Source of Contamination

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

Was a variance granted from the MDH for this well?

69183

Lic. or Reg No.

Date HE-01205-07 (Rev. 2/99)

Wellhead Completion

Casing Protection

Manufacture's name Model number

Abandoned Wells

Petersen Well Co.

JOLLIFFE, G.

Length of drop pipe_____ Material

Well Contractor Cerfication

icense Business Name

350.00 ft

Casing Type Steel (black or low Drive Shoe? YES NO Hole Diameter (in.)

300.00 ft. after 4.00 hrs. pumpting 2.50 g.p.m

Received Date

Well Hydrofractured? YES NO

Open Hole(ft.) From 87.0 to 350.0

Date measured 1978/10/03

✓ 12 in. above grade

Basement offset

Update Date 2020/09/18

Date Well Completed

151. DULUTH HEIGHTS

134. FLOODWOOD

135. MCCARTY RIVER

136. BROOKSTON NV

138. INDEPENDENCE

140. FREDENBERG

142. FRENCH RIVER

144. LITTLE PRAIRIE LAKE

143. KNIFE RIVER

145. PRAIRIE LAKE

123. TOIVOLA SW

125. MEADOWLANDS

130. THOMPSON LAKE

132. MCCARTHY CREEK

118. COMSTOCK LAKE

120. PEQUAYWAN LAKE

119. BOULDER LAKE RESERVOIR NE

129. BOULDER LAKE RESERVOIR

107. WHITEFACE RESERVOIR

54. SHAGAWA LAKE

57. MEADOW BROOK

58. LINDEN GROVE

60. SASSAS CREEK

63. SOUDAN

64. EAGLES NEST

66 KANGAS BAY

67. SIDE LAKE

69. DARK LAKE

70. IDINGTON

72. BIWABIK NW

73. BIWABIK NE

74. EMBARRASS

75. ISAAC LAKE

77. BABBITT NE

79. DEWEY LAKE

81. KINNEY

86. ALLEN

87. BABBITT SW

88. BABBITT SE

89. KEEWATIN

93. EVELETH

96. TURPELA LAKE

97. BIRD LAKE

98. SKIBO

99. TOIMI

104. ZIM

MINNESOTA DEPARTMENT OF HEALTH

MINNESOTA STATUTES CHAPTER 1031

350.00 ft

Drilling Method

WELL AND BORING RECORD

Well Depth

100. SILICA

102. LITTLE SWA

91. BUHL

82. VIRGINIA

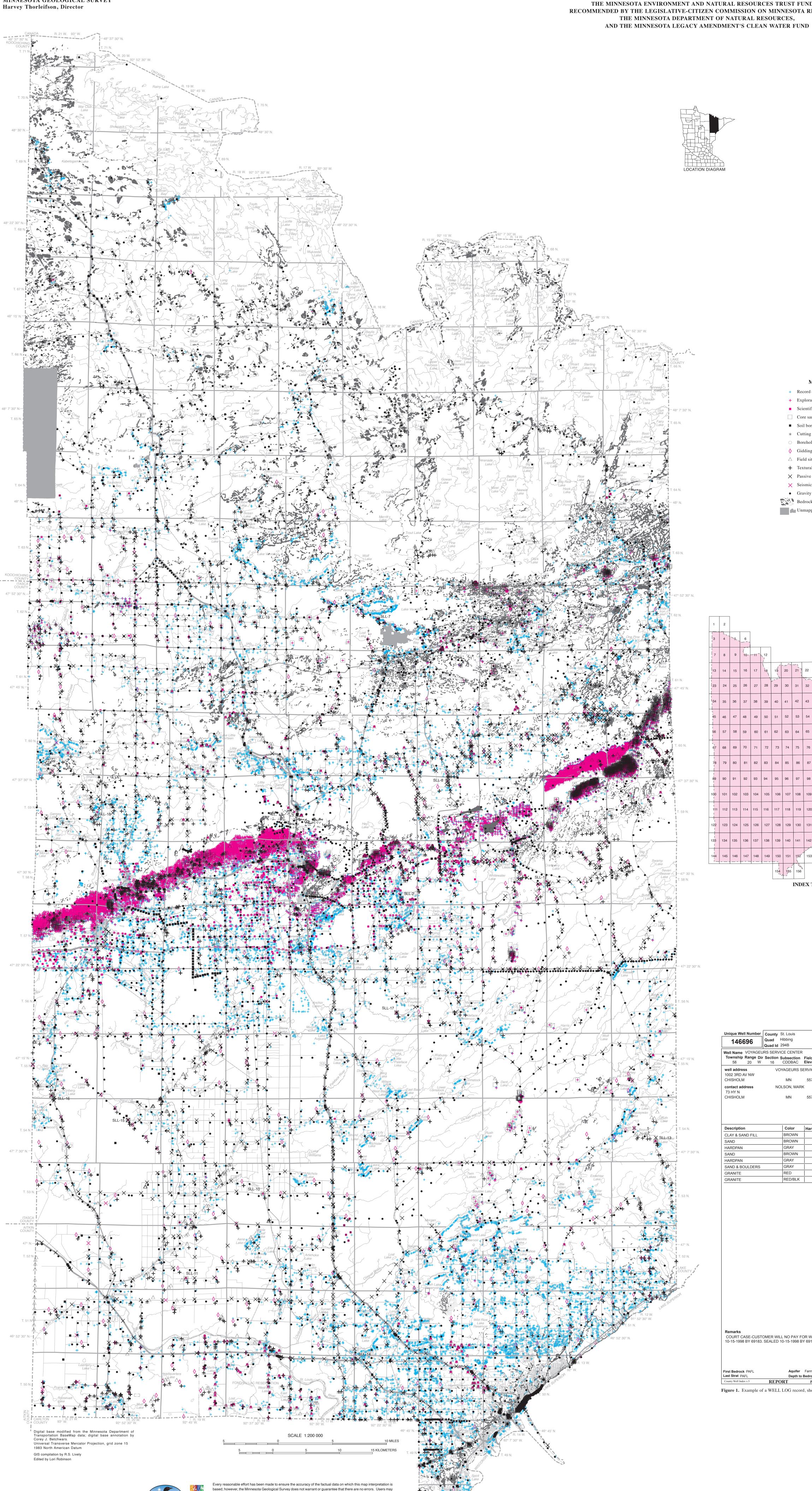
83. MCKINLEY

80. DEWEY LAKE SE

65. BEAR ISLAND

56. BEAR RIVER

the same location.



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.

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DATABASE MAP

Emily J. Bauer

2022

INTRODUCTION

The public health and economic development of St. Louis 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 databases

described here address this need. County Geologic 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. Several sources commonly provide information about an area or an individual property,

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 to have been deposited directly by glacial ice. Understanding the process by which the material formed allows geologists to make predictions about what

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

All of the types of data described on this plate were interpreted by geologists or hydrogeologists to make them meaningful for mapping purposes. The 1:200,000 scale of the maps in this atlas was chosen because it shows 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 databases, depends on the

THE DATABASE MAP

amount of detail needed. Generally, database information must be used to evaluate site-

The types, locations, and density of information used to prepare the St. Louis 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 Database 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.

DRILL-HOLE INFORMATION

lies between and beyond data points.

specific conditions.

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. Included are holes drilled by water-well contractors that were not completed as wells due to insufficient water quantity or lack of water encountered. 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 St. Louis County; about 34,000 logs were used for this atlas. An exploratory boring (exploration hole) is an explorationist's description of the geologic materials penetrated by drilling during mineral exploration. In Minnesota, mineral exploration has been an ongoing venture for over a century as the world's mineral resource needs change and demands for new materials arise. Exploratory work may include the collection of core and cuttings samples (as described below) of the bedrock encountered for descriptive and analytical purposes. In Minnesota, these core and cuttings samples are eventually transferred to the Drill Core Library in Hibbing (the state repository for bedrock

Department of Natural Resources. Scientific investigation holes are drilled by various agencies to study the nature of the subsurface material. Geologic logs were generated that describe the material penetrated for each hole and samples may have been taken for further analysis or study. In St. Louis County, this includes holes drilled by the Minnesota Department of Natural Resources to study the mineral potential in the area, the U.S. Geological Survey to study the hydrologic properties of the glacial deposits, and the Minnesota Geological Survey to acquire a better understanding of the glacial deposits and the Precambrian bedrock

Core samples were collected at various sites in St. Louis County as a means to

and earthen material core samples collected during minerals exploration, engineering,

and geoscience research programs across Minnesota) and maintained by the Minnesota

establish the nature of the subsurface material. Most of the core sampling was done by several different mineral exploration companies and agencies regulating or promoting the use of natural resources, such as the Minnesota Department of Natural Resources, the Department of Iron Range Resources and Rehabilitation, and the Natural Resources Research Institute; but the Minnesota Geological Survey collected a number of cores in order to gain a more general understanding of the subsurface materials that can be found in St. Louis County. Rotary-sonic coring is a technique that 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. Bedrock core is most commonly collected using 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. Mineral exploration in Minnesota in the past several decades has involved using both rotary-sonic and diamond coring, sometimes with a combination of both techniques being used at the same drill site. Detailed geologist's logs describing the glacial deposits for the 17 rotary-sonic cores collected by the Minnesota Geological Survey for this project (labelled SLL-2 through SLL-5 and SLL-7 through SLL-19) are shown in the Appendix to Plate 4, Quaternary Stratigraphy. The Minnesota Department of Transportation collected core at 481 sites for road and bridge foundations. These core samples are stored at the Drill Core

of both soils and 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 size, penetration rate, moisture content, and color. Soil-boring data collected by the Minnesota Department of Transportation are concentrated along Interstate Highway 35 and U.S. Highways 53 and 169. Descriptions of the geologic materials penetrated are interpreted by Minnesota Geological Survey geologists for mapping purposes. The records may be accessed from the Minnesota Department of Transportation's web portal (https:// www.dot.state.mn.us/materials/foundations.html/). Cutting samples collected during drilling and exploration provide physical evidence of subsurface geologic materials. Cuttings are the samples generated as the drill bit cuts

Soil borings are test holes drilled to obtain information about the physical properties

Library in Hibbing, where they are available for inspection

through the subsurface material and are used to interpret and verify driller's logs. They are logged and stored at either the Minnesota Geological Survey or the Drill Core Library in Hibbing. Borehole geophysical logs are collected by Minnesota Geological Survey staff, other government agencies, or private entities 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. Logs can be viewed at the Minnesota Geological Survey or accessed online (http://z.umn.edu/ borehole_geo). The geologic interpretations are available through the County Well Index database described below. Giddings probe holes are borings of glacial materials, 2 inches (5.1 centimeters) in

diameter, collected by Minnesota Geological Survey staff using 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

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. Textural analyses express the proportion of sand-, silt-, and clay-sized 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. Passive seismic 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

Field sites are natural and artificial exposures of unconsolidated Quaternary deposits

to the bedrock surface (or the thickness of unconsolidated sediments above the bedrock surface) beneath that point. The measurements employ a recording seismograph system that is temporarily implanted into the ground and records ambient ground vibrations in three orthogonal directions (two horizontal and one 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; the unit measures background vibrations from a variety of natural and artificial sources that include wind and traffic. 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 (Chandler and Lively, 2014). 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 802 passive seismic stations have been collected within St. Louis County, of which 790 were acquired

as part of this Geologic Atlas.

to travel from a source on the Earth's surface through the subsurface and be refracted back to a receiver. Typically, a hammer or other impact device is used to strike a metal plate on the ground. This generates pressure waves that travel into the ground, refract along the surface of the bedrock, and return to receivers, called geophones, which are arranged in a line at fixed distances along the ground surface. Pressure-wave velocity and thus travel time (measured in milliseconds) is correlated with the density and rigidity of the geologic material: less dense materials have lower velocities and slower travel times than more dense materials. The Precambrian rocks in St. Louis County typically exhibit pressure-wave velocities that are between 5 to 6 kilometers per second, substantially faster than similar pressure waves in glacial sediments, which are about 2 kilometers per second. Depth to bedrock is calculated using the spacing of the geophones and the arrival times of the pressure wave back to the geophones. Seismic refraction soundings are more labor intensive than

passive seismic soundings, but can provide velocity information and higher-quality depth estimates. Seventeen seismic refraction soundings that were acquired in St. Louis County

by the Minnesota Department of Natural Resources were used for this Geologic Atlas.

Seismic refraction soundings measure the time required for sound or pressure waves

Statewide 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 datasets relies on the strong contrasts in density and magnetization that commonly exist between various Precambrian rocks. Apart from some isolated patches of Cretaceous strata, Precambrian rocks form the bedrock surface beneath St. Louis County The aeromagnetic data in St. Louis County were acquired 500 feet (152 meters) above ground along flight lines spaced 0.25 mile (0.4 kilometer) apart, and are compiled into a 328-foot (100-meter) grid (line data not indicated on the map due to high density). The gravity data are based on ground stations that are generally spaced 1 to 2 miles (1.6 to 3.2 kilometers) apart along roads and driveable trails, and these data are compiled into a 3,281-foot (1,000-meter) grid. Derivative-enhanced grids of the gravity and aeromagnetic data are used in conjunction with information from bedrock wells. Bedrock outcrops are natural exposures of solid rock at the land surface. Outcrops in St. Louis County are relatively abundant in the northern half of the county and the

southeastern portion of the county along the shore of Lake Superior, but they are sparse to nonexistent in the central and southwestern parts of the county. 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.

DATABASE MANAGEMENT

and assigned inventory numbers. Included with the St. Louis County Atlas are regularly updated databases containing digital GIS files, developed to provide easy access and rapid retrieval of these site-specific data. Computer storage and retrieval systems are ideal for manipulating large amounts of data because automated geologic databases 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.

All of the data shown on the map were plotted on maps at 1:24,000 or finer resolution

DIGITAL DATABASES

Computerized files were developed for point-source data such as wells and borings in St. Louis 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 databases housed at the Minnesota Land Management Information Center (LMIC). The computerized database developed for St. Louis County by the Minnesota Geological Survey is the County Well Index (CWI). County Well Index (CWI)—Information from water-well records and other subsurface

drill-hole data, such as exploration holes, is entered into this statewide database. Each

record is assigned either a five- or 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 are expressed in feet above sea level and were determined from either topographic maps (see the index to 7.5-minute quadrangles), Minnesota's lidar highresolution elevation dataset, or pre-mining topography compiled from historic topographic maps in the central area of the county (Lively and others, 2002). 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 program also denotes if there are additional data, such as borehole geophysical

The County Well Index is stored in a database that consists of 10 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 the trend and plunge of angled drill holes, 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:

logs, cutting samples, or core, for an individual record.

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 described by a well driller (Fig. 2).

A geologist makes stratigraphic interpretations based on this description, and on her or his knowledge and understanding of the geology of St. Louis County. The interpretations are augmented in some cases by additional data sources, such as cuttings, borehole geophysical logs, or core. Only those drill holes with verified locations have stratigraphy assigned to them. Other digital data—Details about other types of data shown on this plate are available in attribute tables for individual GIS shapefiles included in the atlas products. These include

information that is part of the Quaternary Data Index (QDI), an internal working database.

The Quaternary Data Index contains information from field sites, rotary-sonic cores, soil borings, Giddings probe holes, hand soil auger holes, and textural analyses. Some detailed information associated with these data sources is not included in the digital files that are part of this atlas. This includes descriptions of cutting samples, borehole geophysical logs, and additional information on passive seismic data. It is stored in various formats and can be obtained by request from the Minnesota Geological Survey. Soil borings and mineral exploration records commonly contain detailed information that is not part of the files included in this atlas. The information can be accessed in other digital and paper files from the Minnesota Geological Survey. In addition, data may be obtained from the sources of the soil borings, such as the U.S. Geological Survey. Soil-

boring data from the Minnesota Department of Transportation, Foundations Unit may be found on their web page (https://www.dot.state.mn.us/materials/foundations.html). Mineral exploration records may be obtained from the files maintained by the Minnesota Department of Natural Resources Drill Core Library (https://www.dnr.state.mn.us/lands_ minerals/dc_library.html). Some detailed core descriptions completed by researchers at the University of Minnesota Duluth Natural Resources Research Institute (NRRI) were used in this project. They and others may be accessed online at the Natural Resources Research Institute's web portal (https://www.nrri.umn.edu/research-groups/minerals-andmetallurgy/economic-geology/drill-logs).

Lidar (light detection and ranging) is an optical remote-sensing technique that uses a

sensor, pulsed laser light, and a GPS receiver to sample the Earth's surface and produce highly accurate land-surface information. Lidar data in the Arrowhead region were procured by the Minnesota Department of Natural Resources during a regional acquisition in 2011 and are available from the Minnesota Geospatial Commons website (https://gisdata.mn.gov/ dataset/elev-lidar-arrowhead2011). Data quality for the Arrowhead region is reported at the 95 percent confidence level: \pm 3.8 feet for the horizontal direction and \pm 0.31 foot for the vertical direction. Lidar elevation data are used to map bedrock exposures and glacial landforms. They help mappers more accurately delineate contacts between both bedrock and surficial geologic units. Lidar can also help define the structure of a bedrock unit based on visible features such as fractures, faults, bedding, and weathering profile.

Additional geologic information is generated continuously as new water wells or exploration holes are drilled, construction activities expose more bedrock, or additional wells are tested for water quality. To address this, the library of information prepared for St. Louis 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.

FUTURE DATA COLLECTION

ACKNOWLEDGEMENTS The staff from the St. Louis County Planning and Community Development Department

contributed greatly to the development of the County Well Index database. We thank local water-well contractors, mining companies, exploration companies, and landowners for their valuable assistance. The Minnesota Geological Survey gratefully acknowledges permission granted by the Fond du Lac Band of Lake Superior Chippewa for geologic mapping on tribal land within St. Louis County.

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Lively, R.S., Morey, G.B., and Bauer, E.J., 2002, One hundred years of mining: Alterations to the physical and cultural geography of the western half of the Mesabi Iron Range, northern Minnesota: Minnesota Geological Survey Miscellaneous Map M-118.

Unique Well Number	County S	t. Louis					М	INNES	OTA DEPARTMENT OF HEALTH		Entry Date	1999/06/23
146696 Quad Hibbing							WELL AND BORING RECORD				Update Date 2020/09/18	
Quad Id 294B								INNES	OTA STATUTES CHAPTER 1031	Received Date		
Well Name	Township	Range Dir	Section	Subs	ectio	n D	epth Dr	illed	Depth Completed Date Complete	ed Lic/Reg. No.	Driller Name	
VOYAGEURS SERVICE	CENTE 58	20 W	/ 16	CD	DBAC		3	50 ft	350 ft 1978/10/03	69183	JOLLIFFE, G.	
Elevation 1501.00 ft.	Method 7.5 n	ninute topogi	oth to Bedrock 87 ft. Ope	pen Hole 87-350 SWL 24								
Field Located Minnes	ota Geological	Survey			Lo	catio	n Metho	od Ur	iversal Transverse Mercator(UTM) - NAD8	3 - Zone 15 - Meters		
Program Input Source Minnesota Geological Survey UTM Easting (X) UTM Northing (Y)										(Y)		
	s verification				In	put Da	ate	20	00/06/02	508871	5260632	
Geologic Interpretation	Amy Block				Ą	gency		M	GS	Interpretation Method	Geologic study 1:	24k to 1:100k
				DEP	PTH		ELEVATION			LITHOLOGY		
Geological Material		Color	Hardness	From	То	Thick	From	То	Stratigraphy	Primary	Secondary	Minor
CLAY & SAND FILL		BROWN		0	10	10	1501	1491	clay+sand-brown	fill	clay	sand
SAND		BROWN		10	25	15	1491	1476	sand-brown	sand		
HARDPAN		GRAY		25	45	20	1476	1456	pebbly sand/silt/clay-gray	hardpan		
SAND		BROWN		45	60	15	1456	1441	sand-brown	sand		
HARDPAN		GRAY		60	75	15	1441	1426	pebbly sand/silt/clay-gray	hardpan		
SAND & BOULDERS		GRAY		75	87	12	1426	1414	sand +larger-gray	sand	boulder	
GRANITE		RED		87	230	143	1414	1271	Farm Lake facies of GRB	quartz monzonite	monzodiorite	
GRANITE		RED/BLK		230	350	120	1271	1151	Farm Lake facies of GRB	quartz monzonite	monzodiorite	

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.