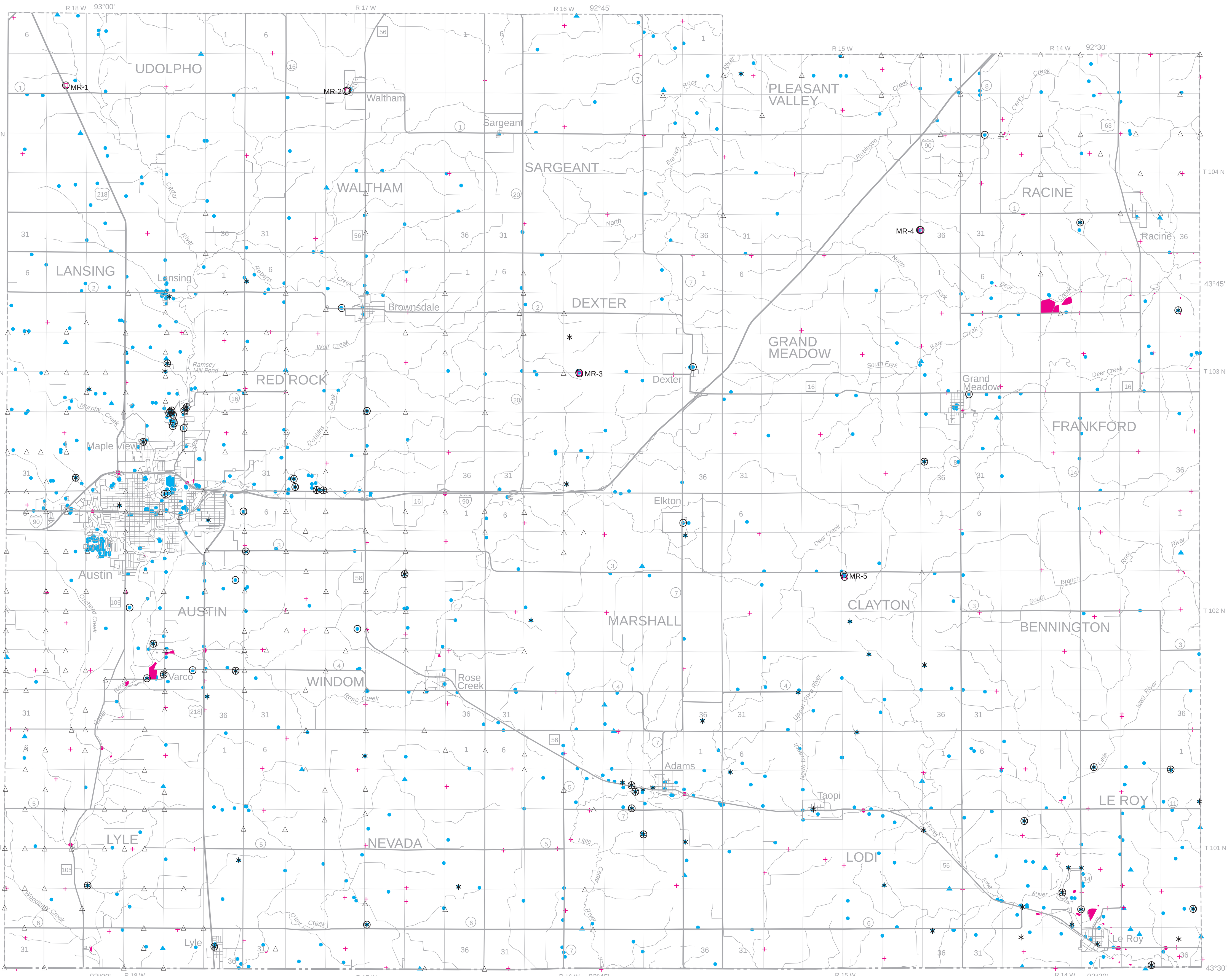
UNIVERSITY OF MINNESOTA

MINNESOTA GEOLOGICAL SURVEY
D.L. Southwick, Director

Prepared and Published with the Support of
THE MOWER COUNTY BOARD OF COMMISSIONERS AND
THE MINNESOTA DEPARTMENT OF NATURAL RESOURCES, DIVISION OF WATERS

COUNTY ATLAS SERIES
ATLAS C-11, PART A
Plate 1—Data Base



Digital base modified from 1990 Census TIGER/Line Files of U.S. Bureau of the Census (source scale 1:100,000); county border files modified from Minnesota Department of Transportation files; digital base annotation by Minnesota Geological Survey

Universal Transverse Mercator Projection, grid zone 15
1927 North American Datum

SCALE 1:100 000

1 0 1 2 3 4 5 MILES

1 0 1 2 3 4 5 6 7 8 KILOMETERS

Cartography by Emily Bauer, Joyce Meints, and T.E. Wahl
Graphic design by Philip Heywood

DATA BASE

By

Emily J. Bauer and Joyce P. Meints

1998

INTRODUCTION

The public health and economic development of Mower County are directly dependent upon the wise use and management of its land and water resources. Geologic and hydrologic information is 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 at all if it is not available when it is needed, or if it is available only in a highly technical form or scattered in many different maps and reports.

County atlases, prepared jointly by the Minnesota Geological Survey and the Minnesota Department of Natural Resources, Division of Waters, present detailed geologic and hydrologic information in an interpretive as well as descriptive form. Maps and texts either summarize basic geologic and hydrologic conditions at a county scale or interpret these conditions in terms of the impacts of possible land-use and water-use decisions. Site-specific information is also available at a greater level of technical detail than shown on the maps of this atlas. These data are too voluminous to present in the 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 a "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 in terms of how it is to be used. In this example, till consists of an unsorted jumble 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.

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

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

EXPLANATION

- **Record of water-well construction (well driller's log)**
- **Cutting sample**
- **Borehole geophysical log**
- **Soil boring**
  - **Minnesota Geological Survey**
  - **Other**
- **Rotasonic core;** MR-3
- **Seismic sounding**
- **Gravity station**
- **Bedrock exposure**

THE DATA-BASE MAP

The types, locations, and density of information used to prepare this atlas are shown on the map. The data are described below to aid the user in assessing which 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 maps.

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 usually do not have 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. Drillers' logs are the primary source of subsurface geologic and hydrologic data for Mower County; about 870 logs were used for this atlas.

Cutting samples collected during drilling provide physical evidence of subsurface geologic materials. They are the principal means of establishing the nature of the subsurface materials and are used to interpret and verify drillers' logs.

Borehole geophysical logs are made by lowering instruments down the 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, in graphic form, characterize the geologic formations penetrated. Spontaneous potential and resistivity are used mainly to locate water levels in wells and the depth of the well casing. An interpretive log is prepared from the geophysical log and correlated with drilling samples from the same hole, information obtained from nearby outcrops, or another nearby geophysical log. Geophysical logs can provide high-quality subsurface geologic and hydrologic information from wells for which little or no other information is available.

Soil borings are test holes drilled to obtain information about the physical properties of subsurface materials for engineering, mapping, or exploration purposes. Most terminate at very shallow depths or where bedrock is encountered. They are logged by an engineer or a geologist using a variety of classification schemes based upon particle sizes, penetration rate, moisture content, and color. Soil-boring data are limited in distribution; in Mower County they are concentrated along the U.S. Interstate Highway I-90 and Minnesota Highway 56 corridors. These data are most useful in determining the composition of unconsolidated deposits. Some logs include the depth to bedrock and the lithology of the first bedrock encountered.

Other Information

Rotasonic cores were collected from five sites in the county to aid the interpretation of Quaternary and Cretaceous deposits. The technique enables recovery of a continuous core, three and a half inches in diameter, from the Quaternary and, if present, the Cretaceous sections and provides excellent subsurface samples for detailed study and comparison with cuttings, geophysical logs, and drillers' logs from surrounding sites.

Textural analyses express the proportion of sand-, silt-, and clay-size particles that make up a sample. They are helpful in identifying and mapping unconsolidated materials, such as glacial deposits. The samples analyzed were taken from natural and artificial exposures, shallow borings, and the Rotasonic cores.

Seismic soundings measure the time required for sound or pressure waves to travel from a source to a receiver. The density and rigidity of the geologic material through which the waves must travel affect their travel time. The Paleozoic carbonate rocks exhibit acoustic- or pressure-wave velocities from one and one-half to two and one-half times those of unconsolidated, saturated Quaternary sediments. The spacing of the receivers (geophones) and the arrival times (measured in milliseconds) are used to calculate the depth to bedrock. Seismic soundings are labor intensive but can provide high-quality data when no other sources of subsurface information are available. They were done at selected localities by Todd Peterson of the Minnesota Department of Natural Resources.

Gravity stations were used to help map the pre-Cretaceous bedrock topography and the thickness of the overlying glacial and Cretaceous deposits. The mass difference between high density Paleozoic rocks and low density Cretaceous and glacial deposits produce small anomalies in the gravity field. The gravity-geologic method incorporates geologic control from drill holes and seismic soundings to isolate the residual gravity signature of pre-Cretaceous bedrock and fill variations from the much larger gravity signatures arising from deep, intrabasement (Precambrian) sources. The residual signature can be converted to estimate bedrock elevation and the thickness of glacial deposits.

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 inventory numbers were assigned to all except some soil borings. 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. Automated geologic data bases may also 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.

Mower County Data Bases

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

County Well Index. Information from water-well records was entered into this data base, which is a statewide file. Each well log is assigned a six-digit unique number that also is 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 map to 7.5-minute quadrangles). The street address of each well is also included whenever 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 has three components:

1. CWI contains basic data on the well, information on aquifer usage and ground-water quality data, and it serves as an index to data that is available in the other two components of the County Well Index. The Minnesota Department of Health collects data on ground-water quality (mostly nitrate and coliform bacteria counts); some depth and construction data from wells that are sampled are included. These data, along with any historic static water-level measurements, are stored in CWI. There are approximately 1930 records in CWI for Mower County (Fig. 1).
2. CWI/WL, or COUNTY WELL INDEX/WELL LOG, contains the well-construction information, pumpage test data, and drillers' and interpreted geologic logs from water-well records. Approximately 870 of the possible 1900 records in Mower County have information in CWI/WL (Fig. 2).
3. CWI/WC, or COUNTY WELL INDEX/WATER CHEMISTRY, contains the results of analyses from water wells. Basic water-chemistry analyses include temperature, pH, conductivity, dissolved oxygen, alkalinity, major anions and cations, stable isotopes, and tritium.

Test Borings Data Base (TESTHOLE). Information from soil borings and engineering test holes is stored in this data base. Descriptions of the types of geologic materials penetrated and the soils classification system used are entered, together with specific field and laboratory tests. The most common tests are blow counts, liquid and plastic limits, water content, and dry density. The depth to the water table is entered if available. Each test hole receives a unique number, and the location is digitized from the site plan.

FUTURE DATA COLLECTION

A data-base map is out of date even before it is printed, because additional information is continually generated as new water wells are drilled, construction activities expose more bedrock, or additional wells are tested for water quality. The library of geologic information prepared for Mower 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.

ACKNOWLEDGMENTS

We thank local water-well contractors, landowners, and the staff at Mower County Soil and Water Conservation District for their valuable assistance.

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.

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*************************************************************************
MINNESOTA COUNTY WELL INDEX/WELL LOG (CWI/WL)
UN.NO./CO.  : 213210/50          NAME    : LAKE LOUISE STATE PARK

   COUNTY   : MOWER              QUAD    : LE ROY
   T/R/SEC. : 101/14/28ABBCBC    ELEV    : 1278 FT.     DEPTH D:  830 FT.
   BDRK ELEV: 1272 FT.           BEDROCK : UPPER CEDAR VALLEY
   OPEN INT.: GALENA/STEWARTVILLE MBR-GALENA/CUMMINGSVILLE MBR
   AQUIFER  : GALENA
   GEO.INTRP: MGS               GEOLGST: JM    METHOD : GEO.STUDY<1:100K

 WELL CONSTRUCTION.
   DRILLNG METHOD: CABLE TOOL      FLUID  :
   CASNG MATERIAL: STEEL           JOINTNG:              TOP:      FT.
                                             [GROUT-------]
               DIAM(IN)  FROM(FT)  TO(FT)    MATERIAL    AMNT  UNITS

   CASING 1   :     10         0      116
   CASING 2   :      6         0      575
   CASING 3   :      5       480      750

 SCREEN.
   PRESENT?: NO        OPEN HOLE FROM:  450 FT.  TO:  625FT.

 PUMP  : DATA UNAVAILABLE.

 PUMPAGE TEST: DATA UNAVAILABLE.

                        DRILLER S/GEOLOGIC LOG

 DEPTH
INTERVAL  DRILLER S DESCRIPTION              COLOR    HARDNESS
[EL.TOP ] [INTERPRETED LITHOLOGY     ][CODE][STRATIGRAPHIC UNIT(S)  ] [AGE]

   0    3 BLACK DIRT
[   1278] [SOIL, ORGANIC DEPOSITS    ][RUUK][BLACK                  ] [REC]
   3    6 YELLOW CLAY (STONEY)
[   1275] [CLAY, COBBLE              ][QPUY][MIXED-W/PEBS.,YELLOW   ] [QUA]
   6   10 YELLOW CLAY (STONEY)
[   1272] [DOLOMITE, LIMESTONE       ][DCVU][UPPER CEDAR VALLEY     ] [DEV]
  10   45 LIMEROCK (BROKEN)
[   1268] [DOLOMITE, LIMESTONE       ][DCVU][UPPER CEDAR VALLEY     ] [DEV]
  45   50 LIMEROCK (HARD)
[   1233] [DOLOMITE, LIMESTONE       ][DCVU][UPPER CEDAR VALLEY     ] [DEV]
  50   53 CREVICE
[   1228] [CREVICE                   ][DCVU][UPPER CEDAR VALLEY     ] [DEV]
  53   60 LIMEROCK (HARD)
[   1225] [DOLOMITE, LIMESTONE       ][DCVU][UPPER CEDAR VALLEY     ] [DEV]
  60   80 LIMEROCK WITH SOFT SHALEY STREAKS          HARD
[   1218] [DOLOMITE, LIMESTONE       ][DCVU][UPPER CEDAR VALLEY     ] [DEV]
  80   85 LIMEROCK (WHITE, SHALEY)
[   1198] [DOLOMITE, LIMESTONE       ][DCVU][UPPER CEDAR VALLEY     ] [DEV]
  85   90 LIMEROCK (BROKEN)
[   1193] [DOLOMITE, LIMESTONE       ][DCVU][UPPER CEDAR VALLEY     ] [DEV]
  90  100 LIMEROCK (BROKEN W/SHALE STREAKS)
[   1188] [DOLOMITE, LIMESTONE       ][DCVU][UPPER CEDAR VALLEY     ] [DEV]
 100  110 LIMEROCK (BROKEN-YELLOW)
[   1178] [DOLOMITE, LIMESTONE       ][DCVU][UPPER CEDAR VALLEY     ] [DEV]
 110  142 LIMEROCK (HARD)
[   1168] [DOLOMITE, LIMESTONE       ][DCVU][UPPER CEDAR VALLEY     ] [DEV]
 142  145 LIMEROCK (HARD)
[   1136] [SHALE, DOLOMITE           ][DCVL][LOWER CEDAR VALLEY     ] [DEV]
 145  186 SHALE (BLUE)
[   1133] [SHALE, DOLOMITE           ][DCVL][LOWER CEDAR VALLEY     ] [DEV]
 186  210 LIMEROCK (YELLOW )
[   1092] [SHALE, DOLOMITE           ][DCVL][LOWER CEDAR VALLEY     ] [DEV]
 210  219 LIMEROCK (YELLOW)
[   1068] [SHALE, DOLOMITE           ][DCVL][LOWER CEDAR VALLEY     ] [DEV]
 219  225 LIMESROCK (YELLOW)
[   1059] [DOLOMITE, LIMESTONE, SHALE][DWPR][WAPSIPINICON/PINICON RI] [DEV]
 225  240 LIMEROCK (SHALE STREAKS)
[   1053] [DOLOMITE, LIMESTONE, SHALE][DWPR][WAPSIPINICON/PINICON RI] [DEV]
 240  260 LIMEROCK (WHITE-SHALE STREAK)
[   1038] [DOLOMITE, LIMESTONE, SHALE][DWPR][WAPSIPINICON/PINICON RI] [DEV]
 260  266 LIMEROCK (WHITE-HARD)
[   1018] [DOLOMITE, LIMESTONE, SHALE][DWPR][WAPSIPINICON/PINICON RI] [DEV]
 266  270 LIMEROCK (WHITE-HARD)
[   1012] [DOLOMITE                 ][DSPL][WAPSIPINICON/SPILLVILLE ] [DEV]
 270  325 LIMEROCK (WHITE-HARD)
[   1008] [DOLOMITE                  ][DSPL][WAPSIPINICON/SPILLVILLE] [DEV]
 325  335 LIMEROCK (SHALEY)
[    953] [DOLOMITE                  ][DSPL][WAPSIPINICON/SPILLVILLE] [DEV]
 335  337 LIMEROCK (BROWN-SOFT)
[    943] [DOLOMITE                  ][DSPL][WAPSIPINICON/SPILLVILLE] [DEV]
 337  395 LIMEROCK (BROWN-SOFT)
[    941] [DOLOMITE, LIMESTONE, SHALE][OMAQ][MAQUOKETA              ] [ORD]
 395  398 LIMEROCK (BROWN-HARD)
[    883] [DOLOMITE, LIMESTONE, CHERT][OMAQ][MAQUOKETA              ] [ORD]
 398  430 LIMEROCK (BROWN-HARD)
[    880] [LIMESTONE                 ][ODUB][DUBUQUE                ] [ORD]
 430  432 LIMROCK (CREAM-HARD)
[    848] [LIMESTONE                 ][ODUB][DUBUQUE                ] [ORD]
 432  476 LIMEROCK (CREAM-HARD)
[    846] [LIMESTONE                 ][OG3SV][GALENA/STEWARTVILLE MBR][ORD]
 476  529 SHALEY ROCK (CREVACED)
[    802] [LIMESTONE, DOLOMITE       ][OGSV][GALENA/STEWARTVILLE MBR] [ORD]
 529  579 SHALEY ROCK (CREVACED)
[    749] [LIMESTONE                 ][OGPR][GALENA/PROSSER MBR     ] [ORD]
 579  580 SHALEY ROCK (CREVACED)
[    699] [LIMESTONE, SHALE          ][OGCM][GALENA/CUMMINGSVILLE MB] [ORD]
 580  605 HARD LIMEROCK (GRAY)
[    698] [LIMESTONE, SHALE          ][OGCM][GALENA/CUMMINGSVILLE MB] [ORD]
 605  649 CREAMISH GRAY LIMEROCK
[    673] [LIMESTONE, SHALE          ][OGCM][GALENA/CUMMINGSVILLE MB] [ORD]
 649  650 CREAMISH GRAY LIMEROCK
[    629] [SHALE                     ][ODCR][DECORAH                ] [ORD]
 650  652 SHALEY SANDROCK
[    628] [SHALE                     ][ODCR][DECORAH                ] [ORD]
 652  685 SHALE GREENISH-BLUE
[    626] [SHALE                     ][ODCR][DECORAH                ] [ORD]
 685  686 LIMEROCK (HARD)
[    593] [SHALE                     ][ODCR][DECORAH                ] [ORD]
 686  704 LIMEROCK (HARD)
[    592] [LIMESTONE                 ][OPVL][PLATTEVILLE            ] [ORD]
 704  710 LIMEROCK (HARD)
[    574] [LIMESTONE                 ][OPVL][PLATTEVILLE            ] [ORD]
 710  714 BLUE SHALE (LIGHT)
[    568] [SHALE                     ][OPVL][PLATTEVILLE            ] [ORD]
 714  720 BLUE SHALEY SANDROCK
[    564] [SHALE                     ][OGWD][GLENWOOD               ] [ORD]
 720  725 BLUE SHALEY SANDROCK
[    558] [SANDSTONE                 ][OSTP][ST.PETER               ] [ORD]
 725  796 SANDROCK (ST. PETER-WHITE-FINE)
[    553] [SANDSTONE                 ][OSTP][ST.PETER               ] [ORD]
 796  830 LIMEROCK-HARD-GRAY
[    482] [DOLOMITE                  ][OPDC][PRAIRIE DU CHIEN GROUP ] [ORD]
*************************************************************************
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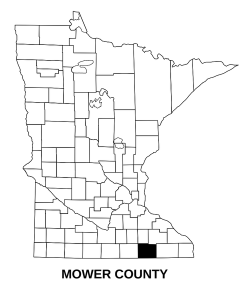
Figure 2. An example of output from CWI/WL (County Well Index/Well Log).

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*********************************************************************
MINNESOTA COUNTY WELL INDEX (CWI)

UN.NO./CO. : 147461/50                         ENTERED: 1992/08/11
NAME       : LYLE 3                            UPDATED: 1996/01/12

  COUNTY   : MOWER            USE    : MUNICIPAL  DRILLED: 1983/08/31
  T/R/SEC. : 101/18/36BDCCCB  DEPTH  : 911 FT.    DEPTH D: 911 FT.
  ELEVATION: 1198 FT.(TOPO  ) CASED  : 695 FT.    GROUT  : YES
  DIAM.    : 12 IN.           DRL/DS : 27010  :LAYNE WELL CO.
  LOC.METH.: INFO.OWNER       LOC.BY : MGS        COORDS.:
  STATUS   : ACTIVE           WHPA   :            DNR PA#: 75-5074

  DPTH BDRK: 48 FT.           BEDROCK: LOWER CEDAR VALLEY
  OPEN HOLE: PRAIRIE DU CHIEN GROUP
  AQUIFER  : PRAIRIE DU CHIEN GROUP

  ADDRESS  : LYLE , MN
  QUAD(7.5): LYLE                     CONTACT:
  POTENTIAL POLLUTION SOURCE:  170 FT.   DIR.: S    TYPE: SEPTIC/DFL
  CWI/WL: YES   CWI/WC: NO    CORE/CTTNGS/GP.: CUTNGS/GEOPHYS

    DATE      NITRATE  BACTERIA  SOURCE     SWL    ELEV   SOURCE
  _________  ________  ________  _______   _____  _____  ______

  1983/08/17                                212    986    27010

    COMMENTS: M.G.S. NO. 1961.  GAMMA & ELECTRIC LOGGED.
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*********************************************************************
MINNESOTA COUNTY WELL INDEX (CWI)

UN.NO./CO. : 213210/50                         ENTERED: 1988/02/05
NAME       : LAKE LOUISE STATE PARK            UPDATED: 1997/01/09

  COUNTY   : MOWER            USE    : PUB.SUPPLY  DRILLED:     /  /
  T/R/SEC. : 101/14/28ABBCBC  DEPTH  : 625 FT.     DEPTH D:  830 FT.
  ELEVATION: 1278 FT.(TOPO  ) CASED  : 450 FT.     GROUT  :
  DIAM.    : 5 IN.            DRL/DS : 27062  :AAMOT WELL CO.
  LOC.METH.: INFO.OWNER       LOC.BY : MGS         COORDS. :
  STATUS   : ACTIVE           WHPA   :             DNR PA# :

  DPTH BDRK: 6 FT.          BEDROCK: UPPER CEDAR VALLEY
  OPEN HOLE: GALENA/STEWARTVILLE MBR-GALENA/CUMMINGSVILLE MBR
  AQUIFER  : GALENA

  ADDRESS  : LE ROY, MN 55951
  QUAD(7.5): LE ROY                   CONTACT: STATE OF MINNESOTA
  CWI/WL: YES   CWI/WC: NO    CORE/CTTNGS/GP.: CUTNGS/GEOPHYS

    COMMENTS: GAMMA LOGGED 12-8-1994. M.G.S. NO. 306.
             WELL GROUTED UP TO 625 FT. & PERFORATED TO 450 FT.
                5-25-1995.
*********************************************************************
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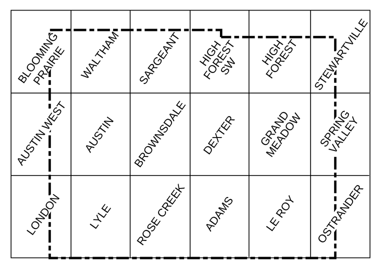
Figure 1. Two examples of output from CWI (County Well Index).



INDEX TO 1:24,000-SCALE TOPOGRAPHIC MAPS

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