UNIVERSITY OF MINNESOTA
MINNESOTA GEOLOGICAL SURVEY
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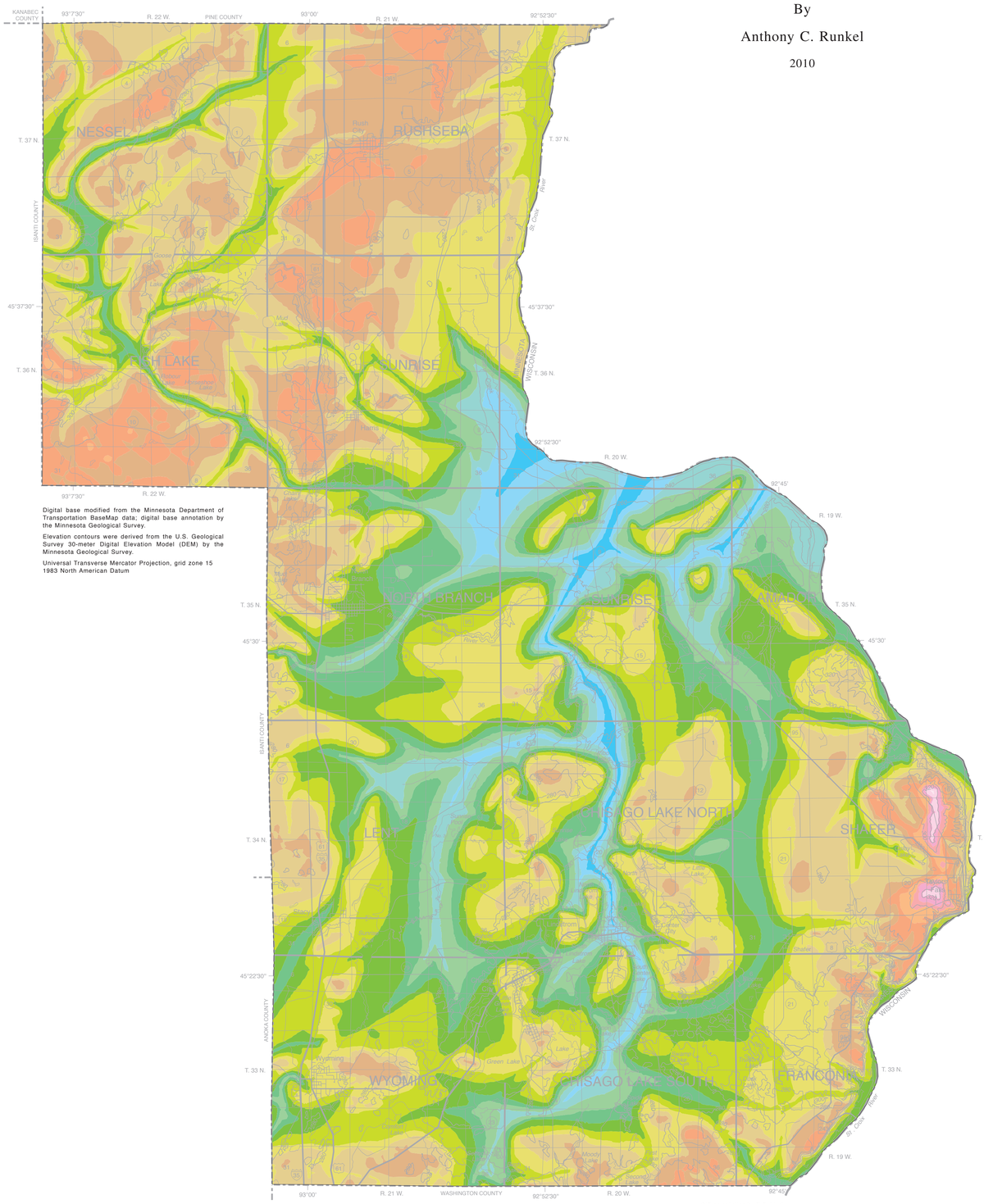
COUNTY ATLAS SERIES
ATLAS C-22, PART A
Plate 6—Bedrock Topography
***and* Depth to Bedrock**

BEDROCK TOPOGRAPHY

By
Anthony C. Runkel
2010



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 R.S. Lively
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

INTRODUCTION

The configuration of the bedrock surface is represented by the colors assigned to 50-foot (15-meter) elevation intervals (example: 751 to 800 feet above sea level) on the Bedrock Topography map. The position of the contour intervals was determined mostly from bedrock outcrop mapping and records of water-well construction. Seismic-refraction techniques were also used to determine the elevation of the bedrock surface in some areas, and linear, sinuous, aeromagnetic anomalies were used to constrain the position of channels on the bedrock surface in the northwestern part of the county (Plate 2, Fig. 4). The geophysical data were collected by the Minnesota Geological Survey (Chandler and others, 2004), the Minnesota Department of Natural Resources, and the Department of Geology and Geophysics at the University of Minnesota. The somewhat irregular distribution of data can be seen on the Data-Base Map (Plate 1) and should be considered when assessing the reliability of the map at any particular location.

The bedrock surface in Chisago County varies from more than 1,100 feet (335 meters) above mean sea level in the southeastern part to less than 400 feet (122 meters) above sea level in buried valleys in the southern part of the county. The most prominent feature of the bedrock topography is an anomalously deep and linearly extensive buried valley in the southern part of the county that approximates the position of the modern Sunrise River system and chain of lakes around the cities of Lindstrom and Chisago City (see cross-section, Plate 2). The buried valley deepens to the north, and crosses beneath the St. Croix River into Wisconsin near the town of Sunrise, where the base of the valley reaches an elevation of less than 400 feet (122 meters). Bedrock topographic constraints in Minnesota south of the county (Mossler and Tipping, 2000), and limited data from the adjacent area in Wisconsin (Johnson, 2000), indicate that this valley either drained to the northeast, towards what is now Lake Superior, or turned south within Wisconsin and ultimately entered the ancestral Mississippi River drainage south of the Twin Cities metropolitan region.

Other highlights of the bedrock topography are the knobs of relatively hard, resistant Mesoproterozoic basalt (Clam Falls Volcanics) that stand at high elevation near Taylors Falls. The tops of some of the highest knobs exceed 1,050 feet (320 meters), about 300 feet (91 meters) above the bedrock surface across most of the rest of the county. Erosion by the St. Croix River and its tributaries through this mass of basalt resulted in the development of the pronounced topographic relief and landscape around Taylors Falls that is more akin to the North Shore of Lake Superior, than to the landscape elsewhere along the St. Croix River.

REFERENCES

Mossler, J.H., and Tipping, R.G., 2000, Bedrock geology and structure of the seven county Twin Cities metropolitan area, Minnesota: Minnesota Geological Survey Miscellaneous Map M-104, scale 1:250,000.

Johnson, M.D., 2000, Pleistocene geology of Polk County, Wisconsin: Wisconsin Geological and Natural History Survey Bulletin 92, 70 p., 1 pl.

Chandler, V.W., Lively, R.S., and Wahl, T.E., 2004, Gravity and aeromagnetic data grids of Minnesota: On file at the Minnesota Geological Survey.

1,101-1,150
1,051-1,100
1,001-1,050
951-1,000
901-950
851-900
801-850
751-800
701-750
651-700
601-650
551-600
501-550
451-500
401-450
351-400

LOCATION DIAGRAM

DEPTH TO BEDROCK

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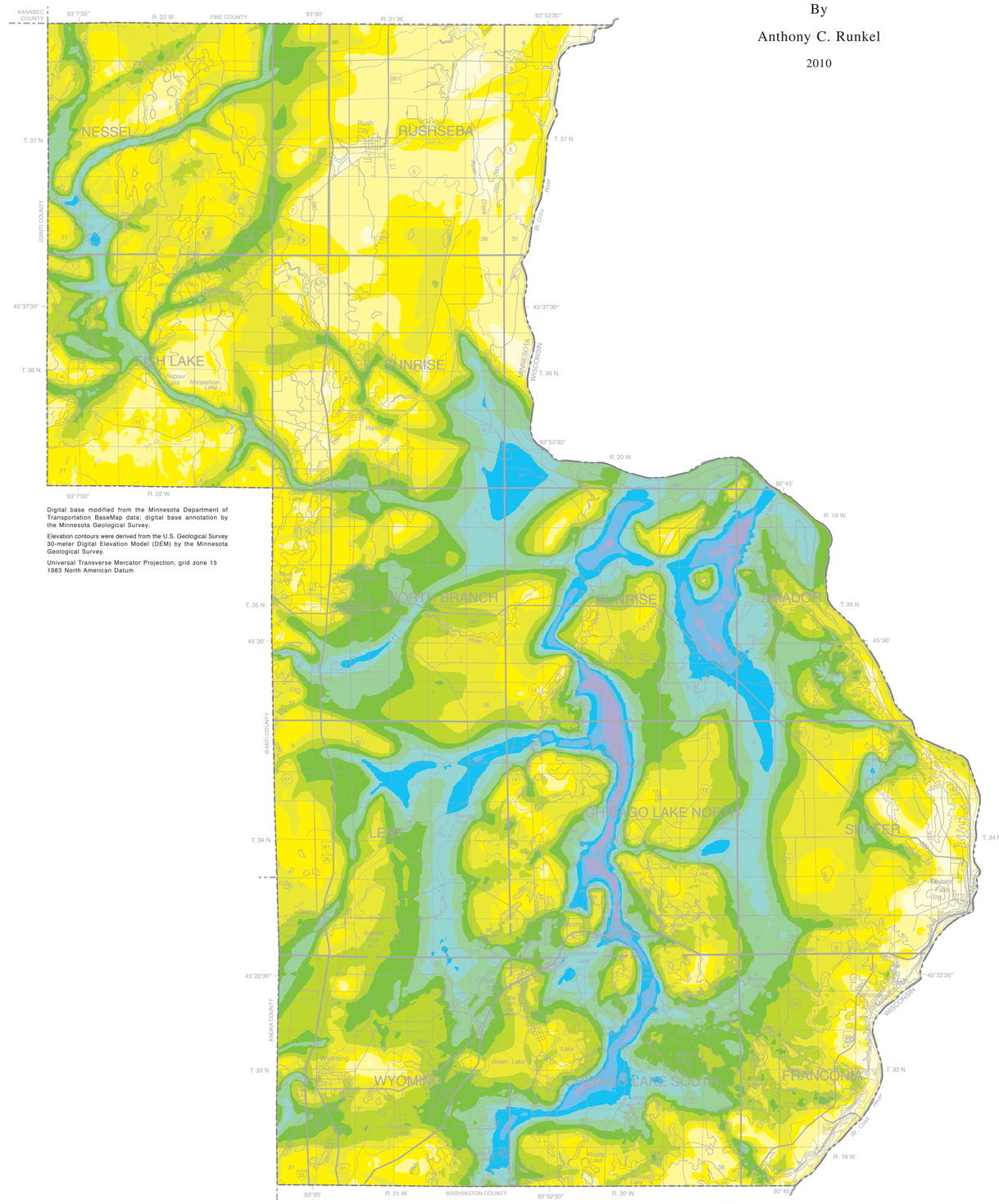

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INTRODUCTION

The thickness of the glacial sediment is equal to the depth from the land surface to the bedrock surface. To calculate this thickness, a grid of bedrock-surface elevations was subtracted from a corresponding grid of land-surface elevations (30-meter cell size). The surface elevation grid was resampled from the National Elevation 10-meter data set of the U.S. Geological Survey, whereas the bedrock elevation grid was interpolated from interpretations of water well and seismic refraction data (see Bedrock Topography explanation, left). The residual grid was then classified at a 50-foot (15-meter) interval to produce the color-coded Depth to Bedrock map. Because the surface of a lake is regarded as the land surface elevation, the thickness of glacial sediment within lake boundaries includes the depth of the lake water. To calculate the true thickness of sediment beneath the lake it is necessary to subtract the water depth at that location. In places the thickness of the glacial sediment varies greatly over short distances, and mapping at this scale (1:100,000) may not properly resolve such prominent variations. For that reason it is best to consult site-specific data, such as well records and seismic soundings, wherever they are available.

The thickest sediments in Chisago County occur over deep, pre-glacial valleys in the bedrock surface. These occur in the southern half of the county where a network of deep buried valleys have more than 500 feet (152 meters) of sediment overlying the bedrock. In contrast, bedrock is at or within 50 feet (15 meters) of the land surface across much of the southeastern part of the county near the St Croix River. Most of the details in the Depth to Bedrock map are related to landforms because the model of the bedrock surface is based on much less data than the land surface topography model.

0-50
51-100
101-150
151-200
201-250
251-300
301-350
351-400
401-450
451-500
501-550
551-600

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.

GEOLOGIC ATLAS OF CHISAGO COUNTY, MINNESOTA