

Preliminary Surficial Geologic Map of the Southwestern Arrowhead Area, St. Louis County, Northeastern Minnesota

By
Kaleb G. Wagner, Jennifer M. Horton, and Gary N. Meyer

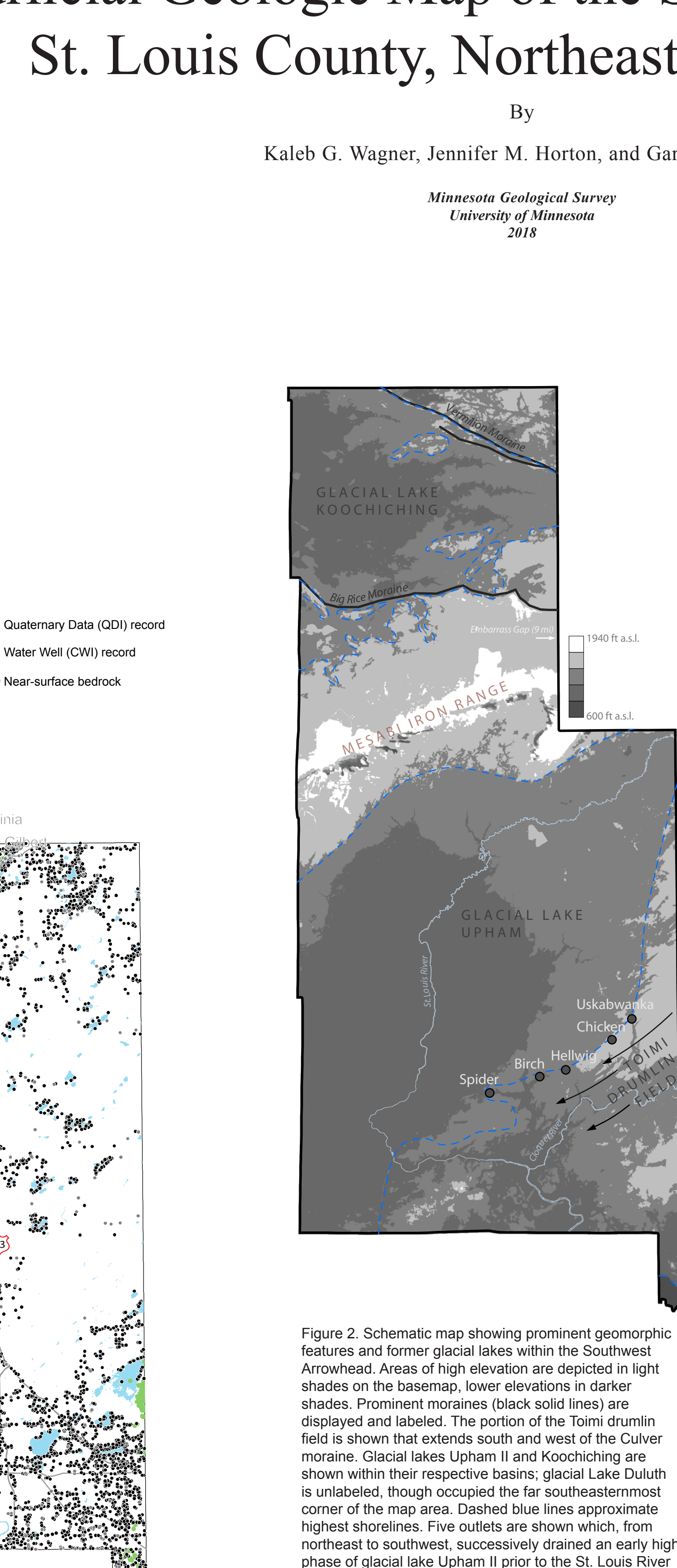
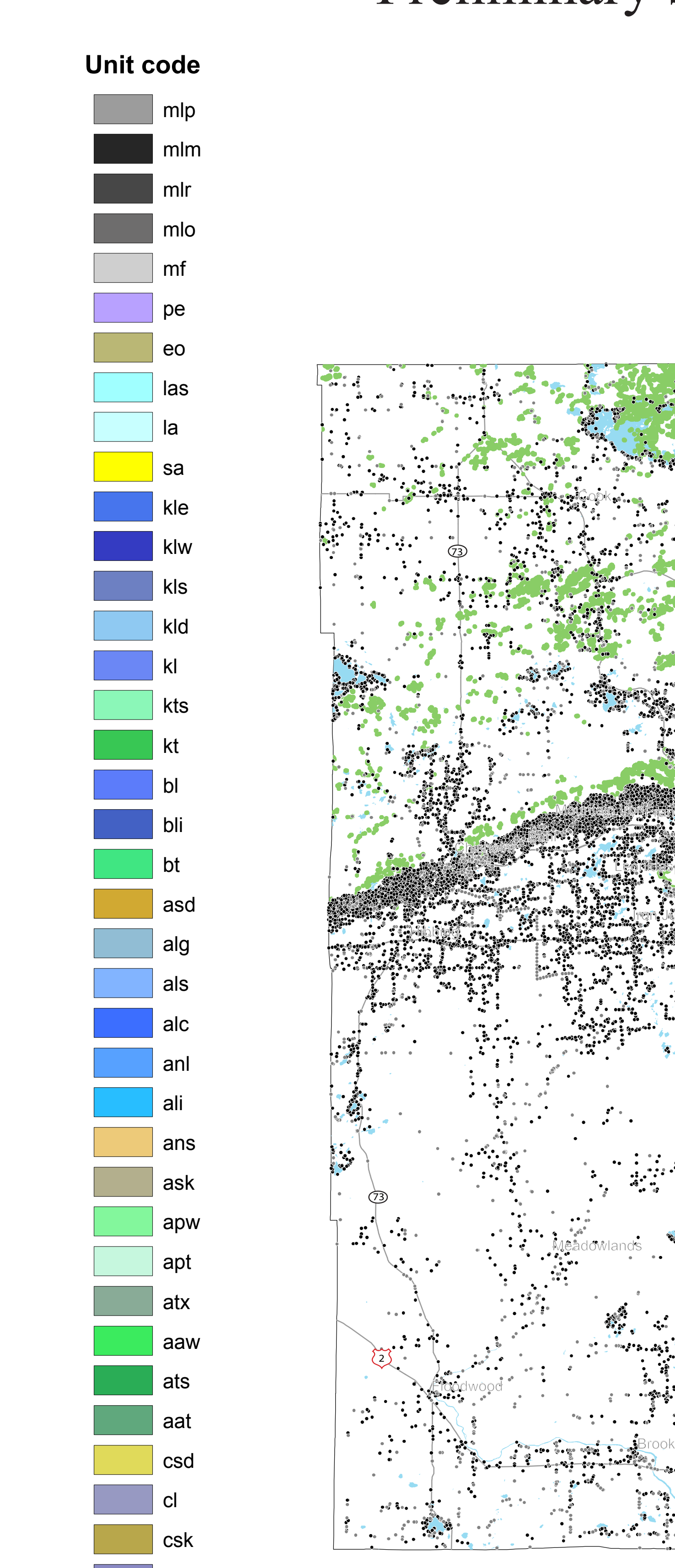
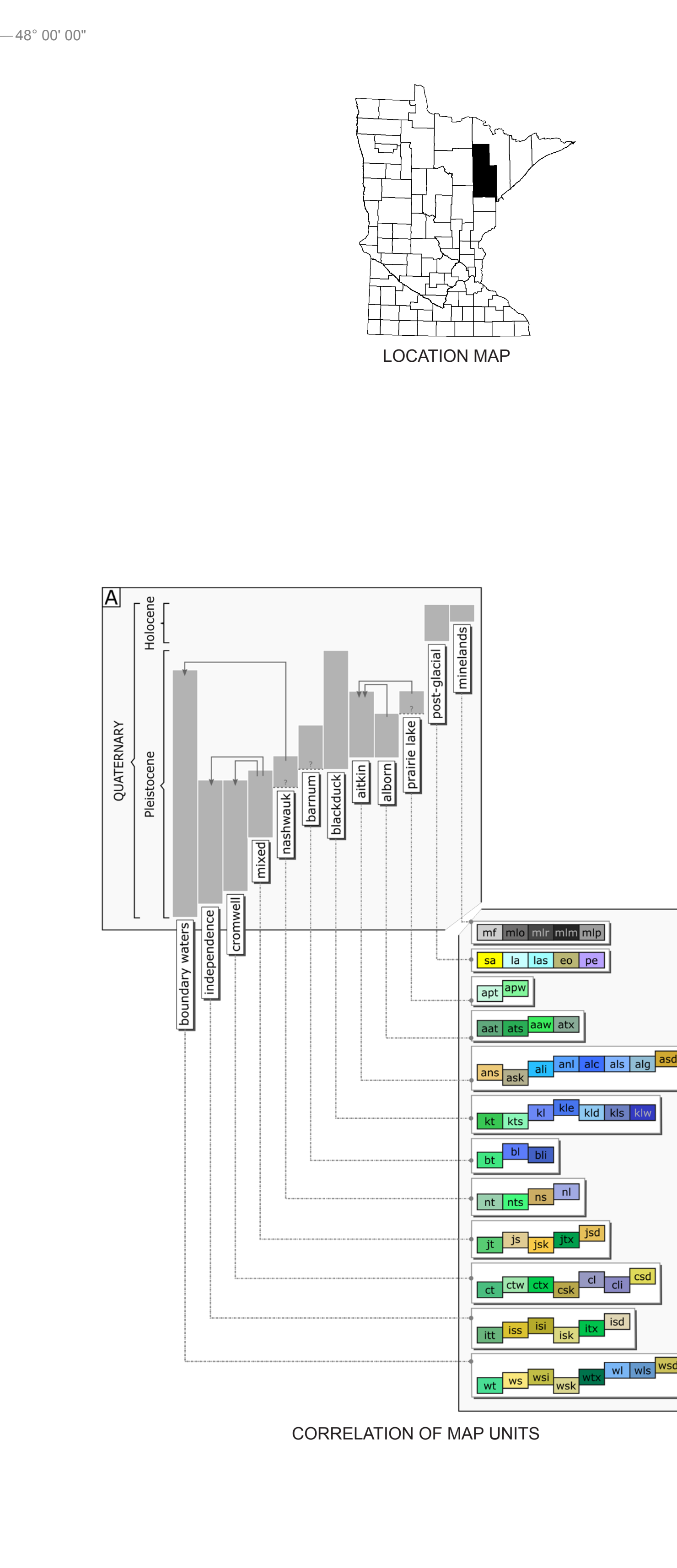
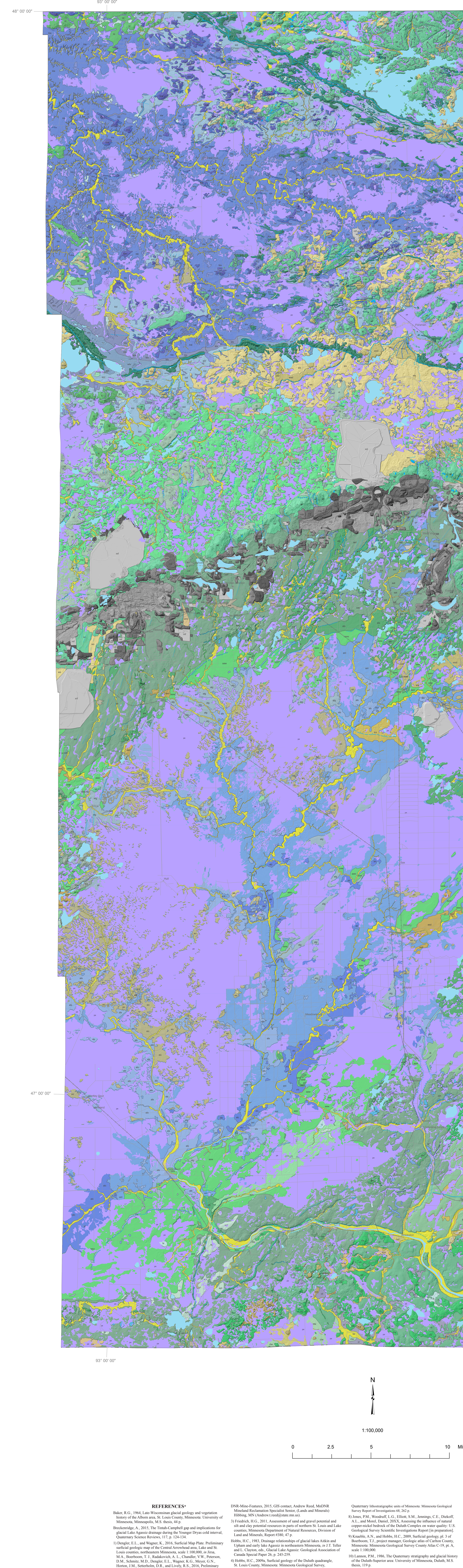


Figure 1. Location of County Well Index (CWI) records (black circles), Quaternary map units (light gray circles), and surface bedrock (green) and trees (black). Major place names and highways are shown in gray.

Figure 2. Schematic map showing prominent geomorphic features and former glacial lakes within the Southwest Arrowhead Area of the study area. The map uses the same color key as the surficial geologic map. The shading indicates the relative portions of sand, silt, and clay in percent. Greater the relative portion of sand, the darker the shading. The shading is darkest in the south and lightest in the north. The map is divided into 18 matrices (A through R) that correspond to the mapped formations and members. The matrix codes are listed in the legend. The map is overlaid with a grid of 1/4 degree squares. The map is oriented with north at the top.

Figure 3. Ternary diagrams showing the relative portions of sand, silt, and clay in 18 matrices corresponding to each of the mapped formations and members. Classification and nomenclature follows United States Department of Agriculture (USDA) texture soil classification. A) Potted texture data for 18 samples collected from 18 units within the Southwest Arrowhead. Displayed by mapped formation and member. B) Potted texture averages and graphical ranges corresponding to each mapped formation and member.

Figure 4. Location of major provinces and the distribution of ice-lobe materials at the land surface. Glacial ice-lobe materials are shown in the color key. The map is oriented with north at the top. The map is overlaid with a grid of 1/4 degree squares. The map is oriented with north at the top.

Table 1. Average values for the composition and matrix texture of 18 units identified in the Southwest Arrowhead area. The table lists formation and member names, and their corresponding sand, silt, and clay percentages.

Table 2. Matrix texture data for 18 units identified in the Southwest Arrowhead area. The table lists formation and member names, and their corresponding sand, silt, and clay percentages.

Table 3. Matrix texture data for 18 units identified in the Southwest Arrowhead area. The table lists formation and member names, and their corresponding sand, silt, and clay percentages.

Table 4. Matrix texture data for 18 units identified in the Southwest Arrowhead area. The table lists formation and member names, and their corresponding sand, silt, and clay percentages.

Table 1. Average values for the composition and matrix texture of 18 units identified in the Southwest Arrowhead area. The table lists formation and member names, and their corresponding sand, silt, and clay percentages.

Table 2. Matrix texture data for 18 units identified in the Southwest Arrowhead area. The table lists formation and member names, and their corresponding sand, silt, and clay percentages.

Table 3. Matrix texture data for 18 units identified in the Southwest Arrowhead area. The table lists formation and member names, and their corresponding sand, silt, and clay percentages.

Table 4. Matrix texture data for 18 units identified in the Southwest Arrowhead area. The table lists formation and member names, and their corresponding sand, silt, and clay percentages.

INTRODUCTION

This map depicts the extent of the surficial materials expected to be encountered beneath the surface in the Southwest Arrowhead region of St. Louis County. Surficial materials associations were inferred from digital aerial photography, satellite imagery, United States Geological Survey (USGS) 1:250,000 scale maps, and 1:50,000 scale aerial photographs. LIDAR data were used to determine the elevation of the surficial materials. The map is overlaid with a grid of 1/4 degree squares. The map is oriented with north at the top.

DESCRIPTION OF MAP UNITS

Unit - Ice till (m) - Typically represents outwash from Paleoproterozoic, Iron-formation and Virginia Formation metasedimentary rocks, with the upper with composed largely of sandstone and siltstone. Includes some beds of sandstone, siltstone, and other metamorphic rocks. **Unit - Sand and gravel (m)** - Includes all units that are composed of sand, silt, and gravel. Includes all units that are composed of sand, silt, and gravel. Includes all units that are composed of sand, silt, and gravel.

BOUNDARY WATERS FORMATION

The Boundary Waters Formation is a complex of glacial and non-glacial materials. It includes all units that are composed of sand, silt, and gravel. It includes all units that are composed of sand, silt, and gravel. It includes all units that are composed of sand, silt, and gravel.

GLACIAL LAKES

Glacial lakes were formed during the last glacial period. They include all units that are composed of sand, silt, and gravel. They include all units that are composed of sand, silt, and gravel. They include all units that are composed of sand, silt, and gravel.

MAP SYMBOLS

- Geologic contact - Approximately located in the southwest corner of the map.
- Meltwater flow direction - Arrows pointing down.
- Stream-scarp - Marks the approximate location of former proglacial meltwater channels.
- Stratigraphic - Break in the high-standing position of an abandoned former lake.
- Fine deposit - Sand and gravel deposits, interpreted to be alluvial fans.
- De cover moraine - Small (1-2 km) ridges, usually narrow (100 ft), 1-3 meters wide, regularly spaced ridges.
- Ice margin - Approximate location of the maximum extent of the glacial ice.
- Ice margin - Approximate location of the maximum extent of the glacial ice.
- Ice margin - Approximate location of the maximum extent of the glacial ice.

PLATONICS

The Black River Formation is a complex of glacial and non-glacial materials. It includes all units that are composed of sand, silt, and gravel. It includes all units that are composed of sand, silt, and gravel. It includes all units that are composed of sand, silt, and gravel.

GLACIAL LAKES

Glacial lakes were formed during the last glacial period. They include all units that are composed of sand, silt, and gravel. They include all units that are composed of sand, silt, and gravel. They include all units that are composed of sand, silt, and gravel.

GLACIAL LAKES

Glacial lakes were formed during the last glacial period. They include all units that are composed of sand, silt, and gravel. They include all units that are composed of sand, silt, and gravel. They include all units that are composed of sand, silt, and gravel.

Bull. U.S. Geol. Surv., 1944, Lake Wisconsin glacial and vegetation...
Bull. U.S. Geol. Surv., 1945, Lake Superior glacial and vegetation...
Bull. U.S. Geol. Surv., 1946, Lake Michigan glacial and vegetation...
Bull. U.S. Geol. Surv., 1947, Lake Huron glacial and vegetation...
Bull. U.S. Geol. Surv., 1948, Lake Erie glacial and vegetation...
Bull. U.S. Geol. Surv., 1949, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1950, Lake St. Clair glacial and vegetation...
Bull. U.S. Geol. Surv., 1951, Lake St. Lawrence glacial and vegetation...
Bull. U.S. Geol. Surv., 1952, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1953, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1954, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1955, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1956, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1957, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1958, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1959, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1960, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1961, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1962, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1963, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1964, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1965, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1966, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1967, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1968, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1969, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1970, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1971, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1972, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1973, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1974, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1975, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1976, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1977, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1978, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1979, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1980, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1981, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1982, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1983, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1984, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1985, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1986, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1987, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1988, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1989, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1990, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1991, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1992, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1993, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1994, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1995, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1996, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1997, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1998, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 1999, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2000, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2001, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2002, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2003, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2004, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2005, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2006, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2007, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2008, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2009, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2010, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2011, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2012, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2013, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2014, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2015, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2016, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2017, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2018, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2019, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2020, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2021, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2022, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2023, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2024, Lake Ontario glacial and vegetation...
Bull. U.S. Geol. Surv., 2025, Lake Ontario glacial and vegetation...