# SURFICIAL GEOLOGY OF THE WATERLOO SOUTH 7.5' QUADRANGLE BLACK HAWK COUNTY, IOWA

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A glacial erratic in the mapping area just off Big Rock Road (an official name)

ABSTRACT

Our objective for developing the surficial geologic map of the Waterloo South Quadrangle was to obtain data that may be used for land use planning tools for the city of Waterloo, IA, the Natural Resources Conservation Service (NRCS), and the local landowners. The city of Waterloo and the surrounding Cedar Falls need these data to improve their water resources management plans, wetland protection programs, aggregate resource management programs, and the pollution potential from Iowa's growing confined animal farming operations (CAFOs). UNI's EDMAP program collaborated with Federal (NRCS, EPA), State (Iowa Geological and Water Survey), and local to address the need for sufficient geologic mapping data. Eight surficial/geologic formations were identified within the Waterloo South Quadrangle (Qal, Qal_lt, Qal_ht, Qe, Qnw2, Qpt_lp, Qnw and Qwa2).

Introduction

The purpose for developing the surficial geologic map of the Waterloo South Quadrangle is to obtain geologic data that can be used for county-specific land use planning tools for the town of Waterloo, IA, the Natural Resources Conservation Service (NRCS), and the local farmers. The study area was located in northeastern Iowa, in Black Hawk County (Fig. 1). The Waterloo South 7.5' Quadrangle covers an area from 42º 30' to 42º22'30'' N latitude and 92º22 30" to 92º 15" W longitude. The Waterloo South Quadrangle lies in a terrain of dissected Pre-Illinoian glacial deposits that blanket a bedrock surface with significant relief. The study area also represents a portion of the Iowan Erosion Surface and exhibits Wisconsinan and Holocene alluvial surfaces, eolian landforms, and discontinuous outcrops of Paleozoic bedrock. Geologic units within the project area include Devonian carbonate bedrock, Pre-Illinoian glacial sediment and alluvium, Wisconsin outwash, loess, Holocene alluvium, and eolian sand.

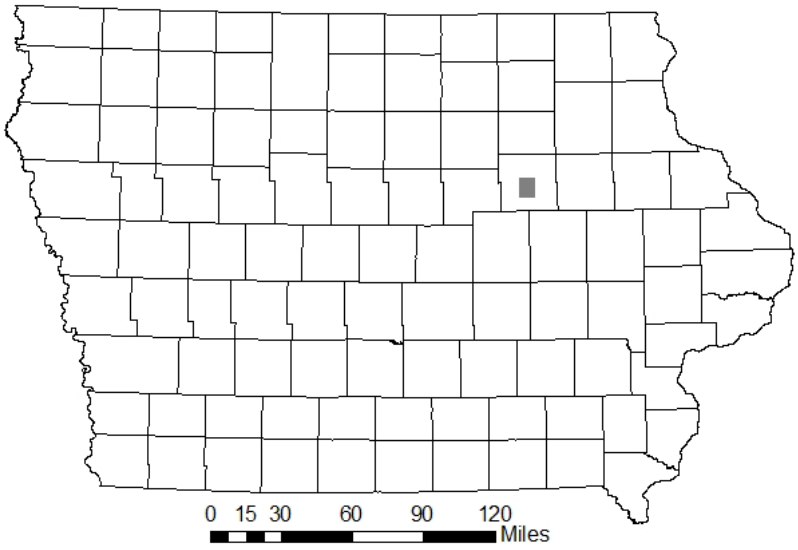


Figure 1. Locality map of Waterloo South Quadrangle (highlighted in black) with an inset depicting the adjacent counties.

Local setting – (*The following summary was written by the Iowa Geological and Water Survey, specifically Deb Quade and Stephanie Tassier-Surine*)

The Waterloo South Quadrangle, located in Black Hawk County, lies within the Iowan Erosion Surface (IES – Figure 2) landform Region (Prior and Kohrt, 2006). This area has been subjected to multiple periods of Quaternary glaciations and subaerial erosion. Generally speaking, the map area consists of unnamed loamy sediments (IES materials) of variable thickness overlying Pre-Illinoian glacial sediments. These deposits are regionally extensive.

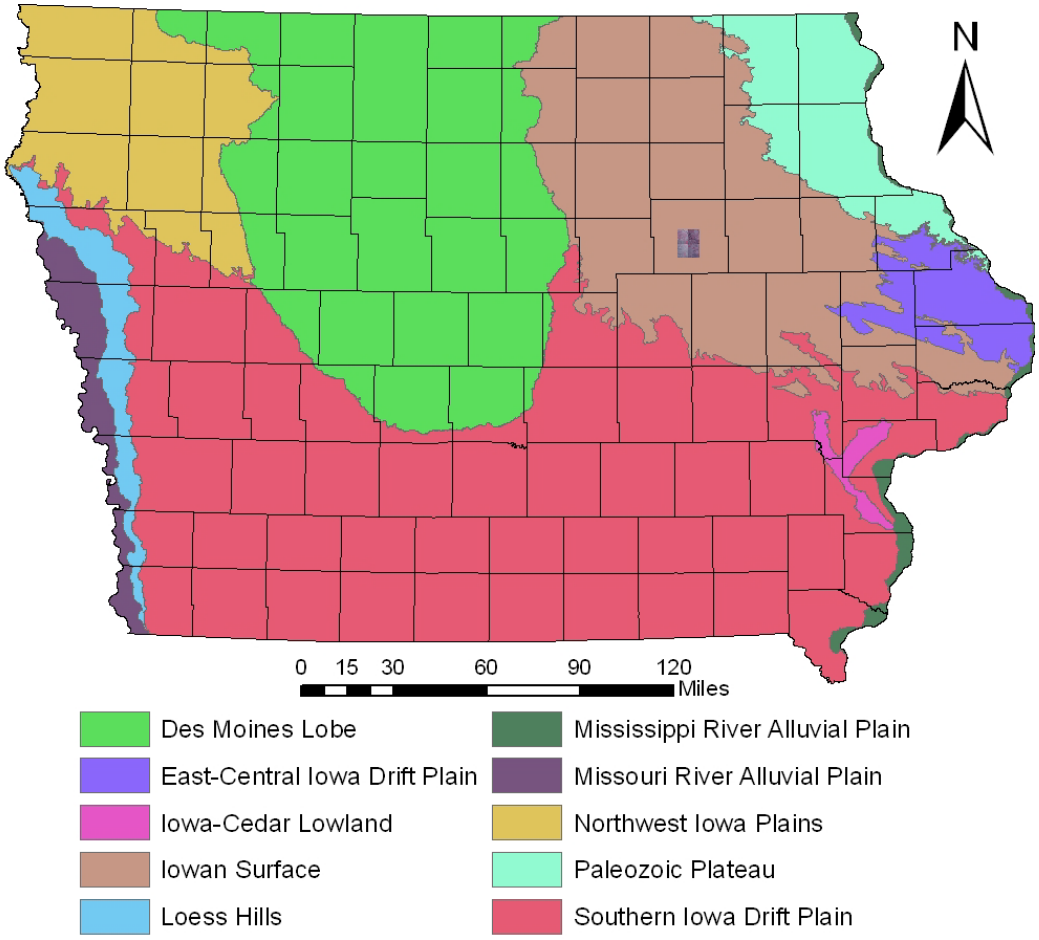


Figure. 2 Landform Regions of Iowa with the Waterloo South Quadrangle (highlighted in grey)

Previous surficial geologic mapping has been completed as part of the STATEMAP program (Tassier-Surine et al., 2007, 2009, 2010) to the north in adjacent Bremer County. The only other regional surficial map of the area consists of the Des Moines 4° x 6° Quadrangle at a scale of 1:1,000,000 (Hallberg et al., 1991). The Devonian stratigraphy of the regional area has been intensively studied by IGWS staff (e.g. Belanski, 1927; Koch, 1970), and re-studied and correlated by Witzke and Bunker (1984), Witzke and others (1988), Anderson and Bunker (1998), and Groves and others (2008). Other studies in the area include Anderson and Garvin (1984) and Day and others (2006). The stratigraphic and nomenclature and correlation in this map follow the stratigraphic framework proposed by Witzke and others (1988).

At least seven episodes of Pre-Illinoian glaciations occurred in this region between approximately 2.2 AND .5 Ma(Boellstorff, 1978a, b; Hallberg, 1980, 1986). Episodic erosion during the last 500,000 years has led to the destruction of pre-existing glacial landforms associated with Pre-Illinoian glaciations. A period of intense cold occurred during the Wisconsin full glacial episode from 21,000 to 16,500 years ago (Bettis, 1989). This cold episode and ensuing upland erosion led to the development of the distinctive landform recognized as the IES (Prior, 1976). A periglacial environment prevailed during this period with intensive freeze-thaw action, solifluction, strong winds and a host of other periglacial processes (Walters, 1996). Surface soils were removed from the IES and the Pre-Illinoian till surface was significantly eroded; resulting in the development of a region-wide colluvial lag deposit referred to as a “stone line”. Other common features of this region are paha, isolated and uneroded topographic highs of loess mantled Pre-Illinoian till with a directional orientation from northwest to southeast and exist as erosional outliers of the once higher and older landscape. Thick packages of stratified loamy and sandy sediments located low in the upland

landscape and adjacent to streams are remnants of solifluction lobes associated with the formation of the IES.

Surficial deposits of the map area are composed of five formations: DeForest, Noah Creek, Peoria, Wolf Creek, and Alburnett formations as well as unnamed erosion surface sediments. Hudson age deposits associated with fine grained alluvial and colluvial sediments include the DeForest formation which is subdivided into the Camp Creek, Roberts Creek, Gunder and Corrington members. The Noah Creek formation includes coarse sand and gravel associated with outwash from the Des Moines Lobe. The Noah Creek Formation included coarse to finer grained fluvial deposits associated with local stream and river valleys. Unnamed erosion surface sediments consist of reworked till and slopewash deposits associated with peri-glacial activity during the Wisconsin ice advance and may be up to 25’ thick. Peoria Formation eolian materials consist of fine sand with thick deposits only present along the Cedar River Valley. Additional eolian materials may be intermittently present mantling most other mapping units, and are more abundant near stream valleys. Pre-Illinoian glacial deposits in northeast Iowa consist of two formations: the younger Wolf Creek Formation and the Alburnett Formation. The Wolf Creek is divided into the Winthrop, Aurora, and Hickory Hills members (oldest to youngest). The Alburnett Formation consists of several “undifferentiated” members. Pre-Illinoian till is not exposed in this map area but is mantled throughout the Gilbertville quadrangle by IES materials, eolian sand or alluvial sediments. Pre-Illinoian deposits may be as thick as 150’ in bedrock valleys, as seen on the cross-section.

## METHODS

### Spatial data collection

Geographically referenced data were necessary for this mapping project. This project required obtaining geospatial data (digital raster – topography, aerial photography, depth to bedrock, and other shape files) from the Iowa Natural Resources Geographic Information Systems Library ( http://www.igsb.uiowa.edu/nrgislibx/gishome.htm ). Spatial data were also collected in the field using a Trimble GeoXH unit. This mobile mapping enables the collection of field data to lessen the possibility of error in identifying geologic sampling points and mapping units.

### Field work

Samples were taken from the field using a hand-auger (2" diameter) and shovel excavations of surficial outcrops. Samples were described in a field notebook on the basis of sediment identification methods. In most cases the maximum range reached for mapable surface geologic units (soil parent material) was 3 to 12 feet. The hand auger was capable of reaching depths of 20 feet, but the UNI EDMAP team often encountered the seasonally high water tables and/or gravel to cobble sized glacial sediment. Each of these naturally occurring conditions made drilling by hand at depths greater than 4 feet difficult. The UNI EDMAP team hand drilled 28 cores and had access to 62 well descriptions from Iowa Geosam database (http://www.igsb.uiowa.edu/webapps/geosam/default.asp?state=1 ). Working in collaboration with the Iowa Geologic and Water Survey on the surficial mapping of the Gilbertville Quadrangle the team participated in drilling five (35 to 45 feet) cores with a drilling rig. We

also extensively used soil profiles, vegetation features, and landscape positions to assist our mapping efforts. The soil samples were collected for lab analysis.

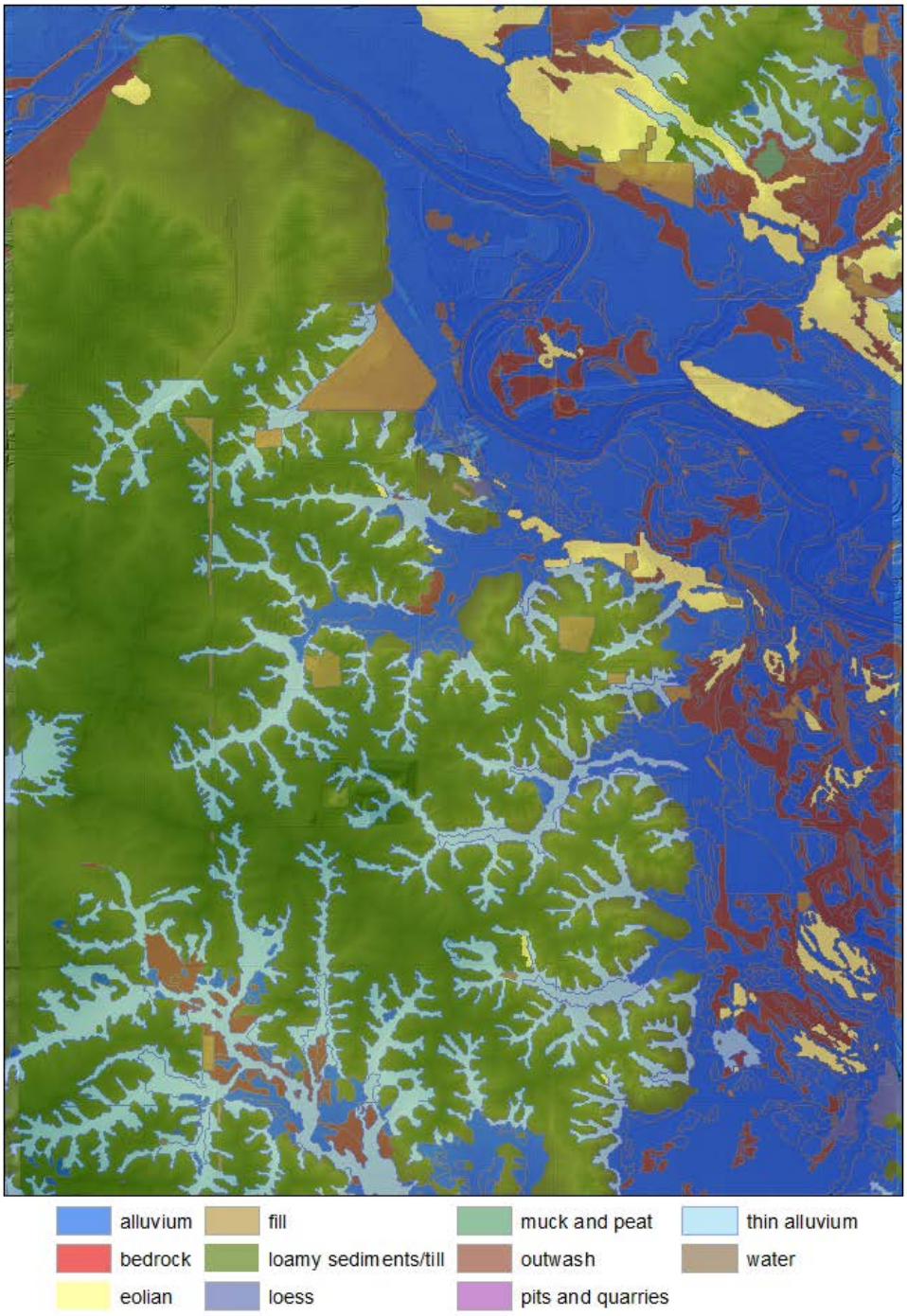


Figure 4. Mapping exhibiting the Waterloo South Quad's primary soil to parent materials relationships.

GIS data processing

Geospatial data were obtained for Black Hawk County and the Waterloo South Quadrangle from the Iowa Natural Resources Geographic Information Systems Library. While drawing the map features (shape files) and contacts a combination of field, supporting geospatial data (aerial photos, NRCS –soil survey data, topography, LIDAR etc. Figure 5), and ArcGIS 10.0 editing tools were used.

Figure 5. General LIDAR coverage exhibiting glacial uplands (green) and alluvial lowlands (purple) through topographic profiling.

Laboratory methods

Particle size analysis is being used to quantify the textural content and variability for unconsolidated sediment (fine-earth fraction) and soil samples from the Waterloo South Quadrangle. Identifying textural variability between a series of depositional units or soil horizons is important because they are indicative of changing energy in depositional systems or changes in weathering environments for soils.

The initial coarse (>2mm) fraction including pebbles, cobbles, and boulders was visually estimated from each stratigraphic unit during field descriptions. Clay-rich units and samples were disaggregated to access homogenous samples. Forced air was used to clean the sieve and crusher between each use to avoid sample contamination of organics and sedimentary particles. The fine particle size (x<2mm) distribution for each sample was determined using the pipette method of Gee and Bauder (1986).

## General map discussion

The majority of the Waterloo South Quadrangle may be characterized as an eroded glacial plain. Qwa2 or a loamy to sandy till sequence makes up approximately seventy-five percent of the quadrangle. It was difficult to map in the urban regions of Waterloo as the construction of levees and other structures has greatly altered the surficial geology. The boundary between the colluvial (Qnw2) and alluvial (Qnw) was difficult to determine, but we believe that our interpretations are accurate based on our field work and available data.

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