ENVIRONMENTAL GEOLOGY
and
LAND USE-PLANNING
in the
SIOUX CITY REGION, IOWA

IOWA GEOLOGICAL SURVEY
SAMUEL J. TUTHILL,
DIRECTOR AND STATE GEOLOGIST
MISCELLANEOUS MAP SERIES 2
1971

by
FRED H. DORHEIM
DONALD L. KOCH
SAMUEL J. TUTHILL
CONTENTS

Introduction ........................................ 1
Information sources ................................ 1
Land-use maps ...................................... 1
Unconsolidated sediments ......................... 1

Bedrock type ........................................ 1
Landslides ........................................... 2
Water resources ..................................... 2
Economic products .................................. 2

MAPS

Legend .................................................. 3

Climbing Hill quadrangle
Land-use ............................................. 4-A
Thickness of unconsolidated sediments ............ 4-B
Elevation and lithology of bedrock ................ 4-C

Luten quadrangle
Land-use ............................................. 5-A
Thickness of unconsolidated sediments ............ 5-B
Elevation and lithology of bedrock ................ 5-C

Salix quadrangle
Land-use ............................................. 6-A

Homer quadrangle
Land-use ............................................. 7-A

Sioux City — South quadrangle
Land-use ............................................. 8-A
Thickness of unconsolidated sediments ............ 8-B
Elevation and lithology of bedrock ................ 8-C

Sergeant Bluff quadrangle
Land-use ............................................. 9-A
Thickness of unconsolidated sediments ............ 9-B
Elevation and lithology of bedrock ................ 9-C

Lawton quadrangle
Land-use ............................................. 10-A
Thickness of unconsolidated sediments .......... 10-B
Elevation and lithology of bedrock ................. 10-C

Moville quadrangle
Land-use ............................................. 11-A
Thickness of unconsolidated sediments .......... 11-B
Elevation and lithology of bedrock ................. 11-C

Union Center — Southeast quadrangle
Land-use ............................................. 12-A
Thickness of unconsolidated sediments .......... 12-B
Elevation and lithology of bedrock ................. 12-C

Union Center — Southwesterly quadrangle
Land-use ............................................. 13-A
Thickness of unconsolidated sediments ............ 13-B
Elevation and lithology of bedrock ................. 13-C

James quadrangle
Land-use ............................................. 14-A
Thickness of unconsolidated sediments ............ 14-B
Elevation and lithology of bedrock ................. 14-C

Sioux City — North quadrangle
Land-use ............................................. 15-A
Thickness of unconsolidated sediments ............ 15-B
Elevation and lithology of bedrock ................. 15-C

Jefferson quadrangle
Land-use ............................................. 16-A
Thickness of unconsolidated sediments ............ 16-B
Elevation and lithology of bedrock ................. 16-C

Elk Point — Northeast quadrangle
Land-use ............................................. 17-A
Thickness of unconsolidated sediments ............ 17-B
Elevation and lithology of bedrock ................. 17-C

Milnerville quadrangle
Land-use ............................................. 18-A
Thickness of unconsolidated sediments ............ 18-B
Elevation and lithology of bedrock ................. 18-C

Hinton quadrangle
Land-use ............................................. 19-A
Thickness of unconsolidated sediments ............ 19-B
Elevation and lithology of bedrock ................. 19-C

Union Center — Northeast quadrangle
Land-use ............................................. 20-A
Thickness of unconsolidated sediments ............ 20-B
Elevation and lithology of bedrock ................. 20-C

Union Center — Northeast quadrangle
Land-use ............................................. 21-A
Thickness of unconsolidated sediments ............ 21-B
Elevation and lithology of bedrock ................. 21-C
INTRODUCTION

This Atlas of maps was compiled to assist planning boards, engineers and other individuals or organizations that are involved in making decisions which affect land use. Environmental planning is especially necessary in areas that are undergoing rapid urban-industrial and agricultural growth with accompanying modification of rural regions. It was with this consideration in mind that the Sioux City Region was selected as a pilot study area. The maps generated for this study are based on extant data. Because the amount of information available is limited and its distribution within the region is variable, the accompanying maps are very generalized. The control points are marked on the various maps. The maps should be used only as reconnaissance aids in the first stages of land-use planning. They do not obviate the need for site investigations. Elimination of investigations of high-risk regions can prevent unnecessary expenditures of money, time, and effort because they reduce the area of land to be considered during planning. It is to this purpose that this Atlas has been developed.

INFORMATION SOURCES AND ACKNOWLEDGMENTS

Data from well records on file at the Iowa Geological Survey were used to prepare maps that show thickness of unconsolidated sediments, elevation of the bedrock surface, and type of bedrock. Aerial photographs were used for terrain analysis and to map distribution of unconsolidated surficial materials. These interpretations were field-checked. A few locations were selected for earth-resistivity investigations in an attempt to determine depth to bedrock where the overburden is relatively thin, and to determine locations where colluvial sediments on long, low slopes extend into stream valleys and are underlain by porous and permeable stream-laid sediments. Data on soil associations is available from reports published by the Agricultural Experiment Station, Ames, Iowa and the appropriate surveys should be consulted for information on surficial materials.

The names within parentheses on the quadrangle index (cover page) indicate the principal investigator for each quadrangle. Raymond R. Anderson drafted camera-ready copies of the maps for publication.

LAND-USE MAPS

Protection of water supplies from pollution should be a primary concern in a program of land-use planning. The color scheme employed on the land-use maps indicates the relative potential for pollution of surface water and groundwater supplies. Colors are used to indicate regions that have the highest potential for pollution (red), regions that have moderate pollution potential (yellow), and regions that have the least pollution potential (green).

Areas colored red mark stream valleys that contain deposits of silt, sand, and gravel, and/or regions where unconsolidated sediments above the bedrock surface are less than 75 feet in thickness. These regions are difficult to protect from erosion because the sediment is easily moved by rain and snowmelt. The potential for water pollution is high in these areas because the sediment can easily be washed into streams and rivers. The potential for pollution of groundwater supplies also is high in these areas because the sediment can be easily moved by water moving through the soil. The potential for pollution of groundwater supplies is low in regions colored green. The potential for pollution of groundwater supplies is moderate in regions colored yellow.

UNCONSOLIDATED SEDIMENTS

The unconsolidated sediments within the region studied consist of unsorted till and peat and sorted clay, silt, sand, and gravel. Thicknesses of the unconsolidated sediments are indicated using a 25-foot contour interval in the eastern portion and a 50-foot contour interval in the western portion of the region.

TILL

Till is an unsorted mixture of clay, silt, sand, pebbles, cobbles and boulders. Clay usually forms the matrix of a till deposit and is therefore usually dense and only slightly permeable material. It is found beneath the loess mantle over most of the region discussed here. Small patches of till are exposed at the surface on a few sites in the Milnerville, Sioux City-North and Union Center-Northeast quadrangles. North of Riverside, along the bluffs of the Big Sioux River, the interval of till is very thin, and at a few locations loss can be observed directly overlying the bedrock. The till apparently increases in thickness a short distance east of the bluffs.

UPLAND SAND AND GRAVEL DEPOSITS

Sand and gravel was deposited by meltwaters that flowed over the region during the period in which the last continental glacier melted from this part of the midwest. Much of the flow of water was channeled down the bluffs of the Big Sioux River. A few locations along the bluffs of the Big Sioux River show localities where these coarse sand and gravel deposits are exposed directly overlying the bedrock. The potential for pollution of surface water is high in these areas because the sediment can easily be washed into streams and rivers.

BEDROCK TYPES

Rocks beneath the unconsolidated sediments consist of shale, sandstone, and limestone beds of Cretaceous age. On most of the bedrock maps, orange indicates areas where sandstone is known or thought to be the bedrock; blue is used where limestone is the expected bedrock, and areas where shale is believed or known to be the bedrock are uncolored.

Peat

Peat is a deposit composed of vegetation matter and fine grain-sized clay and silt materials that accumulated in shallow, poorly drained depressions. The only peat deposit observed in the region discussed here is in the northeastern part of the Elk Point quadrangle. There the peat occurs on a hillside and is underlain by till and coincides with a number of small springs that emerge on the hillside at the contact between the loess and the till.

Loess is a wind-blown deposit composed predominantly of silt with lesser amounts of clay and sand. A thick mantle of loess is present above most of the region. Caves sometimes are developed within the loess. These caves appear to be laterally continuous in this area and tests to determine static load-bearing capacity will be necessary for heavy construction projects.

Valley Clay, Silt, Sand, and Gravel Deposits (Alluvium)

Valley clay, silt, sand, and gravel deposits are present within the valleys of the Missouri, Big Sioux, Floyd and Little Sioux Rivers. These deposits are an important source of water supply in the region.
LANDSLIDES

Although there is no map included in this atlas that is designed to show potential landslide areas, careful analysis of the local topography and composition of the sediments as they relate to landslide potential should be included in a regional planning program. Naturally occurring conditions within the Sioux City Region which should be evaluated as a part of an analysis of landslide potential include:

1) Thick loess deposits that overlie either till or shale units.
2) Steep loess or colluvium slopes.
3) The presence of seepage horizons along steep banks.

Where loess is underlain by either till or water, water will move downward through the loess and then laterally along the contact with either the till or the shale. Where such a contact is exposed along a steep slope or where it is exposed by grading for a road or for building construction a condition may exist or be created that favors the occurrence of landslides.

Some factors that contribute to landslide development as an adjunct of construction are:

1) Derangement of groundwater flow by side-hill fill, diking or compaction.
2) Overloading of weak soils by fill, construction, etc.
3) Over-steepening of cuts in unstable materials. Most common is the overloading of weak soils by fill, construction, etc.

WATER RESOURCES

The largest source of water supply within the Sioux City Region is available from sand and gravel deposits adjacent to the Missouri River. Production will vary with thickness and grain-size of these alluvial deposits, but it is reasonable to anticipate production in excess of 1,000 gallons per minute from relatively shallow wells.

Alluvial deposits adjacent to the Floyd and Little Sioux Rivers and some of the larger creeks provide another important source of water. Many of the farms and some of the smaller communities obtain their water from these sources. Sand points often provide enough water for individual farm wells. Gravel-pack wells are constructed where larger water supplies are needed.

A third important source of water supply, not only within the Sioux City Region but throughout most of northwest Iowa, is the Dakota Sandstone. Depth to the Dakota is variable throughout the region. It's water-bearing zones range in depth from less than fifty feet to over 400 feet. East of the Missouri River valley, production from wells completed in the Dakota Sandstone generally is ten to twenty gallons per minute. Thickness of the sandstone and the occurrence of interbedded shale affect yields significantly. Where the Dakota Sandstone is in hydraulic connection with coarse grain-sized sediments of the Missouri River valley, production may be greater than 750 gallons per minute. Because of this occasional hydraulic connection between the sandstone and the alluvium the protection of both from sources of pollution is extremely important.

Intervals of sand and gravel within the till provide water for many farms. If these sources become polluted, deeper and more costly wells drilled into the Dakota Sandstone will be required to replace shallow supplies. In some areas the Dakota may be incapable of yielding the desired water quality and quantity, and it may be necessary to drill a well in excess of 500 feet.

ECONOMIC PRODUCTS

Sand and gravel are currently produced from deposits along the valley of the Floyd River, and more pits probably can be developed there. They are economically important to the metropolitan and rural roads program. The sellable deposits in reserve should be explored. Restrictive land use or zoning should evaluate their long-term economic impact before they are eliminated as sources of aggregate.

A third potential source of gravel is from deposits within the till. Examples of these deposits are exposed along the road south of the West Fork of the Little Sioux River about one mile north of Climbing Hill, and in a pit about three miles southeast of Holly Springs. An area approximately two miles south of Moville, west of the Moville-Climbing Hill road may be a potential area for gravel exploration. Gravel deposits within the till will probably produce a material suitable only for road metal.

LIMESTONE

Limestone for road aggregate use is unavailable within the Sioux City Region. A low-grade limestone, often referred to as marl, is found in the northern part of the region. If the demand for agricultural lime increases, this stone may become more widely marketable. Marl deposits have been worked in the past near Westfield, Akron and LeMars, and more recently, near Hinton.

SUPPLEMENTARY READING


LEGEND

LAND-USE MAPS

- Alluvial sand and gravel and/or areas where unconsolidated sediments above bedrock are less than 75 feet in thickness. Groundwater occurs through most of area. Unfavorable for sanitary landfill, sewage disposal, or large feeder lot operations.
- Slopes covered with loess-derived colluvial silt. Thickness of colluvium and underlying material must be determined before land-use designation can be made.
- Loess-covered hills and upland slopes with thin to thick interval of loess overlying till. Those areas with moderate slopes and thick till favorable for sanitary landfill and feeder lot operations; may require minor drainage control or other engineering modifications.

BEDROCK MAPS

- Areas where the bedrock is predominantly shale.
- Areas where the bedrock is predominantly sandstone; the sandstone may be an aquifer.
- Areas where the bedrock is predominantly limestone; limestone from exposure west of Hinton is used as a source of agricultural lime.
  - Exposures of sandstone or limestone as denoted by color.
  - Exposures along bluffs of Big Sioux River; thick sequence of sandstone and shale beds; limestone at top of outcrops north of Stone State Park.

- Contours on bedrock surface; all elevations refer to mean sea level datum.
- Well locations; drill cuttings available.
- Well locations; data from drillers' logs.
- Till exposed at land surface.
- Peat bog.
- Gravel exposed at land surface.
- Gravel pit.
- Clay pit.
- Earth resistivity station.

ISOPACH MAPS

- Thickness of unconsolidated material (in feet)
THICKNESS OF UNCONSOLIDATED SEDIMENTS
THICKNESS OF UNCONSOLIDATED SEDIMENTS

SIOUX CITY SOUTH, NEBR.-IOWA-S. DAK. 7.5 MINUTE SERIES (TOPOGRAPHIC) 1963

THICKNESS OF UNCONSOLIDATED SEDIMENTS
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Mapped, edited, and published by the Geological Survey
Control by USGS and USC&GS
Topography by photogrammetric methods from aerial photos taken 1962 and planimetric surveys 1964
Projection: Transverse Mercator, U.S. Central Zone
Scale is 1:24,000
Contour interval is 10 feet
Dotted line represents 5-foot contours
Datum is mean sea level
LAND-USE

LAWTON QUADRANGLE
IOWA-WOODBURY CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
96°07'30"N 42°30'W

10-A
THICKNESS OF UNCONSOLIDATED SEDIMENTS

CONTOUR INTERVAL 20 FEET

DATUM IS MEAN SEA LEVEL

SCALE
1:62500

UNION CENTER
SOUTHEAST,
IOWA

0 1 2 3 miles

42°30' 96°00'
ELEVATION AND LITHOLOGY OF BEDROCK

SCALE
1:62,500

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

UNION CENTER SOUTHEAST, IOWA
LAND-USE

SCALE 1:62500

CONTOUR INTERVAL 20 FEET

DATUM IS MEAN SEA LEVEL

UNION CENTER
SOUTHWEST, IOWA
LAND-USE

SCALE
1:62500

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

UNION CENTER
NORTHWEST
IOWA

T. 92 N.
T. 91 N.
T. 90 N.
T. 91 N.
T. 90 N.

0 1 2 3 miles

20-A
THICKNESS OF UNCONSOLIDATED SEDIMENTS

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

20-B
SCALE
1:62500
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL
20-C

ELEVATION AND LITHOLOGY
OF BEDROCK

UNION CENTER
NORTHWEST
IOWA
THICKNESS OF UNCONSOLIDATED SEDIMENTS

SCALE
1:62500
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

UNION CENTER NORTHEAST, IOWA