Department of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY
Illinois Geologic Quadrangle Map: IGQ Vincennes OI
William W. Shilts, Chief
2000

DIGITAL ORTHOPHOTO IMAGE MAP

VINCENNES QUADRANGLE

KNOX COUNTY, INDIANA AND LAWRENCE COUNTY, ILLINOIS

D.E. Luman and M.L. Barnhardt
Map Compilation B.J. Stiff and R.J. Krumm

Scale 1:24,000

0 — 2 miles

0 — 2 kilometers

0 — 2000 feet

DISCLAIMER: This map was prepared for the purpose of quadrangle mapping, resource evaluation and regional planning. It is based on interpretations of available data obtained from a variety of sources. Location of geologic unit contacts are not surveyed; therefore, the accuracy of contact locations depends on the scale of mapping and the interpretation of the geologist. The accuracy of the unverified data and the interpretations based upon them are not guaranteed by the Illinois State Geological Survey. The information provided on this map cannot be substituted for site-specific investigations.

FOR FURTHER INFORMATION CONTACT:

Illinois State Geological Survey
Natural Resources Building
615 East Peabody Drive
Champaign, IL 61820–6964

(217) 333–4747

http://www.isgs.uiuc.edu

FOR FURTHER INFORMATION CONTACT:

Indiana Geological Survey
611 North Walnut Grove
Bloomington, IN 47405-2208

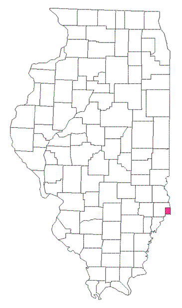
(812) 855–7376

http://adamite.igs.indiana.edu

Released by the authority of the State of Illinois: 2000

Base map compiled at the Illinois State Geological Survey (ISGS) from digital data provided by the U.S. Geological Survey and the ISGS
1927 North American Datum
Universal Transverse Mercator grid –zone 16

Contour Interval 10 Feet
Dashed Lines Represent 5–Foot Contours



1	2	3
4		5
6	7	8

1 Birds
2 Russellville
3 Oaktown
4 Lawrenceville
5 Fritchton
6 St. Francisville
7 Decker
8 Iona

ADJOINING 7.5-MINUTE QUADRANGLES

UTM Grid North
1999 Magnetic North
1°
18 mils
0° 21'
6 mils
declination at center of map area

ACKNOWLEDGEMENTS: This map is one in a series of maps prepared for the Vincennes Quadrangle by a multidisciplinary team of geologists from the Illinois State Geological Survey and the Indiana Geological Survey. D.G. Morse was the Project Coordinator. This project was funded by general funds at the respective surveys.

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This map is one of a series of maps produced for the Vincennes Quadrangle through the Illinois Geologic Mapping Program (IGMaP). Other maps in the series may include the following: geologic materials at land surface, a three-dimensional portrayal of glacial/post-glacial sediments, uppermost bedrock geology, and a three-dimensional portrayal of bedrock materials. Derivative maps may include the following: groundwater resources, aquifer sensitivity, parent material or regular soils maps, geotechnical properties, geochemical properties, aggregate resources, coal resources, oil and gas resources, or other resource maps. Contact the information office for availability of specific quadrangle map products.

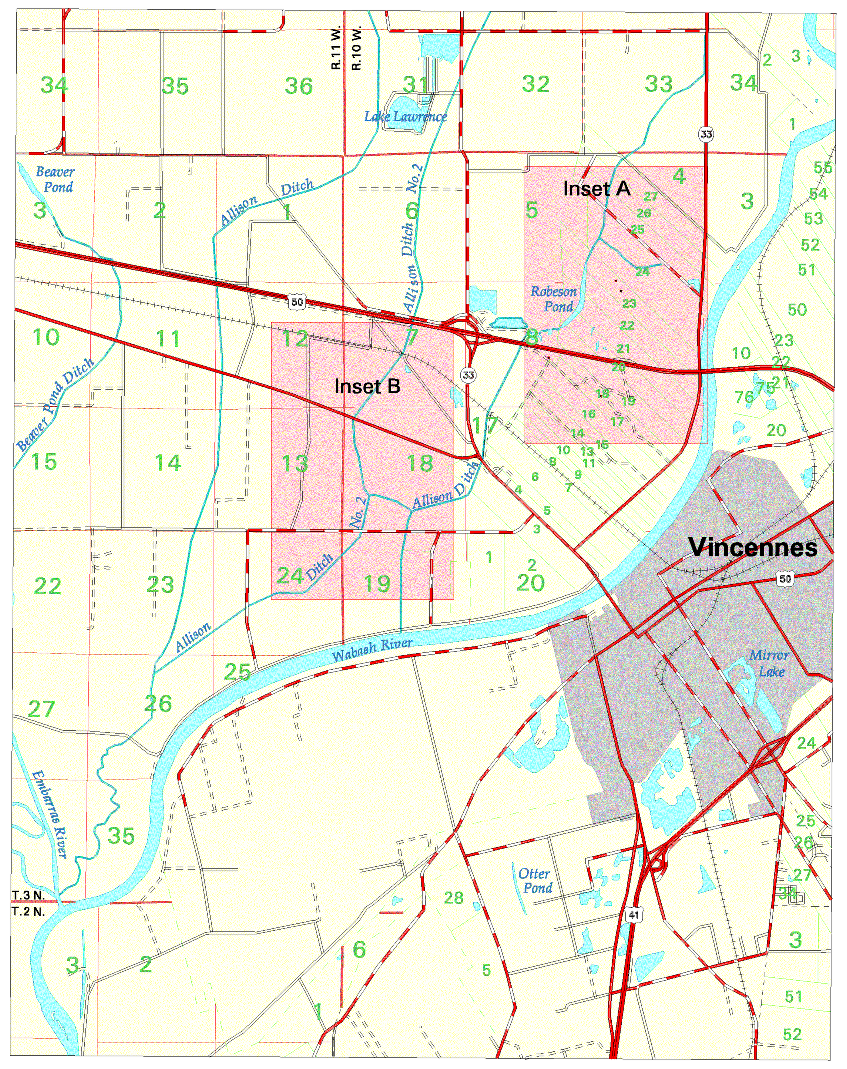


Figure 1. Location Map

township boundary
section line
French boundary
questionable French boundary
US highway
state highway
county road
unimproved road
railroad

Scale 1:62,500
0 — 1 mile

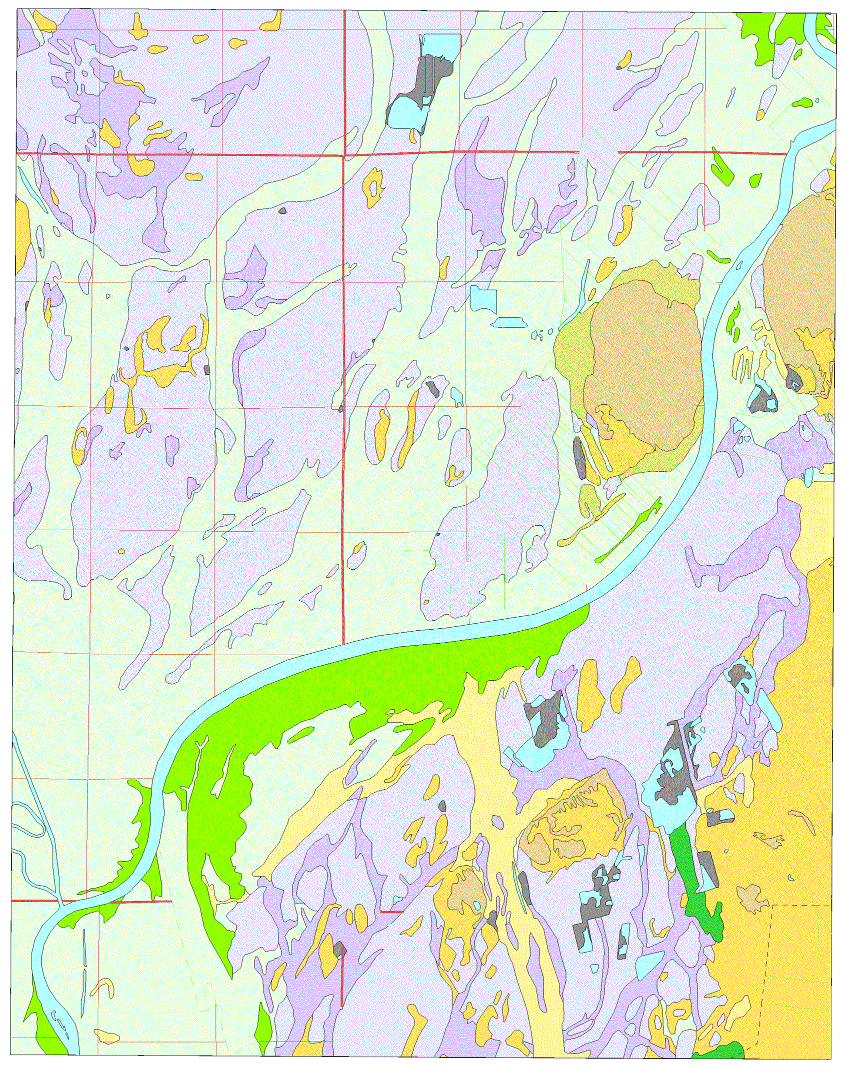


Figure 2. Soil Parent Materials Map

This map was developed by interpreting the soil parent materials and grouping them by geologic material. These materials occur from the land surface to a depth of five or more feet. The majority of the land is underlain by sand and gravel. (Modified from U.S. Department of Agriculture Soil Survey of Knox County, IN and the recompiled and recorrelated USDA Soil Survey for Lawrence County, IL, Vincennes Quadrangle.)

loess over till or bedrock
colluvium over medium textured outwash
eolian sand (intermixed with silt on Robeson Hills)
alluvium (sandy)
alluvium (fine and medium textured)
outwash (sandy with silty cover)
outwash (gravelly with silt cover)
organic materials
lacustrine sediments
surface water
gravel/borrow pits

Scale 1:62,500
0 — 1 mile

Remote Sensing Inputs to Geologic Mapping

Accurate, detailed information on the characteristics of the land surface is an essential component of a geologic map. Geologists use a variety of map data, in addition to field data, to derive information on the landforms and surficial deposits of an area; for example, U.S. Geological Survey (USGS) topographic quadrangle maps, U.S. Department of Agriculture county soil survey maps, and U.S. Fish and Wildlife Service National Wetlands Inventory maps. Maps are important sources of information, nevertheless, they are abstractions and represent the physical landscape in a generalized manner.

Image-based data are a unique information source for portraying the physical and cultural landscapes; the usefulness of aerial image interpretation for mapping geologic features has long been recognized (USGS 1994). In Illinois, agricultural lands dominate three–fourths of the surface area of the state (Illinois Department of Natural Resources 1996) and cultivation practices frequently obscure many surficial geologic features. However, remote sensing imagery acquired during the late winter and early spring seasons with optimum surface conditions can detect subtle differences in the uppermost few feet of geologic materials–differences that are directly related to surficial processes.

What is Digital Orthophotography?

Orthophotography combines the image characteristics of an aerial photograph with the geometric qualities of a map. Unlike a typical aerial photograph, distortions due to relief displacement (hills, stream valleys, buildings, etc.), camera lens, and aircraft attitude have been removed so that all ground features are shown in their correct ground positions. This makes possible a true image map and permits direct measurement of distances, areas, angles, and detailed positions of ground features, many of which may be omitted or generalized on traditional maps. In a digital format, orthophotography fulfills a fundamental role as a geometrically accurate base map onto which additional spatial information can be readily incorporated, using a geographic information system (GIS).

This image map has been derived from the interpretation of digital orthophotography produced through the USGS Digital Orthophoto Quadrangle program (DOQ). DOQs are coincident with the USGS 1:24,000–scale quadrangle coverage, have been geometrically corrected to a standard cartographic map projection, and possess a 1x1 meter ground spatial resolution (USGS 1991). The National Aerial Photography Program (NAPP) and NAPP–like aerial photography are the primary imagery sources used in the production of DOQs. NAPP photography may be either black/white or color infrared, and it is acquired at a nominal scale of 1:40,000. The Vincennes Digital Orthophoto Image Map of Illinois–Indiana is based upon NAPP color infrared (CIR) photography acquired on April 19, 1988, and March 28, 1992.

Interpreting the Image Map

Color Infrared Photography

Although black/white aerial photography has long been used as the standard for geologic interpretation, most applications based on natural resources are improved by using color and especially CIR photography. This is because the human eye can discriminate many more shades of color than gray tints, and the interpretation of color on standard color aerial photography more closely mimics human experience in everyday interpretation of the environment. Standard color photography records the visible portion of electromagnetic energy on three separate layers or emulsions sensitized to blue, green, and red wavelengths (approximately 400 to 700 nanometers), which is the same reflected radiation perceived by the human eye. In CIR photography, however, the blue sensitized layer has been eliminated and the range of sensitivity has been extended to detect reflected near infrared light by the addition of an emulsion sensitive to 700 to 900 nanometers. What this means is that the discrimination of most landscape features is significantly enhanced using CIR photography, including the following phenomena:

- soil moisture gradients across parent material boundaries are better delineated because the near infrared emulsion is quite sensitive to changes in surface moisture conditions;
- changes in surface color, principally controlled by the green and red emulsions, are emphasized with the addition of the near infrared;
- surface water conditions, such as turbidity and the presence of chemical or vegetative matter, are easily distinguished;
- differences in vegetation types and relative vigor, in direct response to the soil surface type and condition, are detectable in the near infrared portion of the electromagnetic spectrum.

Because the emulsion response of CIR photography has been shifted into the longer wavelengths to include the near infrared, CIR photography does not record colors in the environment as they would be seen with normal color photography. For this reason, CIR photography is often referred to as "false color".

Examples of how ground objects on the Vincennes Orthophoto Image Map appear using CIR photography are as follows:

Surface Feature:	Color:
Winter wheat, oats, rye grass; urban lawns and open space; emerging tree canopies.	Light to dark red tones
Nonturbid surface water; exposed wet soils; asphalt rooftops and parking lots.	Dark gray to black
Dark, saturated soil surfaces; urban structures; deciduous wooded areas (little or no leaf canopy); turbid surface water.	Light to dark, blue gray
Exposed, better drained, and light colored soils; barren land; commercial buildings, concrete and gravel parking lots and roadways.	Light–colored to white

In Insets A and B, the areas tinted and labeled (1) denote wheat and rye grass that are maturing during the early spring. Their prominent spectral response effectively obscures the underlying soil surface and prohibits any interpretation of surficial geology. It is desirable to minimize this spectral response pattern by acquiring CIR photography in late winter within the Midwest. The dark red area at (2) is a mixture of woody material and the emerging leaf canopy associated with a dense, deciduous forested area on Robeson Hills (see Photo 1). This color will increase in brightness as the leaf canopy matures through the spring and summer. This dense forest and woodland vegetation is closely associated with steeply sloping terrain and deeply incised gullies in this area. The CIR photography for the southwest quarter of the Vincennes Orthophoto Image Map was acquired three weeks earlier than the CIR photography for the remainder of the image map. Note how forested and woodland areas in this portion of the image map exhibit a distinctive dark, bluish color indicative of little or no emergence of the leaf canopy.

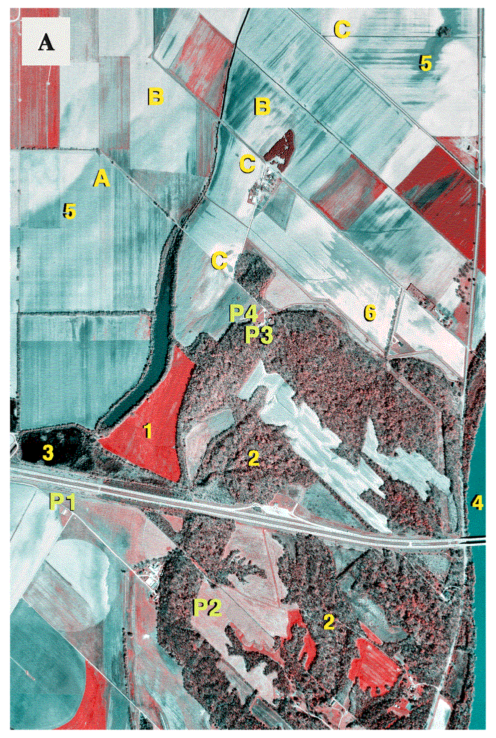
The areas labeled as (3) denote surface water associated with borrow pits, and the almost black color denotes that there is no turbidity or vegetative matter in the uppermost part of the water column. This contrasts with the surface of the Wabash River at (4), where the dark, bluish–gray color is diagnostic of a significant amount of suspended sediment at or very near the water surface. At (5), the dark bluish color delineates areas of exposed saturated soil surfaces closely associated with medium– and fine-textured sediments along drainageways. In contrast, the lighter areas at (6) denote better drained surfaces associated with sandy and silty sediments on terraces (Figure 2).

Using these examples as a guide, the reader can associate these interpretations with additional areas on the Vincennes Orthophoto Image Map. When used in conjunction with other information such as soil survey data in a geographic information system, CIR photography can assist in developing a better understanding of the surficial geology of an area.

Processing the Image Map

Because CIR aerial photography was used for the production of the digital orthophotography, a three–band DOQ resulted, with each band representing the spectral information for the green, red, and near infrared wavelength bands, respectively. Because of the size of the resulting digital file (approximately 500 megabytes), specialized image processing procedures were used to transform the original 1x1 meter, ground resolution cells (grc) to a 2x2 meter DOQ grc, thus reducing the image data to one-quarter of the original file size. The resampling was deemed appropriate because the spatial dimension of the ground features being interpreted exceeds 1x1 meter.

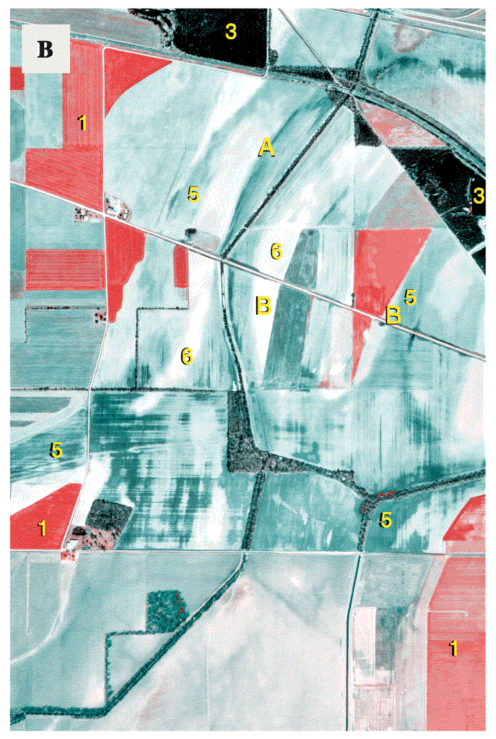
Subsequent to the resampling, reflectance (brightness) values contained within the three–band DOQ were transformed to a single thematic layer of information that can be used to directly interpret geologic conditions within the study area. Using the three spectral bands as input variables, multivariate clustering and image classification routines (Campbell, 1987) produced a map denoting 100 different "spectral" classes of information. Comparison of the resulting image map with the original, unprocessed DOQ image data revealed little or no difference in information content. In traditional applications of image classification, a large number of spectral classes are typically generalized to several known classes through field checks and/or direct inspection of large–scale aerial photography. In contrast, the generalization of spectral classes was minimized in the creation of the Vincennes Orthophoto Image Map to ensure that subtle geologic features were preserved.



Inset A. Geologic Interpretation

Robeson Hills (southeast quarter of inset) is a bedrock outlier covered primarily by a discontinuous, thin (less than 5 feet) clayey diamicton (till) and capped by 20 to 40 feet of windblown silt (loess) intermixed with sand in some places. Along the west side of Robeson Hills, sand and gravel (glacial outwash) is found instead of the till. These deposits form part of the highest outwash terrace on the quadrangle. The steep slopes of Robeson Hills are deeply incised by gullies, and the sediments eroded from the gullies are being redeposited along the footslopes. Farther from the footslopes, modern streams have deposited thin layers of fine–textured sediments (alluvium) in shallow channels carved into the underlying glacial outwash that constitutes most of the floodplain in this quadrangle. In places, the outwash exceeds 90 feet in thickness.

A subtle, subsurface drainage feature (A), clearly visible in the northwestern part of this view, illustrates how photo imagery supplements the information shown on geologic maps. Although this feature does not show up on the contour map, it is clearly visible on the soils map because soils are strongly influenced by drainage. The strong contrasts of light and dark colors in the north–central portions of this view (B) reflect changes in surface texture (sand to sand and gravel to silty clay and silty–clay loam). The light–colored elongate features (C) in the northeastern quarter of this view are sand deposited by water and wind. Photo locations are indicated as P1, P2, P3, and P4.



Inset B. Geologic Interpretation

Surface drainage features (streams, ditches, and channels) and subsurface drainageways with no surface expression (5) are well depicted in this view. The abrupt topographic contact between the terrace (6) and present floodplain (A) is visible in the upper center of the view, and it is easy to trace the silts and clays that are being thinly deposited across parts of the floodplain. Although partially obscured by crops, another terrace with elongate sand dunes draped along its edge is visible (B, right center). At most locations, these contacts are also well defined by soil patterns. Merging imagery with soil and topographic information provides an enhanced view of the landscape.

Photo 1 View of Robeson Hills looking southeast across the Wabash River flood–plain, which is composed primarily of glacial outwash with a thin covering of alluvium. At left center and right center, beyond the barn, is light–colored colluvium overlying shallow bedrock. The notch in the treeline at left center marks the location of a large, active gully that is encroaching upon the uplands to the left of the area illustrated in Photo 2. (See Inset A for photo locations.)

Photo 2 The higher surface in the center background is covered with about 10 feet of windblown sand overlying loess, whereas the surface in the foreground and center left is covered only with loess. The sand sheet that covers much of the southern part of Robeson Hills is being actively eroded in gullies and redeposited at the base of slopes in stream channels and alluvial fans.

Photo 3 Looking northwest from the northwest footslope of Robeson Hills, several landscape surfaces are visible. The drill rig is located on an alluvial fan overlying a terrace with a sand cover (glacial outwash). The barn is about 20 feet lower on colluvium overlying sandy outwash. The lowermost surface in the center left is composed of modern alluvium overlying glacial outwash.

Photo 4 View looking southeast at the landscape surfaces described in photo 3. The upper surface is part of an alluvial fan overlying an outwash terrace. The barn lower down the slope is located on thin colluvium overlying glacial outwash. Bedrock lies within 15 feet of the ground surface. Most of the bedrock core of Robeson Hills is overlain by a discontinuous, thin diamicton (Illinois Episode till) and about 30 feet of silt (primarily Wisconsin Episode loess).

References

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