

# Water Resources and Use in Fulton County

Data Sources: U.S. Geological Survey and Indiana Department of Natural Resources

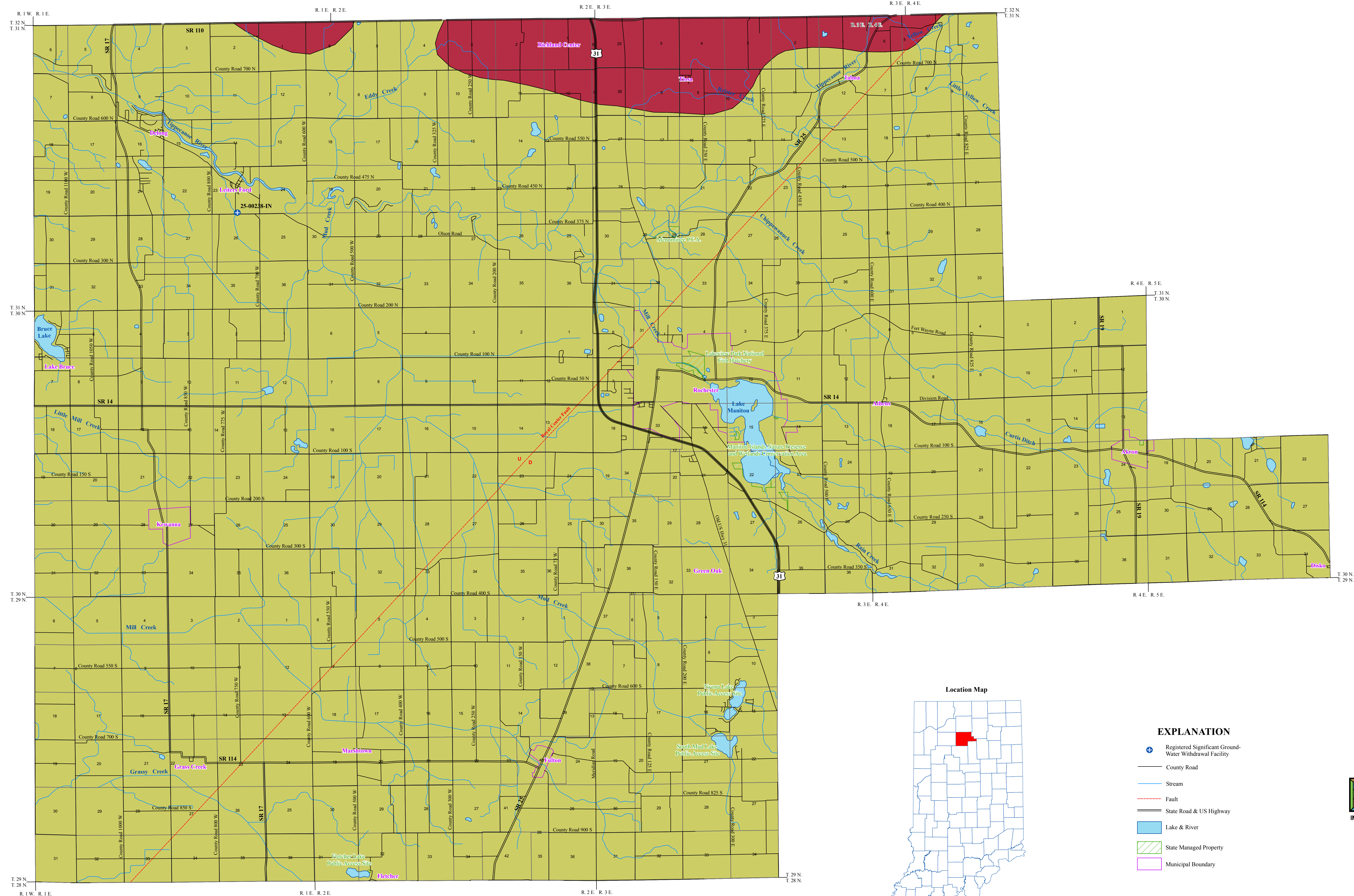
<b>Withdrawal Location</b>		<b>River</b>	<b>Major Lakes</b>
WELL	INTAKE	<b>7Q2 Flow (MGD)</b>	Interstate
●	▼	< 10 MGD	County
●	▼	10 - 50 MGD	City
●	▼	50 - 100 MGD	
●	▼	100 - 500 MGD	
●	▼	> 500 MGD	
●	▼		
●	▼		
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# BEDROCK AQUIFER SYSTEMS OF FULTON COUNTY, INDIANA



The occurrence of bedrock aquifers depends on the original composition of the rocks and subsequent changes which influence the hydraulic properties. Post-depositional processes, which promote jointing, fracturing, and solution activity of exposed bedrock, generally increase the hydraulic conductivity (permeability) of the upper portion of bedrock aquifer systems. Because permeability in many places is greater near the bedrock surface, bedrock units within the upper 100 feet are commonly the most productive aquifers.

Unconsolidated deposits of varying thickness overlie bedrock aquifer systems in Fulton County. Thickness of unconsolidated deposits in Fulton County ranges from 200 to 350 feet. Most of the bedrock aquifers, therefore, are under confined conditions. In other words, the potentiometric surface (water level) in most wells completed in bedrock rises above the top of the water-bearing formation.

The yield of a bedrock aquifer depends on its hydraulic characteristics and the nature of the overlying deposits. Shale and glacial till act as aquicludes, restricting recharge to underlying bedrock aquifers. However, fracturing and/or jointing may occur in aquicludes, which can increase recharge to the underlying aquifers. Hydraulic properties of the bedrock aquifers are highly variable.

The susceptibility of bedrock aquifer systems to surface contamination is largely dependent on the type and thickness of the overlying sediments. Because the bedrock aquifer systems have complex fracturing systems, once a contaminant has been introduced into a bedrock aquifer system, it will be difficult to track and remediate.

Two bedrock aquifer systems are identified for Fulton County. They are the Devonian and Mississippian Coldwater, Ellsworth and Antrim Shales; and the Silurian and Devonian Carbonates.

### Devonian and Mississippian - Coldwater, Ellsworth and Antrim Shales Aquifer System

In Fulton County only the Antrim Shale subcrop in the Coldwater, Ellsworth and Antrim Shales Aquifer System. The Antrim Shale in Indiana is typically described as brownish-black shale and is commonly considered an aquiclude; therefore, the system is an extremely limited ground-water resource. However, in some places the lower portion of the aquifer unit may contain some limestone.

The subcrop area for the Antrim Shale is present along the northern part of the Fulton County line and is generally less than 50 feet thick. Depth to bedrock ranges from 160 to 295 feet.

Due to the availability of the overlying unconsolidated resources very few wells have been completed in the Coldwater, Ellsworth and Antrim Shales Aquifer System in Fulton County. However, a few domestic wells have been reported. Total depths range from 200 to 220 feet with penetration into bedrock less than 25 feet. Reported yields are 10 and 20 gallons per minute (gpm).

Because the permeability of shale materials is considered low and the overlying unconsolidated deposits are thick, susceptibility to contamination introduced at or near the surface is low.

### Silurian and Devonian Carbonates Aquifer System

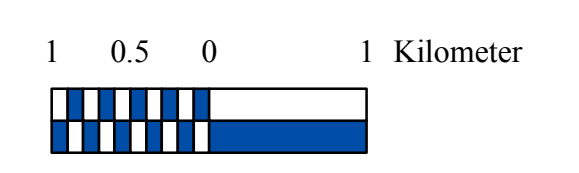
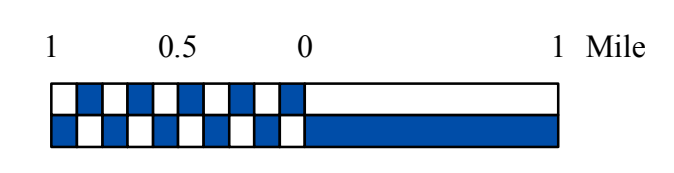
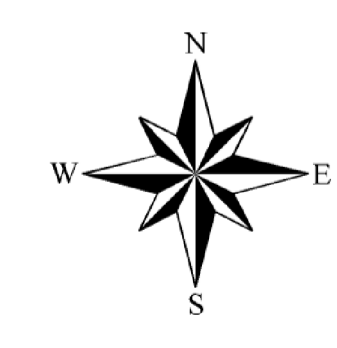
The Silurian and Devonian Carbonates Aquifer System is extensive throughout nearly all of Fulton County. The system includes Silurian age carbonate rock units of the Wabash Formation and Devonian age carbonate rock units of the Muscatatuck Group. Total thickness of the Silurian bedrock is up to 500 feet. Total thickness of Devonian bedrock is up to 100 feet. Depth to the bedrock surface ranges from about 110 to 350 feet. Total well depths range from 125 to 325 feet with penetration into bedrock commonly less than 10 feet.

Few wells utilize the Silurian and Devonian Carbonates Aquifer System due to prolific sand and/or gravel aquifer units that overlie the bedrock system. However, this system is capable of meeting the needs of domestic and some high-capacity users. Domestic yields range from 10 to 60 gpm with static water levels generally from 3 to 38 feet. There is one registered significant ground-water withdrawal facility (1 well) with a reported yield of 72 gpm. However, one industry test well record reports a yield of 400 gpm.

Most of the Silurian and Devonian Carbonates Aquifer System in Fulton County is overlain by thick clay deposits. This aquifer system is generally considered at low risk to contamination. However, there are areas where bedrock is overlain by thick alluvial and outwash deposits and thin intermittent clays. These areas, therefore, are at moderate to high risk to contamination.

### EXPLANATION

- Registered Significant Ground-Water Withdrawal Facility
- County Road
- Stream
- Fault
- State Road & US Highway
- Lake & River
- State Managed Property
- Municipal Boundary



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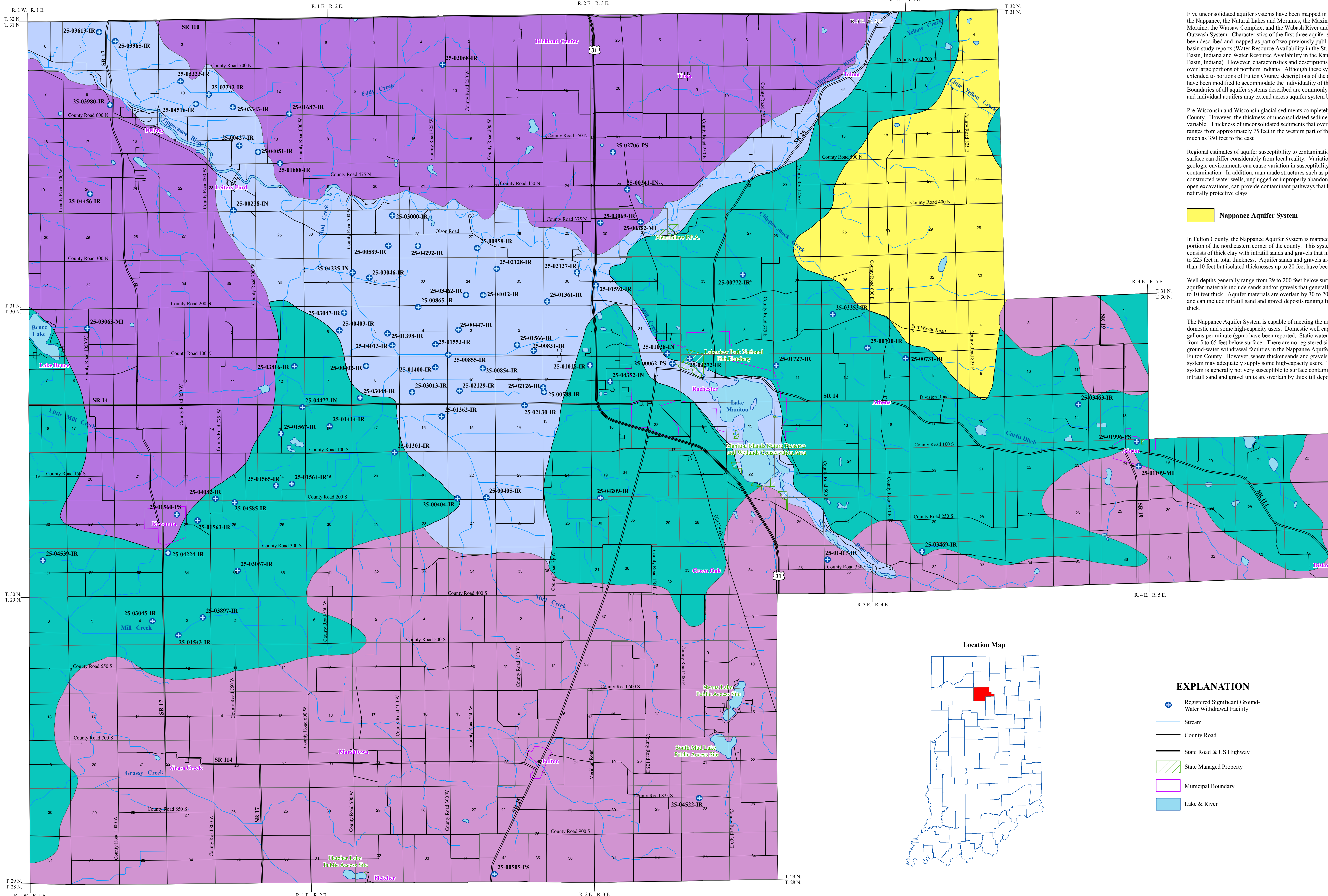
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### Bedrock Aquifer Systems of Fulton County, Indiana

by  
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January 2008

Map generated by Shirley Fitzwater and Randal D. Maier,  
IDNR, Division of Water, Resource Assessment Section

# UNCONSOLIDATED AQUIFER SYSTEMS OF FULTON COUNTY, INDIANA



Five unconsolidated aquifer systems have been mapped in Fulton County: the Nappanee, the Natural Lakes and Moraines, the Maxinkuckee Moraine, the Warsaw Complex, and the Wabash River and Tributaries Outwash System. Characteristics of the first three aquifer systems have been described and mapped as part of two previously published regional basin study reports (Water Resource Availability in the St. Joseph River Basin, Indiana and Water Resource Availability in the Kankakee River Basin, Indiana). However, characteristics and descriptions are generalized over large portions of northern Indiana. Although these systems are extended to portions of Fulton County, descriptions of the aquifer systems have been modified to accommodate the individuality of the county. Boundaries of all aquifer systems described are commonly gradational, and individual aquifers may extend across aquifer system boundaries.

Pre-Wisconsin and Wisconsin glacial sediments completely cover Fulton County. However, the thickness of unconsolidated sediments is quite variable. Thickness of unconsolidated sediments that overlie bedrock ranges from approximately 75 feet in the western part of the county to as much as 350 feet to the east.

Regional estimates of aquifer susceptibility to contamination from the surface can differ considerably from local reality. Variations within geologic environments can cause variation in susceptibility to surface contamination. In addition, man-made structures such as poorly constructed water wells, unplugged or improperly abandoned wells, and open excavations, can provide contaminant pathways that bypass the naturally protective clays.

### Nappanee Aquifer System

In Fulton County, the Nappanee Aquifer System is mapped along a portion of the northeastern corner of the county. This system typically consists of thick clay with intratill sands and gravels that in places are up to 225 feet in total thickness. Aquifer sands and gravels are generally less than 10 feet but isolated thicknesses up to 20 feet have been reported.

Well depths generally range from 29 to 200 feet below surface. Potential aquifer materials include sands and gravels that generally range from 2 to 10 feet thick. Aquifer materials are overlain by 30 to 200 feet of clay and can include intratill sand and gravel deposits ranging from 3 to 9 feet thick.

The Nappanee Aquifer System is capable of meeting the needs of domestic and some high-capacity users. Domestic well capacities up to 60 gallons per minute (gpm) have been reported. Static water levels range from 5 to 65 feet below surface. There are no registered significant ground-water withdrawal facilities in the Nappanee Aquifer System in Fulton County. However, where thicker sands and gravels are present, the system may adequately supply some high-capacity users. This aquifer system is generally not very susceptible to surface contamination because intratill sand and gravel units are overlain by thick till deposits.

### Natural Lakes and Moraines Aquifer System

The Natural Lakes and Moraines Aquifer System in Fulton County is an extension of a broad regional aquifer system initially described in the published report, Water Resource Availability in the St. Joseph River Basin, Indiana. The system in Fulton County is mapped as an apparent transition from the Bluffton Till Aquifer System, mapped further south in Miami and Wabash counties, to the Warsaw Complex Aquifer System in Fulton County.

Unconsolidated deposits overlying bedrock in Fulton County range from 75 to 300 feet thick. Characteristics of this system typically involve thick clay with intratill sands and gravel that overlie the primary aquifer resource. Clay thickness is commonly 50 to 100 feet with the intratill sand and gravels generally less than 15 feet thick.

This system is capable of meeting the needs of domestic and some high-capacity users. Wells completed in the Natural Lakes and Moraines Aquifer System are typically 60 to 120 feet. Aquifer thickness is typically 5 to 15 feet. Domestic well capacities are commonly 10 to 45 gpm. Static water levels are typically 10 to 35 feet below surface with some flowing wells reported. There are 5 registered significant ground-water withdrawal systems (11 wells) utilizing this system with yields ranging from 250 to 1000 gpm.

This aquifer system is generally not very susceptible to surface contamination because intratill sand and gravel units are overlain by thick till deposits.

### Maxinkuckee Moraine Aquifer System

The Maxinkuckee Moraine Aquifer System is mapped mostly north of the Tippecanoe River and along the west-central portion of Fulton County. The system is an extension of a regional aquifer system mapped to the north in Marshall County initially described as part of the Kankakee River Basin Study. Unconsolidated deposits are associated with a large moraine complex with varying characteristics that involve discontinuous and isolated surficial sands and gravels, thick till sequences with discontinuous intratill sands and gravels, and deeper aquifer sands and gravels of varying thickness.

Most wells completed in the Maxinkuckee Moraine Aquifer System utilize the deeper sand and gravel deposits. However, a few wells utilize the shallow sand and gravels. Well depths range from 27 to 245 feet but are commonly 60 to 120 feet. Typical aquifer thickness is from 7 to 30 feet; however, in places aquifer deposits may be thicker.

The Maxinkuckee Moraine Aquifer System is capable of meeting the needs of domestic and high-capacity users. Typical domestic yields range from 10 to 50 gpm with static water levels commonly 15 to 50 feet below surface. There are 12 registered significant ground-water withdrawal facilities (16 wells) with reported yields that range from 120 to 1250 gpm.

This aquifer system is generally not very susceptible to surface contamination because intratill sand and gravel units are overlain by thick till deposits. However, wells that utilize the shallow sands and gravels are at moderate risk to surface contamination.

### Warsaw Complex Aquifer System

The Warsaw Complex Aquifer System is mapped in large portions of central Fulton County. Several glacial advances resulted in a complex sequence of multiple, stacked, till and outwash units that are quite variable in position and thickness. Unconsolidated materials are up to 350 feet thick. Characteristics of this system include either surface sands and gravels (commonly not used as an aquifer resource) that overlie a thick till with intratill sands and gravels above a primary aquifer unit, or a thick clay cap with intratill sands and gravels that is underlain by an aquifer unit.

Well depths range from 25 to 235 feet but are commonly 60 to 100 feet. In places the system exhibits multiple sand and gravel deposits above the primary aquifer resource that are also a potential source of ground-water. These discontinuous sand and gravel deposits vary from thin to massive and are typically overlain by a thick till. Total accumulative sand and gravel thickness ranges from 3 to 165 feet but are typically 20 to 55 feet. Individually, the intratill sand and gravels are typically 10 to 30 feet thick and the deeper, more productive aquifer deposits 8 to 40 feet thick.

The Warsaw Complex Aquifer System is capable of meeting the needs of domestic and high-capacity users. Typical domestic yields range from 15 to 55 gpm. Static water levels commonly range from 10 to 30 feet below surface with some flowing wells reported. There are 33 registered significant ground-water withdrawal facilities (42 wells) with reported yields that range from 80 to 2000 gpm.

This aquifer system is not very susceptible to contamination where thick clay deposits overlie aquifer materials. However, in places clay thickness is thin or not present. These areas are at moderate to high risk to surface contamination.

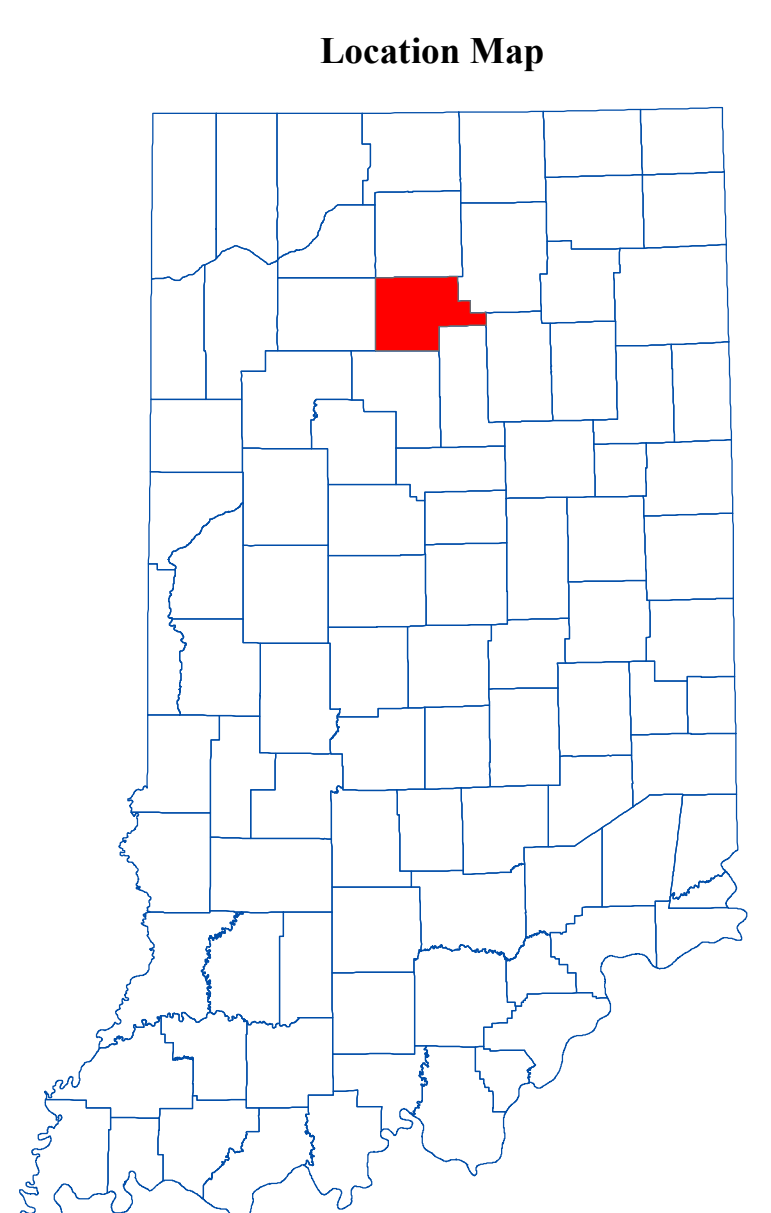
### Wabash River and Tributaries Outwash Aquifer System

The Wabash River and Tributaries Outwash Aquifer System is the most prolific aquifer system mapped in Fulton County. The system is made up of thick, glacially-derived outwash deposits along a broad outwash plain in the central part of the county. The system also includes valley train and recent alluvial deposits along Rain Creek to the south, Lake Manitou southeast of Rochester and the Tippecanoe River floodplain to the north.

Well depths range from 25 to 156 feet below surface with up to 110 feet of continuous sand and gravel. However, typical well depths are 50 to 85 feet. In places, aquifer materials are capped by silt or sandy clay ranging from 10 to 30 feet thick. In addition, aquifer sand and gravel deposits may include discontinuous clay, sandy clay or gravelly clay deposits 5 to 25 feet thick.

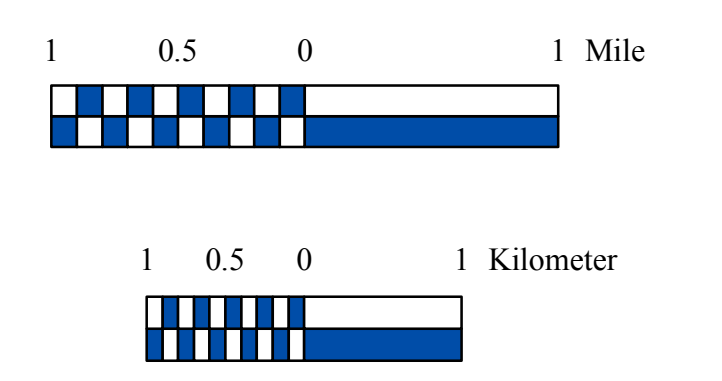
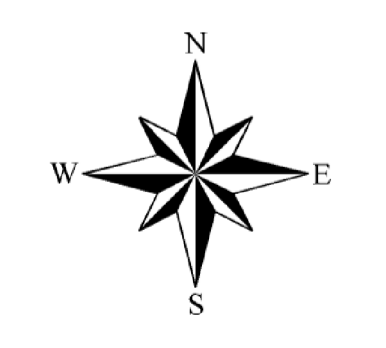
The Wabash River and Tributaries Outwash Aquifer System is capable of meeting the needs of domestic and high-capacity users. Domestic wells are commonly 10 to 60 gpm with static water levels commonly 4 to 20 feet below surface. Some flowing wells are reported. There are 44 registered significant ground-water withdrawal facilities (53 wells) in the outwash system in Fulton County. Well yields range from 80 to 2000 gpm.

Areas that lack overlying clay or silt deposits are highly susceptible to contamination. However, where overlying clay or silt deposits are present the system is moderately susceptible to surface contamination.



### EXPLANATION

- Registered Significant Ground-Water Withdrawal Facility
- Stream
- County Road
- State Road & US Highway
- State Managed Property
- Municipal Boundary
- Lake & River



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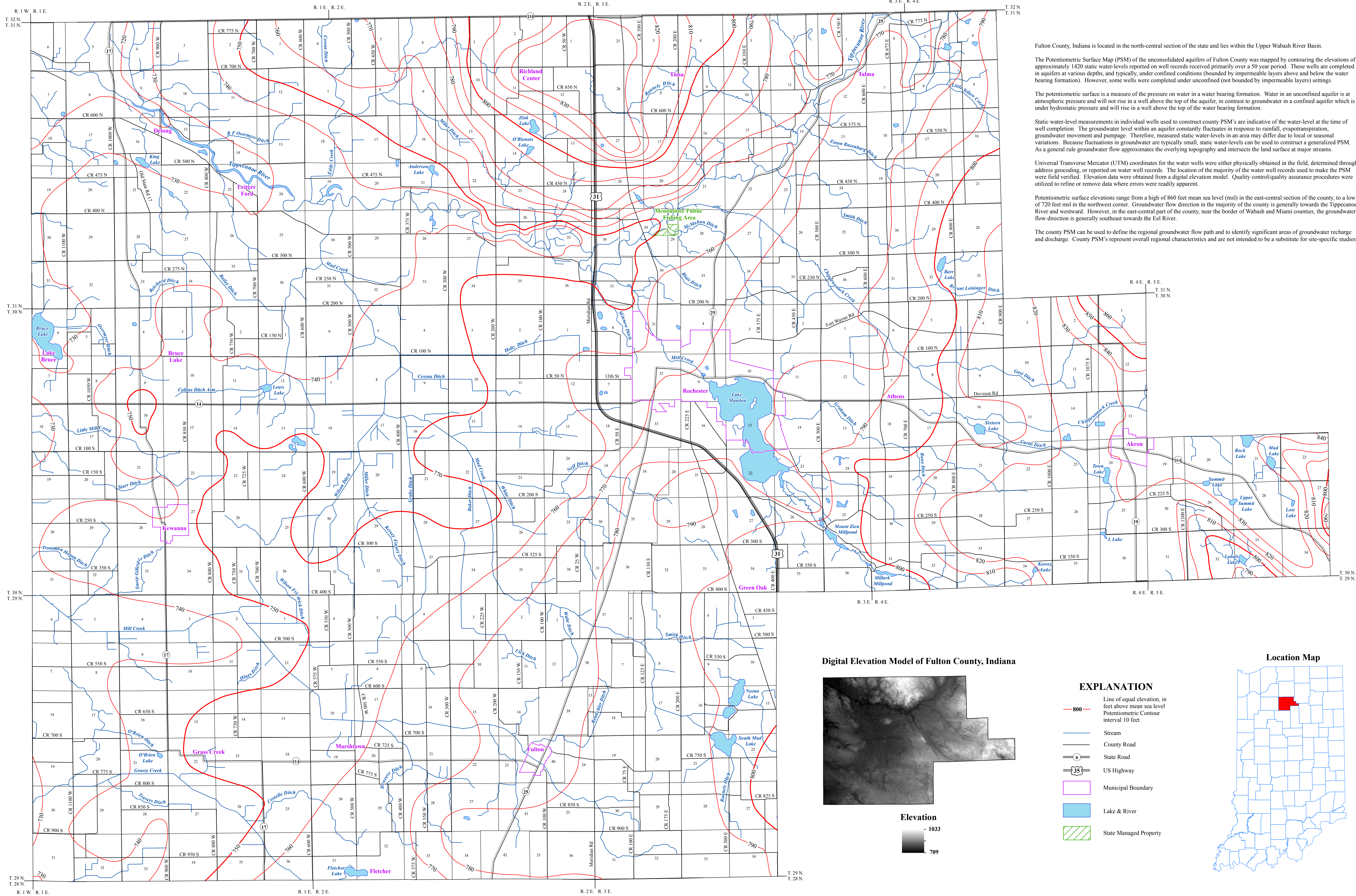
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### Unconsolidated Aquifer Systems of Fulton County, Indiana

by  
Randall D. Maier  
Division of Water, Resource Assessment Section  
February 2008

# POTENTIOMETRIC SURFACE MAP OF THE UNCONSOLIDATED AQUIFERS OF FULTON COUNTY, INDIANA



Fulton County, Indiana is located in the north-central section of the state and lies within the Upper Wabash River Basin.

The Potentiometric Surface Map (PSM) of the unconsolidated aquifers of Fulton County was mapped by contouring the elevations of approximately 1420 static water-levels reported on well records received primarily over a 50 year period. These wells are completed in aquifers at various depths, and typically, under confined conditions (bounded by impermeable layers above and below the water bearing formation). However, some wells were completed under unconfined (not bounded by impermeable layers) settings.

The potentiometric surface is a measure of the pressure on water in a water bearing formation. Water in an unconfined aquifer is at atmospheric pressure and will not rise in a well above the top of the aquifer, in contrast to groundwater in a confined aquifer which is under hydrostatic pressure and will rise in a well above the top of the water bearing formation.

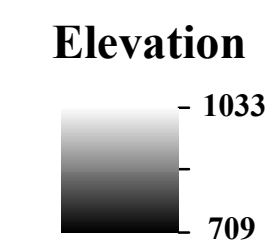
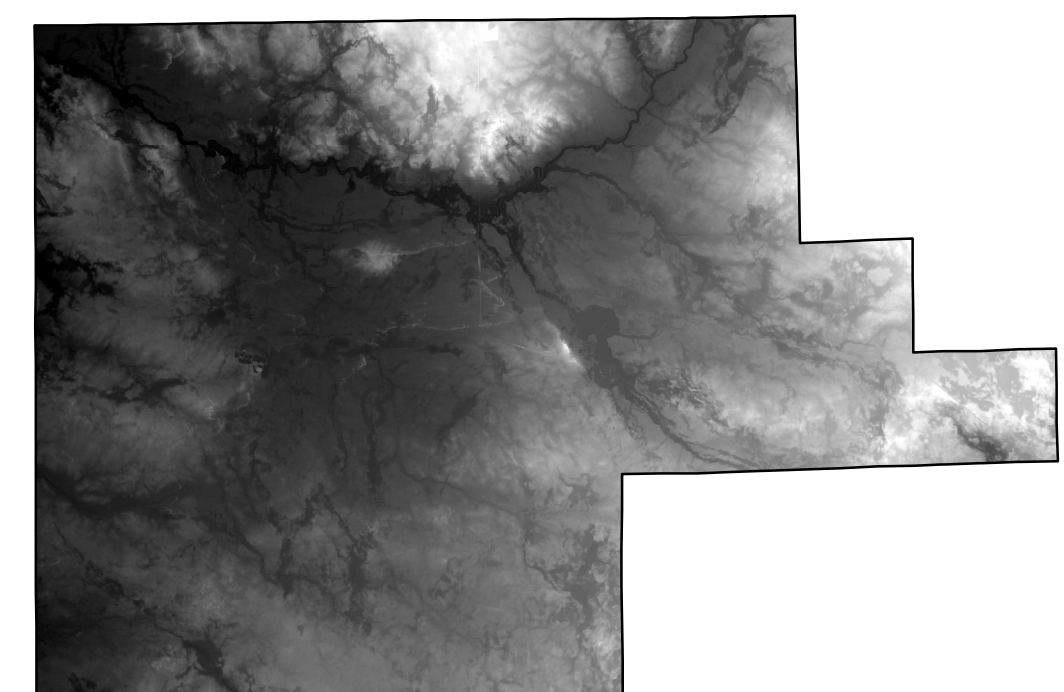
Static water-level measurements in individual wells used to construct county PSM's are indicative of the water-level at the time of well completion. The groundwater level within an aquifer constantly fluctuates in response to rainfall, evapotranspiration, groundwater movement and pumping. Therefore, measured static water-levels in an area may differ due to local or seasonal variations. Because fluctuations in groundwater are typically small, static water-levels can be used to construct a generalized PSM. As a general rule groundwater flow approximates the overlying topography and intersects the land surface at major streams.

Universal Transverse Mercator (UTM) coordinates for the water wells were either physically obtained in the field, determined through address geocoding, or reported on water well records. The location of the majority of the water well records used to make the PSM were field verified. Elevation data were obtained from a digital elevation model. Quality control/quality assurance procedures were utilized to refine or remove data where errors were readily apparent.

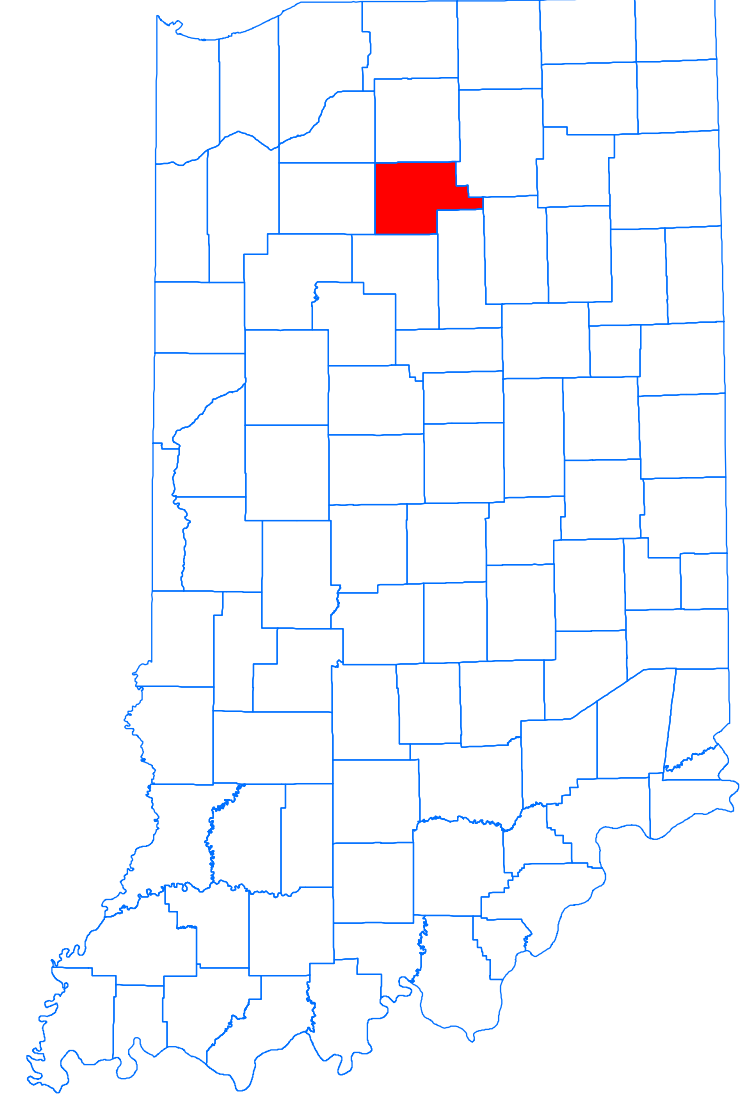
Potentiometric surface elevations range from a high of 860 feet mean sea level (msl) in the east-central section of the county, to a low of 720 feet msl in the northwest corner. Groundwater flow direction in the majority of the county is generally towards the Tippecanoe River and westward. However, in the east-central part of the county, near the border of Wabash and Miami counties, the groundwater flow direction is generally southeast towards the Eel River.

The county PSM can be used to define the regional groundwater flow path and to identify significant areas of groundwater recharge and discharge. County PSM's represent overall regional characteristics and are not intended to be a substitute for site-specific studies.

Digital Elevation Model of Fulton County, Indiana

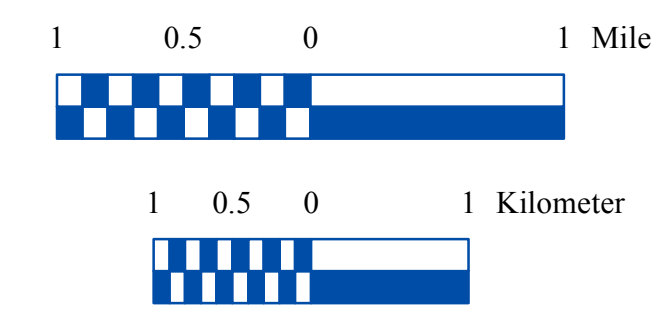
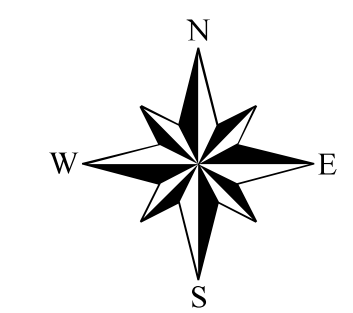


Location Map



### EXPLANATION

- Line of equal elevation, in feet above mean sea level
- Potentiometric Contour interval 10 feet
- Stream
- County Road
- State Road
- US Highway
- Municipal Boundary
- Lake & River
- State Managed Property



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### Potentiometric Surface Map of the Unconsolidated Aquifers of Fulton County, Indiana

by  
Robert K. Schmidt  
Division of Water, Resource Assessment Section

August 2013

Map generated by Joel D. Sanderson  
Indiana Department of Natural Resources  
Division of Water, Resource Assessment Section

# Fulton County

