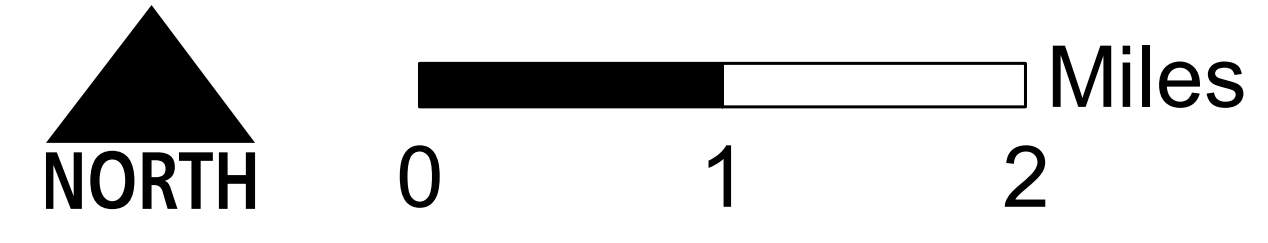


Water Resources and Use in Blackford County

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

Withdrawal Location		River	Major Lakes
WELL INTAKE	INTAKE	7Q2 Flow (MGD)	Interstate
● Energy/Mining	▼ Energy/Mining	<10 MGD	— Interstate
● Industry	▼ Industry	10 - 50 MGD	□ County
● Irrigation	▼ Irrigation	50 - 100 MGD	⊗ City
● Misc.	▼ Misc.	100 - 500 MGD	
● Public Supply	▼ Public Supply	> 500 MGD	
● Rural Use	▼ Rural Use		



BEDROCK AQUIFER SYSTEMS OF BLACKFORD 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 greatest near the bedrock surface, bedrock units within the upper 100 feet are commonly the most productive aquifers.

Bedrock aquifer systems in the county are overlain by unconsolidated deposits of varying thickness. In places, along the Salamonie River near Montpelier, bedrock lies within 10 feet of the surface. However, the bedrock surface is buried beneath more than 400 feet of unconsolidated materials in the deepest parts of the bedrock valley which cuts across northern Blackford County. Most of the bedrock aquifers in the county 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 zone.

The yield of a bedrock aquifer depends on its hydraulic characteristics and the nature of the overlying deposits. Shale and glacial till act as aquitards, restricting recharge to underlying bedrock aquifers. However, fracturing and/or jointing may occur in aquitards, 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 Blackford County. They are, from younger to older: the Silurian and Devonian Carbonates and the Maquoketa Group of Ordovician age.

Silurian and Devonian Carbonates Aquifer System

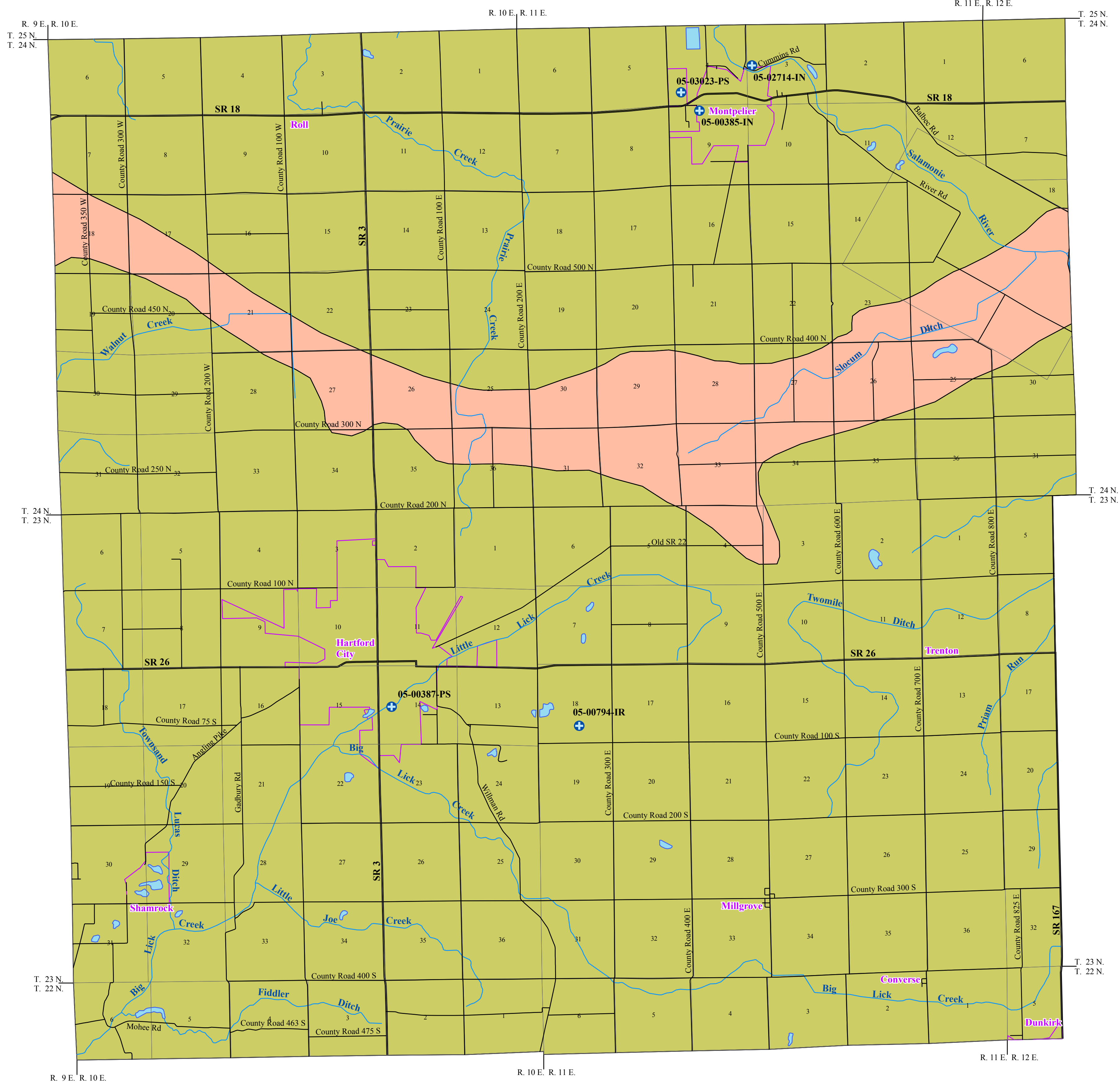
The Silurian and Devonian Carbonates Aquifer System outcrops/subcrops throughout much of Blackford County. This aquifer system consists exclusively of Silurian age carbonates in Blackford County because Devonian age rocks are not present. Total thickness of this aquifer system ranges from 0 to about 250 feet.

Wells completed in the Silurian and Devonian Carbonates Aquifer System are generally capable of meeting the needs of domestic users and some high-capacity users in this county. Domestic wells utilizing this system in Blackford County have reported depths ranging from 30 to 397 feet, but are typically 105 to 200 feet deep. The amount of rock penetrated in this system commonly ranges from 35 to 90 feet. Typical yields for domestic wells range from 10 to 25 gallons per minute (gpm) and static water levels are generally 25 to 55 feet below land surface. There are 5 registered significant ground-water withdrawal facilities (8 wells) with reported yields from 30 to 645 gpm.

In most of Blackford County the Silurian and Devonian Carbonates Aquifer System has a low susceptibility to surface contamination because it is overlain by thick clay deposits. However, solution features (caves) are described on a few well records suggesting minor karst development. Therefore, areas where overlying clays are thin or absent are at moderate to high risk to contamination.

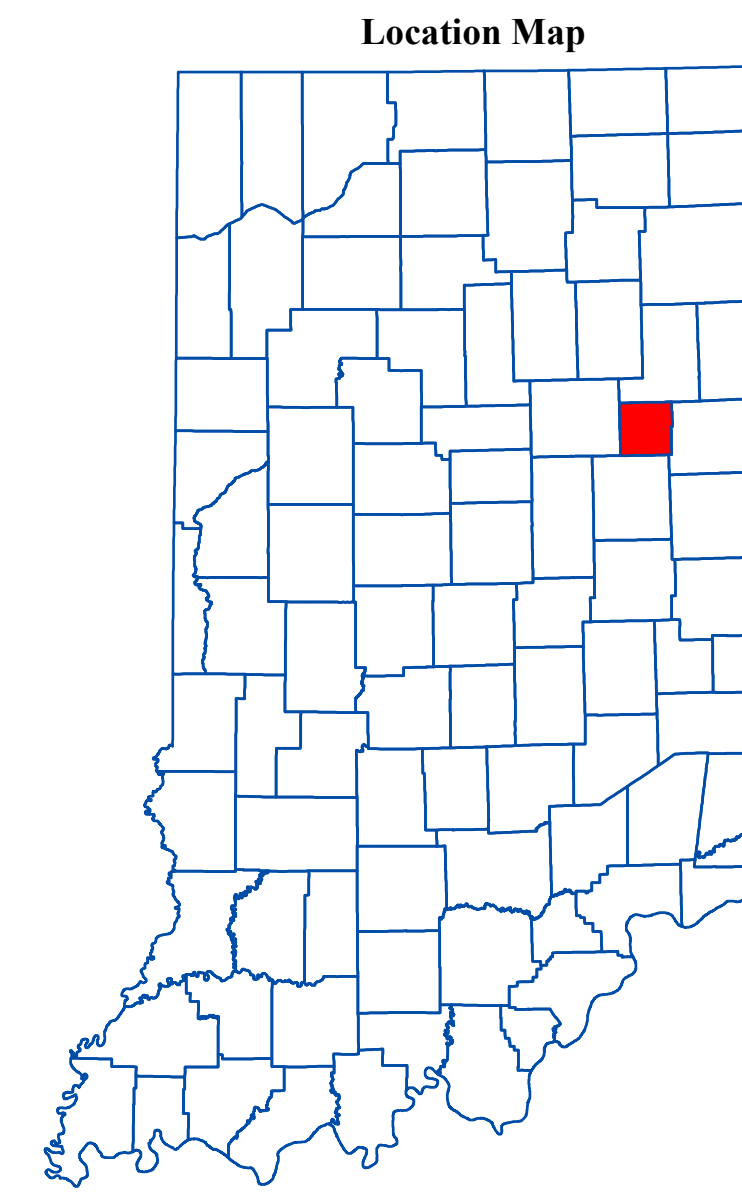
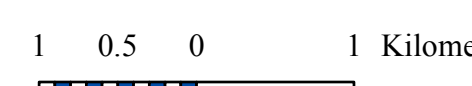
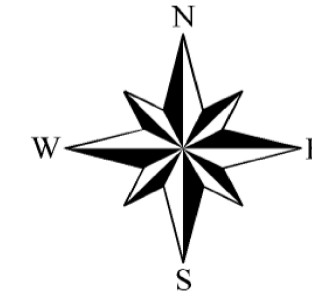
Ordovician - Maquoketa Group Aquifer System

In Blackford County, the Maquoketa Group subcrops in the buried pre-glacial valleys where the overlying Silurian and Devonian bedrock has been removed by erosion. The Maquoketa Group consists mostly of shales with interbedded limestone units. This system is approximately 650 to 750 feet thick in the county. However, no known wells utilize this aquifer system in Blackford County because the Maquoketa Group lies about 200 to 450 feet below the ground surface and adequate water supplies are typically found in the overlying unconsolidated deposits or in the Silurian and Devonian Carbonates, where present. This aquifer system has a low susceptibility to surface contamination because thick clay deposits cover the subcrop area.



EXPLANATION

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



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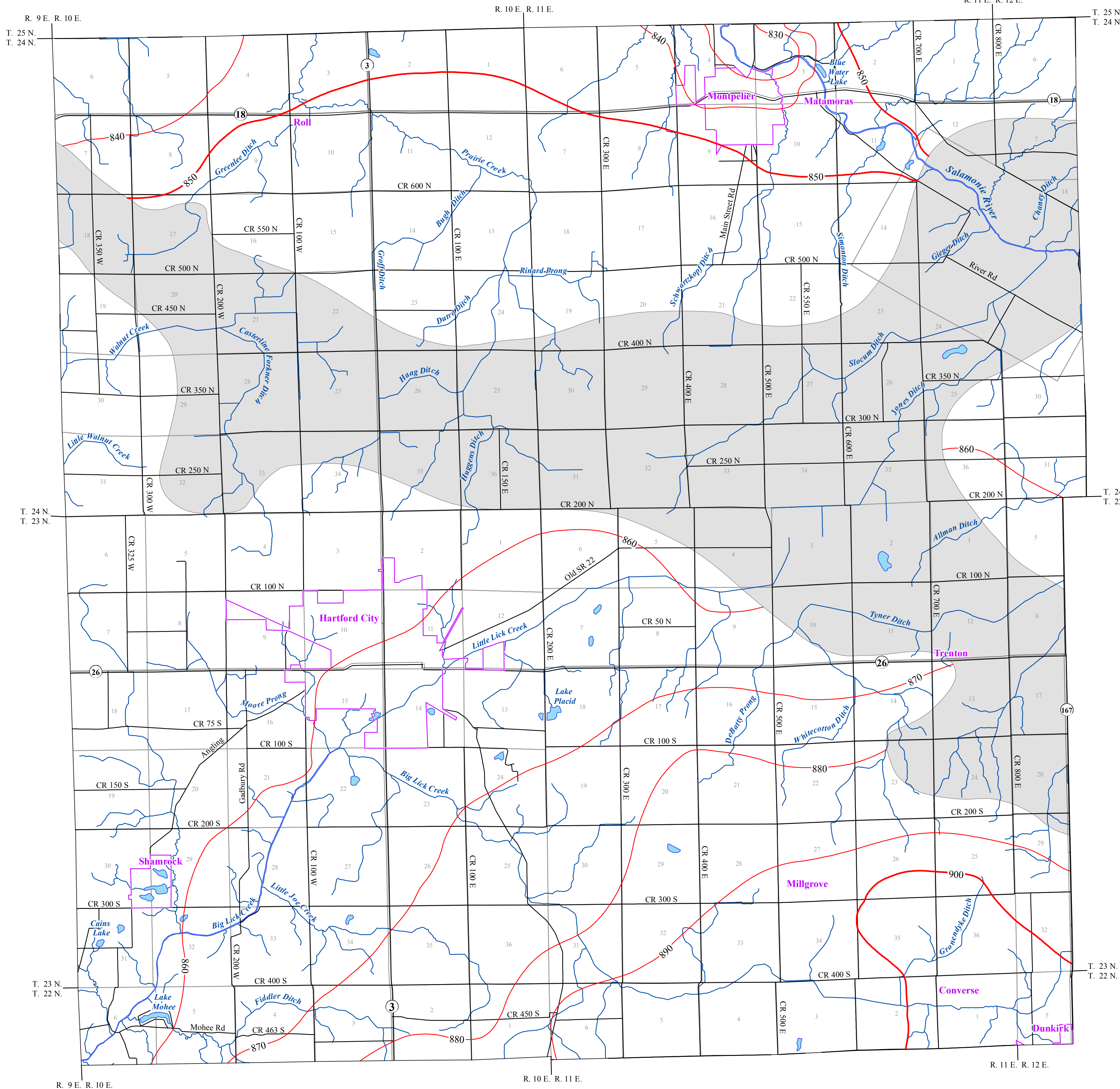
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Bedrock Aquifer Systems of Blackford County, Indiana

by
 Gregory P. Schrader
 Division of Water, Resource Assessment Section

April 2007

POTENTIOMETRIC SURFACE MAP OF THE BEDROCK AQUIFERS OF BLACKFORD COUNTY, INDIANA



Blackford County, Indiana is located in the eastern portion of the state bounded by Grant, Wells, Jay, and Delaware counties in the west, north, east, and south, respectively. Blackford County is within the Upper Wabash River Basin.

The Bedrock Potentiometric Surface Map (PSM) of Blackford County is mapped by contouring the elevations of 303 static water levels reported on well records received primarily over a 50-year period. These wells are completed in bedrock aquifers at various depths and typically under confined conditions (bounded by impermeable layers above and below the water bearing formation). However, some wells are completed in unconfined settings with water bearing formations not bounded by impermeable layers. The potentiometric surface is a measure of the pressure on water in a water bearing formation, or aquifer. The groundwater level in an unconfined aquifer system is at atmospheric pressure and will not rise in a well above the top of the aquifer formation. The potentiometric surface in most wells completed in bedrock within Blackford County rises above the top of the bedrock aquifer due to the confining nature of the system.

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, current site-specific conditions may differ due to local or seasonal variations in measured static water levels. Because fluctuations in groundwater are typically small, static water levels can be used to construct a generalized PSM. Groundwater flow is naturally from areas of recharge toward areas of discharge. The contours were determined based on the amount of data and the degree of change in water levels between wells in each mapped area.

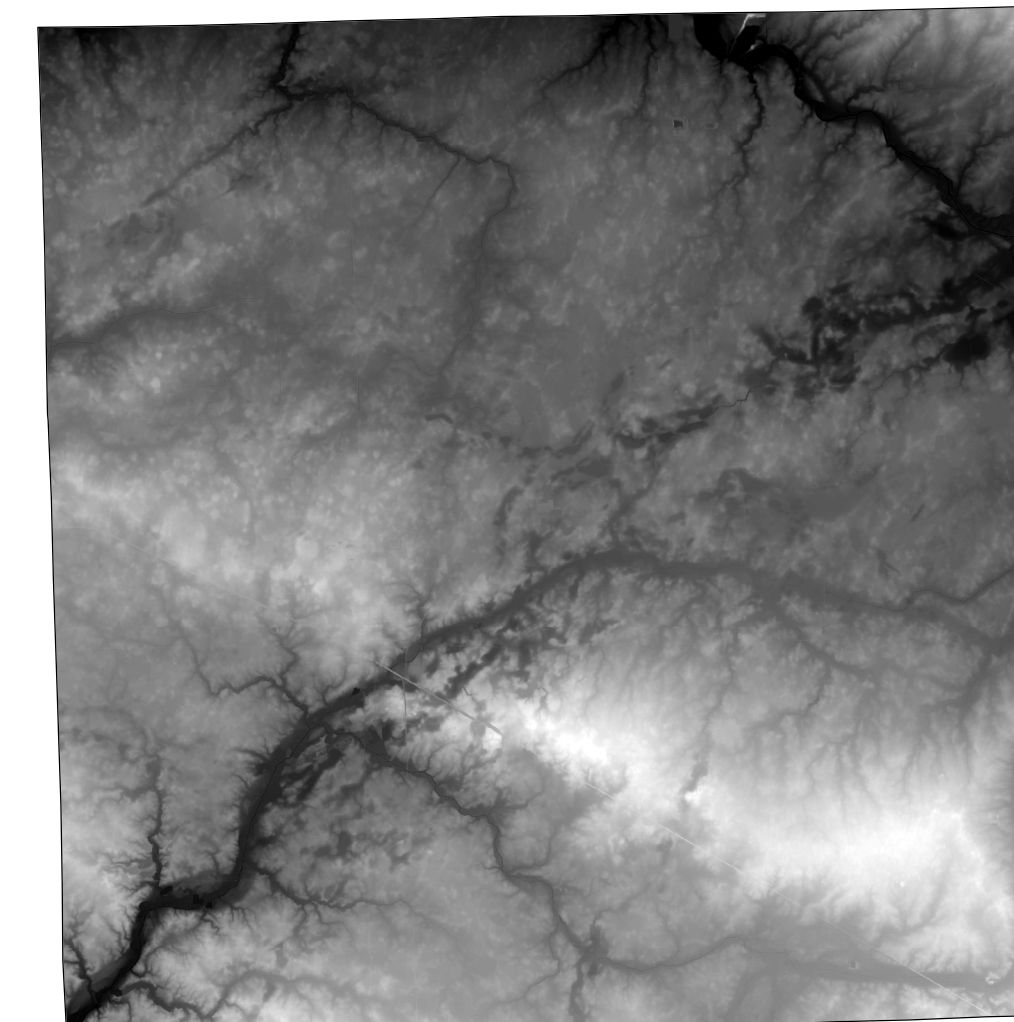
Bedrock potentiometric surface elevation contours have not been extended across the north central portion of Blackford County. Some parts of this area are lacking in data and/or covered by more prolific unconsolidated deposits that limit the necessity to complete wells in bedrock. A deep buried bedrock valley, the Lafayette (Teays) Bedrock Valley System, cut through the overlying Silurian and Devonian Carbonates Aquifer System removing this productive bedrock through north central Blackford County.

Data collected to generate the PSM were standardized and validated for accuracy. Universal Transverse Mercator (UTM) coordinates for the water wells were either physically obtained in the field, determined through address geocoding, or determined based 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 derived from a digital elevation model based on LIDAR. Quality control/quality assurance procedures were utilized to refine or remove data where errors were readily apparent.

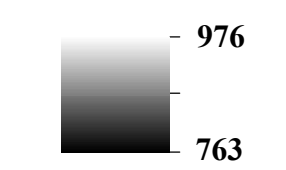
Potentiometric surface contours are developed and displayed here based on the static water levels from the bedrock aquifer system with 10-foot contours and 50-foot index contours. Bedrock potentiometric surface contours in Blackford County range from a high of 900 feet mean sea level (msl) in the southeast corner of the county, to a low of 830 feet msl north of Montpelier, Indiana. Groundwater flow direction within the bedrock aquifer system of Blackford County is generally to the northwest with some flow towards the Salamonie River in the north.

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.

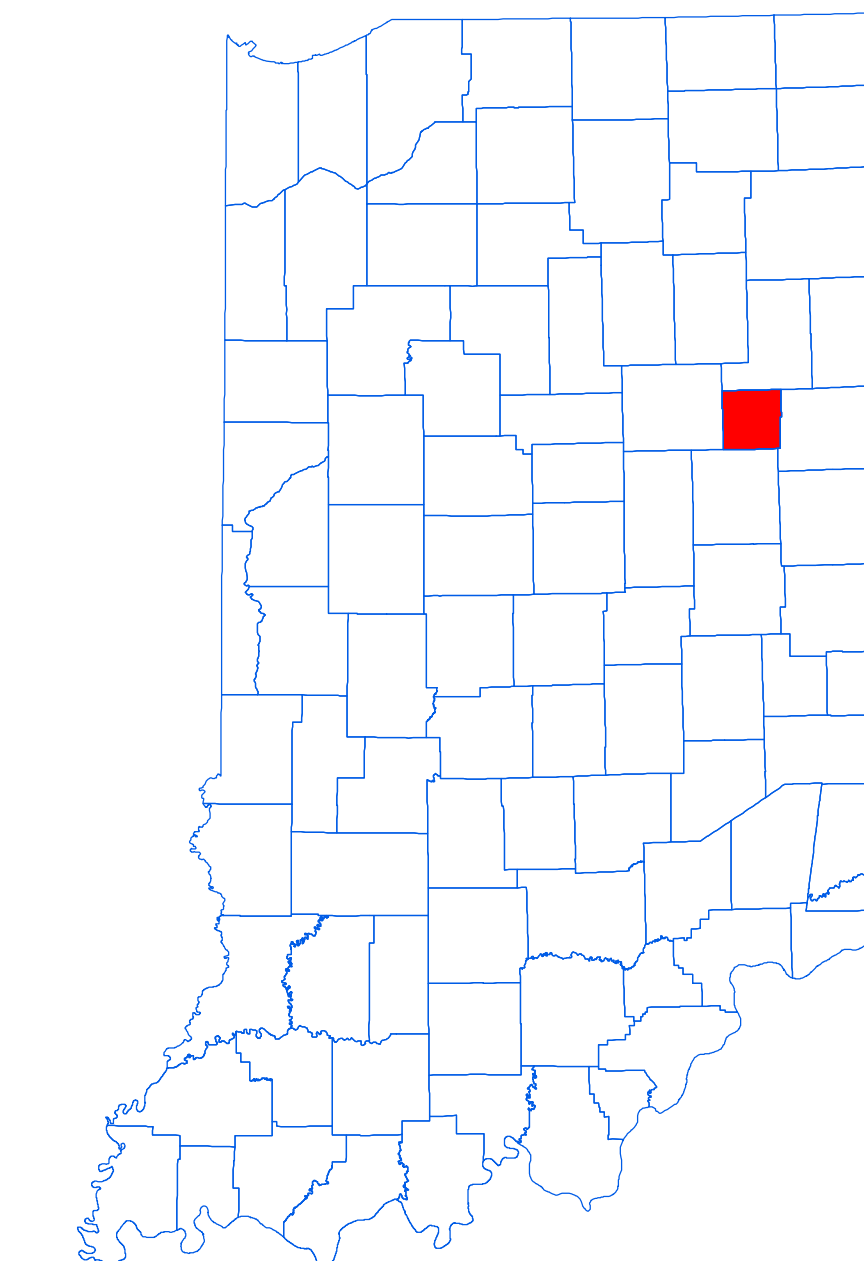
Digital Elevation Model of Blackford County, Indiana



Elevation (feet)

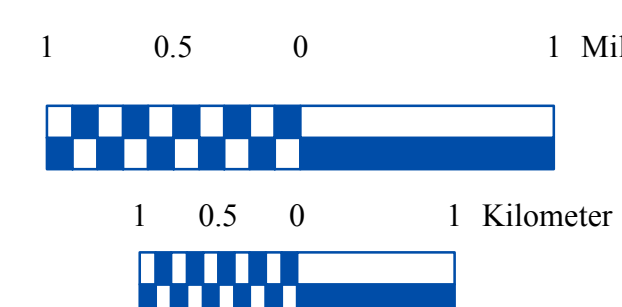
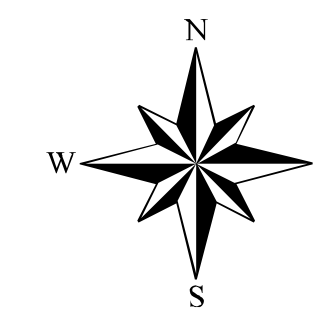


Location Map



EXPLANATION

- Line of equal elevation, in feet above mean sea level
- Potentiometric Contour interval 10 feet
- Stream
- County Road
- State Road
- Municipal Boundary
- Lake & River
- No Aquifer Material or Limited Data



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Potentiometric Surface Map of the Bedrock Aquifers of Blackford County, Indiana

by
Ginger C. Korinek
Division of Water, Resource Assessment Section

September, 2013

UNCONSOLIDATED AQUIFER SYSTEMS OF BLACKFORD COUNTY, INDIANA

Till Veneer Aquifer System

In Blackford County, the Till Veneer Aquifer System encompasses areas where the unconsolidated material is predominantly thin till overlying bedrock. In these areas, this thin till is chiefly the product of the deposition of Wisconsin glacial till over an uneven, eroded bedrock surface. This system has the most limited ground-water resources of the unconsolidated aquifer systems in the county. Total thickness of the Till Veneer Aquifer System generally ranges from about 30 to 45 feet.

There is little potential for ground-water production in the Till Veneer Aquifer System in Blackford County. Potential aquifers within this system include thin isolated sand and/or gravel layers. However, none of the reported wells penetrating this aquifer system are completed in unconsolidated materials, which are bypassed in favor of the underlying bedrock. This system is not very susceptible to contamination from surface sources because the near-surface materials generally have low permeability.

Bluffton Till Aquifer System

The Bluffton Till Aquifer System primarily consists of thick clay with thin intratill sand and gravel layers. In Blackford County, this system ranges in thickness from about 50 feet to more than 400 feet (where glacial deposits have filled bedrock valleys), but is typically 75 to 130 feet thick. Saturated aquifer materials include outwash sands and/or gravels that commonly range from 5 to 15 feet thick and are generally overlain by 40 to 75 feet of till.

Part of the Bluffton Till Aquifer System overlies a deep buried bedrock valley in northern Blackford County. The total unconsolidated thickness exceeds 400 feet in many places. Only a few wells that utilize the deeper aquifers within the buried bedrock valleys have been reported. These wells indicate that the deep sand and gravel deposits are 6 to 15 feet thick in places. Reported domestic well yields are greater than 50 gallons per minute (gpm).

This aquifer system is capable of meeting the needs of domestic and some high-capacity users. Wells are generally 80 to 110 feet deep. Domestic well capacities are typically 10 to 35 gpm and static water levels are commonly 25 to 45 feet below surface.

The Bluffton Till Aquifer System has a low susceptibility to surface contamination because intratill sand and gravel units are generally separated from the surface by till layers within the system.

Bluffton Till Aquifer Subsystem

Areas where unconsolidated materials are generally greater than 50 feet in thickness, yet have little aquifer potential, are mapped as the Bluffton Till Aquifer Subsystem. This system is typically less than 10 feet thick in Blackford County. Potential aquifer materials include thin, intratill sand and gravel deposits. Where present, aquifer materials are capped by till that is generally 50 to 90 feet thick.

This system is capable of meeting the needs of some domestic users. However, about 85 percent of wells constructed in the area mapped as Bluffton Till Aquifer Subsystem in this county bypass the unconsolidated materials and use the underlying bedrock aquifer. The few wells utilizing this unconsolidated aquifer system in Blackford County are completed at depths of 75 to 100 feet.

The Bluffton Till Aquifer Subsystem is generally not very susceptible to surface contamination because its intratill sand and gravel units are overlain by thick till deposits.

Bluffton Complex Aquifer System

The Bluffton Complex Aquifer System is mapped over a large portion of Blackford County. This aquifer system is characterized by deposits that are quite variable in materials and thickness. Sand and gravel aquifer deposits are commonly overlain by a thick till. This system generally also exhibits alternating layers of outwash and till of variable thickness above the main aquifer. The main aquifer deposits that cap the buried bedrock valley are typically thicker and more continuous than the shallower sand and gravels in this system. In Blackford County this system is generally 105 to 160 feet thick.

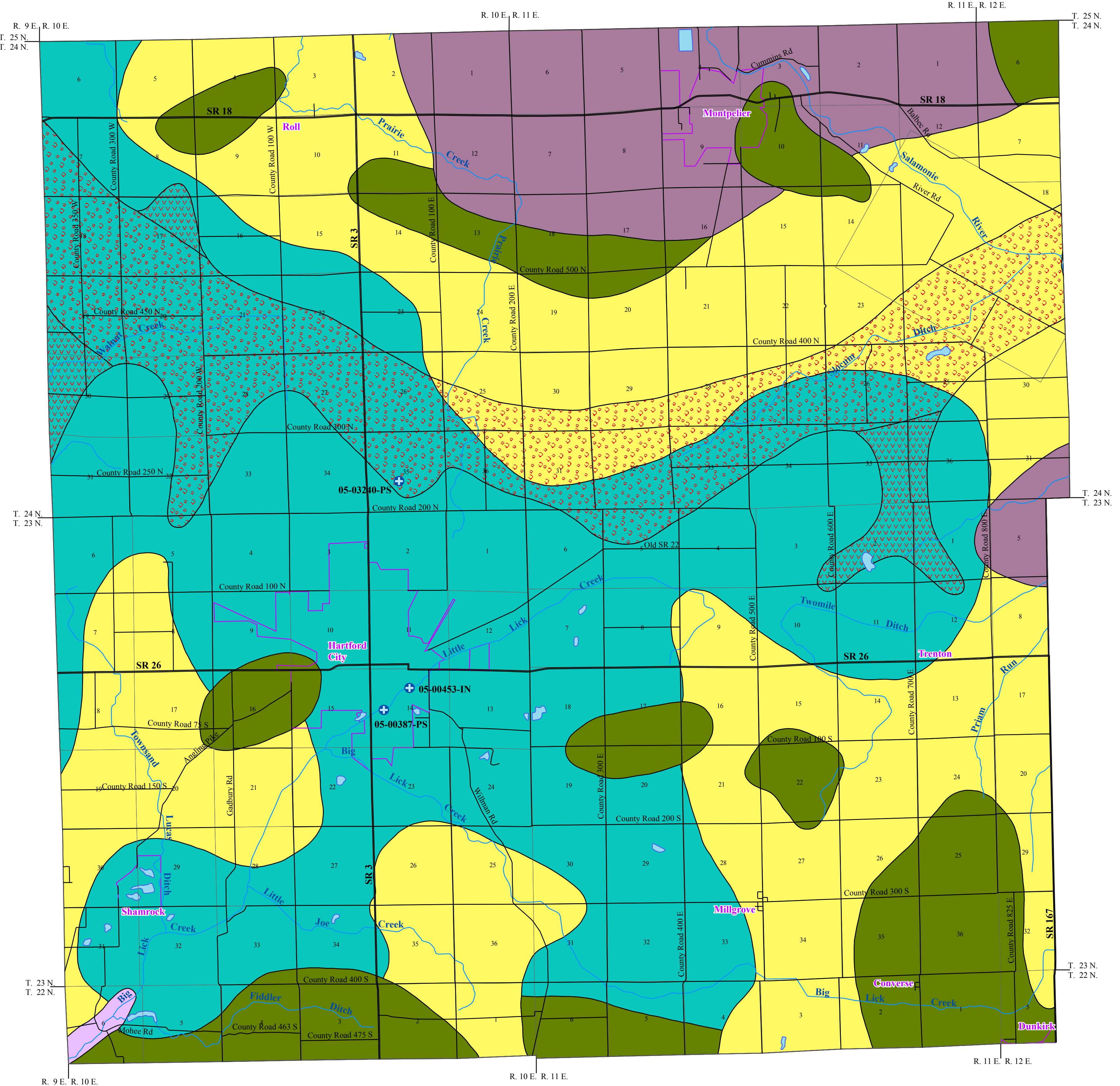
However, in places this system overlies deep buried bedrock valleys. The total unconsolidated thickness exceeds 400 feet in many places. There is little evidence for ground-water potential in some of these buried bedrock valleys because adequate yields are generally found in the shallower aquifers of the Bluffton Complex Aquifer System.

In some areas, ground-water potential is indicated by the few wells that utilize deep sand and gravel deposits within the buried bedrock valleys in this system. Deep aquifer materials are 11 to 20 feet thick and these wells have reported yields of 10 to 72 gpm.

This system is capable of meeting the needs of domestic and high-capacity users in Blackford County. Saturated aquifer materials in the Bluffton Complex Aquifer System are generally 10 to 30 feet thick and are overlain by a till cap which is commonly 35 to 85 feet thick. Wells in this system are typically completed at depths of 80 to 110 feet. Domestic well yields are commonly 10 to 50 gpm and static water levels are generally 35 to 50 feet below the surface. There are 3 registered significant ground-water withdrawal facilities (8 wells) utilizing this system and individual wells produce 100 to 170 gpm. The Bluffton Complex Aquifer System is not very susceptible to contamination because thick clays overlie the aquifer materials.

Wabash River and Tributaries Outwash Aquifer System

This system is mapped along part of Big Lick Creek in southwestern Blackford County. The Wabash River and Tributaries Outwash Aquifer Subsystem has the potential to meet domestic needs. The 2 wells utilizing this system in Blackford County have been reported at depths of 31 and 42 feet. Yields for these wells are 10 and 50 gpm with static water levels of 6 and 25 feet below surface. Areas within this aquifer system that have overlying clay or silt deposits are moderately susceptible to surface contamination, whereas, areas that lack overlying clay or silt deposits are highly susceptible to contamination.



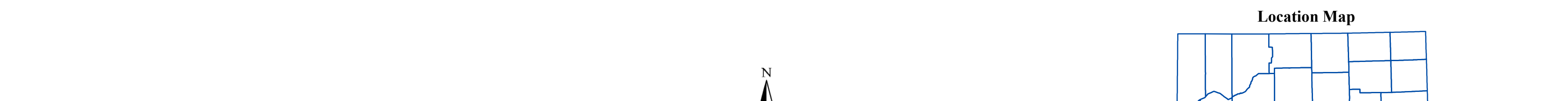
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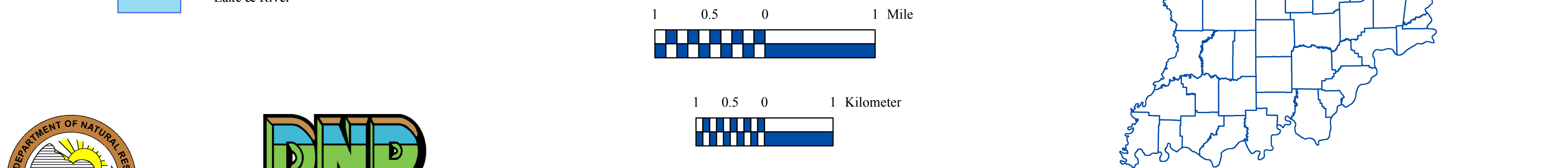
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EXPLANATION	
	Registered Significant Ground-Water Withdrawal Facility
	Stream
	County Road
	State Road & US Highway
	Municipal Boundary
	Lake & River



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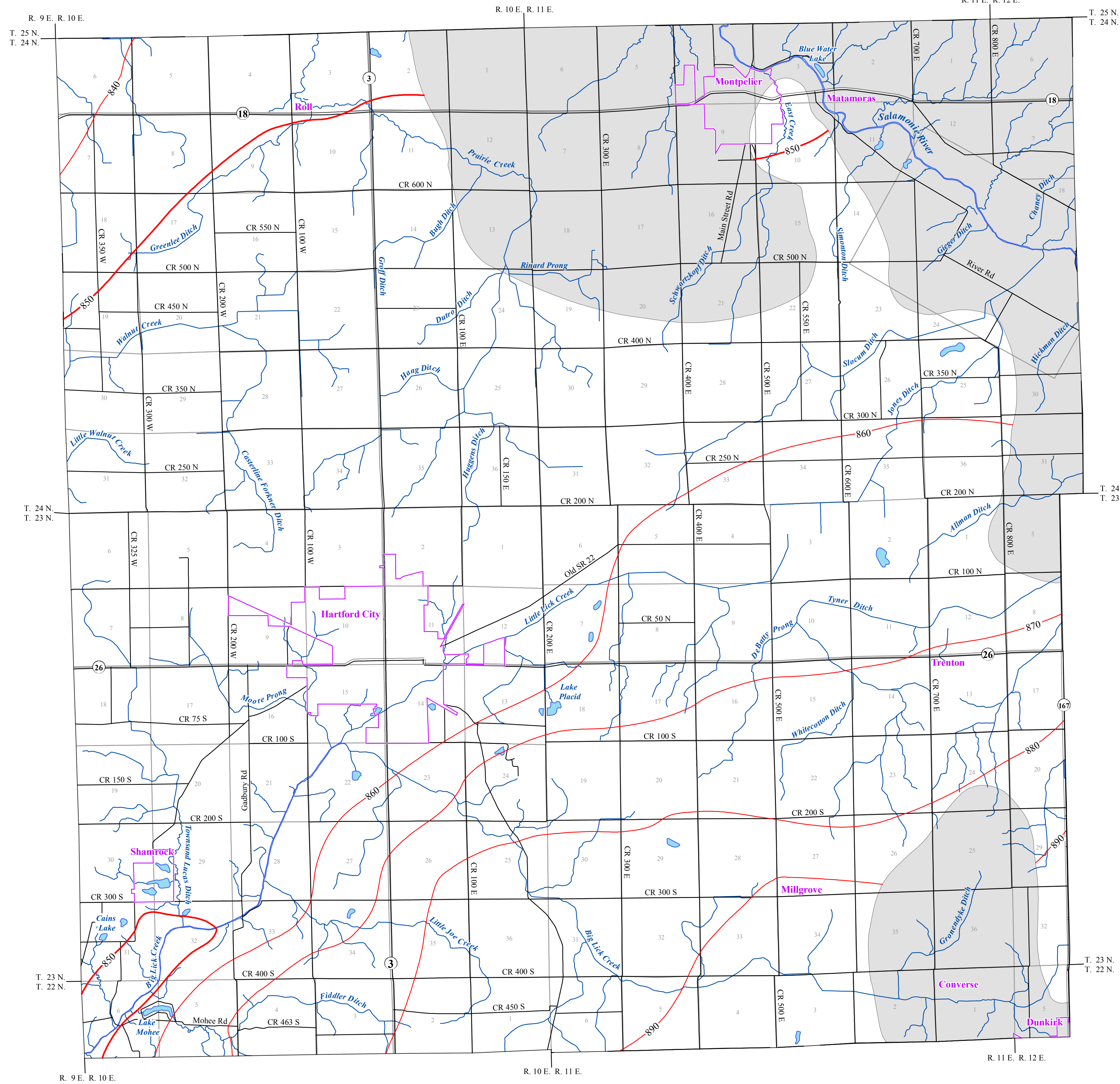
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Unconsolidated Aquifer Systems of Blackford County, Indiana

by
Gregory P. Schrader
Division of Water, Resource Assessment Section

April 2007

POTENTIOMETRIC SURFACE MAP OF THE UNCONSOLIDATED AQUIFERS OF BLACKFORD COUNTY, INDIANA



Blackford County, Indiana is located in the eastern portion of the state bounded by Grant, Wells, Jay, and Delaware counties in the west, north, east, and south, respectively. Blackford County is within the Upper Wabash River Basin.

The Potentiometric Surface Map (PSM) of the unconsolidated aquifers of Blackford County is mapped by contouring the elevations of 327 static water levels reported on well records received primarily over a 50-year period. These wells are completed in unconsolidated aquifers at various depths and typically under confined conditions (bounded by impermeable layers above and below the water bearing formation). However, some wells are completed in unconfined settings with water bearing formations not bounded by impermeable layers. The potentiometric surface is a measure of the pressure on water in a water bearing formation, or aquifer. Water in an unconfined aquifer is at atmospheric pressure and will not rise in a well above the top of the water bearing formation. In contrast is water 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 potentiometric surface contours 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 pumpage. Therefore, current site-specific conditions may differ due to local or seasonal variations in measured static water levels. Because fluctuations in groundwater are typically small, static water levels can be used to construct a generalized PSM. Groundwater flow is naturally from areas of recharge toward areas of discharge. As a general rule, but certainly not always, groundwater flow approximates the overlying topography and intersects the land surface at major streams. The contours were determined based on the amount of data and the degree of change in water levels between wells in each mapped area.

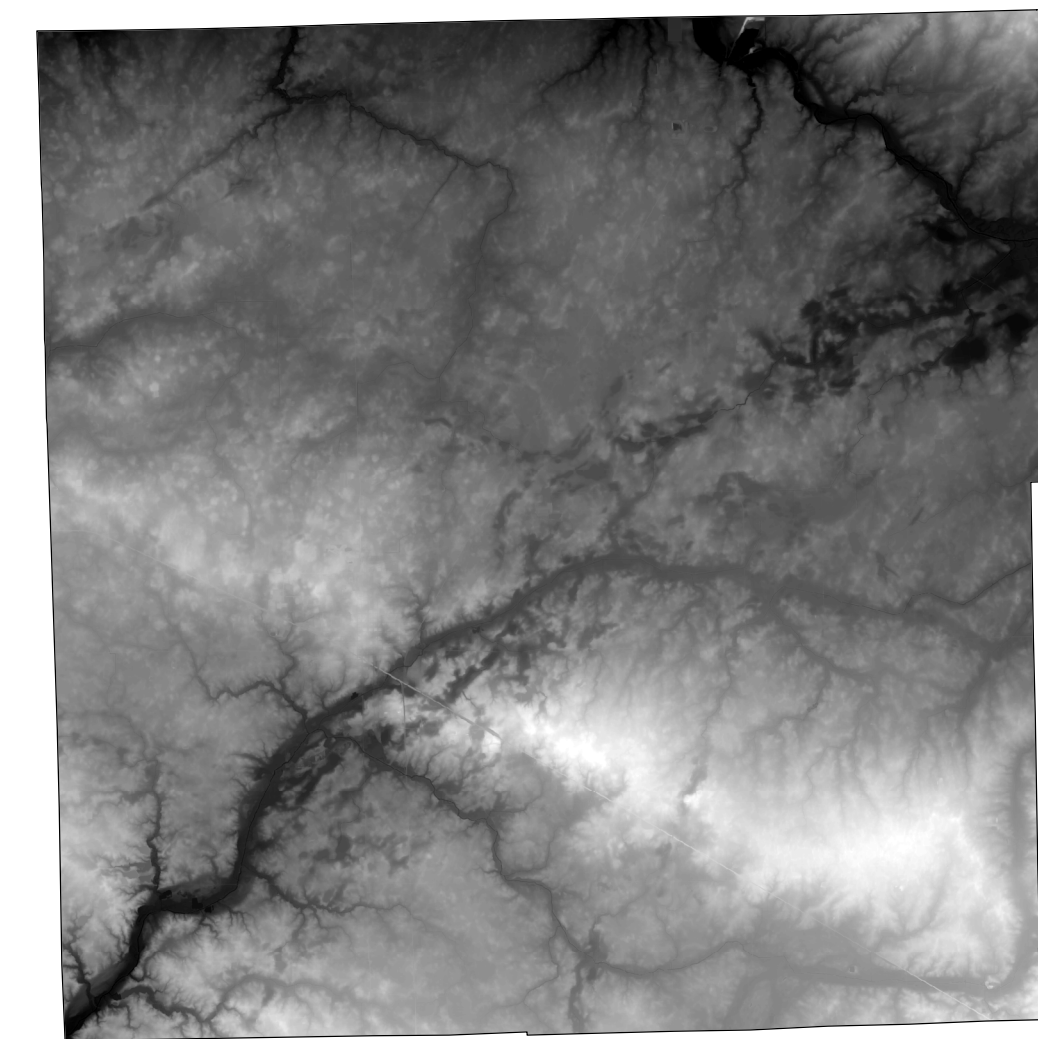
The potentiometric surface contours are mapped primarily for the upper 100 feet of the unconsolidated materials and utilize data for wells 100 feet or less in depth. When shallow data is sparse or unavailable in an area, deeper wells are used to complement the mapping. Unconsolidated potentiometric surface elevation contours have not been extended across the north central and eastern portion of Blackford County. This area is either lacking in data and/or covered by thin or unproductive unconsolidated deposits.

Data collected to generate the PSM were standardized and validated for accuracy. Universal Transverse Mercator (UTM) coordinates for the water wells were either physically obtained in the field, determined through address geocoding, or determined based 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 derived from a digital elevation model based on LIDAR. Quality control/quality assurance procedures were utilized to refine or remove data where errors were readily apparent.

Potentiometric surface contours are developed and displayed here based on the static water levels from the unconsolidated aquifer systems with 10-foot contours and 50-foot index contours. Potentiometric surface contours in Blackford County range from a high of 900 feet mean sea level (msl) in the southeast, to a low of 840 feet msl in the northwest. Groundwater flow direction is generally to the northwest. However, groundwater in the far southwestern portion of the county has flow southwest towards Big Lick Creek.

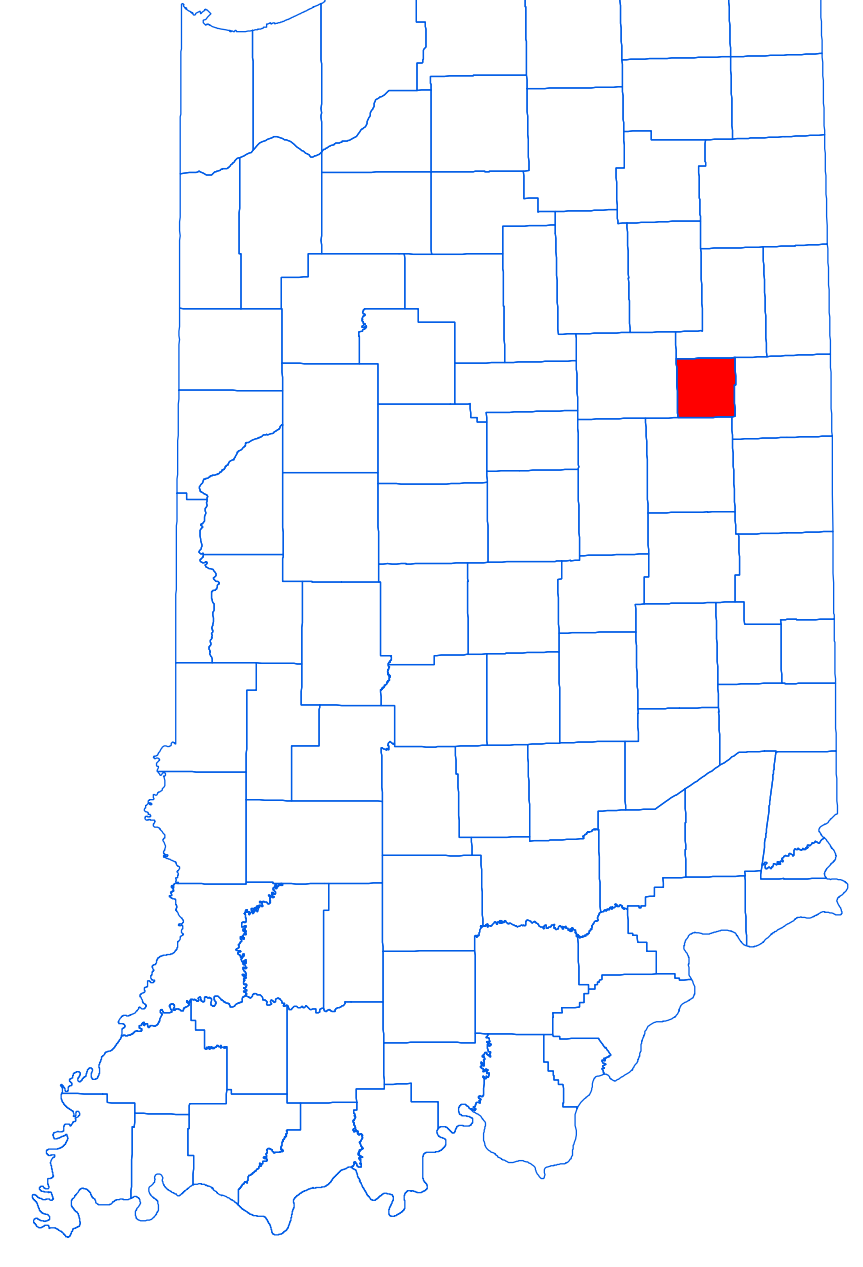
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Digital Elevation Model of Blackford County, Indiana



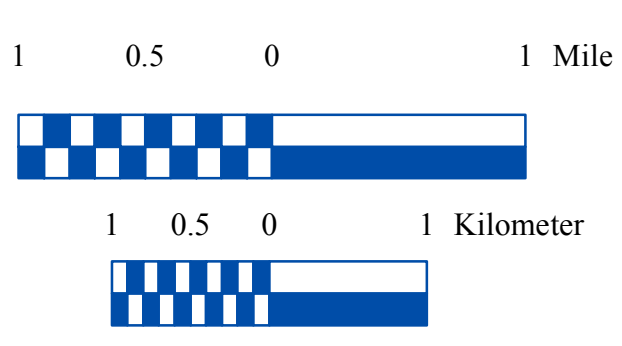
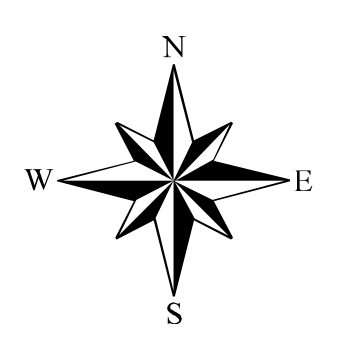
Elevation (feet)
976
763

Location Map



EXPLANATION

- Line of equal elevation, in feet above mean sea level
- Potentiometric Contour interval 10 feet
- Stream
- County Road
- State Road
- Municipal Boundary
- Lake & River
- No Aquifer Material or Limited Data



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Potentiometric Surface Map of the Unconsolidated Aquifers of Blackford County, Indiana

by
Ginger C. Korinek
Division of Water, Resource Assessment Section
September 2013

Map generated by Joel D. Sanderson
IDNR, Division of Water, Resource Assessment Section

Blackford County

