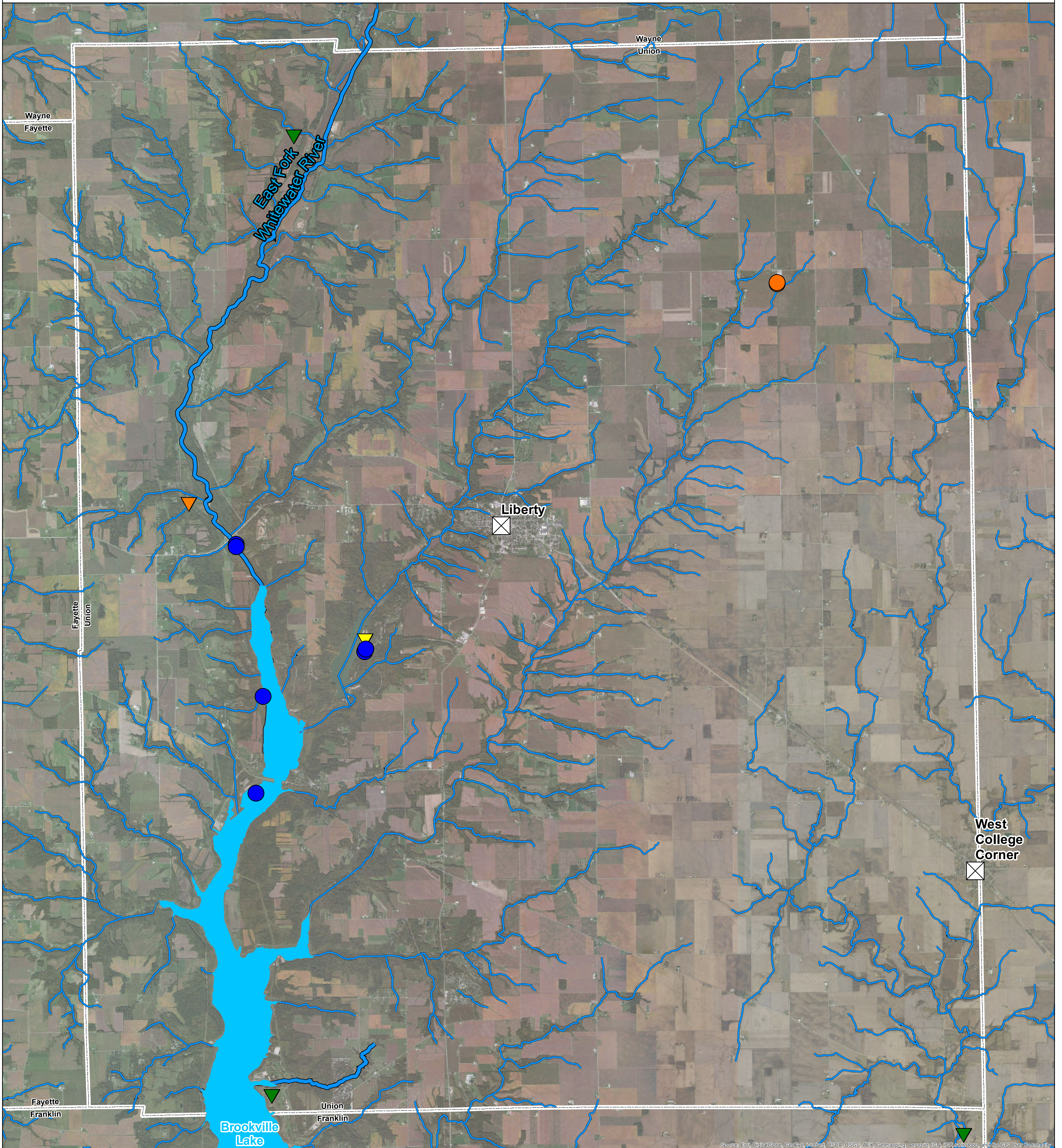
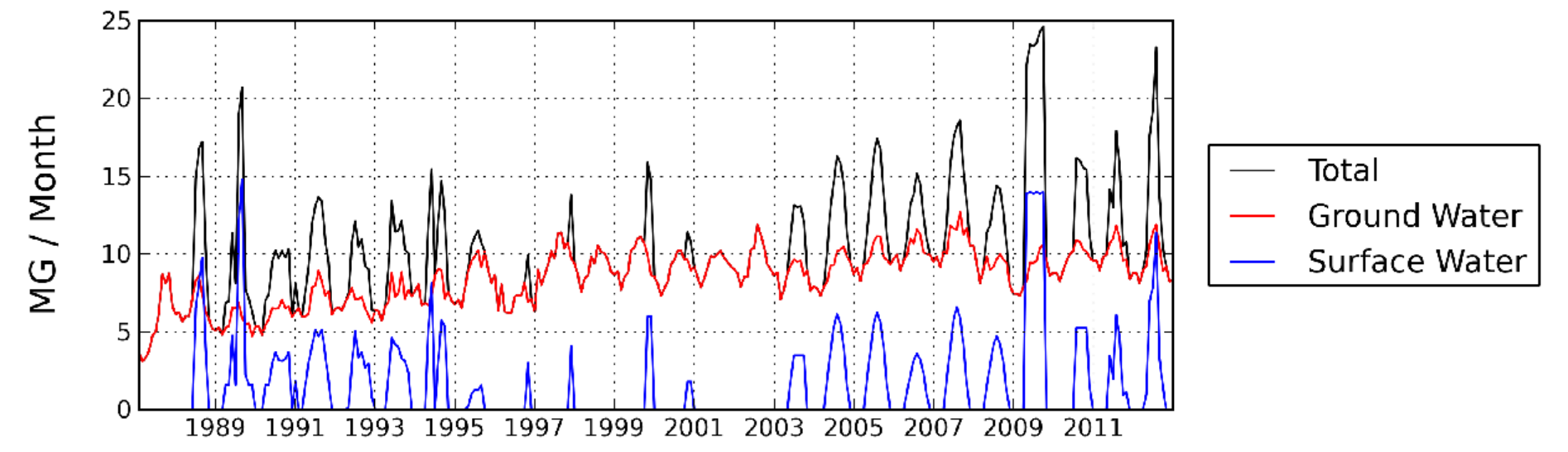
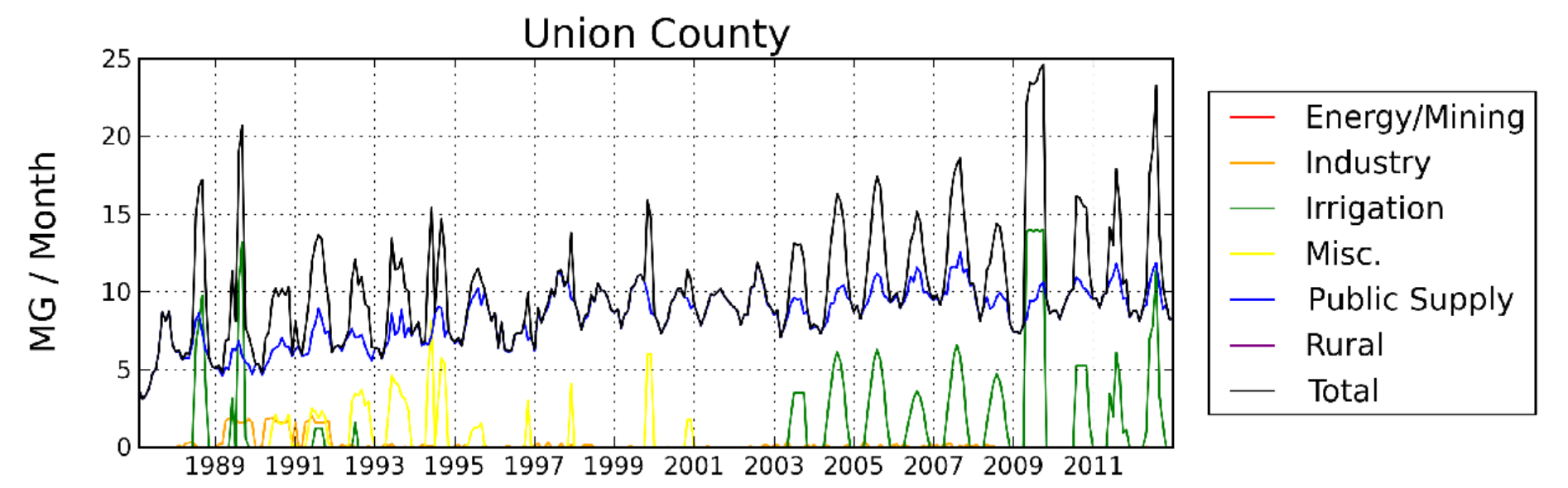


Average Daily Use: 0.4 MGD



Water Resources and Use in Union County

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

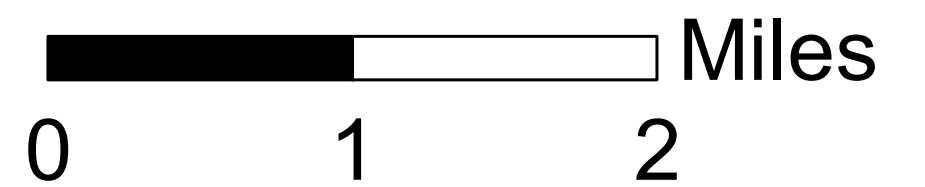
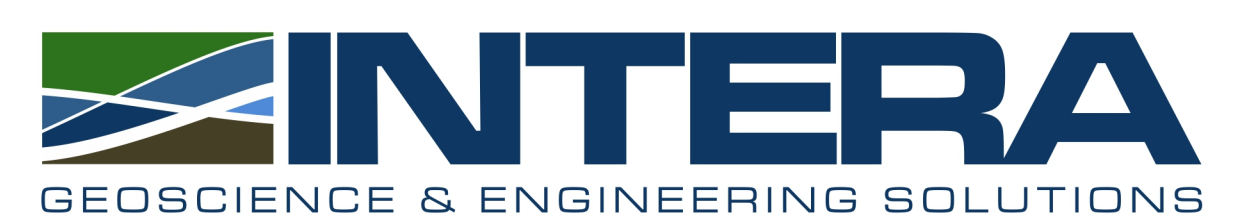
Withdrawal Location

- | WELL | INTAKE | Category |
|---------------|--------------------------|---------------|
| Red Circle | Red Inverted Triangle | Energy/Mining |
| Orange Circle | Orange Inverted Triangle | Industry |
| Green Circle | Green Inverted Triangle | Irrigation |
| Yellow Circle | Yellow Inverted Triangle | Misc. |
| Blue Circle | Blue Inverted Triangle | Public Supply |
| Purple Circle | Purple Inverted Triangle | Rural Use |

River

- | 7Q2 Flow (MGD) | Line Style |
|----------------|------------------------------------|
| <10 MGD | Thin Blue Line |
| 10 - 50 MGD | Medium Blue Line |
| 50 - 100 MGD | Thick Blue Line |
| 100 - 500 MGD | Very Thick Blue Line |
| > 500 MGD | Thick Blue Line with Dashed Border |

- Major Lakes (Blue Area)
- Interstate (Red Line)
- County (Dashed White Line)
- City (White Square with X)



BEDROCK AQUIFER SYSTEMS OF UNION 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.

In Union County thickness of unconsolidated deposits overlying bedrock ranges from less than 4 feet in the south-central part of the county and along portions of the east edge of the East Fork Whitewater River Valley, to as much as 214 feet in the central part of the county where a buried bedrock valley is present.

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 Union County. They are the Silurian and Devonian Carbonates and the Ordovician Maquoketa Group. Approximately 33 percent of all located wells in Union County are completed in bedrock.

Silurian and Devonian Carbonates Aquifer System

The Silurian and Devonian Carbonates Aquifer System subcrops along small portions of northwestern and northeastern Union County. In this county only the older Silurian age carbonates are present.

Due to the availability of overlying unconsolidated deposits and the limited extent of the bedrock aquifer system, very few wells are reported in this system in Union County. Depth to the bedrock surface ranges from 60 to 123 feet with reported total well depths of 85 to 161 feet. Well yields of 1 and 10 gallons per minute (gpm) along with one dry hole have been reported. Static water levels are reported at 14 and 40 feet below surface.

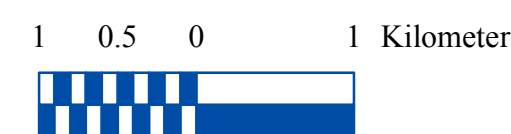
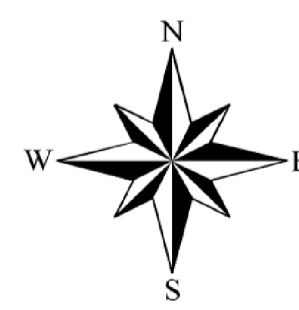
Most of the Silurian and Devonian Carbonates Aquifer System in Union County is overlain by thick clay deposits. These areas are considered at low risk to contamination.

Ordovician - Maquoketa Group Aquifer System

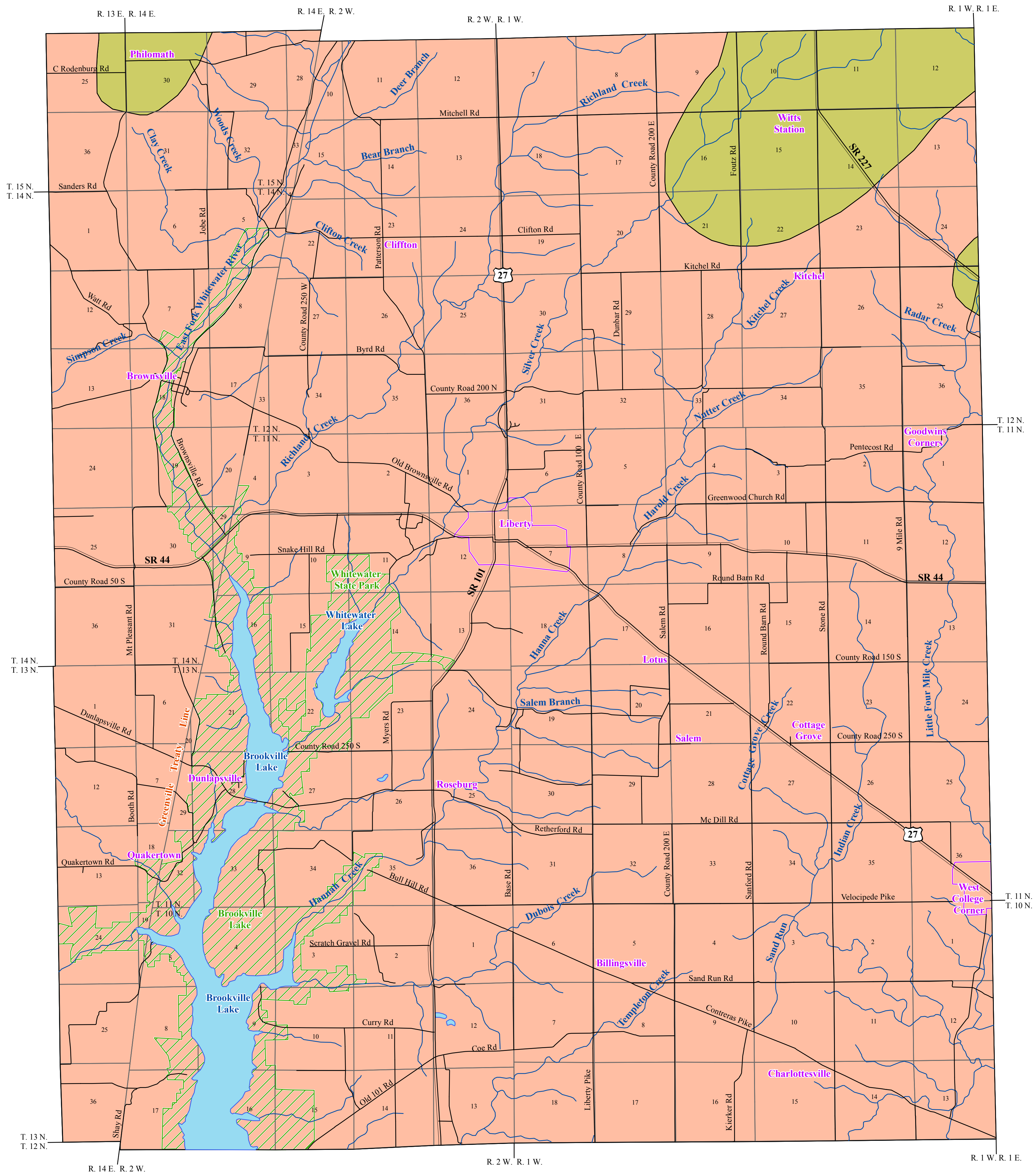
The outcrop/subcrop area of the Maquoketa Group includes nearly all of Union County. The Maquoketa Group consists of the Kope, the Dillsboro, and the Whitewater Formations. However, in Union County, only the Dillsboro and Whitewater Formations are present. This bedrock aquifer system includes mostly shale with some interbedded limestone units.

In Union County depth to the bedrock surface ranges from 4 to 214 feet but is typically 20 to 75 feet. Total well depths are commonly 25 to 100 feet. The amount of penetration into the Maquoketa Group ranges from 1 to 212 feet. The Maquoketa Group is considered a limited groundwater resource. Well yields vary widely from 1 to 60 gpm with static water levels of 1 to 93 feet below surface. However, wells showing greater yields are commonly associated with significant to complete drawdowns and dry holes are reported.

Most of the Maquoketa Group Aquifer System in Union County is overlain by thick clay deposits. These areas are considered at low risk to contamination. However, in some places clay deposits are thin and/or sands and gravels directly overlie the bedrock surface. These areas are considered at high risk to contamination.

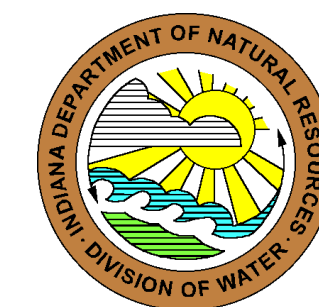


Location Map



EXPLANATION

- Stream
- County Road
- State Road & US Highway
- Municipal Boundary
- State Managed Property
- Lake & River



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Bedrock Aquifer Systems of Union County, Indiana

by
 Randal D. Maier
 Division of Water, Resource Assessment Section

March 2011

UNCONSOLIDATED AQUIFER SYSTEMS OF UNION COUNTY, INDIANA

Five unconsolidated aquifer systems have been mapped in Union County: the Till Veneer, the Alluvial, Lacustrine, and Backwater Deposits, the New Castle Till, the New Castle Till Subsystem, and the Whitewater River Valley Outwash Aquifer Subsystem.

Thicknesses of unconsolidated sediments that overlie bedrock are quite variable in Union County. Total thickness ranges from less than 4 feet along portions of the east edge of the East Fork Whitewater River Valley, to as much as 214 feet in the central part of the county where a buried bedrock valley is present.

Regional estimates of aquifer susceptibility to contamination from the surface can differ considerably due to variations within geologic environments. 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.

Till Veneer Aquifer System

In Union County, the Till Veneer Aquifer System is mapped along the southern third of the county and along the perimeter areas of the East Fork Whitewater River and its tributaries. This system is the most limited groundwater resource of the unconsolidated aquifer systems in the county. This system generally consists of thin till, less than 50 feet thick, that directly overlies an uneven bedrock surface. In places, intermittent and discontinuous subsurface or surface sands and gravels are present.

Most wells started in the Till Veneer Aquifer System are completed in the underlying bedrock aquifer system. However, in Union County several large diameter bucket wells utilize thin, low yield sand and gravel seams and/or reportedly "wet" clay deposits. Also, drillers often complete wells at varying depths below the water bearing deposits. This allows for greater potential yield from storage for short duration pumping needs.

Reported well yields are generally less than 5 gallons per minute (gpm) with dry holes noted in places. Greater well yields have been reported, however, these wells are generally associated with significant to complete drawdown and it is likely that such production cannot be sustained for lengthy periods of time.

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

Alluvial, Lacustrine, and Backwater Deposits Aquifer System

The Alluvial, Lacustrine, and Backwater Deposits Aquifer System is mapped in the central part of Union County along sections of Silver and Hanna Creeks. This system consists of deposits resulting from glacial meltwater drainage, fine-grained glaciolacustrine deposits formed in relatively static water, and colluvium from the surrounding upland areas.

This system is an extremely limited resource and the Division has no records of wells that produce from these deposits in Union County. However, large-diameter bucket wells may be adequate to meet the needs of some domestic users. Typical materials overlying bedrock include fine sand, silt, and clay deposits that are generally greater than 25 feet thick. Aquifer materials commonly include thin sand seams that are typically less than a few feet thick. Yields are generally expected to be less than a few gpm.

A small portion of this system overlies part of a buried bedrock valley. Aquifer potential is generally unknown and no known wells produce from these deposits. However, in this area unconsolidated materials that overlie bedrock are generally thicker and isolated sand and gravel aquifer units may be present. Depth to bedrock in this area is up to 100 feet.

Thick deposits of silt and clay that have a low susceptibility to surface contamination commonly characterize this aquifer system. However, the susceptibility is greater in areas where the surficial silt and clay deposits are thin and directly overlie outwash deposits.

New Castle Till Aquifer System

The New Castle Till Aquifer System is mapped in the east-central and northeast part of Union County and along a small area of the southwestern edge. Typical deposits include a thick glacial till with sand and gravel deposits of varying thickness. Only about 8 percent of unconsolidated wells in Union County produce from the New Castle Till Aquifer System. However, this system is capable of meeting the needs of domestic and some high-capacity users.

Total well depths range from 40 to 118 feet deep. Potential aquifer materials include sand and gravel deposits that range from 1 to 29 feet thick and are capped by 32 to 98 feet of till. Domestic well yields range from 10 to 45 gpm with static water levels that range from flowing to 60 feet below surface. However, significant drawdown is commonly associated with greater yield. There is one significant water withdrawal facility (two wells) registered in this system. Reported combined capacity of the facility is 100 gpm. Greater capacity may be available as evidenced by a recent irrigation well that reports an available yield of 400 gpm.

The New Castle Till Aquifer System is generally not very susceptible to surface contamination because sand and gravel units are overlain by thick till deposits.

New Castle Till Aquifer Subsystem

The New Castle Till Aquifer Subsystem is mapped throughout much of Union County. The subsystem is mapped similar to that of the New Castle Till Aquifer System. However, potential aquifer materials are thinner and potential yield is less in the subsystem than in the system. Also, about 60 percent of wells completed in the subsystem are large diameter bucket wells. Description of aquifer units vary widely ranging from "wet" clay with no noted sands and gravels, to thick low yield sand and gravel deposits. However, the subsystem has the potential of meeting the needs of some domestic users.

Well depths in the New Castle Till Aquifer Subsystem range from 25 to 130 feet but are typically 35 to 55 feet deep. Where present, sand and gravel deposits are generally less than 10 feet thick and are capped by 20 to 55 feet of clay. Isolated thicker sand and gravel deposits have been reported, however, a portion of the thickness is often noted as "dry". Reported well capacities are generally 10 gpm or less. A few wells note greater yields, however, many are associated with deeper static water levels and significant to complete drawdown. Static water levels are generally 9 to 25 feet below surface.

In central Union County a portion of this system overlies part of a major buried bedrock valley. Depth to bedrock in this area ranges from 102 to 214 feet below surface. Although no noted wells are completed in deeper unconsolidated deposits, wells completed in bedrock report thin sands and gravels.

This aquifer subsystem is generally not very susceptible to surface contamination because sand and gravel units are overlain by thick till deposits. However, some areas have surface sands and gravels or thin to no clay deposits. These areas are considered at moderate to high risk to contamination.

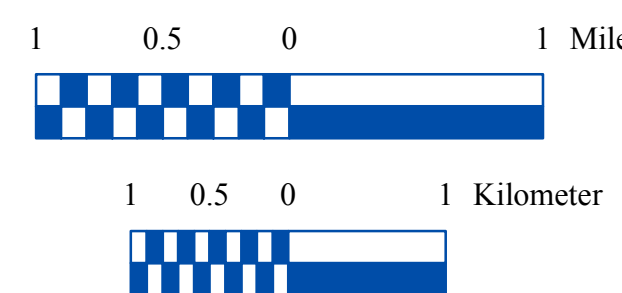
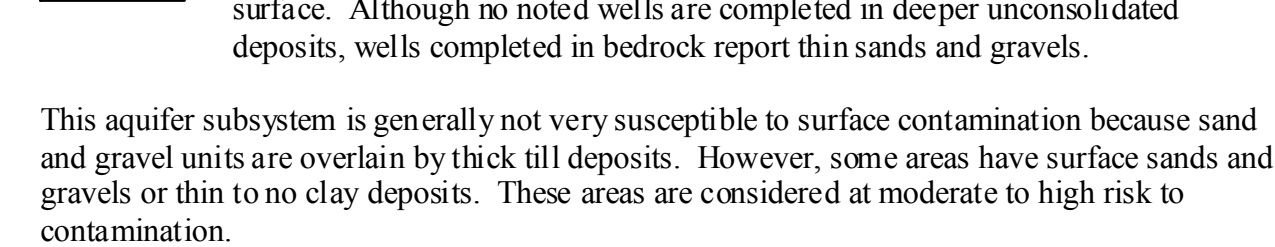
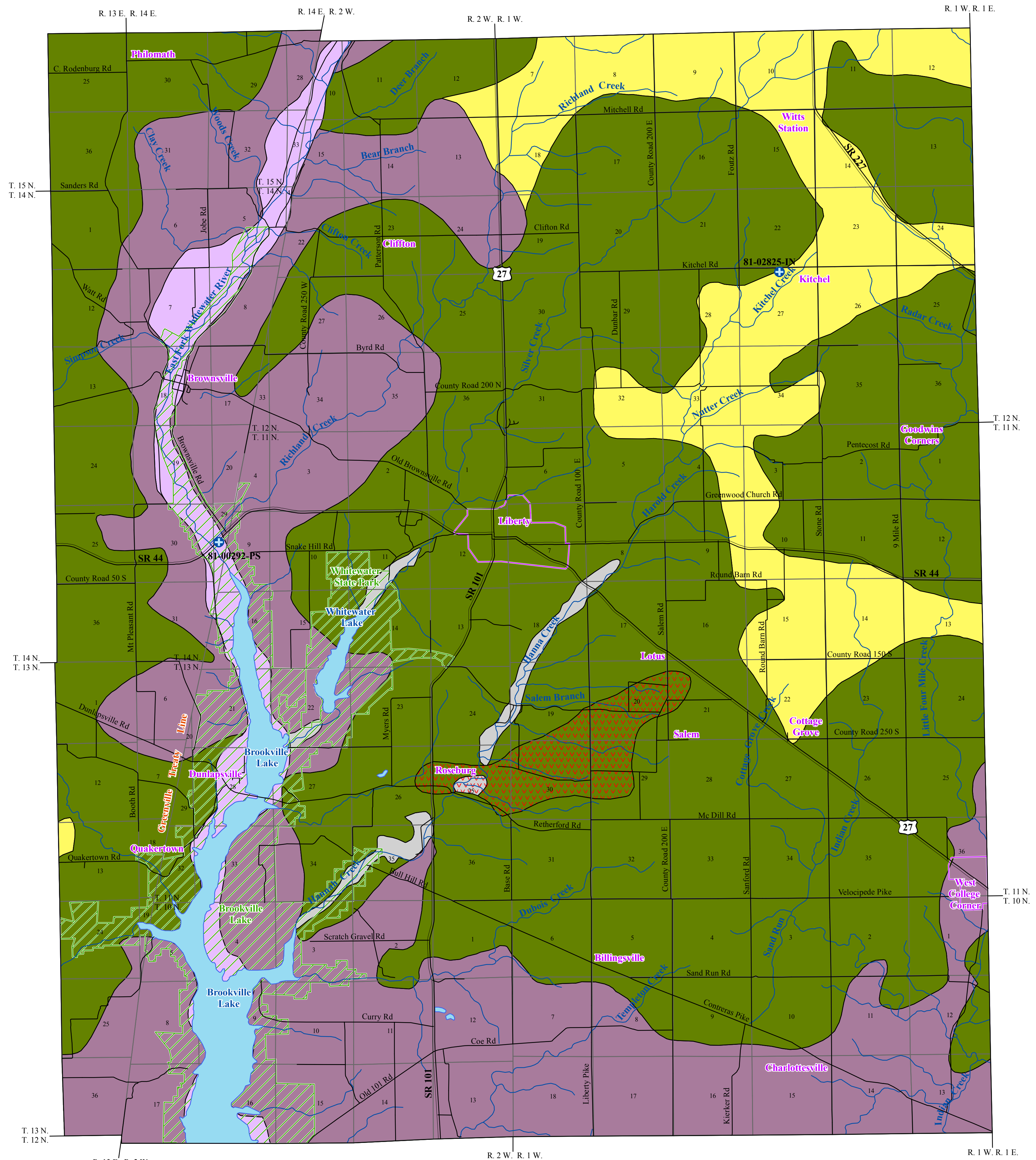
Whitewater River Valley Outwash Aquifer Subsystem

The Whitewater River Valley Outwash Aquifer Subsystem is mapped mostly along the East Fork of the Whitewater River. Potential aquifer materials include thick outwash and alluvial sands and gravels that may be capped by silt or clay.

Well depths in the Whitewater River Valley Outwash Aquifer Subsystem range from 25 to 125 feet. In places, aquifer materials are up to 71 feet of continuous sand and gravel and may be capped by alluvial silt and/or clay materials from 3 to 15 feet thick. However, in some areas the upper portions of the total aquifer sequence of sands and gravels are reported as "dry".

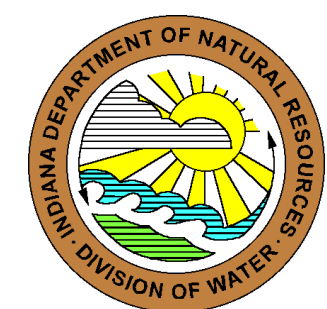
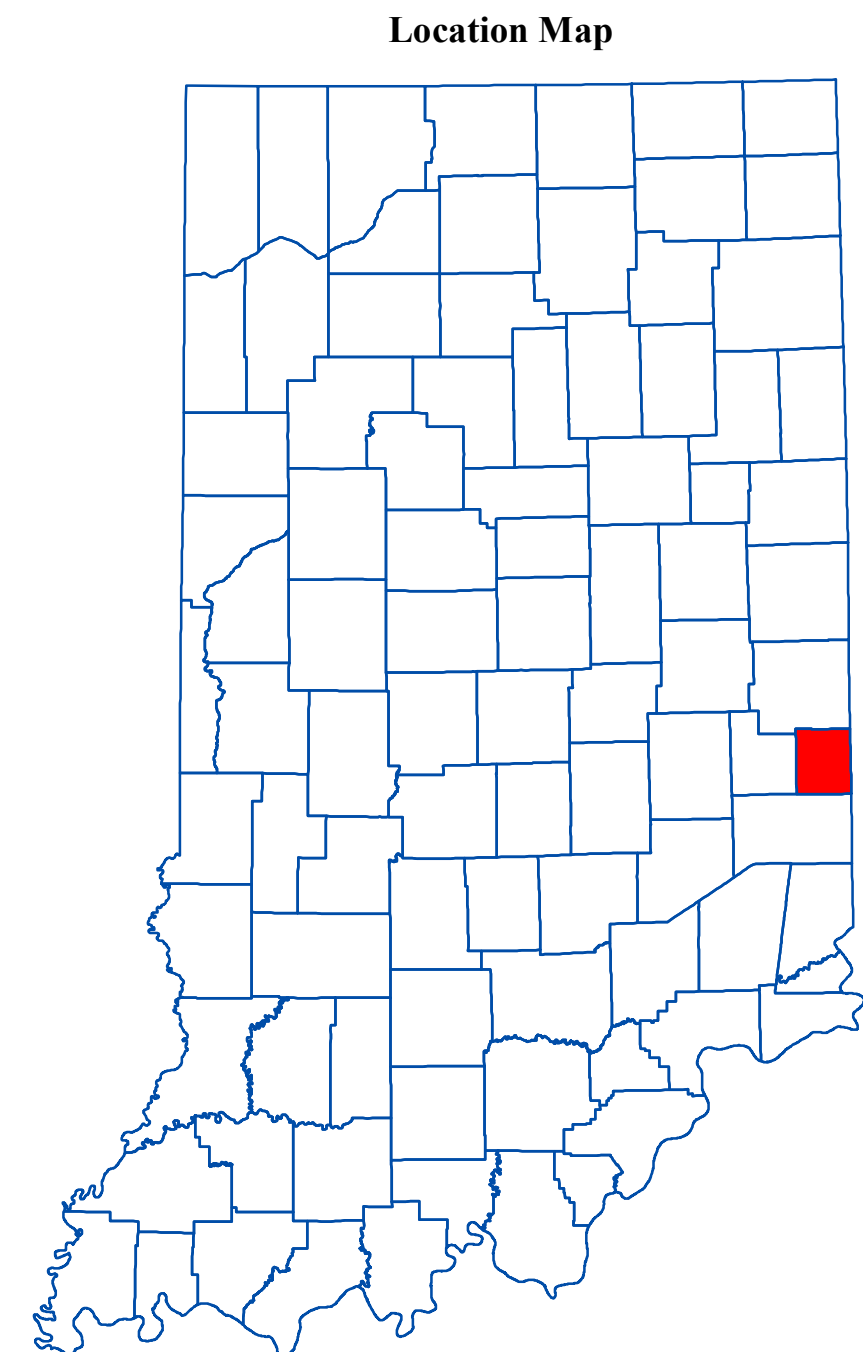
The subsystem is capable of meeting the needs of domestic and some high-capacity users. Domestic well capacities range from 10 to 40 gpm with static water levels of 1 to 50 feet below surface. There is one registered significant groundwater withdrawal facility (two wells) with capacities of 326 and 350 gpm.

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



EXPLANATION

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



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Unconsolidated Aquifer Systems of Union County, Indiana

by
 Randal D. Maier
 Division of Water, Resource Assessment Section

March 2011

Union County

