

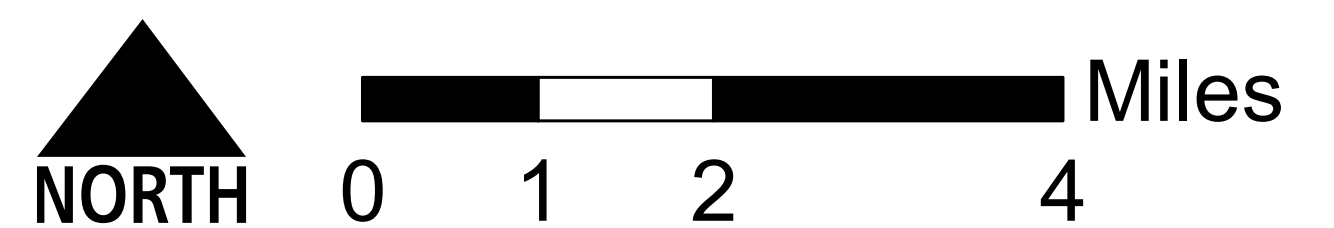
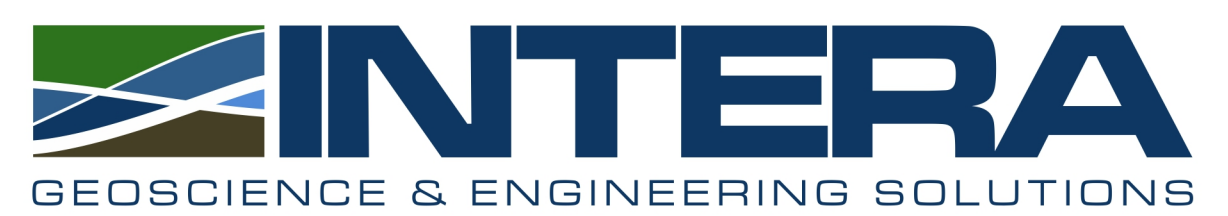
Water Resources and Use in Benton County

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

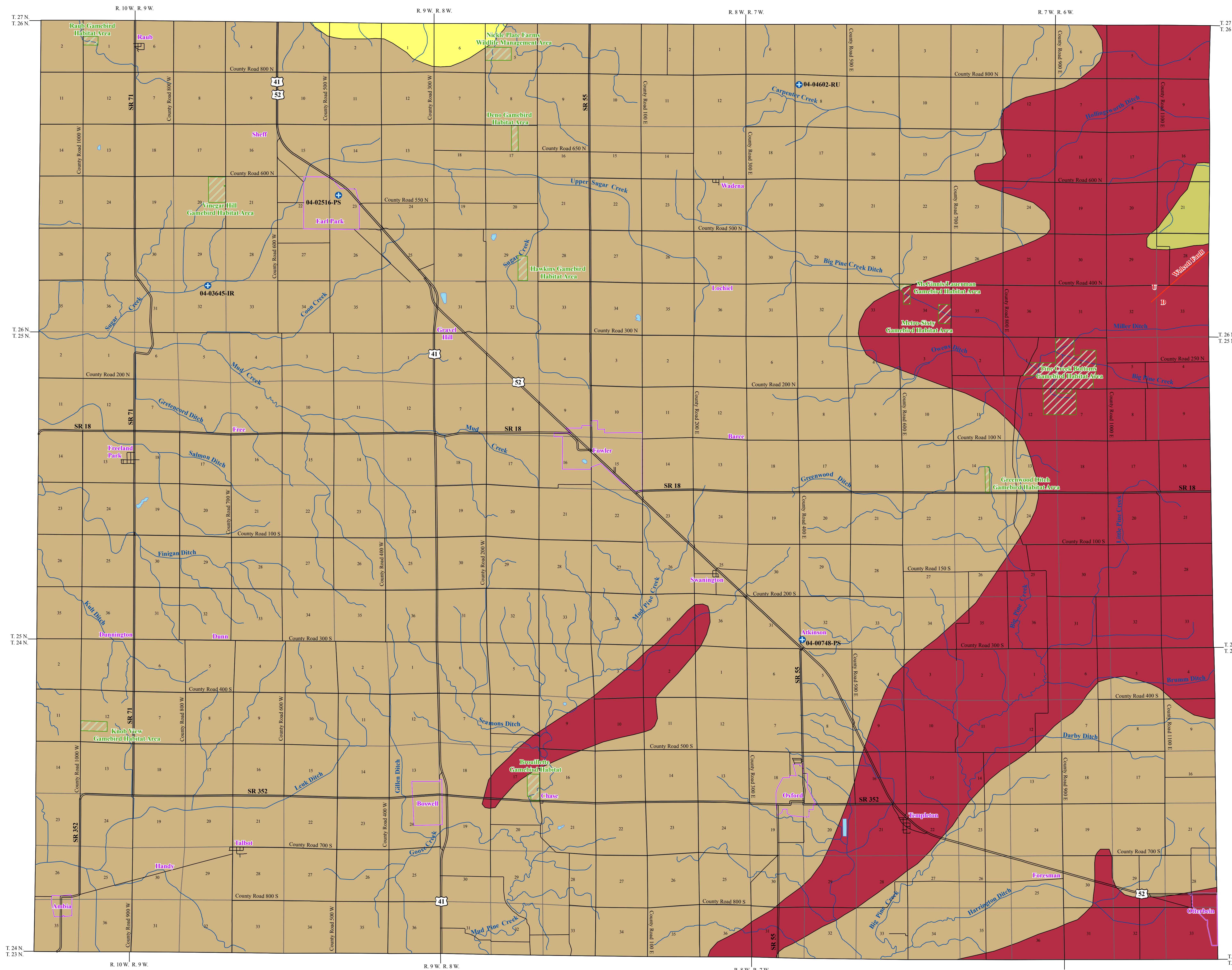
- Withdrawal Location**
- | WELL | INTAKE | Category |
|---------------|--------------------------|---------------|
| Red Circle | Red Inverted Triangle | Energy/Mining |
| Orange Circle | Orange Inverted Triangle | Industry |
| Green Circle | Green Inverted Triangle | Irrigation |
| Yellow Circle |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

- River**
- | 7Q2 Flow (MGD) | |
|---------------------|---------------|
| Blue Line | <10 MGD |
| Light Blue Line | 10 - 50 MGD |
| Medium Blue Line | 50 - 100 MGD |
| Dark Blue Line | 100 - 500 MGD |
| Very Dark Blue Line | > 500 MGD |

- | | |
|------------------------------|-------------|
| Light Blue Box | Major Lakes |
| Red Line | Interstate |
| White Box with Dashed Border | County |
| White Box with 'X' | City |



BEDROCK AQUIFER SYSTEMS OF BENTON 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, ranging from outcropping in areas located in the northern portion of the county to about 400 feet along the Lafayette (Terry) Bedrock Valley System, which is located along the southern boundary of the 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.

Four bedrock aquifer systems are identified for Benton County. They are, from younger to older: Racoon Creek Group of Pennsylvanian age, Borden Group of Mississippian age, New Albany Shale of Devonian and Mississippian age, and the Silurian and Devonian Carbonates. Bedrock wells represent about 50 percent of all wells completed in the county.

The susceptibility of bedrock aquifer systems to surface contamination is largely dependent on the type and thickness of the overlying sediments. However, 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.

Pennsylvanian -- Racoon Creek Group Aquifer System

The Pennsylvanian age Racoon Creek Group Aquifer System subgroups in an area located in the northwestern portion of the county. This bedrock aquifer system is composed mostly of sandstone and shale with minor amounts of limestone, coal, and limestone. The system is overlain by unconsolidated deposits up to 100 feet in thickness. There are no reported wells completed in the Racoon Creek Group for Benton County.

This system is often described as an aquitard and well yields are typically expected to be quite limited. Most domestic wells from adjacent counties that were completed in the Racoon Creek Group Aquifer System generally have reported testing rates of less than 5 gallons per minute (gpm).

The Racoon Creek Group is composed primarily of fine-grained materials that limit the movement of ground water to fractures, joints, and along the bedrock surface. This, along with the overlying, typically fine-grained clay materials, puts most of this system in Benton County at low risk to contamination from the surface or near surface sources.

Mississippian -- Borden Group Aquifer System

The Mississippian age Borden Group Aquifer System subgroups in most of the central and western portions of Benton County. This bedrock aquifer system is composed mostly of siltstone and shale, but fine-grained sandstones are common. Carbonates are rare, but do occur as discontinuous interbedded limestone lenses, mostly in the upper portion of the group. In Benton County, this system is overlain by unconsolidated deposits with a maximum thickness ranging from outcropping to about 400 feet.

Because this system is generally not very productive, it is typically used only where overlying deposits do not contain aquifer material. The Borden Group is often described as an aquitard, and yields of wells completed in it are typically quite limited. Most of the domestic wells in the mapped area either produce from the overlying unconsolidated deposits or penetrate through the shale and siltstone in favor of the underlying Silurian and Devonian Carbonates. Reported well depths in this system commonly range from 90 to 205 feet deep and the amount of rock penetrated in this system typically ranges from 15 to 95 feet. The typical domestic well in the subgroup produces between 5 and 25 gpm with many dry holes reported. Static water levels commonly range from 15 to 50 feet below the surface.

This system is composed primarily of fine-grained materials that limit the movement of ground water to fractures, joints, and along the bedrock surface. Where the overlying sediment consists of thick fine-grained clay materials, the Borden Group Aquifer System in Benton County is at low risk to contamination from the surface or near surface sources.

Devonian and Mississippian -- New Albany Shale Aquifer System

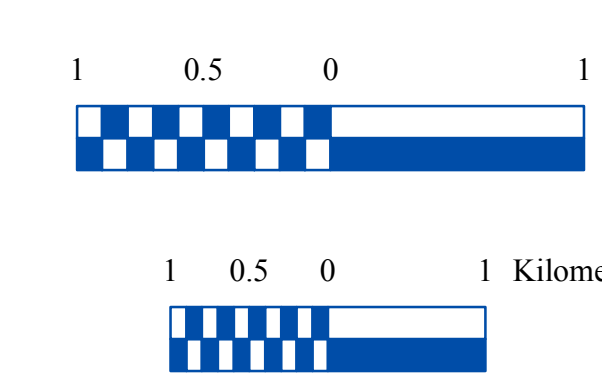
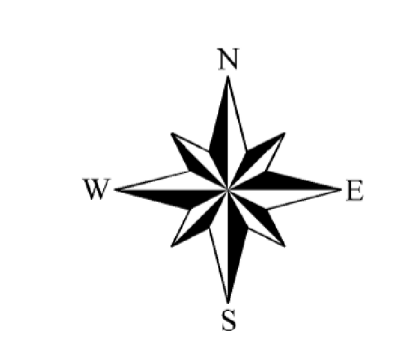
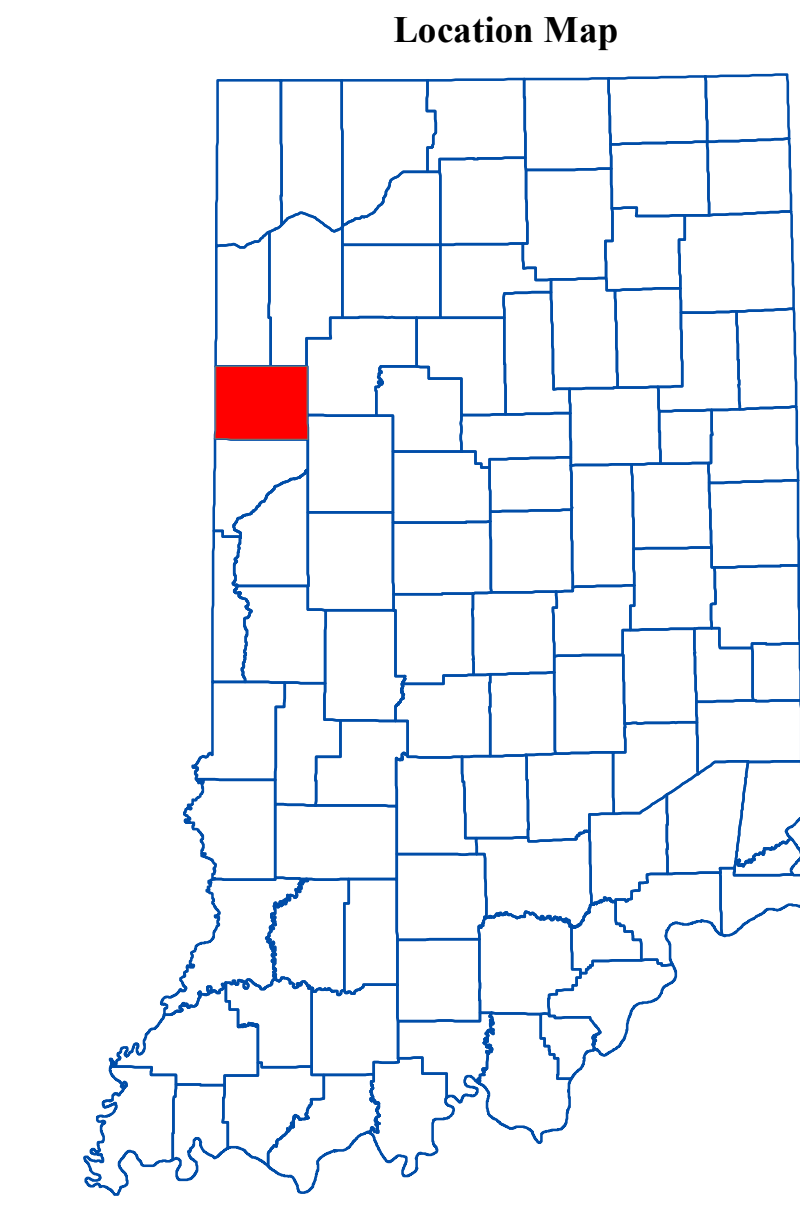
The New Albany Shale consists mostly of brownish-black carbon-rich shale, greenish-gray shale, and minor amounts of dolomite and dolomitic quartz sandstone. The New Albany Shale subgroups along the eastern portion of Benton County and in a small area trending northeast near Boswell. About half of the domestic wells penetrate through the shale in favor of the underlying Silurian and Devonian Carbonates. There are no registered significant ground-water withdrawal facilities completed in this system for Benton County.

Because the New Albany Shale is generally not very productive, it is typically used only where overlying deposits do not contain aquifer material. The New Albany Shale is often described as an aquitard, and yields of wells completed in it are typically quite limited. Reported depths commonly range from 45 to 100 feet deep. The amount of rock penetrated in this system typically ranges from 10 to 60 feet. Domestic water wells commonly yield between 10 and 15 gpm with associated drawdowns commonly ranging from 25 to 55 feet, however, many dry holes have been reported in this system. Typical static water levels range from 5 to 20 feet below the surface. The permeability of shale materials is considered low. The New Albany Shale Aquifer System, therefore, has a low susceptibility to contamination introduced at or near the surface.

Silurian and Devonian Carbonates Aquifer System

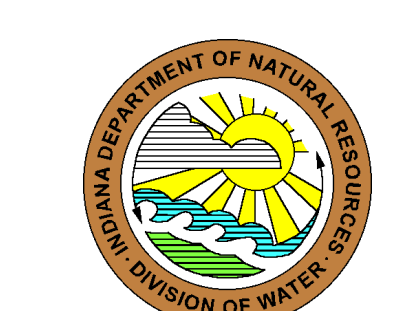
In Benton County, this aquifer system consists primarily of middle Devonian age carbonates of the Muscatuck Group and underlying Silurian carbonates. Because individual units of the Silurian and Devonian systems consist of similar carbonate rock types and cannot easily be distinguished on the basis of water well records, they are considered as a single water-bearing system. The Silurian and Devonian Carbonates Aquifer System subgroups in an area located in the northeast portion of Benton County.

This system is capable of meeting the needs of domestic and high-capacity users in the county. However, few wells utilize the Silurian and Devonian Carbonates Aquifer System in the subgroup area due to the overlying thick productive unconsolidated deposits. Reported depths range from 180 to 210 feet deep and the amount of rock penetrated in this system ranges from 15 to 40 feet. Water wells completed in this system are generally capable of meeting the needs of domestic users with reported yields ranging from 25 to 35 gpm, however, a few dry holes have been reported in this system. Static water levels range from 10 to 35 feet below the surface. There are four registered significant ground-water withdrawal facilities (7 wells) started in the Borden Group Aquifer System and finished in limestone of the Silurian and Devonian Carbonates Aquifer System. High-capacity well yields up to 900 gpm are reported. The Silurian and Devonian Carbonates Aquifer System has a low susceptibility to surface contamination due to thick clay deposits over most of the county.



EXPLANATION

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



Map Use and Disclaimer Statement

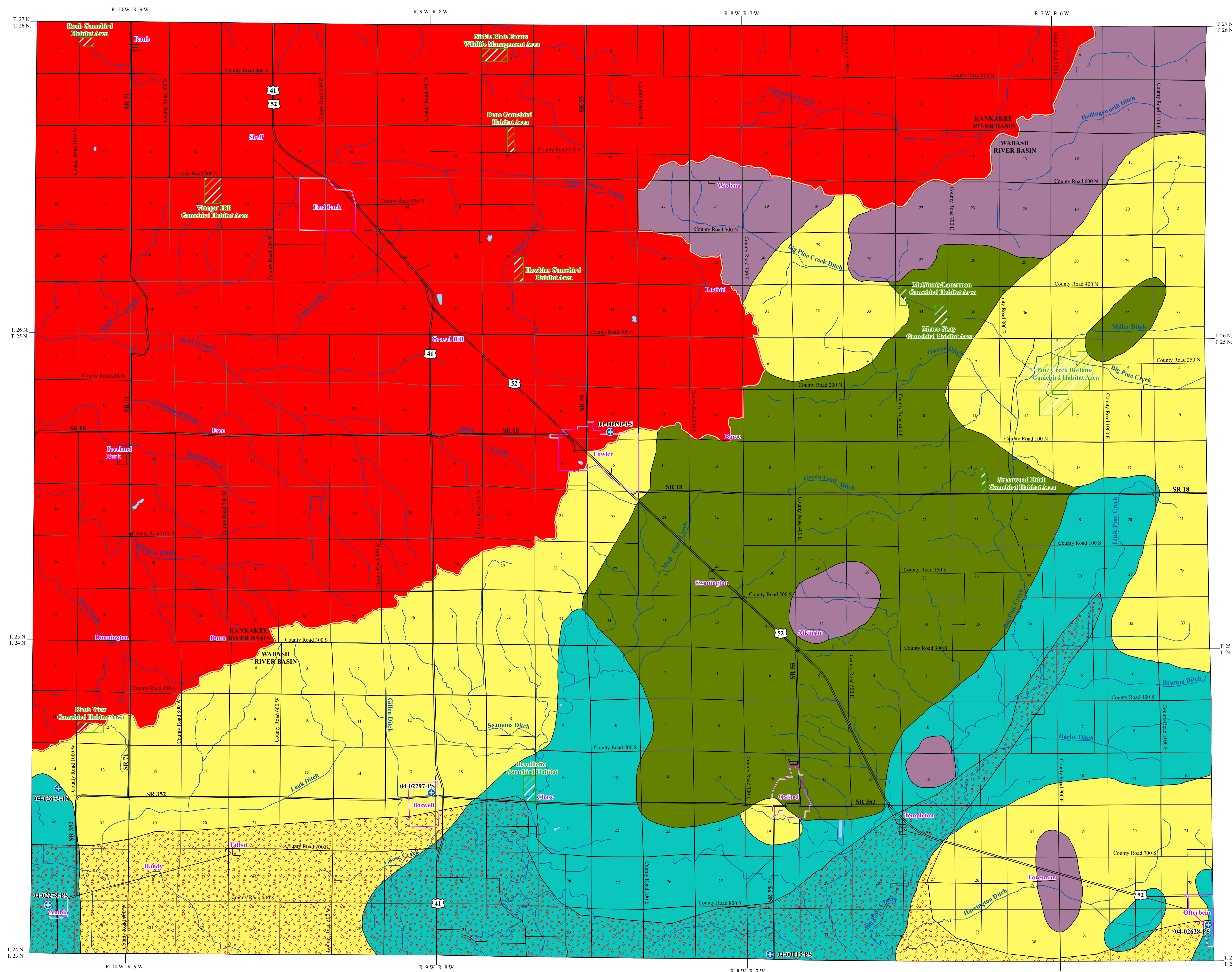
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This map was created from several existing shapefiles. Township and Range Lines of Indiana (line shapefile, 20020621), Land Survey Lines of Indiana (polygon shapefile, 20020621) and County Boundaries of Indiana (polygon shapefile, 20020621), were all from the Indiana Geological Survey and based on a 1:24,000 scale, except the Bedrock Geology of Indiana (polygon shapefile, 20020318), which was at a 1:500,000 scale. Draft road shapefiles, System1 and System2 (line shapefiles, 2003), were from the Indiana Department of Transportation and based on a 1:24,000 scale. Populated Areas in Indiana 2000 (polygon shapefile, 20021000) was from the U.S. Census Bureau and based on a 1:100,000 scale. Streams27 (line shapefile, 20000420) was from the Center for Advanced Applications in GIS at Purdue University. Structural Features of Indiana (line shapefile, 20020718) was from the Indiana Geological Survey and based on various scales. Managed Areas 96 (polygon shapefile, various dates) was from IDNR.

Bedrock Aquifer Systems of Benton County, Indiana

by
Robert A. Scott
Division of Water, Resource Assessment Section
May 2009

UNCONSOLIDATED AQUIFER SYSTEMS OF BENTON COUNTY, INDIANA



Five unconsolidated aquifer systems have been mapped in Benton County: the Till Veneer, the Iroquois Basin, the Iroquois Till, the Iroquois Till Subsystem, and the Iroquois Complex. Boundaries of all aquifer systems described are commonly gradational and individual aquifers may extend across aquifer system boundaries.

The thickness of unconsolidated deposits in Benton County is quite variable, due to glacial material that has been deposited over an uneven bedrock surface. The thickness of unconsolidated deposits ranges from outcropping in the northern half of the county to about 400 feet along the Lafayette (Teays) Bedrock Valley System located along the southern boundary of the county.

Regional estimates of potential contamination to aquifer systems from the surface can differ considerably by location. Variations within geologic environments can result in a wide range of susceptibility to these systems. 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 Benton County, the Till Veneer Aquifer System consists of areas where the unconsolidated material is predominantly thin till overlying bedrock. Along some of the major streams, this system also includes thin alluvium and surficial sand and gravel outwash deposits overlying shallow bedrock. The Till Veneer Aquifer System in Benton County is mapped in portions of the eastern half of the county. This system has the most limited ground-water resources of the unconsolidated aquifer systems in the county. There is little potential for ground-water production in this system in Benton County. Potential aquifers within this system include thin isolated sand and/or gravel layers ranging up to 10 feet thick. These sands and gravels are overlain by a till cap which is commonly 20 to 40 feet thick.

Very few of the reported wells penetrating this aquifer system in the county are completed in unconsolidated materials. Approximately 70 percent of wells started in the Till Veneer Aquifer System are completed in the underlying bedrock aquifer system in Benton County. The depth of the few wells completed in the Till Veneer Aquifer System range from 30 to 50 feet deep with static water levels between 10 to 15 feet below the surface. The majority of the wells have reported capacities of less than 10 gallons per minute (gpm) with associated drawdowns between 10 to 18 feet. There are no registered significant ground-water withdrawal facilities in this system in Benton County.

This system is generally not very susceptible to contamination from surface sources because of the low permeability of the near-surface materials. However, areas where protective clay layers are thin or absent are susceptible to contamination.

Iroquois Basin Aquifer System

The Iroquois Basin Aquifer System in Benton County is an extension of a broad regional aquifer system initially described in the published report, Water Resource Availability in the Kankakee River Basin, Indiana, IDNR, 1990. The system is mapped along most of the northwestern quarter of the county. Characteristics of this system generally consist of either thick clay deposits with thin intermittent sands and gravels that overlie shallow bedrock, or, isolated surface sands with thin to no clay that directly overlie bedrock. Total thickness of these deposits ranges from about 10 feet to over 120 feet.

Approximately 50 percent of the wells completed in the mapped area utilize the underlying bedrock aquifer system. However, this system is capable of meeting the needs of most domestic users and some high-capacity users in the county. Potential aquifer sands and gravels generally range from 2 to 10 feet thick and may directly overlie the bedrock surface. Domestic well yields generally range from 5 to 30 gpm with static water levels from 10 to 40 feet below surface. There is one registered significant ground-water withdrawal facility (2 wells) in this system in Benton County. Each of the high-capacity wells is reported to yield up to 450 gpm.

This aquifer system is generally not very susceptible to surface contamination where sand and gravel units are overlain by thick till deposits. However, areas where overlying clays are thin or absent are at moderate to high risk of contamination.

Iroquois Till Aquifer System

In Benton County, the Iroquois Till Aquifer System ranges from approximately 100 to 400 feet in thickness. Wells completed in this system are capable of meeting the needs of most domestic users in Benton County. However, approximately 40 percent of wells started in this system utilize the underlying bedrock aquifer. Saturated aquifer materials include sand and/or gravel deposits that are commonly 2 to 10 feet thick and are generally overlain by 40 to 100 feet of till. Wells producing from the Iroquois Till Aquifer System are typically 55 to 110 feet deep. Domestic well capacities are commonly 5 to 30 gpm and static water levels generally range from 10 to 35 feet below the surface. There is one registered significant ground-water withdrawal facility (2 wells) in this system in Benton County. The reported yield for each high capacity well is 250 gpm.

Along the southern boundary, this system overlies part of the Lafayette (Teays) Bedrock Valley System. Wells completed in this portion of the system produce from both shallow and deep sand and gravel aquifers. The wells completed in the shallow portions of the buried bedrock valley are up to 90 feet in depth with aquifer thicknesses ranging from 2 to 15 feet. Domestic well capacities are generally up to 10 gpm with static water levels averaging 40 feet below the surface. The few wells completed in the deeper portion of the buried bedrock valley range from approximately 300 to 345 feet deep with aquifer thicknesses up to 35 feet. Well capacities are generally up to 40 gpm with static water levels around 92 feet below surface.

The Iroquois Till Aquifer System typically has a low susceptibility to surface contamination because intratill sand and gravel units are commonly overlain by thick glacial till. Shallow wells completed in this system are moderately susceptible to contamination where surficial clay deposits are thin.

Iroquois Till Aquifer Subsystem

The Iroquois Till Aquifer Subsystem is mapped similar to the Iroquois Till Aquifer System, however, potential aquifer materials are typically thinner and potential yield is generally less in the subsystem. The unconsolidated material in the Iroquois Till Aquifer Subsystem ranges from about 50 to 200 feet thick. Potential aquifer materials include thin intratill sand and gravel deposits. Where present, aquifer materials are typically capped by till that is commonly 25 to 60 feet thick.

In Benton County, approximately 60 percent of wells started in the Iroquois Till Aquifer Subsystem are completed in the underlying bedrock aquifer system. However, this subsystem is capable of meeting the needs of some domestic users in the county. The few wells producing from the subsystem are generally completed at depths of 50 to 90 feet. Intratill sand and gravel aquifer materials are typically 5 to 10 feet thick. Reported well yields generally range from 5 to 15 gpm and static water levels are commonly 10 to 30 feet below the surface. There are no registered significant ground-water withdrawal facilities in this system in Benton County.

This subsystem is generally not very susceptible to surface contamination because intratill sand and gravel units are overlain by thick till deposits. However, in some areas where aquifers are shallow and overlying clay deposits are thin, the system is at moderate risk.

Iroquois Complex Aquifer System

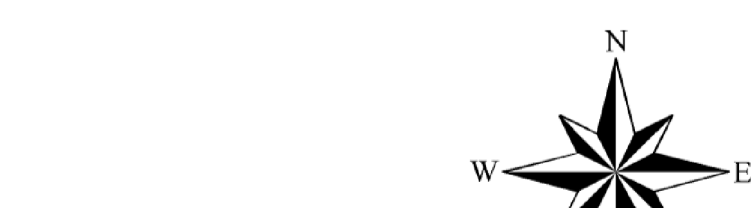
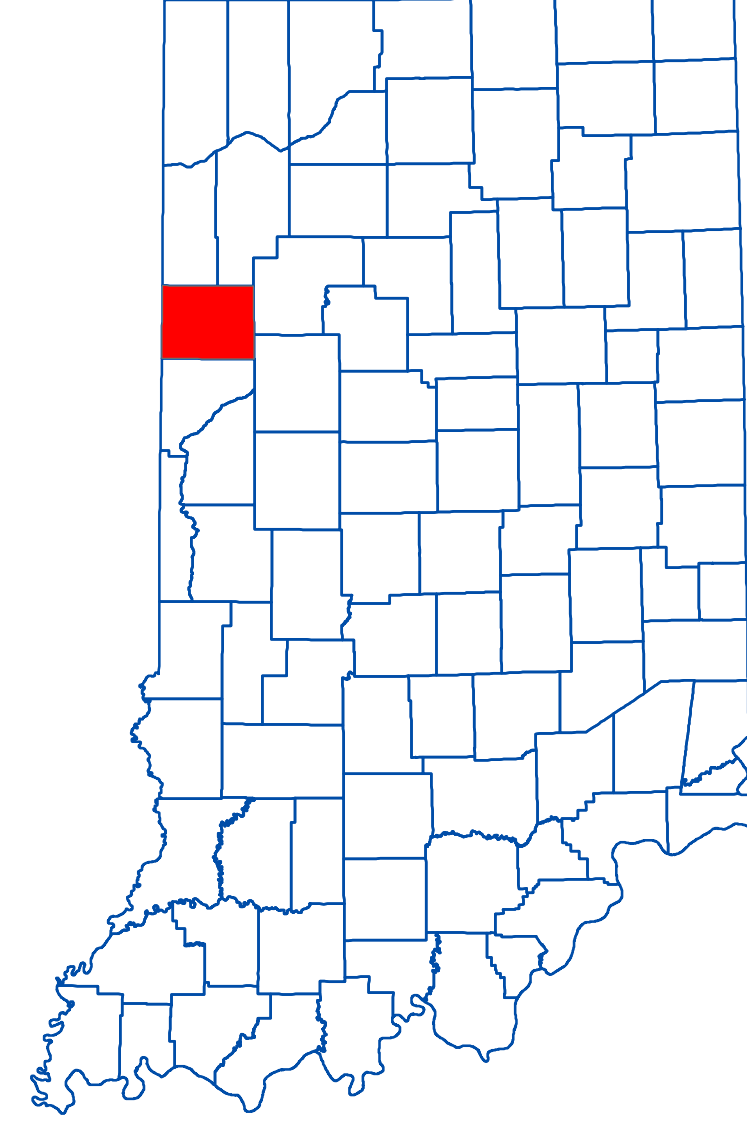
The Iroquois Complex Aquifer System is characterized by unconsolidated deposits that are quite variable in materials and thickness. Aquifers within the system range from thin to thick and include single or multiple intratill sands and gravels. The aquifers are highly variable in depth and lateral extent and are typically confined by thick clay layers. The total unconsolidated thickness of the Iroquois Complex Aquifer System generally ranges from about 150 to 300 feet in Benton County.

This system is capable of meeting the needs of domestic and most high-capacity users in the county. However, approximately 15 percent of wells started in this system utilize the underlying bedrock aquifer. Aquifer layers utilized in this system are generally 10 to 20 feet thick sands and/or gravels. These sands and gravels are overlain by a till cap which is commonly 15 to 60 feet thick with thin intratill sand and gravel layers. Wells in this system are typically completed at depths ranging from 85 to 160 feet. Domestic well yields are commonly 15 to 60 gpm and static water levels are generally 5 to 35 feet below the surface. There are four registered significant ground-water withdrawal facilities (7 wells) in this system in Benton County. High-capacity well yields up to 650 gpm are reported.

In the southern third of Benton County a portion of this system overlies the Lafayette (Teays) Bedrock Valley System. Wells completed in this portion of the system produce from both shallow and deep sand and gravel aquifers. The wells completed in the shallow portion of the buried bedrock valley are up to 175 feet in depth with aquifer thicknesses ranging from 2 to 30 feet. Well capacities are generally up to 25 gpm with static water levels around 30 feet below surface. The few wells completed in the deeper portion of the buried bedrock valley are up to 250 feet in depth with aquifer thicknesses up to 100 feet. Well capacities are generally up to 60 gpm with static water levels around 60 feet below surface.

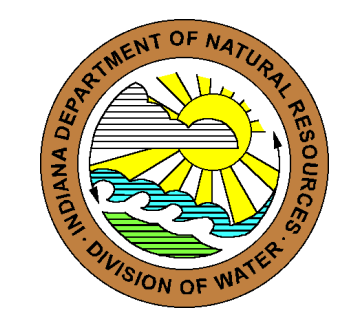
The Iroquois Complex Aquifer System is generally not susceptible to contamination because it is typically overlain by thick clay deposits. However, in some areas where surficial clay deposits are thin or lacking, the shallow aquifer, if present, is at moderate to high risk of surface contamination.

Location Map



EXPLANATION

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



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This map was created from several existing shapefiles. The Kankakee River Basin coverage was from the Water Resource Availability in the Kankakee River Basin, Indiana, IDNR, 1990 publication and based on a 1:48,000 scale. Township and Range Lines of Indiana (line shapefile, 20020621), Land Survey Lines of Indiana (polygon shapefile, 20020621), and County Boundaries of Indiana (polygon shapefile, 20020621), were all from the Indiana Geological Survey and based on a 1:24,000 scale. Draft road shapefiles, System1 and System2 (line shapefiles, 2003), were from the Indiana Department of Transportation and based on a 1:24,000 scale. Populated Areas in Indiana 2000 (polygon shapefile, 20021000) was from the U.S. Census Bureau and based on a 1:100,000 scale. Streams27 (line shapefile, 20000420) was from the Center for Advanced Applications in GIS at Purdue University. Managed Areas 96 (polygon shapefile, various dates) was from IDNR. Unconsolidated aquifer systems coverage (Scott, 2009) was based on a 1:24,000 scale.

Unconsolidated Aquifer Systems of Benton County, Indiana

by
Robert A. Scott
Division of Water, Resource Assessment Section

May 2009

Benton County

