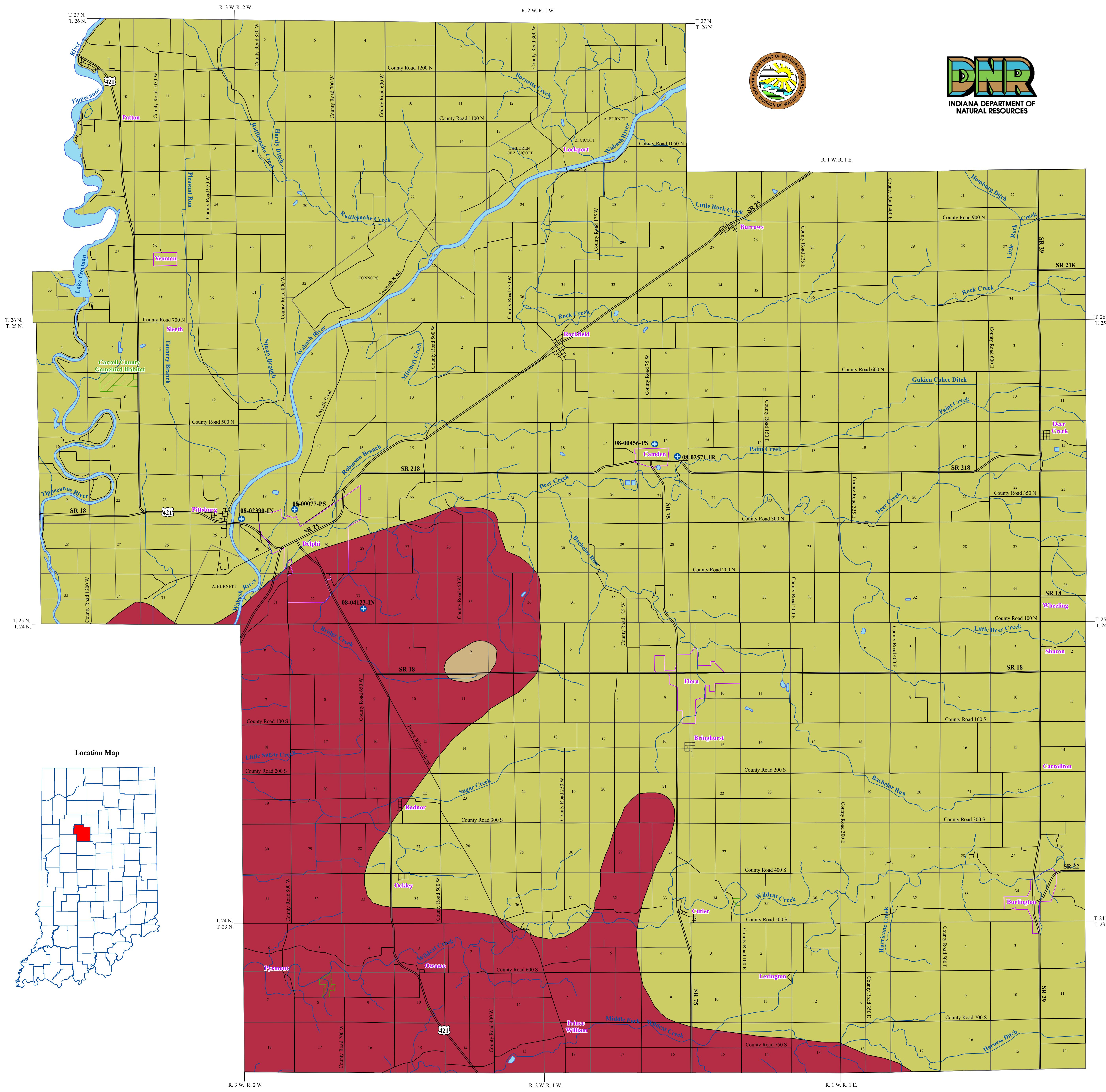


BEDROCK AQUIFER SYSTEMS OF CARROLL COUNTY, INDIANA



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 up to 300 feet. 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.

Three bedrock aquifer systems are identified for Carroll County. They are, from younger to older, the Borden Group of Mississippian age, the New Albany Shale of Devonian and Mississippian age, and the Silurian and Devonian Carbonates. Bedrock wells represent about twenty-three 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.

Mississippian -- Borden Group Aquifer System

The Mississippian age Borden Group subgroups in a small area located in the south-central portion of Carroll 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.

The Borden Group in Carroll County is overlain by unconsolidated deposits with a maximum thickness ranging from 50 to 100 feet. Because the Borden Group 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 wells completed in it typically have quite limited yields. There is only one reported well completed in the Borden Group for Carroll County. This well is 143 feet deep and penetrates 83 feet of bedrock. The yield for the domestic well is 3 gallons per minute (gpm) and the static water level is reported to be 10 feet below the land surface.

The Borden Group is composed of primarily 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 the Borden Group Aquifer System in Carroll County 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 mostly in the southwestern portion of Carroll County. There are a limited number of reported wells completed in the system in this county. Typically domestic wells either produce from the overlying unconsolidated deposits or penetrate through the shale in favor of the underlying Silurian and Devonian Carbonates.

Because the New Albany Shale is generally not very productive, it is typically used only where overlying deposits do not contain aquifer material. This system is often described as an aquitard, and yields of wells completed in it are typically quite limited. The wells utilizing the New Albany Shale Aquifer System in Carroll County have reported depths ranging from 90 to 240 feet deep. The amount of rock penetrated in this system ranges from 5 to 70 feet. The water wells completed in this system are generally capable of meeting the needs of the domestic user. The reported yields for the domestic wells range from 2 to 10 gpm. The static water levels are reported to range from 20 to 65 feet below the land 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

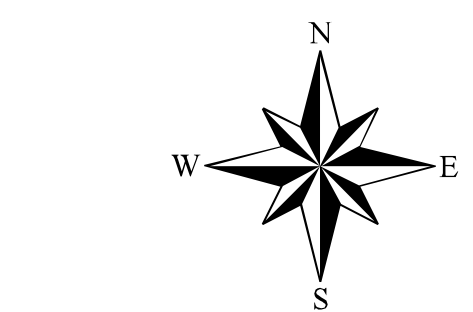
In Carroll County this aquifer system consists primarily of middle Devonian age carbonates of the Mississippian Group and underlying Silurian carbonates. Because individual units of the Silurian and Devonian systems consist of similar carbonate rock types and cannot easily be distinguished on the basis of water well records, they are considered as a single water-bearing system.

Wells utilizing the Silurian and Devonian Carbonates Aquifer System in Carroll County have reported depths commonly ranging from 100 to 200 feet, but some have been reported up to 300 feet deep. The amount of rock penetrated in this system typically ranges from 10 to 75 feet. Water wells completed in this system are generally capable of meeting the needs of domestic users. Typical yields for domestic wells range from 15 to 70 gpm. Static water levels commonly range from 15 to 65 feet below the land surface. There are five registered significant ground-water withdrawal facilities (16 wells) in this system in Carroll County. High-capacity well yields up to 1000 gpm are reported.

This aquifer system has a low susceptibility to surface contamination due to thick clay deposits over most of the county. However, the Silurian and Devonian Carbonate Aquifer System is moderately to highly susceptible where overlain by sand and gravel and in places where clay aquitards are absent.

EXPLANATION

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



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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. Managed Areas 96 (polygon shapefile, various dates) was from IDNR.

Bedrock Aquifer Systems of Carroll County, Indiana

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February 2009