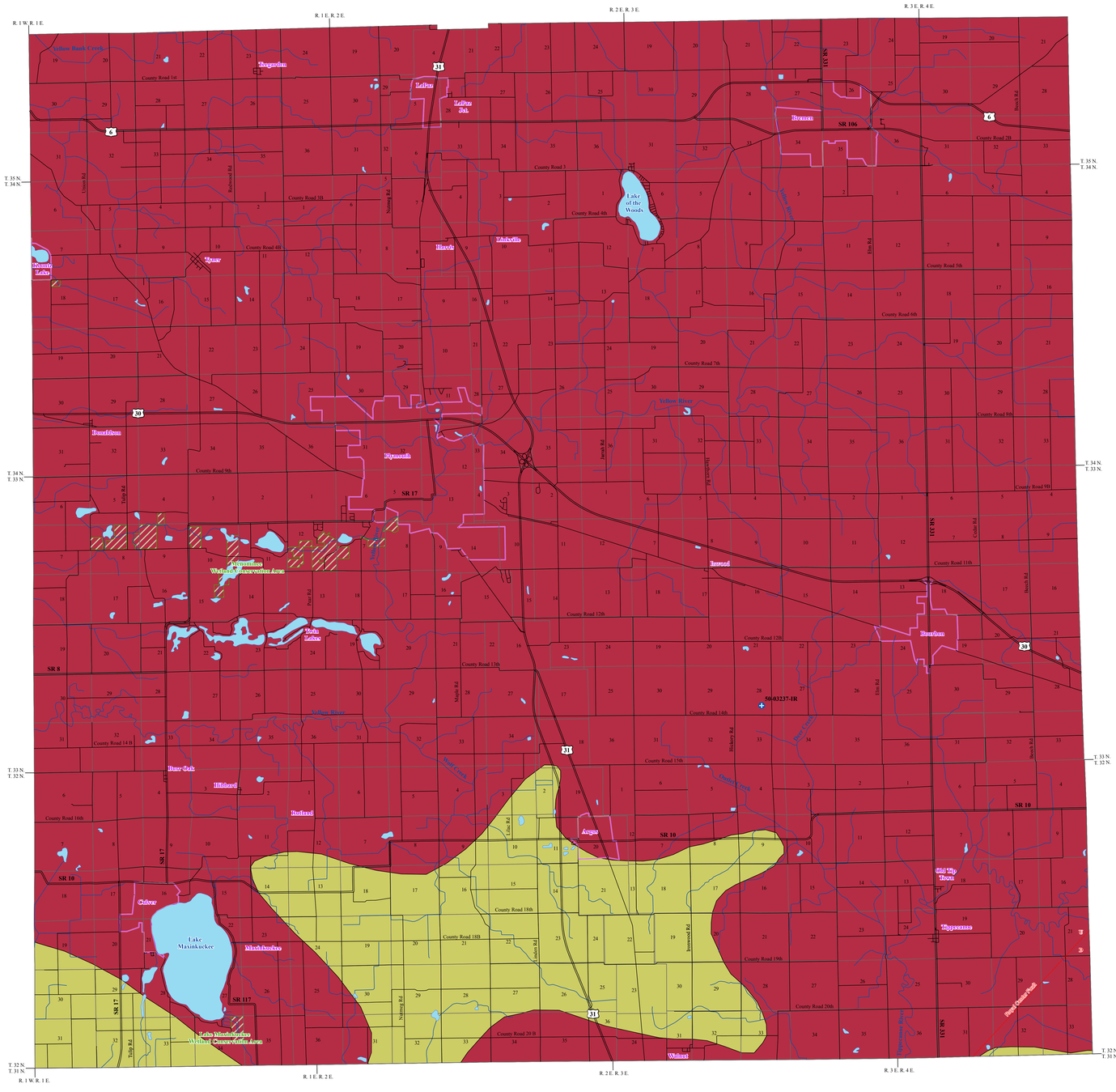
BEDROCK AQUIFER SYSTEMS OF MARSHALL COUNTY, INDIANA



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.

Unconsolidated deposits of varying thickness overlie bedrock aquifer systems in Marshall County. Thickness of unconsolidated deposits in Marshall County ranges from 105 to 370 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 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 Marshall County. They are the Devonian and Mississippian Coldwater, Ellsworth and Antrim Shales; and the Silurian and Devonian Carbonates.

Devonian and Mississippian -- Coldwater, Elsworth and Antrim Shales Aquifer System

In Marshall County only the Ellsworth and Antrim shales subcrop in the Coldwater, Ellsworth and Antrim Shales Aquifer System. The Ellsworth Shale in Indiana is typically described as alternating greenish gray to brownish-black shale while the Antrim Shale is described as brownish-black shale. Both are commonly considered an aquitard: therefore, the system is an extremely limited ground-water resource. However, in some places the lower portion of the Antrim Shale may contain some limestone.

The subcrop area for the Ellsworth Shale includes most of the northern half of Marshall County while the Antrim Shale includes most of the southern half. Depth to bedrock ranges from 105 to 236 feet. Many oil and gas and domestic wells that penetrate through the shale to the underlying Devonian Carbonates provide information on range of thickness for the Ellsworth and Antrim shale. General reported thickness of the Ellsworth Shale in the subcrop area ranges from 60 to 220 feet while reported thickness of the Antrim ranges from 25 to 99 feet.

Due to the availability of the overlying unconsolidated deposits and the resource limitation of shale, only one well (dry hole) is reported in the Coldwater, Ellsworth and Antrim Shales Aquifer System in Marshall County. 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. However, outwash areas to the southeast are considered moderate to high risk to contamination.

Silurian and Devonian Carbonates Aquifer System

The Silurian and Devonian Carbonates Aquifer System subcrops over a small area of south-central Marshall County and includes Devonian age carbonate rock units of the Muscatatuck Group. Total thickness of Devonian bedrock is up to 125 feet. Depth to the bedrock surface ranges from about 110 to 370 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. Total well depths range from 325 to 370 feet with penetration into bedrock ranging from 1 to 162 feet. Domestic yields generally range from 10 to 70 gallons per minute (gpm) with static water levels ranging from 6 to 160 feet. There is one registered significant ground-water withdrawal facility (two wells) utilizing the Silurian and Devonian Carbonates Aquifer System with reported yields of 200 and 1000 gpm.

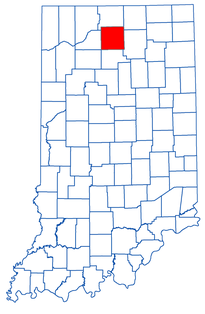
Most of the Silurian and Devonian Carbonates Aquifer System in Marshall County is overlain by thick clay deposits. This aquifer system is generally considered at low risk to contamination.

N
W E
S

1 0.5 0 1 Mile

1 0.5 0 1 Kilometer

Location Map



EXPLANATION

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

INDIANA DEPARTMENT OF NATURAL RESOURCES

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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.

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April 2008