

# **Bedrock Aquifer Systems of Marion County, Indiana**

by

Robert K. Schmidt

Division of Water, Resource Assessment Section

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The occurrence of bedrock aquifers depends on the original composition of the geologic material 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.

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 bedrock aquifers are highly variable.

Most bedrock aquifers are under confined conditions, mainly a result of low vertical hydraulic conductivity clay-rich materials, such as glacial till, overlying the bedrock. Therefore, the potentiometric surface (water level) in most wells completed in bedrock rises above the top of the water-bearing zone.

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

Three bedrock aquifer systems are identified within Marion County. They are, from youngest to oldest and from west to east: the Borden Group of Mississippian age; the New Albany Shale of Devonian and Mississippian age; and the Silurian and Devonian Carbonates.

Depth to bedrock ranges from outcropping along a relatively small area of the White River in the north-central section of Marion County, to being overlain by unconsolidated deposits up to about 305 feet thick in the northeast. Approximately 19 percent of all wells in this county are completed in bedrock.

## **Mississippian -- Borden Group Aquifer System**

The Borden Group subcrops in the southwestern area of Marion County, and in a relatively small area of the northwestern corner of the county. This bedrock aquifer system is composed mostly of sandstone, siltstone, mudstone and shale. Although carbonates are somewhat rare,

discontinuous interbedded limestone lenses are present. The Borden Group in Marion County is overlain by unconsolidated deposits up to approximately 240 feet in thickness.

The Borden Group is composed primarily of fine-grained materials that limit the movement of groundwater to fractures, joints, and along the bedrock surface. This aquifer system is often described as an aquitard, and yields of wells completed in it are typically quite limited. Because the Borden Group is generally not very productive, most wells produce either from the overlying unconsolidated deposits or penetrate through the sandstone, siltstone, mudstone and shale in favor of the underlying carbonates.

Wells started in this system are completed at depths ranging from approximately 35 to 400 feet. Domestic well yields range from 2 to 20 gallons per minute (gpm) with static water levels from about 5 to 250 feet below surface. There are no registered significant groundwater withdrawal facilities using the Borden Group Aquifer System.

Where bedrock is shallow, risk to contamination from the surface or near surface sources is high. Where the overlying sediments consist of thick fine-grained clay materials, the Borden Group Aquifer System is at low risk to contamination. However, in some areas the aquifer system is overlain by unconsolidated deposits composed primarily of sand and gravel outwash materials. In such areas, the aquifer system is considered at high risk.

### **Devonian and Mississippian -- New Albany Shale Aquifer System**

The New Albany Shale subcrops in a northwest to southeast trend in Marion County and consists mostly of brownish-black carbon-rich shale, greenish-gray shale, and minor amounts of dolomite and dolomitic quartz sandstone. The New Albany Shale is often described as an aquitard, and yields of wells completed in it are typically quite limited. Therefore, most wells either produce from the overlying unconsolidated deposits or penetrate through the shale in favor of the underlying Silurian and Devonian Carbonates.

The depths of the relatively few wells reported in the New Albany Shale Aquifer System range from approximately 30 to 415 feet deep, and the amount of rock penetrated in this system is generally about 10 to 240 feet. Domestic water well yields are typically less than 5 gpm with many dry holes having been reported in this system. There are no registered significant groundwater withdrawal facilities using the New Albany Shale Aquifer System.

The permeability of shale materials is considered low, therefore, the New Albany Shale Aquifer System is considered to have a low susceptibility to contamination introduced at or near the surface.

### **Silurian and Devonian Carbonates Aquifer System**

In Marion County, the outcrop/subcrop area of the Silurian and Devonian Carbonates Aquifer System is present in the central and eastern portions of the county. This system includes middle-Devonian age carbonates (limestone and dolomite) of the Muscatatuck Group, and the underlying carbonates of Silurian age. Because carbonate units of Silurian and Devonian age are

similar 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 is capable of meeting the needs of domestic and some high-capacity users. Wells in the system penetrate up to 400 feet into the carbonate bedrock with completed well depths ranging from 30 to 485 feet. Typical domestic yields are 10 gpm or greater with static water levels reported from flowing to 227 feet below surface.

There are 14 registered significant groundwater withdrawal facilities (39 wells) using the Silurian and Devonian Carbonates Aquifer System. These facilities are used for public supply, industry, irrigation, and energy production. The reported yields for these wells range from 93 to 1,200 gpm.

Most of the Silurian and Devonian Carbonates Aquifer System is overlain by thick clay deposits. Therefore, most of the aquifer system is considered at low risk to contamination. However, in some areas the aquifer system is overlain by unconsolidated deposits composed primarily of sand and gravel outwash materials. In such areas, the aquifer system is considered at high risk.

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