

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

by

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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 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.

Three bedrock aquifer systems are identified for Knox County. They are, from west to east and younger to older: the McLeansboro Group of Pennsylvanian age; the Carbondale Group of Pennsylvanian age; and the Raccoon Creek Group of Pennsylvanian age. Bedrock aquifer systems in Knox County are overlain by unconsolidated deposits ranging in thickness from less than one foot to 210 feet.

The unconsolidated sand and gravel outwash aquifers near the Wabash and White rivers have far greater groundwater potential than the bedrock aquifers in the county. However, bedrock aquifers are widely used in Knox County where unconsolidated sediments are relatively thin and unproductive. Approximately 65 percent of all wells in this county are completed in bedrock.

## **Pennsylvanian -- McLeansboro Group Aquifer System**

The McLeansboro Group subcrop area is located throughout nearly all of Knox County excluding the area along the eastern portion of the county. This aquifer system consists in

descending order of the Mattoon, Bond, Patoka, and Shelburn Formations; however, the Mattoon Formation is not present in Knox County.

The Bond and Patoka Formations are composed of sandstone, shale, mudstone, siltstone, and limestone. The underlying Shelburn Formation consists of sandstone, shale, siltstone, mudstone, limestone, and coal. Two important members of the Shelburn Formation include the West Franklin Limestone at the top of the formation and the Busseron Sandstone at the base. These are the primary aquifer units within the McLeansboro Group Aquifer System in Knox County.

The depth to the bedrock surface ranges from less than one foot to 180 feet; however, the typical depth to bedrock ranges from 18 to 62 feet throughout the county. Total well depths commonly range from 75 to 160 feet. The amount of rock penetrated generally ranges from 35 to 115 feet. Domestic well yields range from 2 to 15 gallons per minute (gpm) with static water levels ranging from 14 to 45 feet below the surface. High yields are typically associated with significant drawdowns. A few dry (pumped) holes have been reported. There are no registered significant groundwater withdrawal facilities using the McLeansboro Group Aquifer System in Knox County.

In the majority of Knox County, the McLeansboro Group Aquifer System has a low susceptibility to surface contamination where thick clay deposits overlie the system. However where overlying clays are thin or absent, these areas are at moderate to high risk to contamination.

### **Pennsylvanian -- Carbondale Group Aquifer System**

The Carbondale Group Aquifer System subcrops in portions of eastern Knox County. The group consists in ascending order of the Linton, Petersburg, and Dugger Formations. Bedrock deposits include mostly shale and sandstone with some limestone and commercially important coal.

Depth to the bedrock surface ranges from 5 to 210 feet, however the depth to bedrock is typically from 28 to 140 feet throughout the county. Well depths generally range from 85 to 235 feet. The amount of rock penetrated ranges from 22 to 120 feet. The Carbondale Group is considered a minor groundwater source with most wells producing from the thicker sandstone and coal units found in the upper formations of the group. Reported domestic well yields range from 2 to 10 gpm with static water levels ranging from 15 to 75 feet below the surface. High yields are typically associated with significant drawdowns. A few dry (pumped) holes have been reported. Water quality from the deeper bedrock units is highly mineralized. There are no registered significant groundwater withdrawal facilities using the Carbondale Group Aquifer System in Knox County.

Where the overlying sediment consists of thick fine-grained clay materials, the Carbondale Group Aquifer System in Knox County is at low risk to contamination from the surface or near surface sources. Where bedrock is shallow, risk to contamination from the surface or near surface sources is high.

## **Pennsylvanian -- Raccoon Creek Group Aquifer System**

The Raccoon Creek Group Aquifer System is present in a relatively small portion of northeastern Knox County. This aquifer system consists of three formations: Mansfield, Brazil, and Staunton Formations. The Raccoon Creek Group is composed primarily of shale and sandstone with some clay, coal, and limestone present.

The Division has no records of domestic wells that are completed in this system in Knox County. However, in nearby Daviess County well depths are highly variable, ranging from 25 to 490 feet with 60 to 220 feet of typical bedrock penetration. Also, in Daviess County domestic well yields are generally 4 to 30 gpm with reported static water levels ranging from 1 to 197 feet below land surface. There are no registered significant groundwater withdrawal facilities using the Raccoon Creek Group Aquifer System in Knox County.

As noted in Daviess County, water quality is generally satisfactory for domestic use, with some wells producing hard water (calcium-magnesium-bicarbonate type) and some soft water (sodium bicarbonate type). However, records of a few of the deeper wells note salty water. Such water quality may also be noted in shallower wells in scattered low-lying areas. The aquifer system is not very susceptible to contamination from the land surface because of the typical presence of low-permeability materials above the water-bearing zones.

## **Underground Mine Areas**

In approximately 5 percent of the county various coal seams, within the McLeansboro Group and the Carbondale Group, have been extracted by underground mining methods. About 50 percent of most coal seams are removed during mining operations leaving the potential for storage of substantial amounts of water. The Division of Water has information on a facility with two wells drilled into underground mines for such purposes as coal preparation. These wells have capacities of 40 and 500 gpm. A limitation on use of the water could be its more mineralized nature.

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