BEDROCK AQUIFER SYSTEMS OF GIBSON COUNTY, INDIANA

Gibson County Bedrock Aquifer Systems

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. In Gibson County, rock types exposed at the bedrock surface range from relatively unproductive shales to moderately productive sandstones. Thin limestone and coal seams are noted as water bearing in some wells.

Bedrock aquifer systems in the county are overlain by unconsolidated deposits of varying thickness. Refer to the map for unconsolidated aquifer systems for more information. 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 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.

Two bedrock aquifer systems are identified for Gibson County based on bedrock lithology. They are, from west to east and younger to older: McLeansboro Group of Pennsylvanian age and Carbondale Group of Pennsylvanian age. The McLeansboro Group covers about 92 percent of the county. The Carbondale is only exposed in eastern Gibson County where streams have incised deeply enough into the southwest-dipping Pennsylvanian strata to completely remove overlying McLeansboro Group rocks.

Bedrock aquifers are used extensively throughout the county except along the northwestern county boundary where adequate ground water is generally available from shallower unconsolidated material within the floodplains of the Wabash and White Rivers and in the central part of the county where wells are commonly completed in intratill sand and gravel units. Elsewhere in the county, unconsolidated materials are very thin, primarily consisting of weathered bedrock residuum, till, loess, and/or lacustrine silt and clay.

The susceptibility of bedrock aquifer systems to surface contamination is largely dependent on the type and thickness of the overlying sediments. Just as recharge for bedrock aquifers cannot exceed that of overlying unconsolidated deposits, susceptibility to surface contamination will not exceed that of overlying deposits. 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--McLeansboro Group Aquifer System

The outcrop/subcrop area of the McLeansboro Group covers about 92 percent of Gibson County. Down-cutting streams have removed the McLeansboro Group in the eastern part of the county. It ranges in thickness from 0 feet at its eastern contact with the underlying Carbondale Group to about 700 feet near the western county line. This aquifer system consists in ascending order of the Shelburn, Patoka, Bond, and Mattoon Formations, all of which are present in parts of the county. The Shelburn Formation contains the BusieronSandstone Member at or near its base. The sandstone is typically gray to tan in color, fine to medium-grained, and massive. It is interbedded in places with gray shale. It is fairly extensive and is used in places as an aquifer, even though its low permeability typically limits well yields. Overlying the Shelburn Formation is the Patoka Formation, which contains the Inglefield Sandstone Member, its chief water-bearing unit, near its base. The Inglefield Sandstone is gray to white in color, fine-grained, and thin to thick bedded. The subcrop of the Bond and Mattoon Formations occurs beneath the prolific unconsolidated outwash aquifer system in the county, therefore these formations are rarely if ever used to produce potable water.

The depth to the bedrock surface in the McLeansboro Group is generally less than 50 feet. Wells range in depth from 26 to 337 feet, but are typically 75 to 170 feet deep. The amount of rock penetrated typically ranges from 35 to 130 feet, with a maximum of 317 feet. Static water levels in wells developed in the McLeansboro Group range from 2 to 200 feet below land surface, but are typically between 15 and 50 feet below the surface.

In general the McLeansboro Group in Gibson County is considered a minor ground-water source with most wells producing from the Inglefield Sandstone, the Busseron Sandstone, or from a combination of McLeansboro and Carbondale Group formations. Most domestic wells produce between 2 and 10 gallons per minute (gpm) with localized yields of up to 50 gpm. A few (pumped) dry holes have been reported.

Water quality is generally good and the aquifer system is not very susceptible to contamination from the land surface. However, in limited areas some improperly constructed or abandoned oil wells may have caused some contamination in the immediate vicinity of the wells. Expected contaminants would be dissolved solids, especially sodium and chloride, and crude oil. Natural water quality gets progressively worse (more salty) in wells deeper than about 300 feet.

Pennsylvanian--Carbondale Group Aquifer System

The outcrop/subcrop of the Carbondale Group in Gibson County occurs only in bedrock valleys in the eastern part of the county. The thickness of the group ranges from about 200 feet along its eastern edge to about 425 feet near the western county line. The Carbondale Group consists in ascending order of the Linton, Petersburg, and Dugger Formations. It overlies the Raccoon Creek Group and underlies the McLeansboro Group. The Carbondale Group consists mostly of shales and sandstones with some coal and limestone. This group includes some laterally persistent limestones and four of Indiana's commercially important coals. Persistent shales and underclays are associated with several of these coals. Coal beds 5 to 8 feet thick are widespread. Clay beds as much as 10 feet thick underlie coals. Two limestone beds are 5 to 15 feet thick.

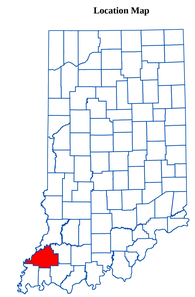
The Carbondale Group is considered a minor ground-water source in the county with most wells producing from the thicker sandstone and coal units. Most wells for homes, irrigation, and stock produce between 2 and 10 gpm with localized yields of up to 40 gpm. A few (pumped) dry holes have been reported.

The depth to the bedrock surface is typically less than 45 feet. Well depths in the Carbondale Group range from 46 to 245 feet with most constructed at depths between 75 and 185 feet. The amount of rock penetrated by these wells typically ranges from 45 to 150 feet with a maximum of 219 feet. Static water levels in the wells vary from 5 to 100 feet below the land surface, but are typically between 12 and 45 feet below the surface.

Water quality is generally good and the aquifer system is not very susceptible to contamination from the land surface. However, in areas of surface and underground coal mining, some localized contamination may have occurred. (Refer to the unconsolidated aquifer systems map for locations of areas surface mined for coal.) Contaminants are typically dissolved solids, including calcium, magnesium, sulfate, bicarbonate, and iron. The natural quality of well water gets progressively more mineralized (commonly changing from a calcium-magnesium-bicarbonate type to a sodium bicarbonate or sodium chloride type) as wells are drilled deeper than about 300 feet and the rock strata dip beneath younger rocks to the southwest.

Underground Mine Areas

In about 4 percent of the county various coal seams within the Carbondale Group have been removed by underground mining methods. In underground mines, approximately 50 percent of the coal seam was typically removed, leaving the potential for storage of substantial amounts of water in the larger mines. Although the Division has no records of wells drilled into these mines, yields of a few hundred gpm are possible. A limitation on use of the water could be its more mineralized nature.



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This map was created from several existing shapefiles, Underground Coal Mines in Southwestern Indiana (polygon shapefile, 20001002), Township and Range Lines of Indiana (line shapefile, 20020621), Land Survey Lines of Indiana (polygon shapefile, 20020621), and County Boundaries of Indiana (polygon shapefile, 20050621) were all from the Indiana Geological Survey and based on a 1:24,000 scale, except the Bedrock Geology of Southwestern Indiana (polygon shapefile, 20001124), which was at a 1:500,000 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. Draft road shapefiles, System1 and System2 (line shapefiles, 2003), were from the Indiana Department of Transportation and based on a 1:24,000 scales. Structural Features of Indiana (line shapefile, 20020718) was from the Indiana Geological Survey and based on various scales.

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