

# Water Resources and Use in Morgan County

- |                            |                       |
|----------------------------|-----------------------|
| <b>Withdrawal Location</b> | <b>River</b>          |
| WELL INTAKE                | <b>7Q2 Flow (MGD)</b> |
| ● Energy/Mining            | — <10 MGD             |
| ● Industry                 | — 10 - 50 MGD         |
| ● Irrigation               | — 50 - 100 MGD        |
| ● Misc.                    | — 100 - 500 MGD       |
| ● Public Supply            | — > 500 MGD           |
| ● Rural Use                |                       |

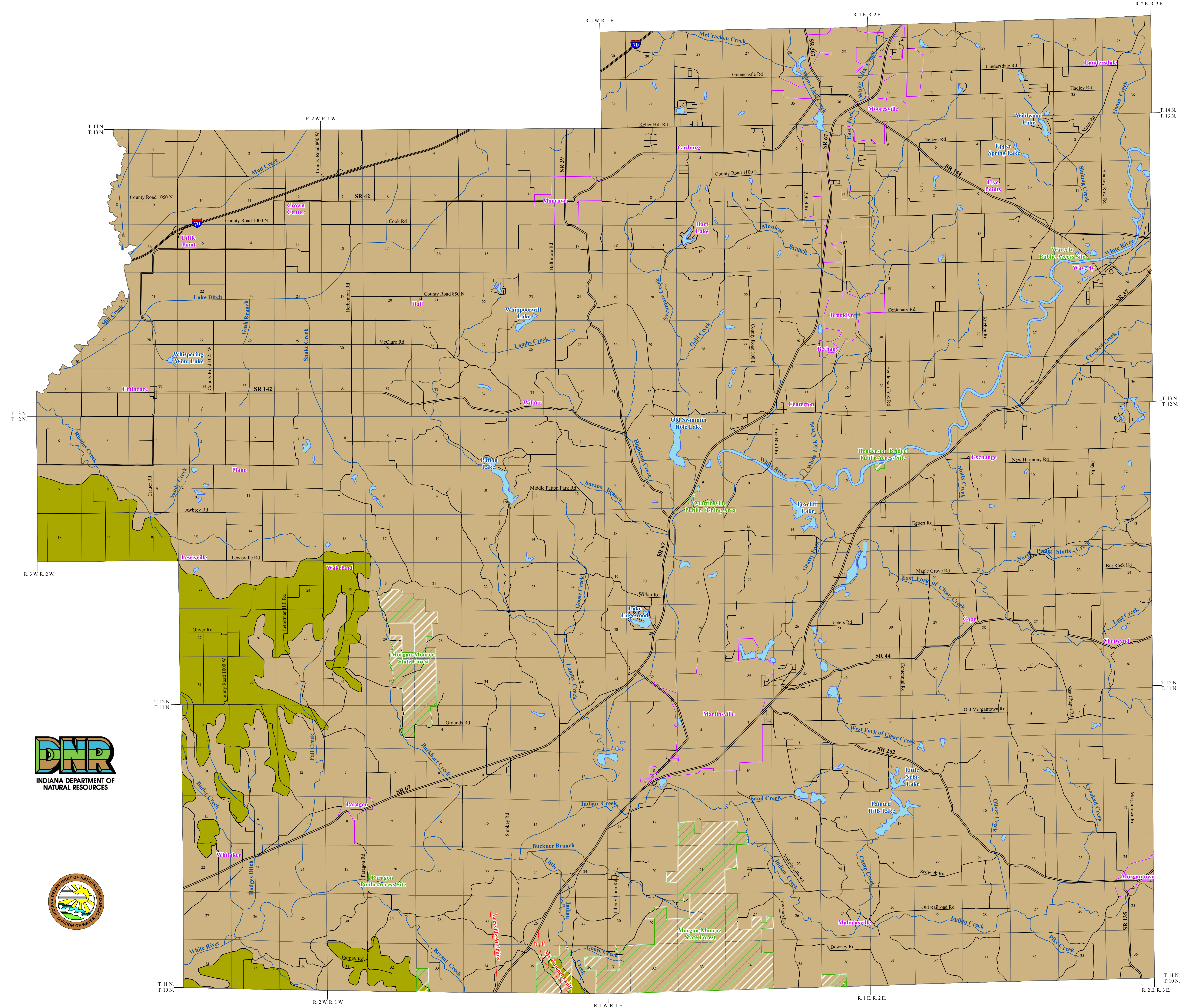
Major Lakes  
 Interstate  
 County  
 City

**INTERA**  
 GEOSCIENCE & ENGINEERING SOLUTIONS

NORTH  
 0 1 2 4 Miles

Data Sources: U.S. Geological Survey and Indiana Department of Natural Resources

# BEDROCK AQUIFER SYSTEMS OF MORGAN 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 Morgan County. Total thickness ranges from less than one foot where bedrock is near the surface or outcrops along portions of the White River, to an estimated 250 feet where glacial lacustrine and outwash sediments have filled bedrock valleys. 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.

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.

Approximately 69 percent of all wells in Morgan County are completed in bedrock. Two bedrock aquifer systems are identified for Morgan County. They are the Mississippian Blue River and Sanders Groups, and the Mississippian Borden Group.

### Mississippian -- Blue River and Sanders Groups Aquifer System

The Blue River and Sanders Groups Aquifer System is limited to portions of western and southwestern Morgan County. The Sanders Group includes primarily limestone with some shale and dolomitic limestone content. The overlying Blue River Group is absent in Morgan County. Thickness of the Sanders Group is estimated at 75 feet or less.

The Blue River and Sanders Groups Aquifer System is not regarded as a major groundwater resource in Morgan County. Very few wells are available with many that are drilled in the subcrop area penetrating through to the underlying Borden Group. However, the few wells that do utilize the Blue River and Sanders Groups Aquifer System in Morgan County generally range from 50 to 80 feet in depth. Depth to bedrock ranges from 12 to 29 feet below land surface with 36 to 68 feet of penetration into bedrock. Domestic well capacities are generally less than 5 gallons per minute (gpm) with reported static water levels that range from 23 feet to 40 feet below surface. Greater capacities have been reported in isolated areas. However, higher yields are commonly associated with significant to complete drawdown.

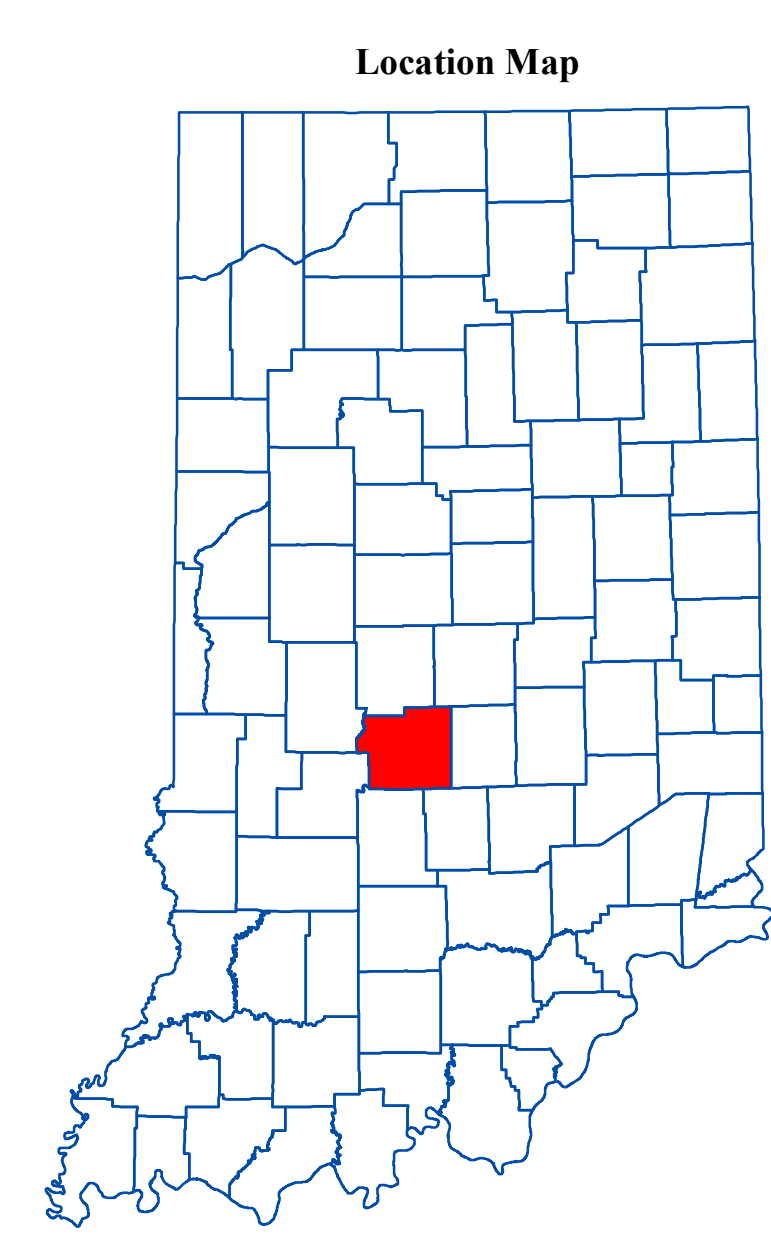
In areas where overlying clay materials are present, the Blue River and Sanders Group Aquifer System is at low risk to contamination. However, in some areas the clay deposits are thinner. These areas are at moderate to high risk from surface contamination.

### Mississippian -- Borden Group Aquifer System

The Borden Group Aquifer System outcrop/subcrop area includes nearly all of Morgan County. This bedrock aquifer system is composed of siltstone and shale, but fine-grained sandstones are also common. Although carbonates are rare, discontinuous interbedded limestone lenses are present, mainly in the upper portion of the group. Thickness of the Borden Group in Morgan County is estimated up to 600 feet.

Well depths in Morgan County are typically 70 to 150 feet with penetration commonly 2 to 12 feet into bedrock. Domestic well capacities are typically 2 to 10 gpm with reported static water levels that range from 12 feet to 40 feet below surface. Greater capacities have been reported in isolated areas. However, higher yields are commonly associated with significant to complete drawdown.

The Borden Group is composed primarily of fine-grained materials that limit the movement of groundwater and is overlain with thick clay materials. The Borden Group Aquifer System, therefore, is at low risk to contamination from the surface or near surface. However, areas where outwash deposits are near or at the surface and bedrock is shallow and may be fractured are at moderate to high risk from surface contamination.



### EXPLANATION

- Stream
- County Road
- State Road & US Highway
- Interstate
- Leesville Anticline and Mt. Carmel Fault
- Municipal Boundary
- State Managed Property
- Lake & River



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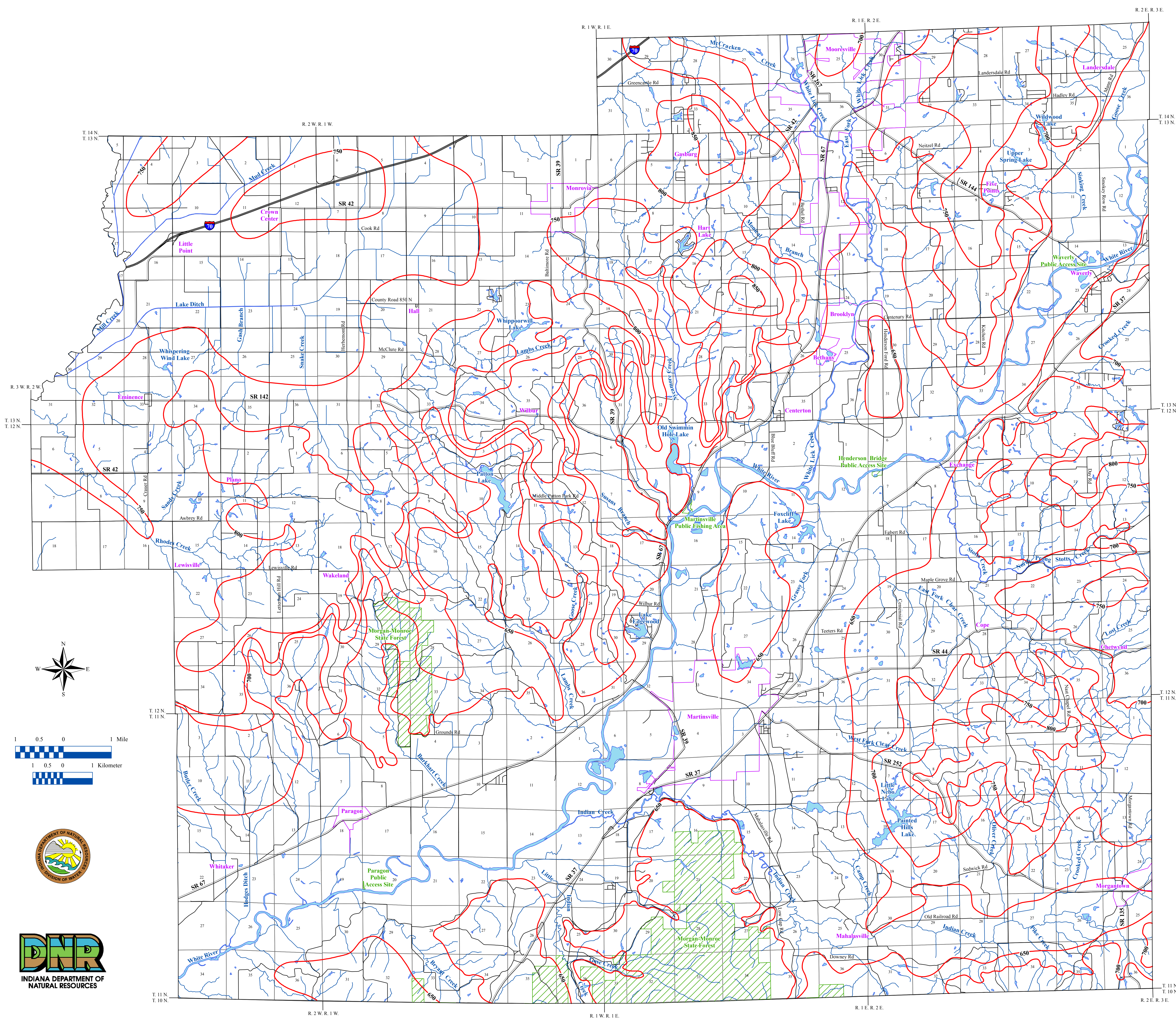
### Bedrock Aquifer Systems of Morgan County, Indiana

by  
Randal D. Maier  
Division of Water, Resource Assessment Section

April 2010

Map generated by Scott H. Dean  
IDNR, Division of Water, Resource Assessment Section

# POTENTIOMETRIC SURFACE MAP OF THE BEDROCK AQUIFERS OF MORGAN COUNTY, INDIANA



Morgan County, Indiana is located in the central portion of the state and is situated within the White and West Fork White River Basin.

The Bedrock Potentiometric Surface Map (PSM) of Morgan County was mapped by contouring the elevations of over 1,350 static water-levels reported on well records received over a 50 year period. These wells are completed in bedrock aquifers at various depths, and typically, under confined conditions (bounded by impermeable layers above and below the water bearing formation). However, some wells were completed under unconfined (not bounded by impermeable layers) settings. The potentiometric surface is a measure of the pressure on water in a water bearing formation. Water in an unconfined aquifer water table is at atmospheric pressure and will not rise in a well above the top of the water bearing formation, in contrast to water in a confined aquifer which is under hydrostatic pressure and will rise in a well above the top of the water bearing formation.

Static water-level measurements in individual wells used to construct county PSM's are indicative of the water-level at the time of well completion. The groundwater level within an aquifer constantly fluctuates in response to rainfall, evapotranspiration, groundwater movement, and groundwater pumping. Therefore, current site specific conditions may differ due to local or seasonal variations in measured static water-levels. Because fluctuations in groundwater are typically small, static water-levels can be used to construct a generalized PSM. Groundwater flow is naturally from areas of recharge toward areas of discharge. As a general rule, but certainly not always, groundwater flow approximates the overlying topography and intersects the land surface at major streams.

Universal Transverse Mercator (UTM) coordinates for the water wells were either, physically obtained in the field, determined through address geocoding, or reported on water well records; however, the location of the majority of the water well records used to make the PSM were not field verified. Elevation data were either obtained from topographic maps or a digital elevation model. Quality control/quality assurance procedures were utilized to refine or remove data where errors were readily apparent.

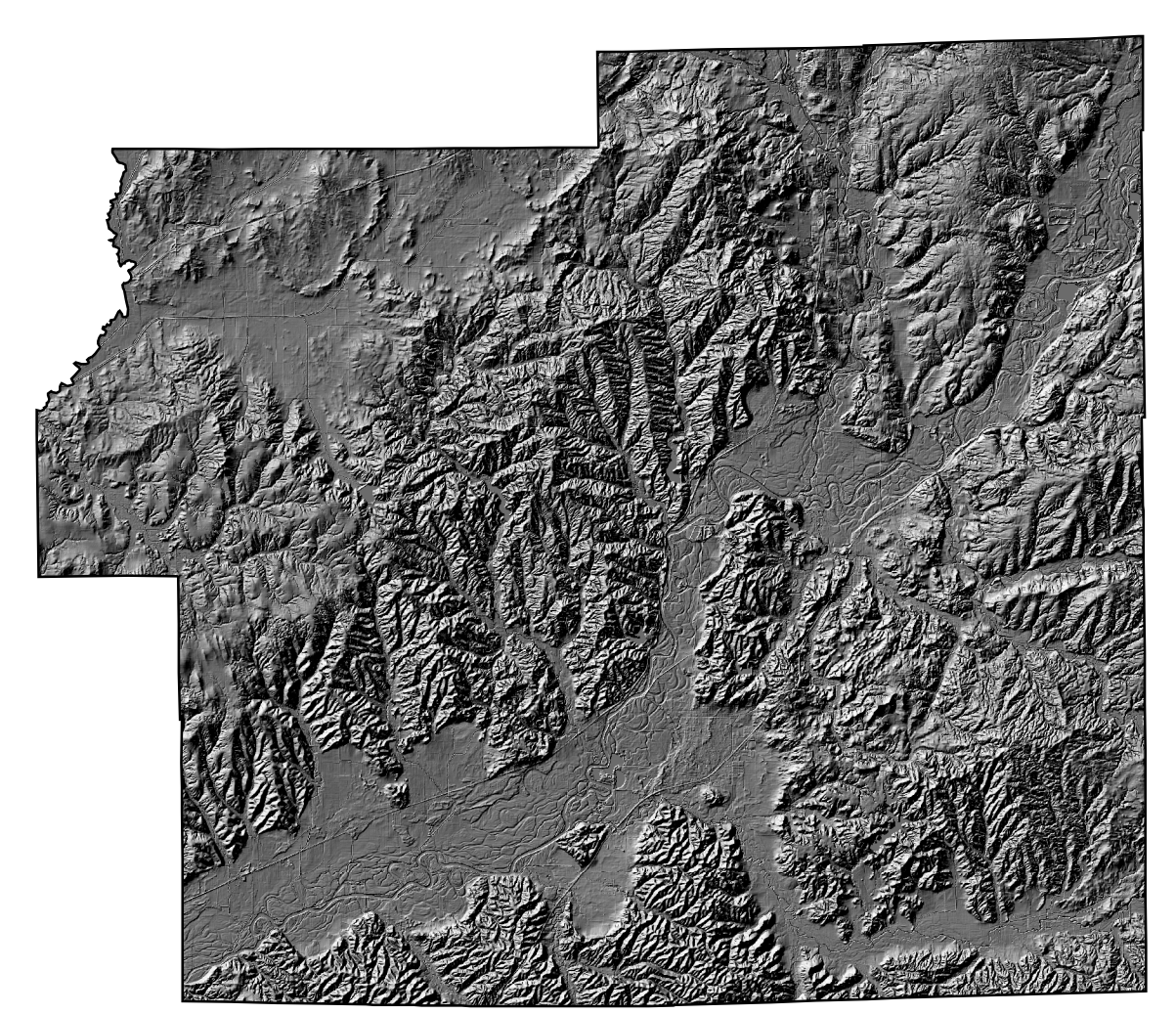
Bedrock potentiometric surface elevations in Morgan County range from a high of approximately 900 feet mean sea level (msl) in the north-central region of the county, to a low of about 500 feet msl in the central portion of the county. Generalized groundwater flow direction for most of Morgan County is towards major drainage relevant to the basin. Therefore, groundwater flow is generally south west toward White River in the southern portion of the county or toward Middle Creek in the northern portion of the county.

Much of the Morgan County bedrock surface is overlain by unconsolidated deposits that range from less than one foot, to an estimated 250 feet in thickness (Maier, 2010). Where bedrock is shallow, the potentiometric surface is generally under unconfined or semi-confined conditions. However, most of Morgan County is covered by thicker sediments overlying bedrock. Therefore, the potentiometric surface for most of the county is considered under confined conditions.

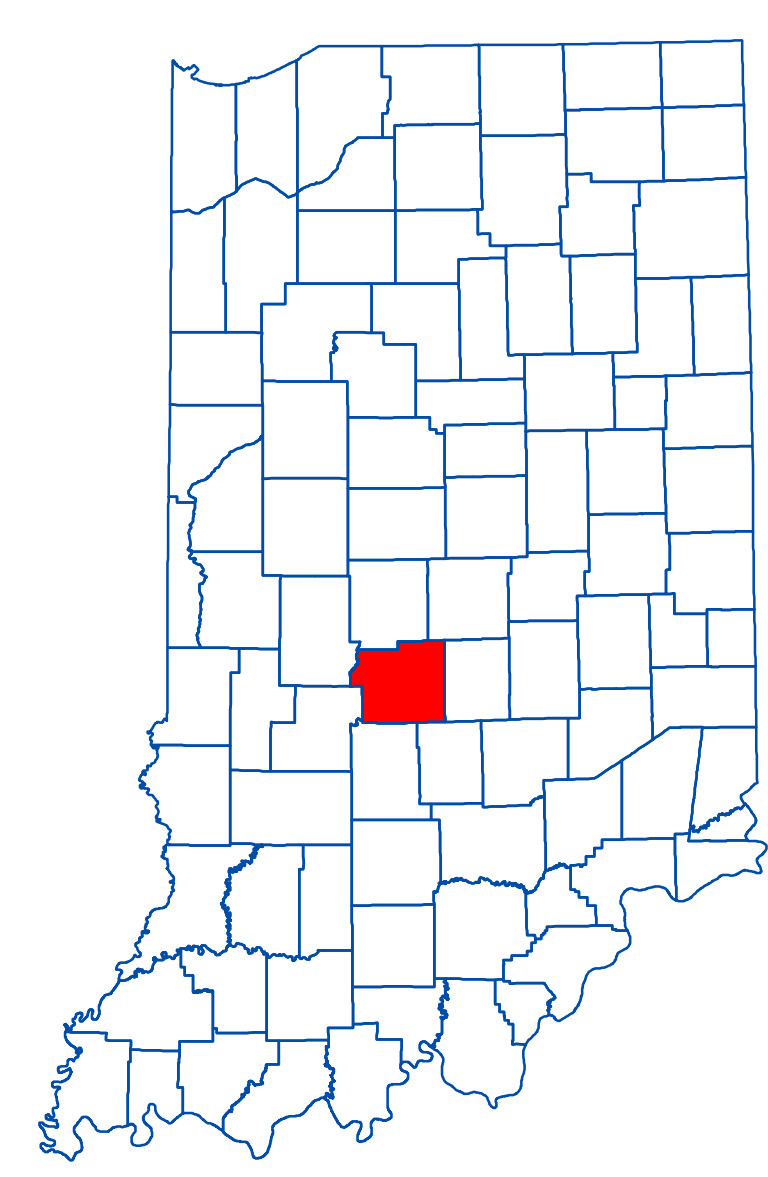
The county PSM can be used to define the regional groundwater flow path and to identify significant areas of groundwater recharge and discharge. County PSM's represent overall regional characteristics and are not intended to be a substitute for site-specific studies.

Maier, 2010, Bedrock Aquifer Systems of Morgan County, Indiana, Indiana Department of Natural Resources, Division of Water, Aquifer Systems Map 70-B.

Hillshade Map of Morgan County, Indiana



Location Map



### EXPLANATION

- Line of equal elevation, in feet above mean sea level
- Potentiometric Contour interval 50 feet
- Stream
- County Road
- State Road & US Highway
- Municipal Boundary
- State Managed Property
- Lake & River

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### Potentiometric Surface Map of the Bedrock Aquifers of Morgan County, Indiana

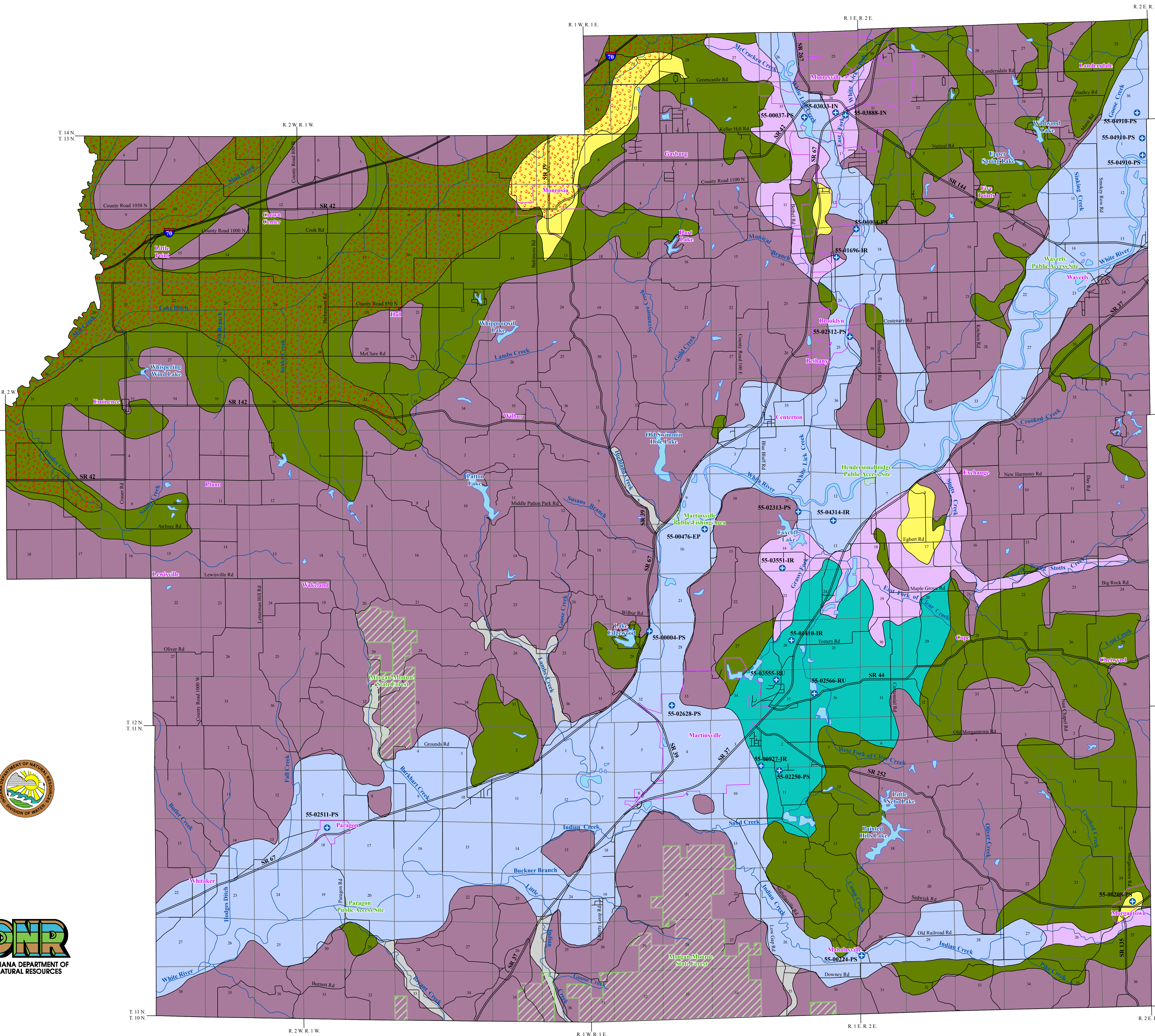
by  
Robert A. Scott  
Division of Water, Resource Assessment Section

June 2012

Map generated by Scott H. Dean  
IDNR, Division of Water, Resource Assessment Section



# UNCONSOLIDATED AQUIFER SYSTEMS OF MORGAN COUNTY, INDIANA



Seven unconsolidated aquifer systems have been mapped in Morgan County: the Till Veneer / Dissected Till and Residuum, the Alluvial, Lacustrine, and Backwater Deposits, the Tipton / New Castle Till, the Tipton / New Castle / Martinsville Hills Till Subsystem, the Martinsville Hills / Tipton Complex, the White River and Tributaries Outwash, and the White River and the Tributaries Outwash Subsystem. Boundaries of all aquifer systems described are commonly gradational, and individual aquifers may extend across aquifer system boundaries.

Thicknesses of unconsolidated sediments that overlie bedrock are quite variable in Morgan County. Total thickness ranges from less than one foot where bedrock is shallow or outcrops along sections of tributaries to the White River, to an estimated 240 feet in the northwest part of the county. Approximately 21 percent of all wells completed in the county are completed in unconsolidated deposits.

### Till Veneer / Dissected Till and Residuum Aquifer System

The Till Veneer / Dissected Till and Residuum Aquifer System is mapped throughout much of Morgan County and is mapped as one system because they are similar in composition and aquifer characteristics. The Dissected Till and Residuum Aquifer System includes areas of central and southern Morgan County where glacial deposits are thin and includes weathered bedrock materials. The Till Veneer Aquifer System includes areas of northern and eastern Morgan County where thin till, generally less than 50 feet thick, directly overlies an uneven bedrock surface. Also, along some of the major streams this system may include thin alluvium and surficial sands and gravels that directly overlie the bedrock surface.

There is little potential for groundwater production in this system in Morgan County. Nearly all wells drilled in areas mapped as Till Veneer / Dissected Till and Residuum bypass the unconsolidated deposits in favor of the underlying bedrock aquifer system. However, there are a few wells with aquifer deposits that include thin, isolated sands and gravels. Yields are generally less than 7 gallons per minute (gpm) with significant to complete drawdowns reported.

This aquifer system is generally not very susceptible to surface contamination because intertil sand and gravel units are overlain by till deposits. However, some areas have surface sands and gravels or thin to no clay deposits above the aquifer resource. These areas are considered at moderate to high risk to contamination.

### Alluvial, Lacustrine, and Backwater Deposits Aquifer System

The Alluvial, Lacustrine, and Backwater Deposits Aquifer System in Morgan County is mapped within several wide valleys along small tributaries of the White River. This system consists of deposits resulting from glacial meltwater drainage, fine-grained glaciolacustrine deposits formed in relatively static water, and colluvium from the surrounding upland areas.

This system is an extremely limited resource and the Division has no records of wells that produce from these deposits in Morgan County. However, large-diameter bucket wells may be adequate to meet the needs of some domestic users. Typical materials overlying bedrock include fine sand, silt, and clay deposits that are generally greater than 25 feet thick. Aquifer materials commonly include thin sands that are typically less than a few feet thick. Yields are generally expected to be less than a few gpm.

Thin deposits of silt and clay that have a low susceptibility to surface contamination commonly characterize this aquifer system. However, the susceptibility is greater in areas where the surficial silt and clay deposits are thin and directly overlie sand deposits.

### Tipton / New Castle Till Aquifer System

The Tipton / New Castle Till Aquifer System is mapped along small portions of north-central, east-central, and southeastern Morgan County. The system typically consists of thick clay with discontinuous intertil sands and gravels. The discontinuous sands and gravels, where present, are generally less than 10 feet thick with some noted as "dry".

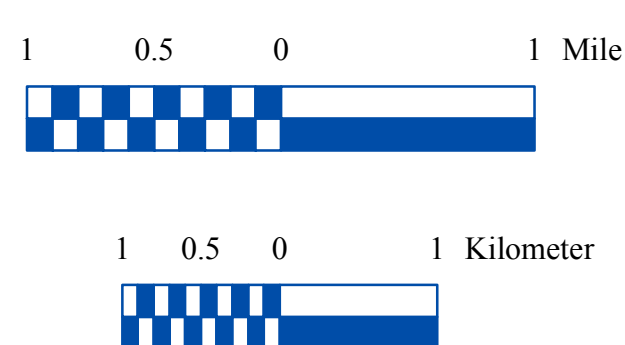
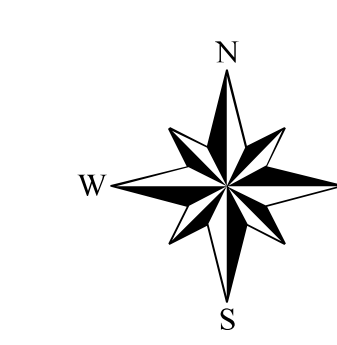
Few wells are reported in the Tipton / New Castle Till Aquifer System in Morgan County. However, this system is capable of meeting the needs of domestic and some high capacity users. Well depths range from 38 to 130 feet. Aquifer sands and gravels generally range from 2 to 28 feet thick and are capped by 15 to 97 feet of clay. Domestic well yields generally range from 7 to 55 gpm with static water levels that range from 5 to 63 feet below surface.

A portion of this system overlies part of a major buried bedrock valley that includes lacustrine sand, silt, and clay deposits. The few wells completed in these areas are up to 142 feet in depth. Aquifer sands and gravels are generally less than 20 feet thick with 5 to 132 feet of clay overlying. Well capacities range from 7 to 25 gpm with static water levels from 5 to 39 feet below the surface.

This system is generally not very susceptible to surface contamination because sand and gravel units are overlain by thick till deposits.

## EXPLANATION

- Registered Significant Groundwater Withdrawal Facility
- Stream
- County Road
- State Road & US Highway
- Interstate
- Municipal Boundary
- State Managed Land
- Lake & River



### Tipton / New Castle / Martinsville Hills Till Aquifer Subsystem

The Tipton / New Castle / Martinsville Hills Till Aquifer Subsystem is mapped throughout Morgan County. The subsystem is mapped similar to that of the Tipton / New Castle Till Aquifer System. However, potential aquifer materials are thinner and potential yield is less in the subsystem than in the system.

In Morgan County approximately 50 percent of the wells drilled in areas mapped as till subsystem are completed in the underlying bedrock aquifer system. However, the subsystem has the potential of meeting the needs of some domestic users. Well depths typically range from 45 to 90 feet. Potential aquifer materials include sand and gravel deposits that generally range from 3 to 20 feet thick and are capped by 25 to 70 feet of till with, in places, intertil sands and gravels. Where present, the intertil sands and gravels are generally less than 10 feet thick and are often noted as "dry". The few wells that utilize the available sand and gravel deposits have yields that range from 1 to 10 gpm with static water levels of 10 to 35 feet below the surface. Most wells with yields of 10 gpm or greater are associated with significant drawdowns. Many wells with deeper static water levels have limited available drawdown.

A portion of this system overlies part of a major buried bedrock valley that includes lacustrine sand, silt, and clay deposits. Depth to bedrock in these areas is up to 220 feet. Few wells are completed in these areas; however, those reported are up to 188 feet in depth. Thickness of aquifer deposits range from 2 to 97 feet with 25 to 138 feet of overlying clay. Well capacities range from 2 to 40 gpm with static water levels from 2 to 48 feet below surface.

This aquifer subsystem is generally not very susceptible to surface contamination because intertil sand and gravel units are overlain by thick till deposits. However, some areas have surface sands and gravels or thin to no clay deposits above the aquifer resource. These areas are considered at moderate to high risk to contamination.

### Martinsville Hills / Tipton Complex Aquifer System

The Martinsville Hills / Tipton Complex Aquifer System is mapped only in the east-central portion of Morgan County. Complex multiple glacial advances resulted in a sequence of multiple, stacked, till and outwash units that are quite variable in position and thickness. The sand and gravel deposits vary from thin to massive and are typically discontinuous and overlain by a thick till.

Completed well depths range from 80 to 185 feet. Thickness of clay deposits that overlie the aquifer resource generally ranges from 25 to 105 feet. In places, the system exhibits multiple sand and gravel deposits above the primary aquifer resource that are also a potential source of groundwater, although some are noted as "dry". Individually, the discontinuous sands and gravels range from 2 to 160 feet thick and the deeper, more productive aquifer deposits are 10 to 60 feet thick.

The Martinsville Hills / Tipton Complex Aquifer System is capable of meeting the needs of domestic and some high-capacity users. Domestic yields are reported up to 50 gpm with static water levels from 50 to 110 feet below surface. There are 5 registered significant groundwater withdrawal facilities (15 wells) with reported yields up to 650 gpm.

This aquifer system is not very susceptible to contamination where thick clay deposits overlie aquifer materials. However, in places where clay deposits are thin, these areas are at moderate to high risk to surface contamination.

### White River and Tributaries Outwash Aquifer System

The White River and Tributaries Outwash Aquifer System includes thick glacial outwash sands and gravels capped by recent alluvial deposits. The system is mapped primarily along the White River and along portions of White Lick Creek and Indian Creek.

Wells completed in the White River and Tributaries Outwash Aquifer System range from 16 to 195 feet but are typically 40 to 80 feet in depth. In places, the outwash aquifer deposits are up to 188 feet of continuous sands and gravels and may be capped by alluvial silt and clay materials that generally range from 2 to 45 feet thick. The White River and Tributaries Outwash Aquifer System is capable of meeting the needs of domestic and high-capacity users. Domestic well capacities range from 10 to 90 gpm with static water levels from 10 to 25 feet below the ground surface. There are 13 registered significant groundwater withdrawal facilities (38 wells) with capacities that range from 100 to 3000 gpm.

Areas that lack overlying clay deposits are highly susceptible to contamination. However, where overlying clay or silt deposits are present the system is moderately susceptible to surface contamination.

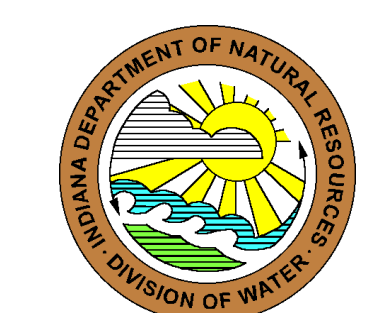
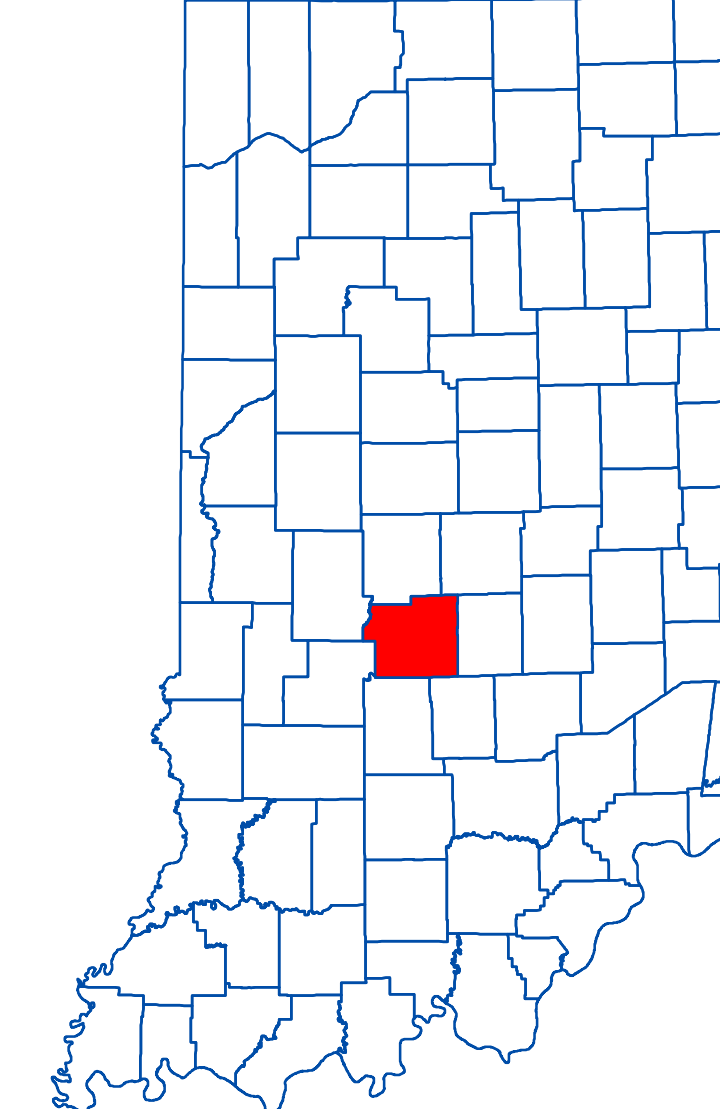
### White River and Tributaries Outwash Aquifer Subsystem

The White River and Tributaries Outwash Aquifer Subsystem is mapped mostly along portions of several tributaries to the White River. The subsystem is mapped similar to the White River and Tributaries Outwash Aquifer System. However, potential aquifer materials are thinner, overlying silt or clay materials are generally thicker and potential yield is less in the subsystem than in the system.

Well depths in the White River and Tributaries Outwash Aquifer Subsystem generally range from 30 to 125 feet. In places, aquifer materials are up to 127 feet of continuous sand and gravel and may be capped by alluvial silt and/or clay materials that generally range from 3 to 62 feet thick. However, in some areas the upper portions of the total aquifer sequence of sands and gravels are reported as "dry". The subsystem is capable of meeting the needs of domestic and some high-capacity users. Domestic well capacities range from 10 to 60 gpm with static water levels of 5 to 70 feet below ground surface. There are 5 registered significant groundwater withdrawal facilities (13 wells) with capacities up to 500 gpm.

Areas that lack overlying clay deposits are highly susceptible to contamination. However, where overlying clay or silt deposits are present the system is moderately susceptible to surface contamination.

### Location Map



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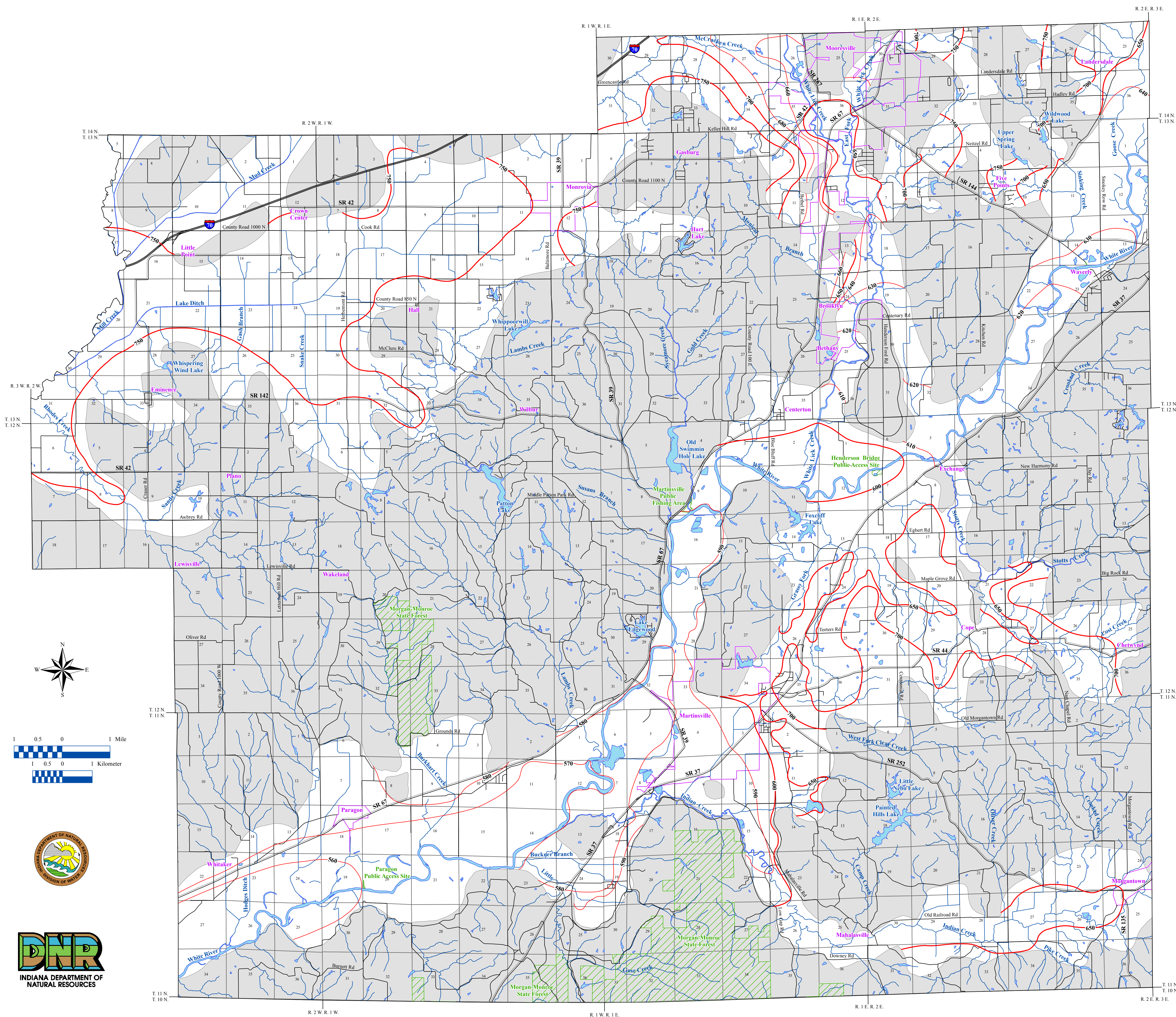
### Unconsolidated Aquifer Systems of Morgan County, Indiana

by  
Randall D. Maier  
Division of Water, Resource Assessment Section

April 2010

Map generated by Scott H. Dean  
IDNR, Division of Water, Resource Assessment Section

# POTENTIOMETRIC SURFACE MAP OF THE UNCONSOLIDATED AQUIFERS OF MORGAN COUNTY, INDIANA



Morgan County, Indiana is located in the central portion of the state and is situated within the White and West Fork White River Basin.

The Unconsolidated Potentiometric Surface Map (PSM) of the unconsolidated aquifers of Morgan County was mapped by contouring the elevations of approximately 850 static water-levels reported on well records received primarily over a 50 year period. These wells are completed in aquifers at various depths, and typically, under confined conditions (bounded by impermeable layers above and below the water bearing formation). However, some wells were completed under unconfined (not bounded by impermeable layers) settings. The potentiometric surface is a measure of the pressure on water in a water bearing formation. Water in an unconfined aquifer is at atmospheric pressure and will not rise in a well above the top of the water bearing formation, in contrast to water in a confined aquifer which is under hydrostatic pressure and will rise in a well above the top of the water bearing formation.

Portions of Morgan County were not mapped due to a general lack of water well data and/or limited water bearing deposits. These areas are generally considered to have limited aquifer resources leaving it difficult to represent accurate PSM elevations (See Aquifer Systems Map 70-A: Unconsolidated Aquifer Systems of Morgan County, Indiana, Maier 2010). Also, because areas of the county are variable in the quantity and quality of data, the PSM contour elevation intervals are variable throughout the map.

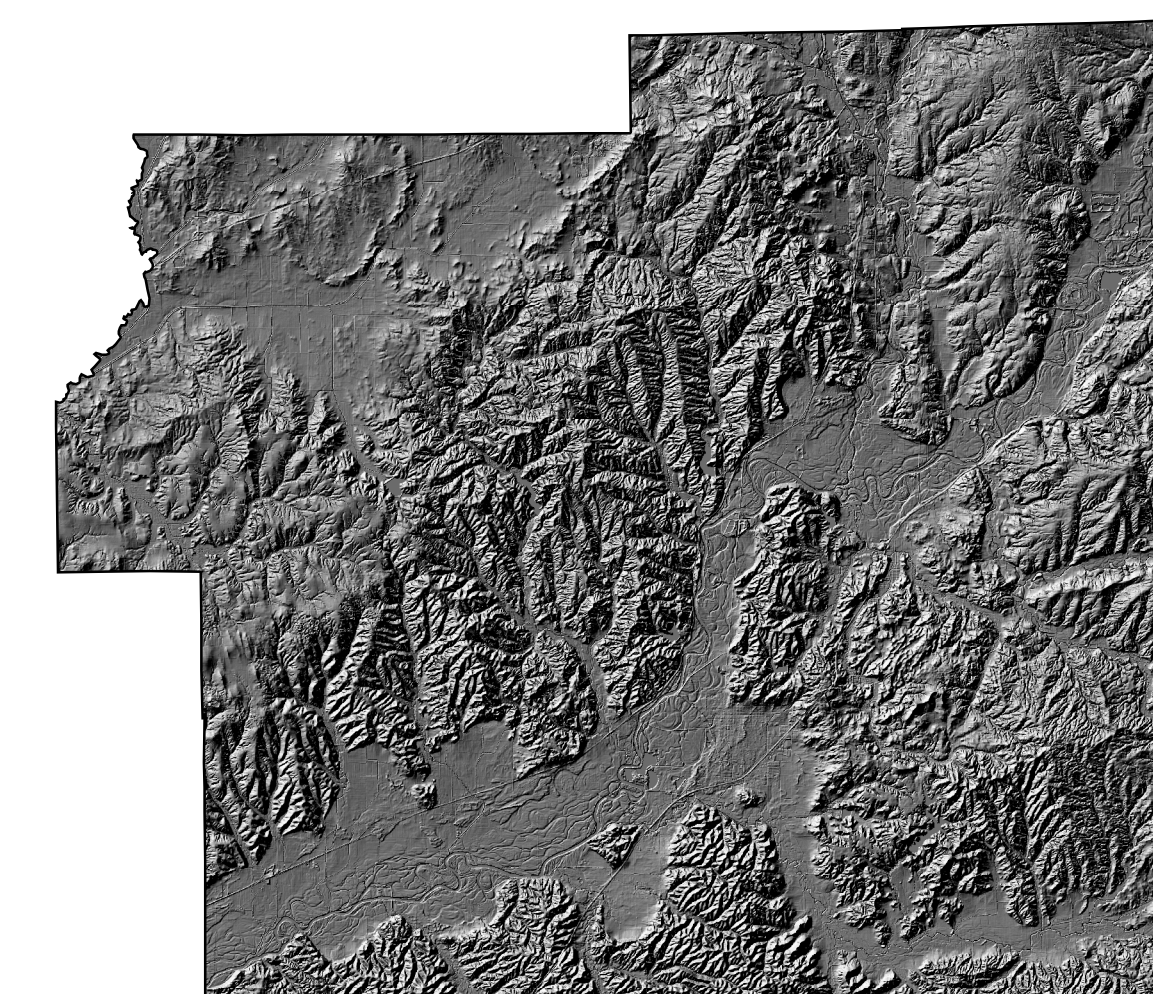
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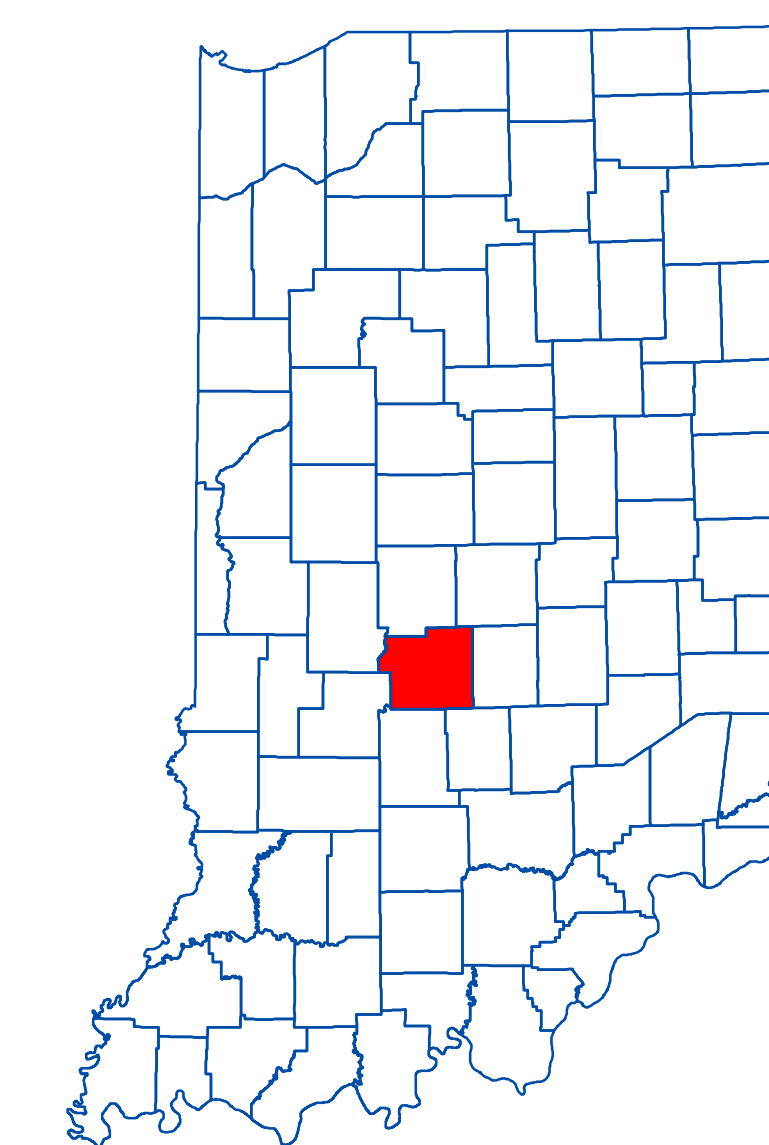
Unconsolidated static water levels in Morgan County range from a high of 881 feet mean sea level (msl) in the north-central region of the county, to a low of 556 feet msl in the southwest portion of the county. Generalized groundwater flow direction for most of Morgan County is towards major drainage relevant to the basin. Therefore, groundwater flow is generally southwest towards White River in the southern portion of the county or towards Mill Creek in the northern portion of the county.

The county PSM can be used to define the regional groundwater flow path and to identify significant areas of groundwater recharge and discharge. County PSM's represent overall regional characteristics and are not intended to be a substitute for site-specific studies.

Hillshade Map of Morgan County, Indiana

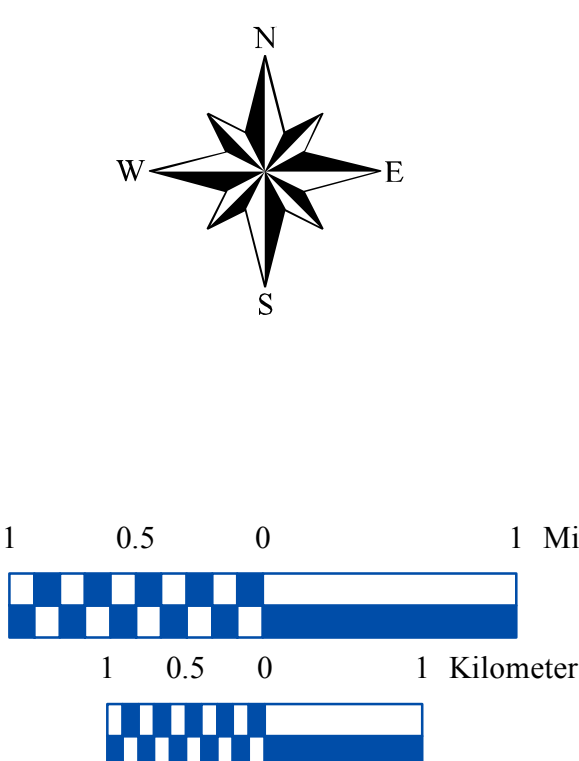


Location Map



### EXPLANATION

- 800 - Line of equal elevation, in feet above mean sea level
- Potentiometric Contour interval 10, 20, or 50 feet
- Stream
- County Road
- State Road & US Highway
- Municipal Boundary
- State Managed Property
- Lake & River
- No Aquifer Material or Limited Data



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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 a gift from the Indiana Geological Survey and based on a 1:24,000 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. Hydrography, Streams (NHD) (line shapefile, 20081218), Rivers (NHD) (polygon shapefile, 20081218), Lakes (NHD) (polygon shapefile, 20081218) was from the U.S. Geological Survey and the U.S. Environmental Protection Agency and based on a 1:24,000 scale. Managed Lands (DNR LN) (polygon shapefile, 20100920) was from DNR and based on a 1:24,000 scale. County Hillshade image was from the U.S. Geological Survey National Elevation Dataset (raster image, 20100324). No Aquifer Material and Limited Data (polygon shapefile) was based on the Unconsolidated Aquifer Systems of Morgan County, Indiana (polygon shapefile, Maier, 2010). Potentiometric Surface Map of the Unconsolidated Aquifers of Morgan County, Indiana (line shapefiles, Scott, 2012) was based on a 1:24,000 scale.

### Potentiometric Surface Map of the Unconsolidated Aquifers of Morgan County, Indiana

by  
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June 2012

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# Morgan County

