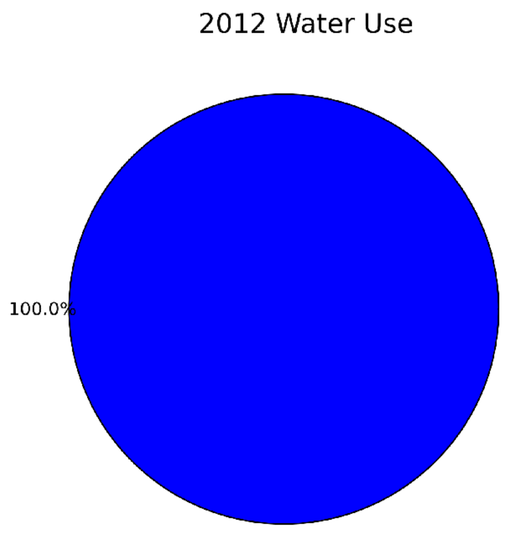
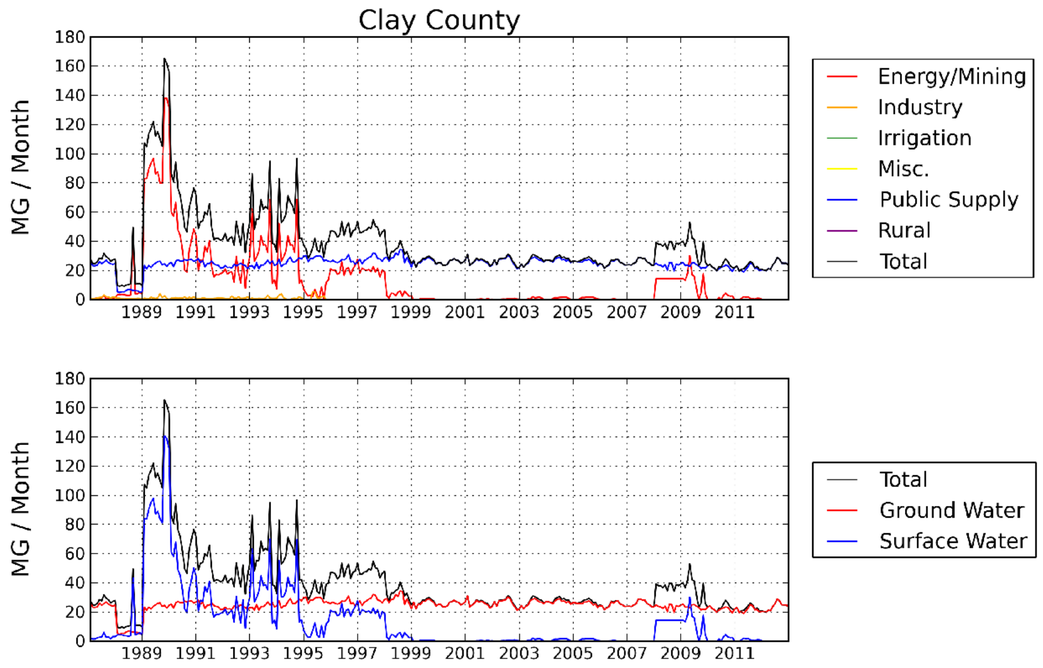
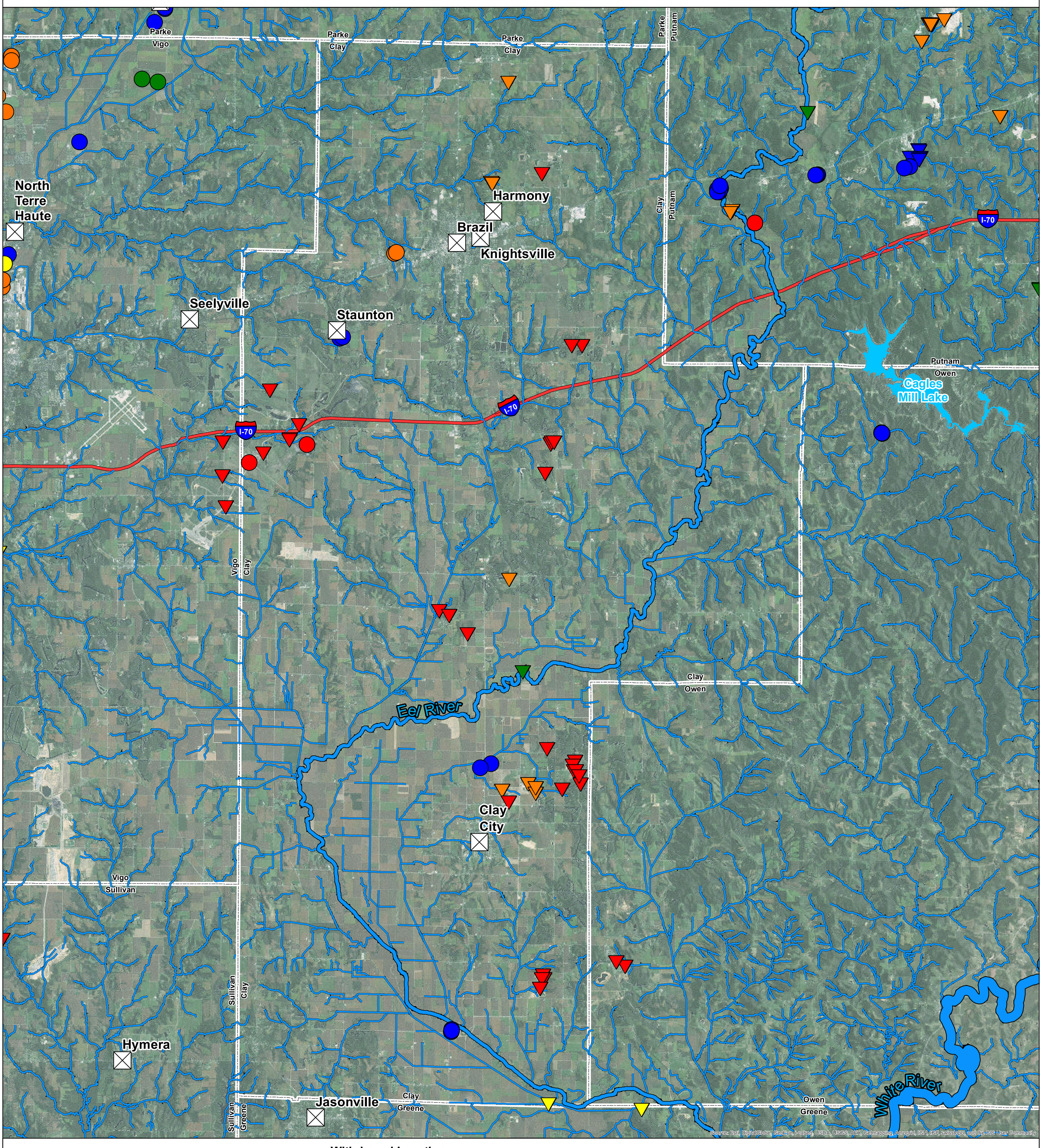


Average Daily Use: 0.8 MGD





Water Resources and Use in Clay County

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

Withdrawal Location

WELL INTAKE

- Energy/Mining
- Industry
- Irrigation
- Misc.
- Public Supply
- Rural Use

River

7Q2 Flow (MGD)

- <10 MGD
- 10 - 50 MGD
- 50 - 100 MGD
- 100 - 500 MGD
- > 500 MGD

- Major Lakes
- Interstate
- County
- City

INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

NORTH

0 1 2 4 Miles

BEDROCK AQUIFER SYSTEMS OF CLAY 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.

Bedrock aquifer systems in Clay County are overlain by unconsolidated deposits of varying thickness ranging from less than 2 feet thick in the northern portion of the county to 215 feet thick in the southeastern portion of the county. Bedrock, in places, is near the surface along several streams in the county.

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.

Most bedrock aquifers in the county 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.

Four bedrock aquifer systems are identified for Clay County. They are the Pennsylvanian Carbondale Group; the Pennsylvanian Raccoon Creek Group; the Mississippian Buffalo Wallow, Stephensport, and West Baden Groups; and the Mississippian Blue River and Sanders Groups.

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.

Pennsylvanian -- Carbondale Group Aquifer System

The Carbondale Group Aquifer System is present along portions of the western part of Clay County. Bedrock deposits include mostly shale and sandstone with some limestone and commercially important coal. Wells penetrating the Carbondale Group have reported depths ranging from 25 to 340 feet, but are commonly 75 to 230 feet deep. The amount of rock penetrated in this system typically ranges from 20 to 145 feet.

Wells utilizing the Carbondale Group Aquifer System are generally capable of meeting the needs of domestic users in this county. Domestic well yields commonly range from 2 to 10 gallons per minute (gpm) with significant drawdowns reported. Static water levels typically range from 18 to 64 feet below the land surface. There are no high-capacity groundwater withdrawal facilities utilizing the Carbondale Group Aquifer System in Clay County.

Where the overlying sediment consists of thick fine-grained clay materials, the Carbondale Group Aquifer System in Clay 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 subcrops throughout most of Clay County. The group consists in ascending order of the Mansfield, Brazil and Staunton formations. The basal sandstone formation of the group, the Mansfield Formation, rests unconformably on Mississippian rocks. Bedrock consists mostly of shale, mudstone, and siltstone with minor amounts of coal, sandstone and limestone. The Raccoon Creek Group in Clay County ranges from near exposure at the ground surface to being overlain by up to 215 feet of unconsolidated deposits; however unconsolidated deposits generally range from 20 to 60 feet thick.

Wells completed in the Raccoon Creek Group Aquifer System are generally capable of meeting the needs of domestic users in this county. Wells in this system are completed at depths ranging from 95 to 230 feet. The amount of penetration into bedrock generally ranges from 25 to 160 feet. Yields for domestic wells range from 2 to 12 gpm with some dry holes reported. Static water levels range from flowing to 70 feet below the land surface. There is one registered significant groundwater withdrawal facility (3 wells) utilizing the Raccoon Creek Group Aquifer System in Clay County. The reported high-capacity well depths are completed from 300 to 385 feet below the land surface and the well yields range from 70 to 100 gpm.

In the majority of Clay County, the Raccoon Creek Group Aquifer System has a low susceptibility to surface contamination where thick clay deposits overlie the system. However, in some areas outwash, alluvial, and lacustrine sands directly overlie the bedrock surface. These areas are at moderate to high risk from surface contamination.

Mississippian -- Buffalo Wallow, Stephensport, and West Baden Groups Aquifer System

This Upper Mississippian bedrock aquifer system is present in a relatively small portion of eastern Clay County. This aquifer system consists of three groups, from oldest to youngest: West Baden, Stephensport, and Buffalo Wallow. However, no Stephensport or Buffalo Wallow strata are present in the county. The West Baden Group is composed primarily of shale, limestone, and sandstone.

The Division has no records of wells that are completed in this system in Clay County. However, in nearby Owen County well depths range from 115 to 250 feet with 7 to 50 feet of typical bedrock penetration. Also, in Owen County domestic well yields are generally 4 to 15 gpm with reported static water levels ranging from 45 to 160 feet below land surface.

As noted in Owen County, some areas of the Buffalo Wallow, Stephensport and West Baden Groups Aquifer System bedrock are shallow and some karst has developed in the limestone beds. These conditions warrant considering the aquifer system as a whole to be somewhat susceptible to contaminants introduced at and near land surface.

Mississippian -- Blue River and Sanders Groups Aquifer System

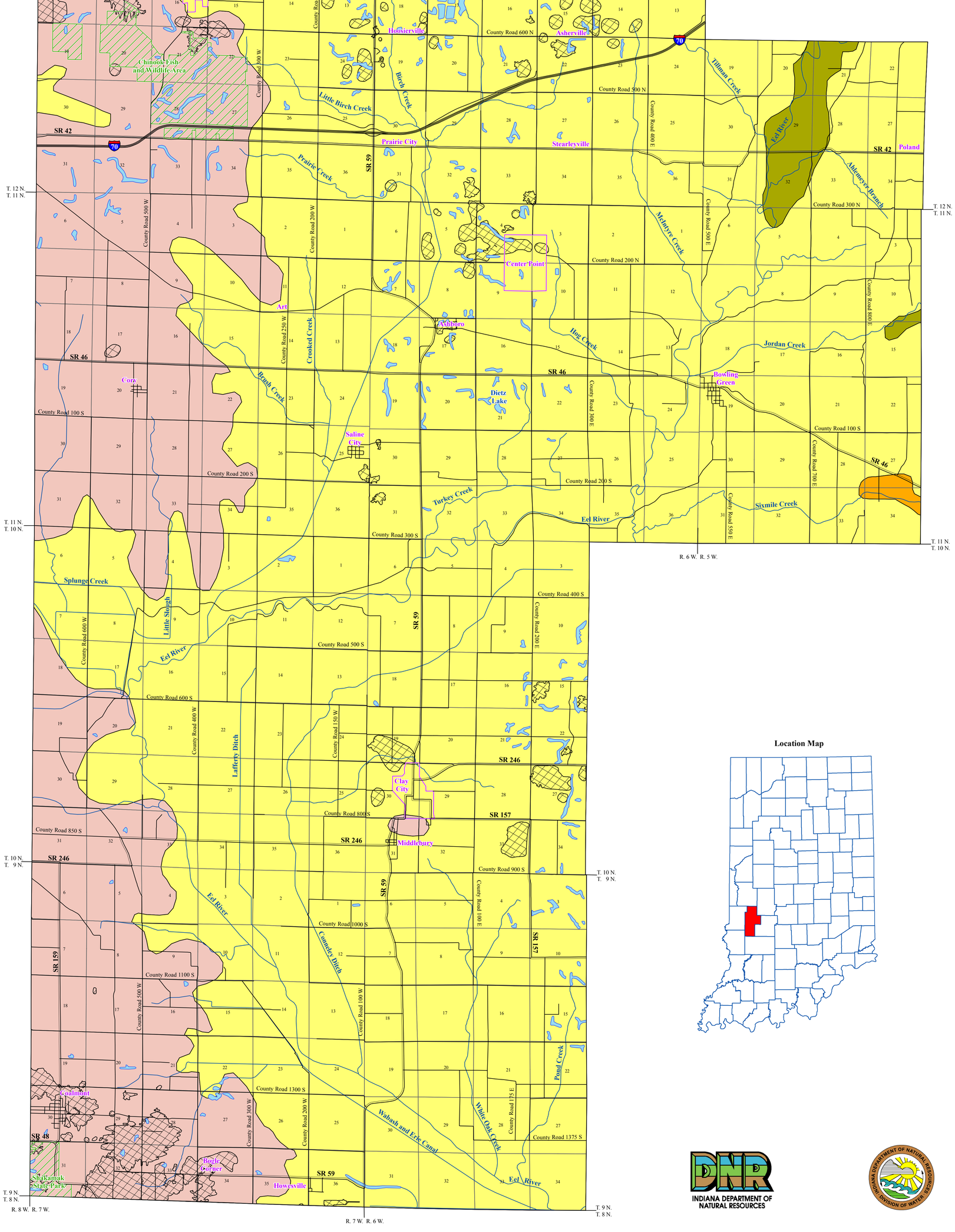
The Blue River and Sanders Groups Aquifer System subcrops in two small portions of eastern Clay County. The Sanders Group includes primarily limestone with some dolomitic limestone content. The overlying Blue River Group includes mostly limestones containing significant amounts of gypsum, anhydrite, shale, chert, and calcareous sandstone.

Wells completed in the Blue River and Sanders Groups Aquifer System are generally capable of meeting the needs of most domestic users in this county. Well depths in Clay County range from 80 to 160 feet. Depth to bedrock ranges from 14 to 38 feet below land surface. The reported domestic well capacities range up to 20 gpm. The static water levels range from 32 to 47 feet below surface. There are no registered significant groundwater withdrawal facilities using the Blue River and Sanders Groups Aquifer System in Clay County.

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 karst has developed in the limestone beds and outwash, alluvial, and lacustrine sands directly overlie the bedrock surface. These areas are at moderate to high risk from surface contamination.

Underground Mine Areas

In Clay 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 has been 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 gallons per minute are possible. A limitation on use of the water could be its more mineralized nature.



N
W E
S

1 0.5 0 1 Mile

1 0.5 0 1 Kilometer

EXPLANATION

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

Location Map

INDIANA DEPARTMENT OF NATURAL RESOURCES

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

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Bedrock Aquifer Systems of Clay County, Indiana

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

December 2010

UNCONSOLIDATED AQUIFER SYSTEMS OF CLAY COUNTY, INDIANA

The unconsolidated aquifer systems of Clay County are composed of sediments deposited by, or resulting from, a complex sequence of glaciers, glacial meltwaters, and post-glacial precipitation events. Five unconsolidated aquifer systems have been mapped in Clay County: the Dissected Till and Residuum, the Alluvial, Lacustrine, and Backwater Deposits; the Martinsville Hills / Wabash Lowland Till Subsystem; the White River and Tributaries Outwash Subsystem; and the Coal Mine Spoil. Because of the complicated glacial geology, boundaries of the aquifer systems in this county are commonly gradational and individual aquifers may extend across aquifer system boundaries. Approximately 10 percent of all wells in this county are completed in unconsolidated deposits.

The thickness of unconsolidated deposits in Clay County is quite variable, due to the deposition of glacial material over an uneven bedrock surface. Unconsolidated deposits in the county range from less than 2 feet thick in the northern portion of the county to 215 feet thick in the southeastern portion of the county.

Regional estimates of aquifer susceptibility to contamination from the surface can differ considerably due to a wide range of variation within geologic environments. In addition, man-made structures such as poorly constructed water wells, unplugged or improperly abandoned wells, and open excavations can provide contaminant pathways that bypass the naturally protective clays.

Dissected Till and Residuum Aquifer System

In Clay County, the Dissected Till and Residuum Aquifer System occurs in areas where pre-Wisconsin till is thin and dissected due to deep down-cutting by streams. This system is generally less than 50 feet thick and has been mapped throughout Clay County.

The Dissected Till and Residuum Aquifer System has the most limited groundwater resources of the unconsolidated aquifer systems. Approximately 98 percent of the wells started in this system in Clay County are completed in the underlying bedrock; however, some wells do utilize this aquifer system. Potential aquifers within this system include thin isolated sand and/or gravel layers, and surficial sand and gravel outwash or alluvium. Wells are completed at depths ranging from 25 to 40 feet with sand and gravel aquifer materials commonly 2 to 6 feet thick. Most of the wells in this system have reported capacities of 5 gallons per minute (gpm) or less with some wells being reported as “dry”. Static water levels range between 8 and 16 feet below the surface. There are no registered significant groundwater withdrawal facilities utilizing this system.

This system is generally not very susceptible to contamination from surface sources because of the low permeability of the near-surface materials. However, areas where protective clay layers are thin or absent are very susceptible to contamination.

Alluvial, Lacustrine, and Backwater Deposits Aquifer System

The Alluvial, Lacustrine, and Backwater Deposits Aquifer System in Clay County is mapped within a valley along a portion of Croy’s Creek and a portion of Billy Creek. 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 Clay 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 sand seams that are typically less than a few feet thick. In some isolated areas, however, these deposits are thicker. Yields are generally expected to be less than a few gpm.

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

Martinsville Hills / Wabash Lowland Till Aquifer Subsystem

The Martinsville Hills / Wabash Lowland Till Aquifer Subsystem is mapped throughout much of northern Clay County. This system typically consists of thick clay with discontinuous intertill sands and gravels. Portions of this system include fine-grained lacustrine sand, silt and clay deposits. The discontinuous sands and gravels, where present, are commonly less than 10 feet thick with some noted as “dry”.

In Clay County approximately 80 percent of the wells drilled in areas mapped as till subsystem are completed in the underlying bedrock aquifer system. However, the Martinsville Hills / Wabash Lowland Till Aquifer Subsystem has the potential of meeting the needs of some domestic users. Reported well depths range from 50 to 90 feet. Where present, potential aquifer materials include sand and gravel deposits that generally range from 2 to 22 feet thick and are capped by 18 to 80 feet of till.

The few wells that utilize the available sand and gravel deposits have yields that range from 4 to 8 gpm with static water levels of 16 to 40 feet below the surface.

A portion of this system overlies part of a major buried bedrock valley that includes mixtures of lacustrine sand, silt, and clay deposits along with isolated sands and gravels up to 132 feet in thickness. This area is capable of meeting the needs of domestic users; however, few unconsolidated wells are completed in this area. Those wells reported are up to 125 feet in depth with aquifer deposits generally ranging from 20 to 85 feet and are capped by 15 to 60 feet of overlying clay. Reported well capacities range from 10 to 20 gpm with static water levels from 22 to 52 feet below surface.

This aquifer subsystem is generally not very susceptible to surface contamination because intertill 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.

White River and Tributaries Outwash Aquifer Subsystem

The White River and Tributaries Outwash Aquifer Subsystem is mapped in a wide floodplain of the Eel River, along Jordan Creek, and a portion of White Oak Creek. This system includes glacial outwash sands and gravels that are generally capped by a layer of clay and silt deposits.

The White River and Tributaries Outwash Aquifer Subsystem has the potential to meet the needs of domestic and some high-capacity users. The wells in this subsystem are completed at depths commonly ranging from 40 to 70 feet. Aquifer materials include sand and gravel deposits that are typically 10 to 35 feet thick and may be capped by alluvial silt and/or clay materials that generally range from 14 to 38 feet thick. Domestic well capacities range from 15 to 30 gpm with static water levels ranging from 10 to 16 feet below the surface. There are two registered significant groundwater withdrawal facilities (5 wells) using this system. The reported yields for the wells range from 300 to 500 gpm.

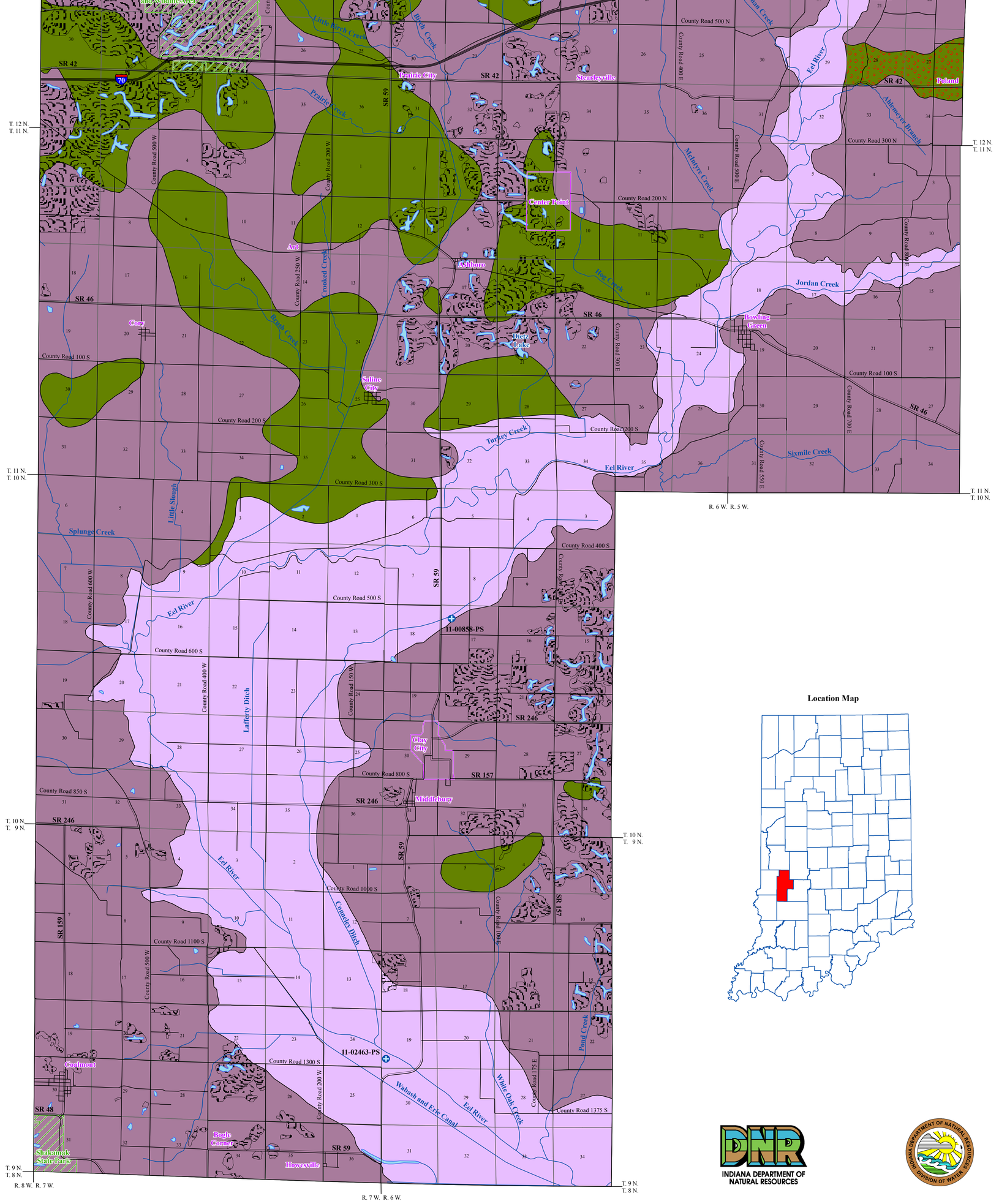
Areas that lack overlying clay deposits are highly susceptible to contamination. However, where overlying clay deposits are present the system is moderately susceptible to surface contamination.

Coal Mine Spoil Aquifer System

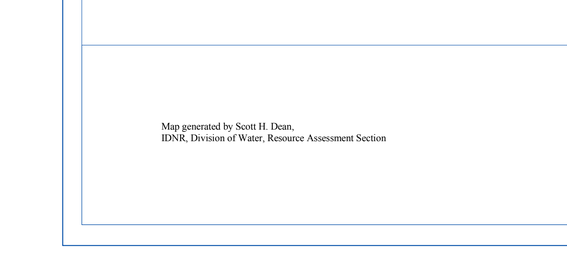
The Coal Mine Spoil Aquifer System covers about ten percent of Clay County. This aquifer system was formed during the process of mining coal by surface-mining methods. The overburden was typically broken up by blasting and moved aside to uncover the desired coal seam. The overburden, most of which was originally solid rock, became a heterogeneous mixture of particles ranging in size from clay, silt, and sand up to gravel, slabs, and boulders. Where extensive these spoil areas contain considerable amounts of groundwater. Although data are sorely lacking on permeability of these spoil materials, it is generally accepted that the spoil permeability is greater than that for most of the original rock layers above the coal seam mined.

The quality of groundwater in this system is generally much poorer than that in the overburden before mining took place. Typically a significant increase in total dissolved solids, especially calcium, magnesium, bicarbonate, and sulfate, occurs. High iron, and sometimes low pH, can also severely limit potential uses of groundwater from this system.

There are no well records reported in this aquifer system in Clay County. Very generally, it is expected that aquifers in old spoil areas that were not graded and capped with compacted soil are highly susceptible to surface contamination, whereas new spoil areas benefiting from modern reclamation methods are likely to be only moderately susceptible.



Location Map



1 0.5 0 1 Mile

1 0.5 0 1 Kilometer

EXPLANATION

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

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

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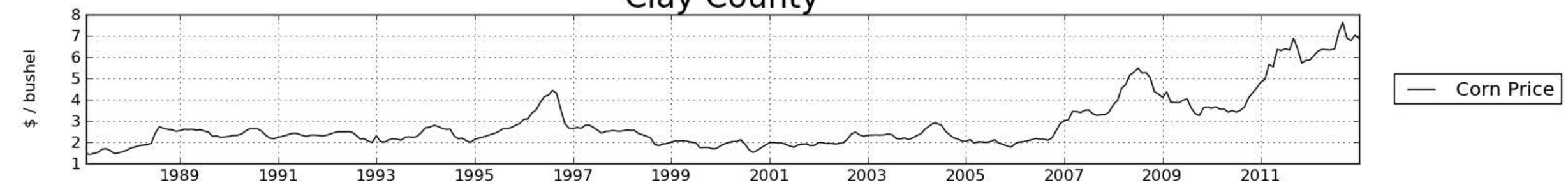
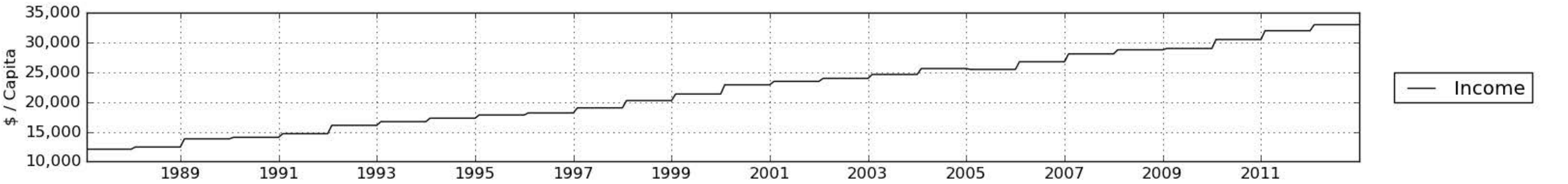
Unconsolidated Aquifer Systems of Clay County, Indiana

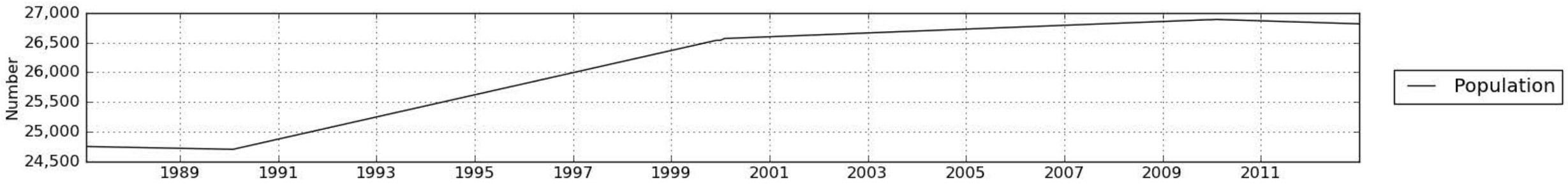
by
Robert A. Scott
Division of Water, Resource Assessment Section

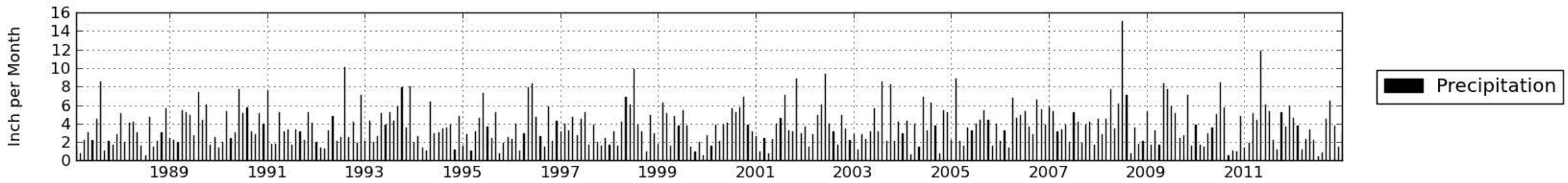
December 2010

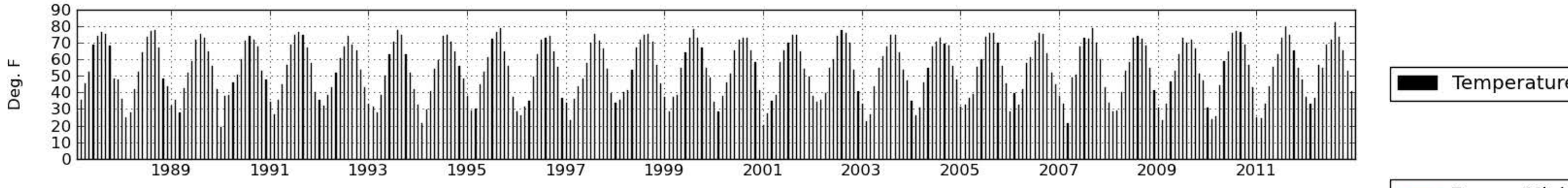
Clay County

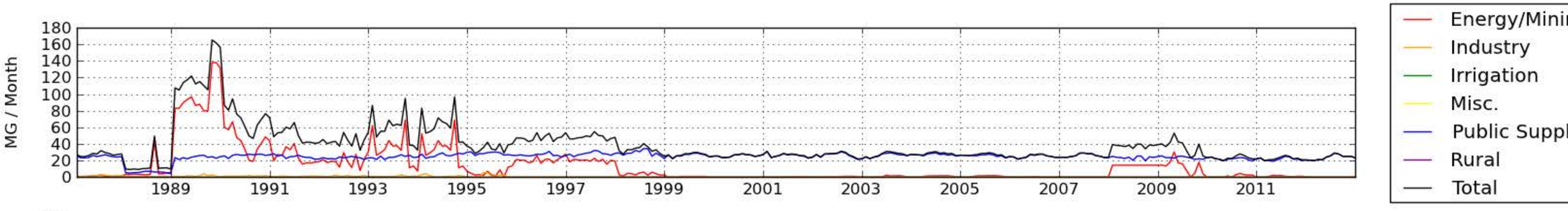

$ / bushel
Corn Price

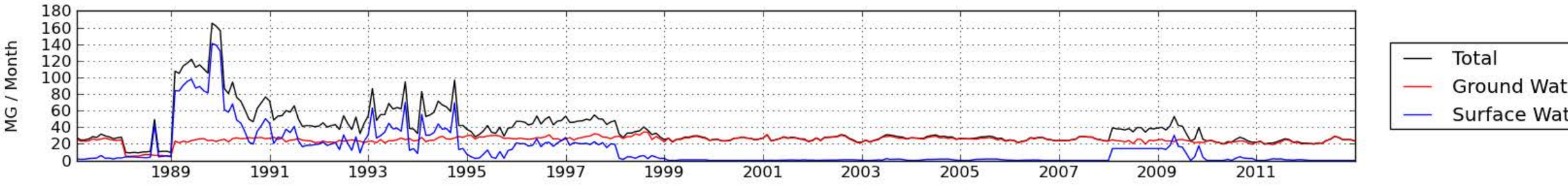

$ / Capita
Income


Number
Population


Inch per Month
Precipitation


Deg. F
Temperature


MG / Month
Energy/Mining
Industry
Irrigation
Misc.
Public Supply
Rural
Total


MG / Month
Total
Ground Water
Surface Water