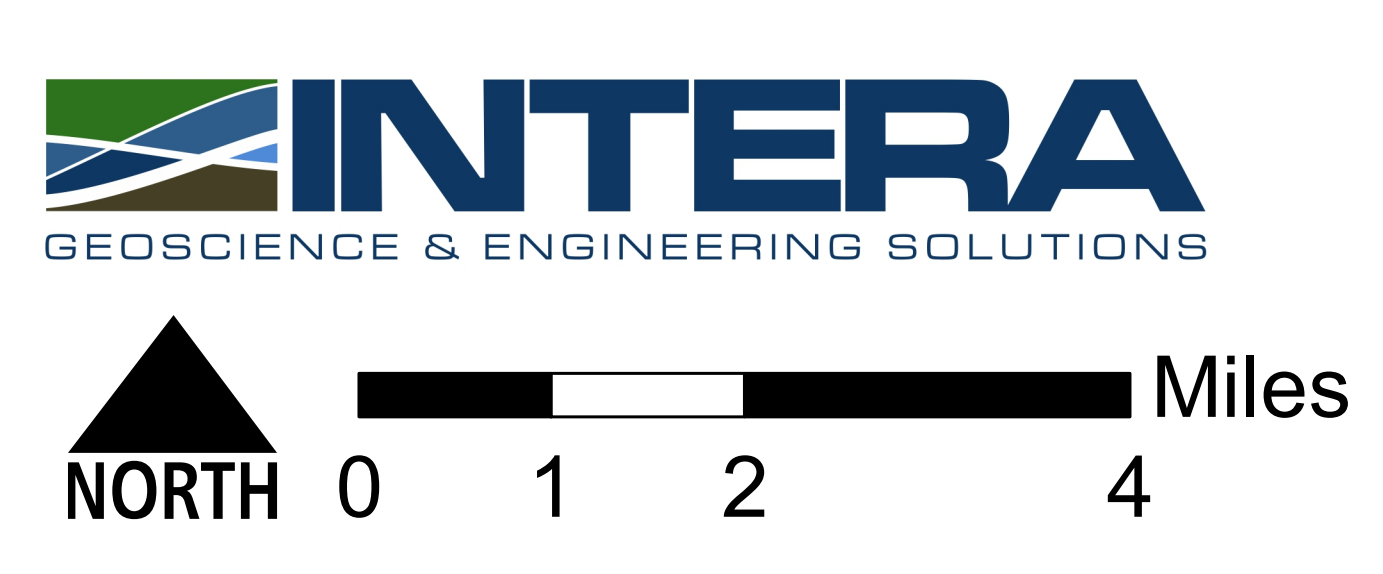
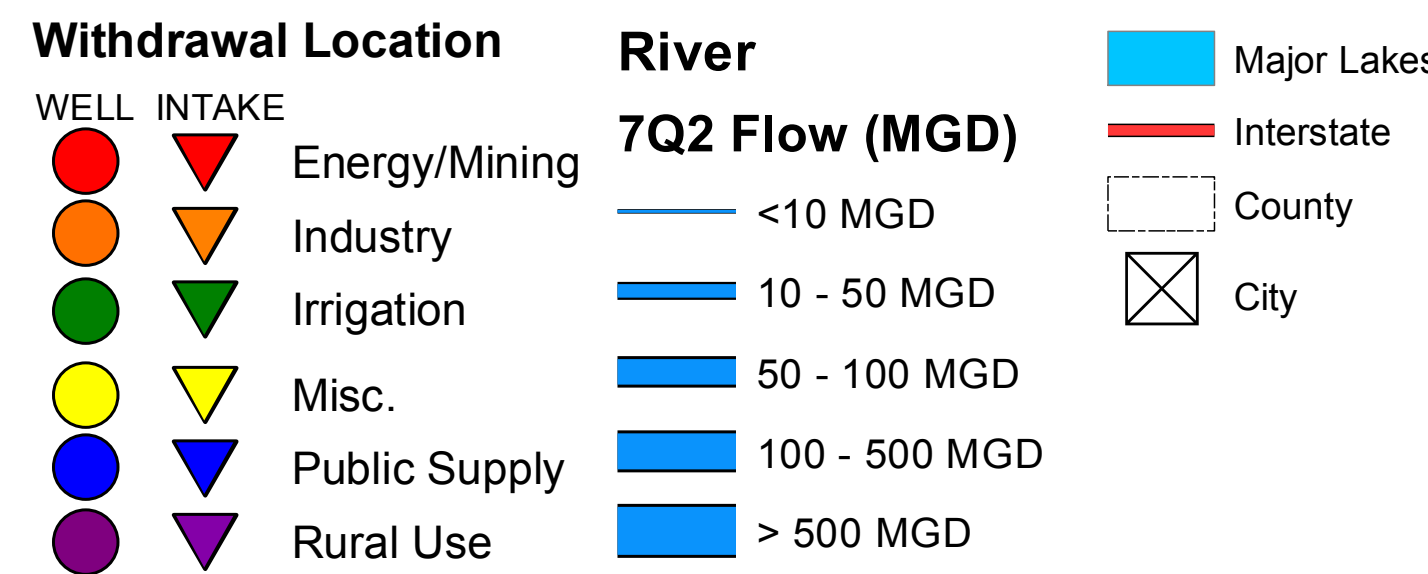
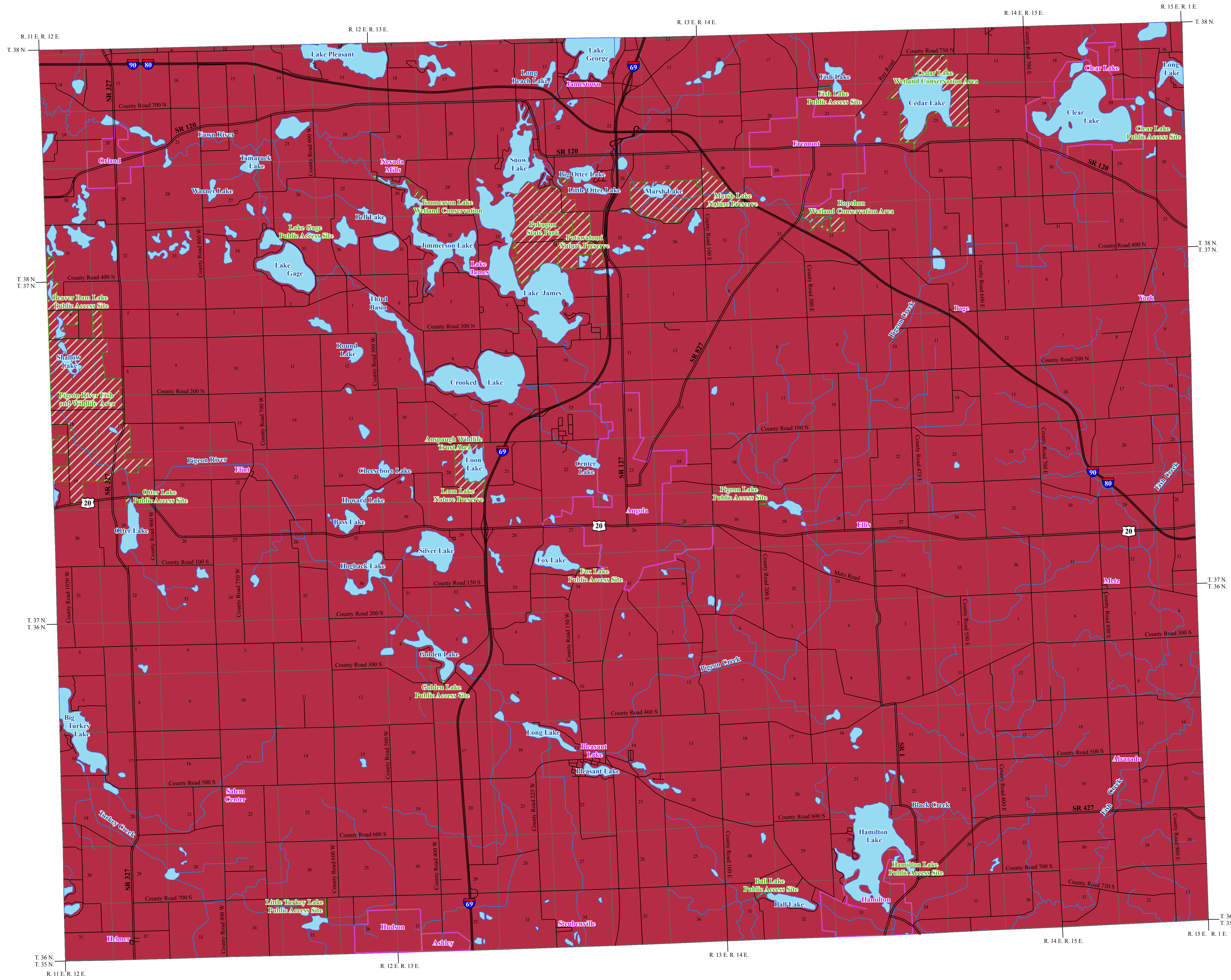


Water Resources and Use in Steuben County

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



BEDROCK AQUIFER SYSTEMS OF STEUBEN COUNTY, INDIANA



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. In general, hydraulic properties of bedrock aquifers are highly variable. Most bedrock aquifers overlie thick glacial deposits, such as in Steuben 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 zone.

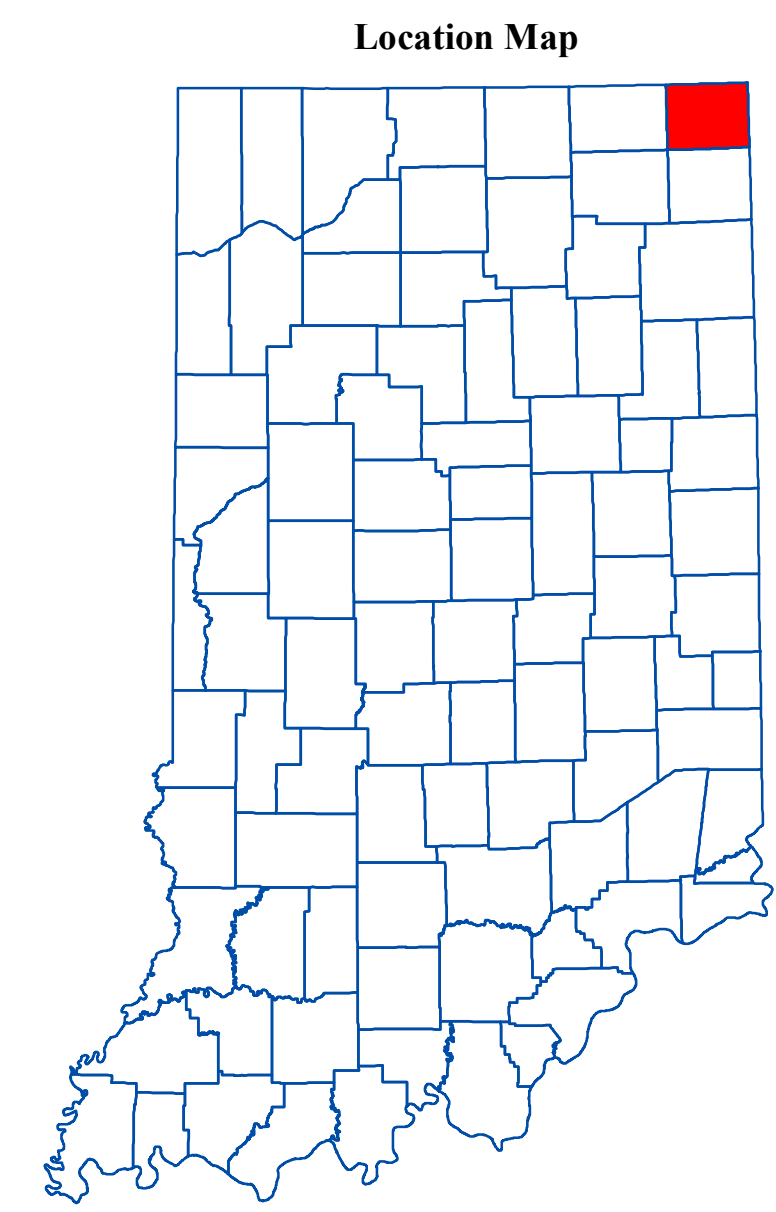
The susceptibility of bedrock aquifer systems to surface contamination is largely dependent on the type and thickness of the overlying sediments. Because the bedrock aquifer systems have complex fracturing systems, once a contaminant has been introduced into a bedrock aquifer system, it will be difficult to track and remediate.

Coldwater, Ellsworth, and Antrim Shales Aquifer System

One bedrock aquifer system is identified for Steuben County; the Devonian and Mississippian age Coldwater, Ellsworth, and Antrim Shales. The shales subcrop throughout the entire county and thicken from south to north. Oil and gas drillers' logs show that the shales attain a thickness of about 300 feet in the southern part of the county and thicken to over 700 feet in the north. These shales are commonly considered an aquitard; therefore, the system is an extremely limited ground-water resource.

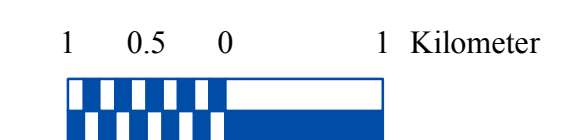
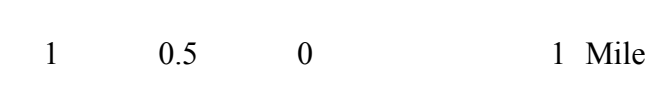
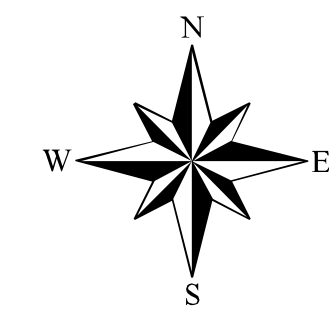
Steuben County has a complex glacial history and was subjected to multiple glacial advances from the north, northeast, and east resulting in glacial sediment deposits completely covering the county. The unconsolidated sediments range in thickness from greater than 150 feet northeast of Fremont to over 400 feet in southwestern areas of the county. Major sand and gravel aquifers occur in these unconsolidated deposits overlying the bedrock. Because of the availability of the overlying unconsolidated resources, no water wells utilize the Coldwater, Ellsworth, and Antrim Shales Aquifer System in Steuben County.

Since the permeability of shale materials is considered low and the overlying unconsolidated deposits are thick, this bedrock system is not very susceptible to contamination introduced at or near the surface.



EXPLANATION

- Stream
- County Road
- State Road & US Highway
- Interstate
- Municipal Boundary
- State Managed Property
- Lake & River



Map Use and Disclaimer Statement

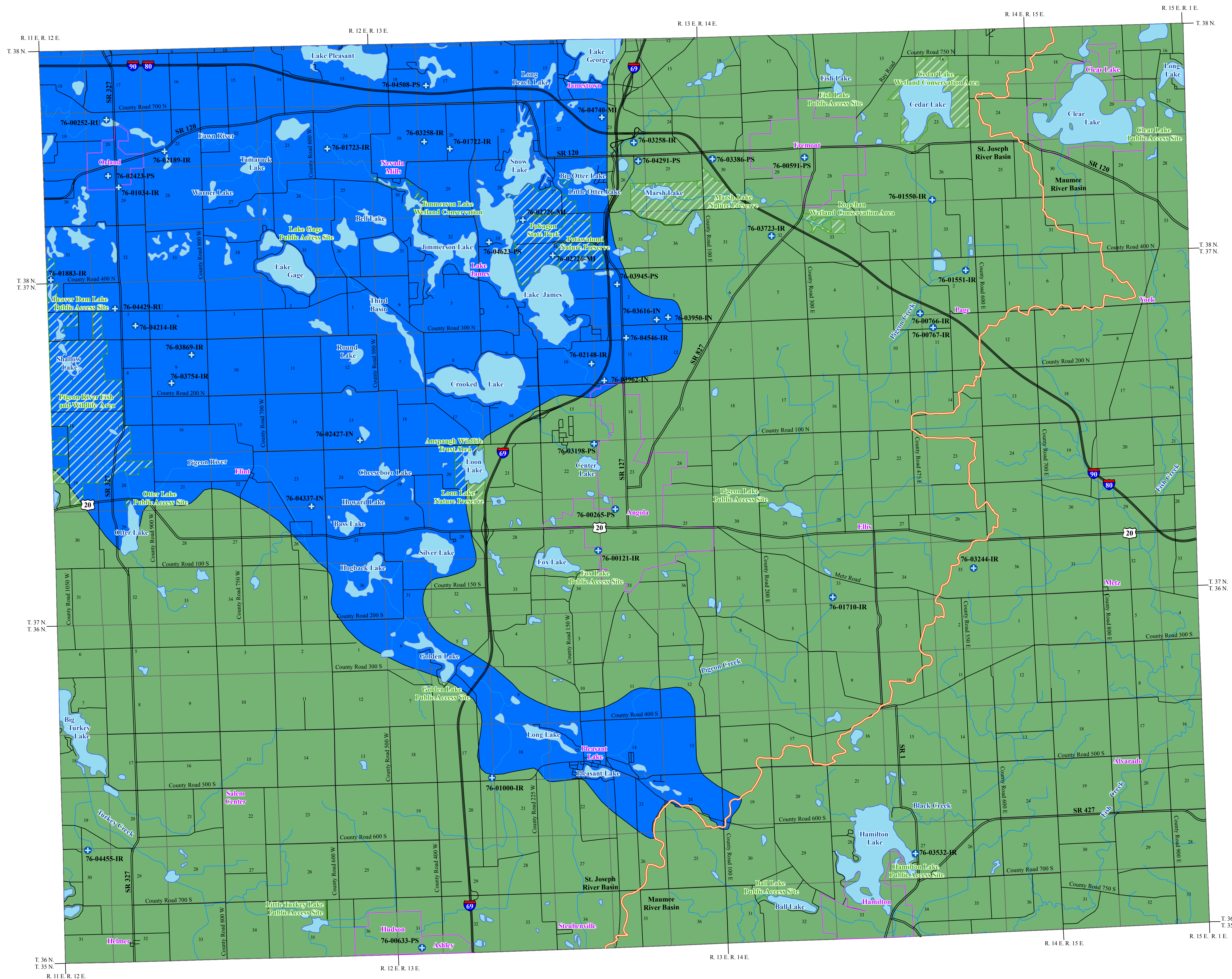
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Bedrock Aquifer Systems of Steuben County, Indiana

by
Division of Water
1987, 1996

UNCONSOLIDATED AQUIFER SYSTEMS OF STEUBEN COUNTY, INDIANA



The following is a summary of the availability of ground water in Steuben County and was derived from the Indiana Department of Natural Resources 1987 publication Water Resource Availability in the St. Joseph River Basin, Indiana, and the Indiana Department of Natural Resources 1996 publication Water Resource Availability in the Maumee River Basin, Indiana. The two reports describe the availability, distribution, quality, and use of ground and surface water in the St. Joseph River Basin, and the Maumee River Basin, and can be viewed and downloaded at <http://www.in.gov/dnr/water>.

Unconsolidated deposits of glacial sands and gravels are the principle source of ground water in Steuben County. Two unconsolidated aquifer systems have been mapped and defined on the basis of geologic environments and aquifer characteristics. Due to the availability of prolific unconsolidated aquifer systems and the extreme limitations of shale materials, the underlying bedrock is generally not used as an aquifer resource.

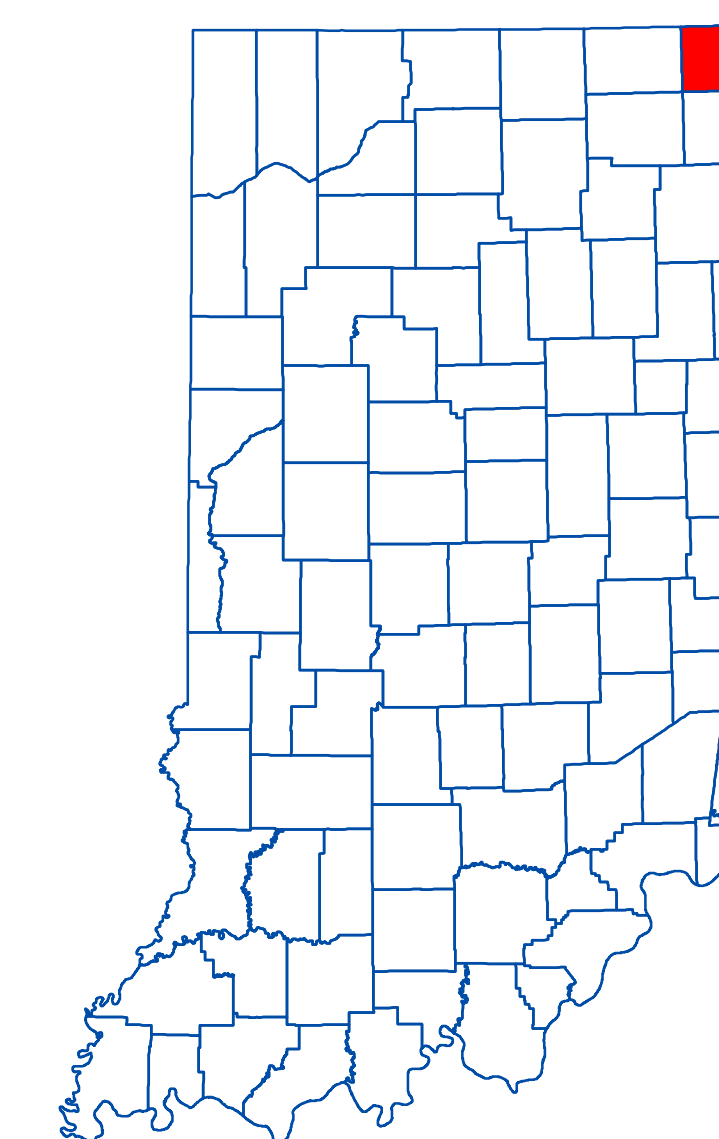
Kendallville Aquifer System

The Kendallville Aquifer System contains discontinuous sand and gravel outwash lenses that occur at various depths within a till and mixed drift complex. Individual sand and gravel aquifers within the system commonly range from 5 to 30 feet in thickness, but there is a general increase in outwash thickness northward where local accumulations approach 95 feet. Large diameter, high-capacity wells in Steuben County yield from 80 to 1300 gallons per minute (gpm). The susceptibility of this aquifer system to surface contamination varies from low to moderate. Susceptibility is low for much of the aquifer system overlain by clay-rich, protective Erie Lobe tills. However, the aquifer system in many parts of Steuben County, where these tills are missing and permeable sediments occur at the surface, are significantly more susceptible to surface contamination than other parts of the system.

Howe Outwash Aquifer System

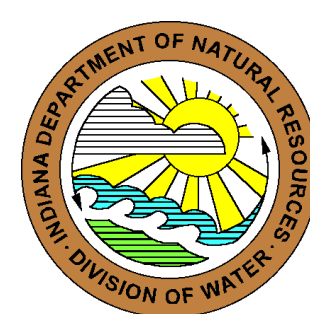
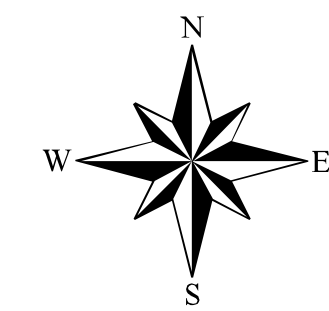
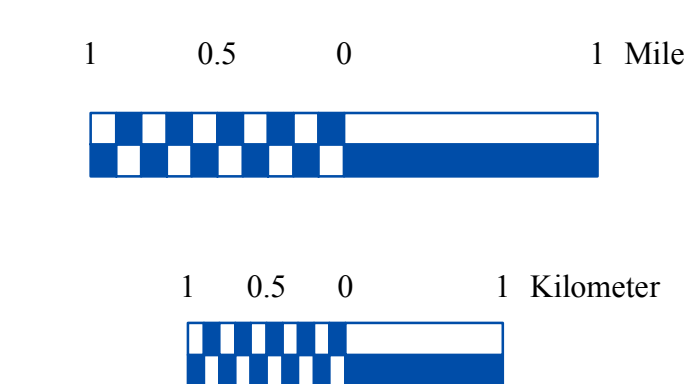
The Howe Outwash Aquifer System is located primarily in northwestern Steuben County. The prevailing character of this aquifer system is moderately thick near surface sand and gravel deposits that overlie an altered till plain. The near surface outwash deposits are the most extensive granular deposits in this system and vary from 15 to 135 feet in thickness. Within the underlying till sequence, clay zones alternate with sand and gravel layers. These sand and gravel layers average 5 to 25 feet in thickness, although some localized lenses reach thicknesses of 100 feet. Two or more sand and gravel deposits often occur at depth within the till sequence, but are only continuous locally. This is an area with good to excellent ground-water availability (100 to 1200 gpm). The surficial deposits are highly susceptible to contamination and the deeper sand and gravels are moderately so.

Location Map



EXPLANATION

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



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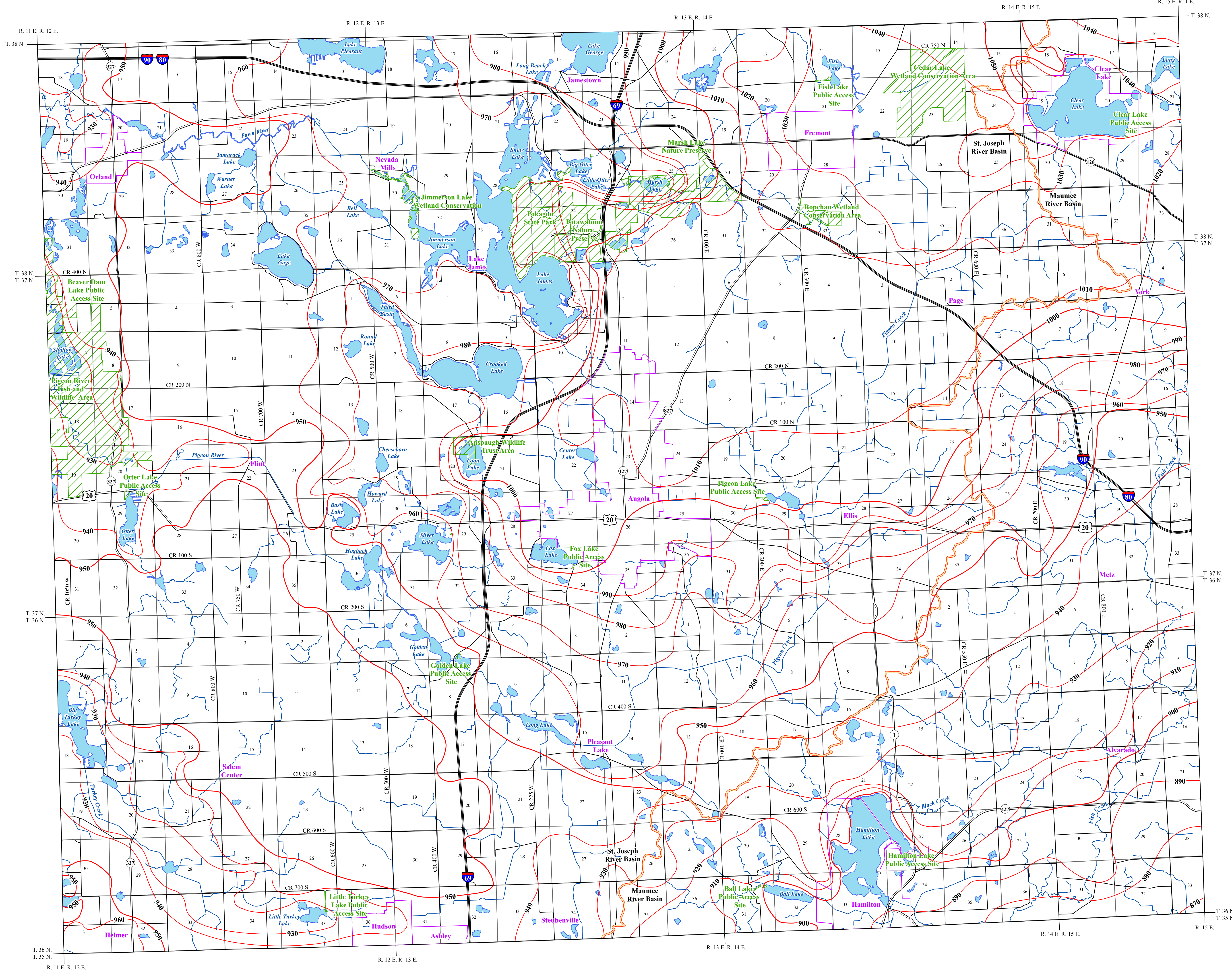
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Unconsolidated Aquifer Systems of Steuben County, Indiana

by
Division of Water
1987, 1996

POTENTIOMETRIC SURFACE MAP OF THE UNCONSOLIDATED AQUIFERS OF STEUBEN COUNTY, INDIANA



Steuben County, Indiana is located in the northeastern portion of the state, adjacent to Michigan and Ohio, and is situated within two major drainage basins. Portions of the northeast and southeast corners of the county are located within the Maumee River Basin, with the rest of the county situated within the St. Joseph River Basin.

The Potentiometric Surface Map (PSM) of the unconsolidated aquifers of Steuben County was mapped by contouring the elevations of 3150 static water-levels reported on well records received 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 mapped potentiometric surface contours are primarily for the upper 100 feet of the unconsolidated materials and utilize data for wells 100 feet or less in depth. If the shallow data was sparse or unavailable in an area, deeper wells were used to complement the mapping.

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 aquifer, in contrast to groundwater 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 pumping. Therefore, measured static water-levels in an area may differ due to local or seasonal variations. Because fluctuations in groundwater are typically small, static water-levels can be used to construct a generalized PSM. 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. The location of the majority of the water well records used to make the PSM were field verified. Elevation data were obtained from a digital elevation model. Quality control/quality assurance procedures were utilized to refine or remove data where errors were readily apparent.

Potentiometric surface elevations range from a high of 1067 feet mean sea level (msl) in the northeast, to a low of 851 feet msl in the southeast. Generalized groundwater flow direction, therefore, appears to be from the northeast to the southwest for the northeastern, eastern and south-central portions of the county, to the northeast in the southwest corner, and to the west in the north-central and western portions of the county.

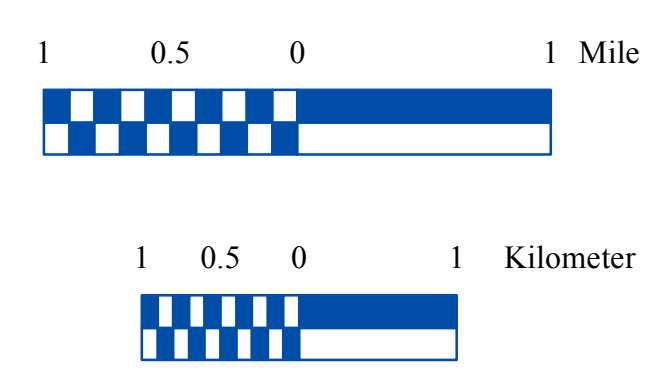
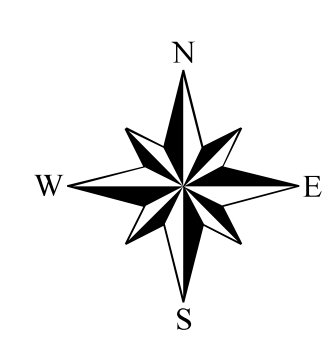
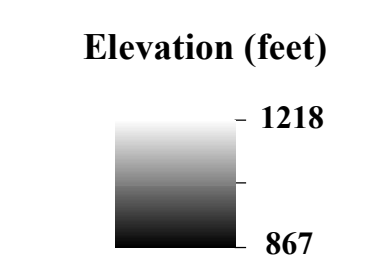
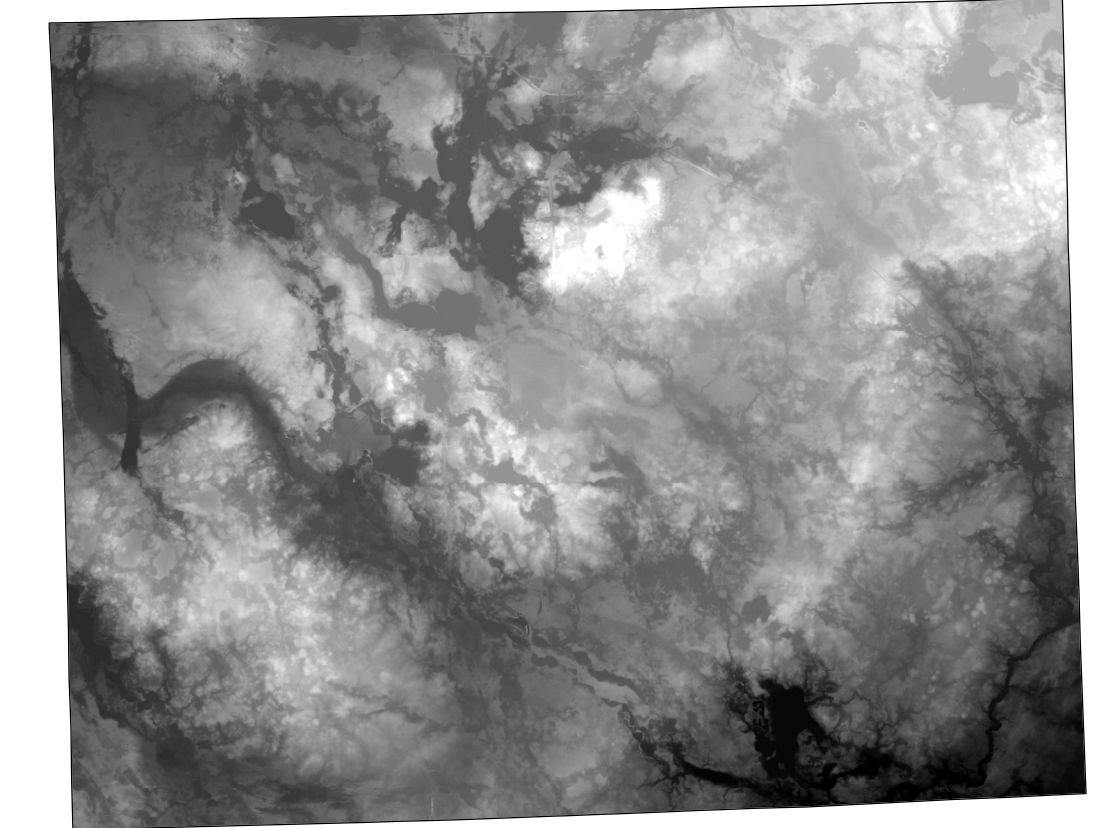
The county PSM can be used to define the regional groundwater flow path and to identify significant areas of groundwater recharge and discharge. County PSM's are intended to represent overall regional characteristics and not intended to be a substitute for site-specific studies.

EXPLANATION

- Line of equal elevation, in feet above mean sea level
- Potentiometric Contour interval 10 feet
- Stream
- County Road
- State Road
- US Highway
- Interstate
- Basin Boundary
- Municipal Boundary
- State Managed Property
- Lake & River

Location Map

Digital Elevation Model of Steuben County, Indiana



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Potentiometric Surface Map of the Unconsolidated Aquifers of Steuben County, Indiana

by Robert K. Schmidt
Division of Water, Resource Assessment Section

September, 2011

Steuben County

