GROUND WATER POLLUTION POTENTIAL OF WAYNE COUNTY, OHIO

BY

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GROUND WATER POLLUTION POTENTIAL REPORT NO. 57

OHIO DEPARTMENT OF NATURAL RESOURCES

DIVISION OF WATER

WATER RESOURCES SECTION

2002

ABSTRACT

A ground water pollution potential map of Wayne County has been prepared using the DRASTIC mapping process. The DRASTIC system consists of two major elements: the designation of mappable units, termed hydrogeologic settings, and the superposition of a relative rating system for pollution potential.

Hydrogeologic settings incorporate hydrogeologic factors that control ground water movement and occurrence including depth to water, net recharge, aquifer media, soil media, topography, impact of the vadose zone media, and hydraulic conductivity of the aquifer. These factors, which form the acronym DRASTIC, are incorporated into a relative ranking scheme that uses a combination of weights and ratings to produce a numerical value called the ground water pollution potential index. Hydrogeologic settings are combined with the pollution potential indexes to create units that can be graphically displayed on a map.

Ground water pollution potential analysis in Wayne County resulted in a map with symbols and colors, which illustrate areas of varying ground water pollution potential indexes ranging from 56 to 187.

Wayne County lies entirely within the Glaciated Central hydrogeologic setting. The buried valleys underlying the present main channel of Killbuck Creek and Chippewa Creek contain sand and gravel outwash, which are capable of yielding up to 500 gallons per minute (gpm) from properly designed, large diameter wells. Yields of 5-100 gpm are obtained from buried valleys underlying Sugar Creek, Apple Creek, and smaller tributaries of the Mohican River and Tuscarawas River. Yields of 25 gpm to less than 5 gpm are obtained from thin lenses of sand and gravel interbedded with glacial till and lacustrine sediments along the margins of the buried valleys and in upland areas containing moderately thick drift.

Interbedded sandstones, shales, and siltstones of the Pennsylvanian System and interbedded sandstones and shales of the Mississippian System comprise the aquifer for many of the upland areas in Wayne County. Wells developed from highly fractured sandstones and shales of the Pennsylvanian Pottsville Group yield over 100 gpm in parts of eastern Wayne County. Elsewhere in the county, yields in the Pottsville range from 5-100 gpm, depending upon the proportion of sandstones to finer-grained rocks and presence of fractures. In the southeastern corner of the county, thin limestones, coals, and clays are encountered. These rocks commonly have yields around 5-10 gpm. Wells developed in the Mississippian Logan Formation and Black Hand Sandstone typically yield from 5 to 25 gpm with limited yields up to 50 gpm. The Mississippian Cuyahoga Group consists of shales, fine-grained sandstones, and siltstones, which have yields in the 5-10 gpm range.

The ground water pollution potential mapping program optimizes the use of existing data to rank areas with respect to relative vulnerability to contamination. The ground water pollution potential map of Wayne County has been prepared to assist planners, managers, and local officials in evaluating the potential for contamination from various sources of pollution. This information can be used to help direct resources and land use activities to appropriate areas, or to assist in protection, monitoring, and clean-up efforts.

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ACKNOWLEDGEMENTS

The preparation of the Wayne County Ground Water Pollution Potential report and map involved the contribution and work of a number of individuals in the Division of Water. Grateful acknowledgement is given to the following individuals for their technical review and map production, text authorship, report editing, and preparation:

Map preparation and review:	Mike Akins Michael P. Angle
GIS coverage production and review:	Paul Spahr
Report production and review:	Michael P. Angle
Report editing:	Kathy Sprowls

INTRODUCTION

The need for protection and management of ground water resources in Ohio has been clearly recognized. About 42 percent of Ohio citizens rely on ground water for drinking and household use from both municipal and private wells. Industry and agriculture also utilize significant quantities of ground water for processing and irrigation. In Ohio, approximately 750,000 rural households depend on private wells; 16,200 of these wells exist in Wayne County.

The characteristics of the many aquifer systems in the state make ground water highly vulnerable to contamination. Measures to protect ground water from contamination usually cost less and create less impact on ground water users than remediation of a polluted aquifer. Based on these concerns for protection of the resource, staff of the Division of Water conducted a review of various mapping strategies useful for identifying vulnerable aquifer areas. They placed particular emphasis on reviewing mapping systems that would assist in state and local protection and management programs. Based on these factors and the quantity and quality of available data on ground water resources, the DRASTIC mapping process (Aller et al., 1987) was selected for application in the program.

Considerable interest in the mapping program followed successful production of a demonstration county map and led to the inclusion of the program as a recommended initiative in the Ohio Ground Water Protection and Management Strategy (Ohio EPA, 1986). Based on this recommendation, the Ohio General Assembly funded the mapping program. A dedicated mapping unit has been established in the Division of Water, Water Resources Section to implement the ground water pollution potential mapping program on a countywide basis in Ohio.

The purpose of this report and map is to aid in the protection of our ground water resources. This protection can be enhanced by understanding and implementing the results of this study, which utilizes the DRASTIC system of evaluating an area's potential for ground water pollution. The mapping program identifies areas that are vulnerable to contamination and displays this information graphically on maps. The system was not designed or intended to replace site-specific investigations, but rather to be used as a planning and management tool. The map and report can be combined with other information to assist in prioritizing local resources and in making land use decisions.

APPLICATIONS OF POLLUTION POTENTIAL MAPS

The pollution potential mapping program offers a wide variety of applications in many counties. The ground water pollution potential map of Wayne County has been prepared to assist planners, managers, and state and local officials in evaluating the relative vulnerability of areas to ground water contamination from various sources of pollution. This information can be used to help direct resources and land use activities to appropriate areas, or to assist in protection, monitoring, and clean-up efforts.

An important application of the pollution potential maps for many areas will be assisting in county land use planning and resource expenditures related to solid waste disposal. A county may use the map to help identify areas that are suitable for disposal activities. Once these areas have been identified, a county can collect more site-specific information and combine this with other local factors to determine site suitability.

Pollution potential maps may be applied successfully where non-point source contamination is a concern. Non-point source contamination occurs where land use activities over large areas impact water quality. Maps providing information on relative vulnerability can be used to guide the selection and implementation of appropriate best management practices in different areas. Best management practices should be chosen based upon consideration of the chemical and physical processes that occur from the practice, and the effect these processes may have in areas of moderate to high vulnerability to contamination. For example, the use of agricultural best management practices that limit the infiltration of nitrates, or promote denitrification above the water table, would be beneficial to implement in areas of relatively high vulnerability to contamination.

A pollution potential map can assist in developing ground water protection strategies. By identifying areas more vulnerable to contamination, officials can direct resources to areas where special attention or protection efforts might be warranted. This information can be utilized effectively at the local level for integration into land use decisions and as an educational tool to promote public awareness of ground water resources. Pollution potential maps may be used to prioritize ground water monitoring and/or contamination clean-up efforts. Areas that are identified as being vulnerable to contamination may benefit from increased ground water monitoring for pollutants or from additional efforts to clean up an aquifer.

Individuals in the county who are familiar with specific land use and management problems will recognize other beneficial uses of the pollution potential maps. Planning commissions and zoning boards can use these maps to help make informed decisions about the development of areas within their jurisdiction. Developers proposing projects within ground water sensitive areas may be required to show how ground water will be protected.

Regardless of the application, emphasis must be placed on the fact that the system is not designed to replace a site-specific investigation. The strength of the system lies in its ability to make a "first-cut approximation" by identifying areas that are vulnerable to contamination. Any potential applications of the system should also recognize the assumptions inherent in the system.

SUMMARY OF THE DRASTIC MAPPING PROCESS

DRASTIC was developed by the National Ground Water Association for the United States Environmental Protection Agency. This system was chosen for implementation of a ground water pollution potential mapping program in Ohio. A detailed discussion of this system can be found in Aller et al. (1987).

The DRASTIC mapping system allows the pollution potential of any area to be evaluated systematically using existing information. Vulnerability to contamination is a combination of hydrogeologic factors, anthropogenic influences, and sources of contamination in any given area. The DRASTIC system focuses only on those hydrogeologic factors that influence ground water pollution potential. The system consists of two major elements: the designation of mappable units, termed hydrogeologic settings, and the superposition of a relative rating system to determine pollution potential.

The application of DRASTIC to an area requires the recognition of a set of assumptions made in the development of the system. DRASTIC evaluates the pollution potential of an area under the assumption that a contaminant with the mobility of water is introduced at the surface and flushed into the ground water by precipitation. Most important, DRASTIC cannot be applied to areas smaller than 100 acres in size and is not intended or designed to replace site-specific investigations.

Hydrogeologic Settings and Factors

To facilitate the designation of mappable units, the DRASTIC system used the framework of an existing classification system developed by Heath (1984), which divides the United States into 15 ground water regions based on the factors in a ground water system that affect occurrence and availability.

Within each major hydrogeologic region, smaller units representing specific hydrogeologic settings are identified. Hydrogeologic settings form the basis of the system and represent a composite description of the major geologic and hydrogeologic factors that control ground water movement into, through, and out of an area. A hydrogeologic setting represents a mappable unit with common hydrogeologic characteristics and, as a consequence, common vulnerability to contamination (Aller et al., 1987).

Figure 1 illustrates the format and description of a typical hydrogeologic setting found within Wayne County. Inherent within each hydrogeologic setting are the physical characteristics that affect the ground water pollution potential. These characteristics or factors identified during the development of the DRASTIC system include:

D – Depth to Water
R – Net Recharge
A – Aquifer Media
S – Soil Media
T – Topography
I – Impact of the Vadose Zone Media
C – Conductivity (Hydraulic) of the Aquifer

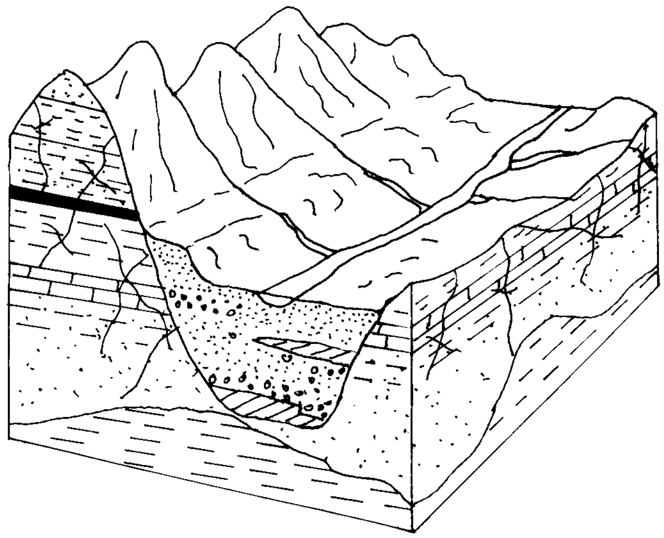
These factors incorporate concepts and mechanisms such as attenuation, retardation, and time or distance of travel of a contaminant with respect to the physical characteristics of the hydrogeologic setting. Broad consideration of these factors and mechanisms coupled with existing conditions in a setting provide a basis for determination of the area's relative vulnerability to contamination.

Depth to water is considered to be the depth from the ground surface to the water table in unconfined aquifer conditions or the depth to the top of the aquifer under confined aquifer conditions. The depth to water determines the distance a contaminant would have to travel before reaching the aquifer. The greater the distance the contaminant has to travel, the greater the opportunity for attenuation to occur or restriction of movement by relatively impermeable layers.

Net recharge is the total amount of water reaching the land surface that infiltrates the aquifer measured in inches per year. Recharge water is available to transport a contaminant from the surface into the aquifer and affects the quantity of water available for dilution and dispersion of a contaminant. Factors to be included in the determination of net recharge include contributions due to infiltration of precipitation, in addition to infiltration from rivers, streams and lakes, irrigation, and artificial recharge.

Aquifer media represents consolidated or unconsolidated rock material capable of yielding sufficient quantities of water for use. Aquifer media accounts for the various physical characteristics of the rock that provide mechanisms of attenuation, retardation, and flow pathways that affect a contaminant reaching and moving through an aquifer.

Soil media refers to the upper six feet of the unsaturated zone that is characterized by significant biological activity. The type of soil media influences the amount of recharge that can move through the soil column due to variations in soil permeability. Various soil types also have the ability to attenuate or retard a contaminant as it moves throughout the soil profile. Soil media is based on textural classifications of soils and considers relative thicknesses and attenuation characteristics of each profile within the soil.



7D Buried Valley

This hydrogeologic setting is widespread throughout Wayne County. All of the major trunk streams and many modern tributaries overlie buried valley deposits. There are also former drainage ways overlying buried valleys that lack modern streams. Broad, flat-lying floodplains and gently sloping terraces characterize the setting. Depths to water are variable; they are typically less than 30 feet in valleys containing modern streams and are commonly over 45 feet in valleys lacking modern streams. Aquifers are composed of variable thicknesses of sand and gravel interbedded with finer-grained alluvium, till, and lacustrine deposits. The modern streams may be in direct hydraulic connection with the underlying aquifer. Yields up to 500 gpm have been reported for some of the coarser, thicker, more continuous sand and gravel outwash in Chippewa Creek and Killbuck Creek south of Wooster. Yields up to 100 gpm are developed in Sugar Creek, Killbuck Creek northwest of Wooster, Muddy Fork of the Mohican River south of New Pittsburgh, and lower Apple Creek. Some valleys, including Muddy Fork of the Mohican River in the northwestern corner of the county and Little Chippewa Creek, contain thin lenses of sand and gravel interbedded with much thicker sequences of finer-grained alluvial and lacustrine deposits. Soils on terraces are typically sandy loams derived from outwash; soils on floodplains are silt loams derived from modern alluvium. Recharge is typically relatively high due to the flat-lying topography, shallow depth to water, high permeability of the soils and vadose zone materials, and presence of modern overlying streams. Recharge tends to be less in valleys lacking modern streams, having greater depths to water, and less permeable soils and vadose media.

GWPP index values for the hydrogeologic setting of Buried Valley range from 85 to 187, with the total number of GWPP index calculations equaling 120.

Figure 1. Format and description of the hydrogeologic setting - 7D Buried Valley.

Topography refers to the slope of the land expressed as percent slope. The slope of an area affects the likelihood that a contaminant will run off or be ponded and ultimately infiltrate into the subsurface. Topography also affects soil development and often can be used to help determine the direction and gradient of ground water flow under water table conditions.

The impact of the vadose zone media refers to the attenuation and retardation processes that can occur as a contaminant moves through the unsaturated zone above the aquifer. The vadose zone represents that area below the soil horizon and above the aquifer that is unsaturated or discontinuously saturated. Various attenuation, travel time, and distance mechanisms related to the types of geologic materials present can affect the movement of contaminants in the vadose zone. Where an aquifer is unconfined, the vadose zone media represents the materials below the soil horizon and above the water table. Under confined aquifer conditions, the vadose zone is simply referred to as a confining layer. The presence of the confining layer in the unsaturated zone has a significant impact on the pollution potential of the ground water in an area.

Hydraulic conductivity of an aquifer is a measure of the ability of the aquifer to transmit water, and is also related to ground water velocity and gradient. Hydraulic conductivity is dependent upon the amount and interconnectivity of void spaces and fractures within a consolidated or unconsolidated rock unit. Higher hydraulic conductivity typically corresponds to higher vulnerability to contamination. Hydraulic conductivity considers the capability for a contaminant that reaches an aquifer to be transported throughout that aquifer over time.

Weighting and Rating System

DRASTIC uses a numerical weighting and rating system that is combined with the DRASTIC factors to calculate a ground water pollution potential index or relative measure of vulnerability to contamination. The DRASTIC factors are weighted from 1 to 5 according to their relative importance to each other with regard to contamination potential (Table 1). Each factor is then divided into ranges or media types and assigned a rating from 1 to 10 based on their significance to pollution potential (Tables 2-8). The rating for each factor is selected based on available information and professional judgment. The selected rating for each factor is multiplied by the assigned weight for each factor. These numbers are summed to calculate the DRASTIC or pollution potential index.

Once a DRASTIC index has been calculated, it is possible to identify areas that are more likely to be susceptible to ground water contamination relative to other areas. The higher the DRASTIC index, the greater the vulnerability to contamination. The index generated provides only a relative evaluation tool and is not designed to produce absolute answers or to represent units of vulnerability. Pollution potential indexes of various settings should be compared to each other only with consideration of the factors that were evaluated in determining the vulnerability of the area.

Pesticide DRASTIC

A special version of DRASTIC was developed for use where the application of pesticides is a concern. The weights assigned to the DRASTIC factors were changed to reflect the processes that affect pesticide movement into the subsurface with particular emphasis on soils. Where other agricultural practices, such as the application of fertilizers, are a concern, general DRASTIC should be used to evaluate relative vulnerability to contamination. The process for calculating the Pesticide DRASTIC index is identical to the process used for calculating the general DRASTIC index. However, general DRASTIC and Pesticide DRASTIC numbers should not be compared because the conceptual basis in factor weighting and evaluation differs significantly. Table 1 lists the weights used for general and pesticide DRASTIC.

Table 1. Assigned weights for DRASTIC features

Feature	**General DRASTIC Weight**	**Pesticide DRASTIC Weight**
Depth to Water	5	5
Net Recharge	4	4
Aquifer Media	3	3
Soil Media	2	5
Topography	1	3
Impact of the Vadose Zone Media	5	4
Hydraulic Conductivity of the Aquifer	3	2

Table 2. Ranges and ratings for depth to water

Depth to Water (feet)	
Range	**Rating**
0-5	10
5-15	9
15-30	7
30-50	5
50-75	3
75-100	2
100+	1
Weight: 5	Pesticide Weight: 5

Table 3. Ranges and ratings for net recharge

Net Recharge (inches)	
Range	**Rating**
0-2	1
2-4	3
4-7	6
7-10	8
10+	9
Weight: 4	Pesticide Weight: 4

Table 4. Ranges and ratings for aquifer media

Aquifer Media		
Range	**Rating**	**Typical Rating**
Shale	1-3	2
Glacial Till	4-6	5
Sandstone	4-9	6
Limestone	4-9	6
Sand and Gravel	4-9	8
Interbedded Ss/Sh/Ls/Coal	2-10	9
Karst Limestone	9-10	10
Weight: 3	Pesticide Weight: 3	

Table 5. Ranges and ratings for soil media

Soil Media	
Range	**Rating**
Thin or Absent	10
Gravel	10
Sand	9
Peat	8
Shrink/Swell Clay	7
Sandy Loam	6
Loam	5
Silty Loam	4
Clay Loam	3
Muck	2
Clay	1
Weight: 2	Pesticide Weight: 5

Table 6. Ranges and ratings for topography

Topography (percent slope)	
Range	**Rating**
0-2	10
2-6	9
6-12	5
12-18	3
18+	1
Weight: 1	Pesticide Weight: 3

Table 7. Ranges and ratings for impact of the vadose zone media

Impact of the Vadose Zone Media		
Range	**Rating**	**Typical Rating**
Confining Layer	1	1
Silt/Clay	2-6	3
Shale	2-5	3
Limestone	2-7	6
Sandstone	4-8	6
Interbedded Ss/Sh/Ls/Coal	4-8	6
Sand and Gravel with Silt and Clay	4-8	6
Glacial Till	2-6	4
Sand and Gravel	6-9	8
Karst Limestone	8-10	10
Weight: 5	Pesticide Weight: 4	

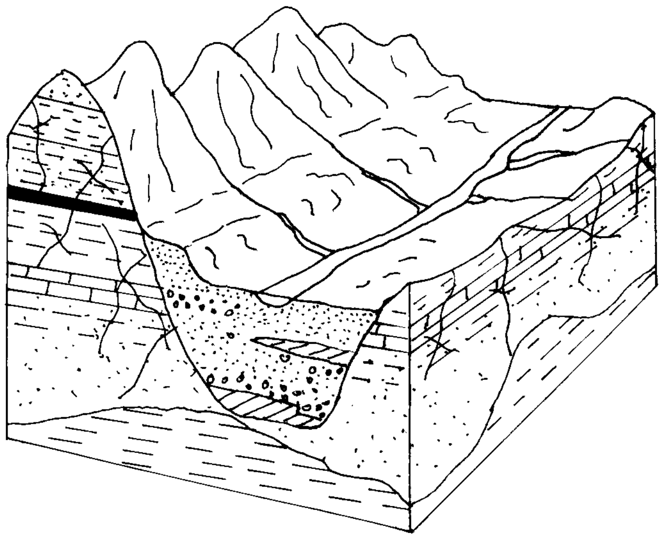
Table 8. Ranges and ratings for hydraulic conductivity

Hydraulic Conductivity (GPD/FT^2)	
Range	**Rating**
1-100	1
100-300	2
300-700	4
700-1000	6
1000-2000	8
2000+	10
Weight: 3	Pesticide Weight: 2

Integration of Hydrogeologic Settings and DRASTIC Factors

Figure 2 illustrates the hydrogeologic setting 7D1, Buried Valley, identified in mapping Wayne County, and the pollution potential index calculated for the setting. Based on selected ratings for this setting, the pollution potential index is calculated to be 148. This numerical value has no intrinsic meaning, but can be readily compared to a value obtained for other settings in the county. DRASTIC indexes for typical hydrogeologic settings and values across the United States range from 45 to 223. The diversity of hydrogeologic conditions in Wayne County produces settings with a wide range of vulnerability to ground water contamination. Calculated pollution potential indexes for the 10 settings identified in the county range from 56 to 187.

Hydrogeologic settings identified in an area are combined with the pollution potential indexes to create units that can be graphically displayed on maps. Pollution potential analysis in Wayne County resulted in a map with symbols and colors that illustrate areas of ground water vulnerability. The map describing the ground water pollution potential of Wayne County is included with this report.



SETTING 7D1		GENERAL		
FEATURE	**RANGE**	**WEIGHT**	**RATING**	**NUMBER**
Depth to Water	15-30	5	7	35
Net Recharge	7-10	4	8	32
Aquifer Media	Sand & Gravel	3	7	21
Soil Media	Silty Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	6	30
Hydraulic Conductivity	300-700	3	4	12
		DRASTIC	INDEX	148

Figure 2. Description of the hydrogeologic setting - 7D1 Buried Valley.

INTERPRETATION AND USE OF GROUND WATER POLLUTION POTENTIAL MAPS

The application of the DRASTIC system to evaluate an area's vulnerability to contamination produces hydrogeologic settings with corresponding pollution potential indexes. The susceptibility to contamination is greater as the pollution potential index increases. This numeric value determined for one area can be compared to the pollution potential index calculated for another area.

The map accompanying this report displays both the hydrogeologic settings identified in the county and the associated pollution potential indexes calculated in those hydrogeologic settings. The symbols on the map represent the following information:

7D1 - defines the hydrogeologic region and setting
148 - defines the relative pollution potential

Here the first number (**7**) refers to the major hydrogeologic region and the upper case letter (**D**) refers to a specific hydrogeologic setting. The following number (**1**) references a certain set of DRASTIC parameters that are unique to this setting and are described in the corresponding setting chart. The second number (**148**) is the calculated pollution potential index for this unique setting. The charts for each setting provide a reference to show how the pollution potential index was derived.

The maps are color-coded using ranges depicted on the map legend. The color codes used are part of a national color-coding scheme developed to assist the user in gaining a general insight into the vulnerability of the ground water in the area. The color codes were chosen to represent the colors of the spectrum, with warm colors (red, orange, and yellow) representing areas of higher vulnerability (higher pollution potential indexes), and cool colors (greens, blues, and violet) representing areas of lower vulnerability to contamination. The maps also delineate large man-made and natural features such as lakes, landfills, quarries, and strip mines, but these areas are not rated and therefore not color-coded.

GENERAL INFORMATION ABOUT WAYNE COUNTY

Demographics

Wayne County occupies approximately 561 square miles in northeastern Ohio (Figure 3). Wayne County is bounded to the north by Medina County, to the northeast by Summit County, to the east by Stark County, to the south by Holmes County, and to the west by Ashland County.

The approximate population of Wayne County, based upon 2002 estimates, is 111,564 (Department of Development, Ohio County Profiles, 2002). Wooster is the largest community and the county seat. Agriculture accounts for roughly 72 percent of the land usage in Wayne County. Wayne County leads the state in dairy farming. Woodlands, industry, and residential are the other major land uses in the county. Residential growth is increasing both in the Wooster area and areas adjacent to Stark and Summit Counties. Mining, including sand and gravel pits, is a land use in southern and eastern Wayne County. More specific information on land usage can be obtained from the Ohio Department of Natural Resources, Division of Real Estate and Land Management (REALM), Resource Analysis Program (formerly OCAP).

Climate

The *Hydrologic Atlas for Ohio* (Harstine, 1991) reports an average annual temperature of approximately 50 degrees Fahrenheit for Wayne County. The average temperatures increase slightly towards the higher elevation upland areas to the southwest. Harstine (1991) shows that the average precipitation is approximately 36 inches per year for the county, with precipitation increasing towards the south. The mean annual precipitation for Wooster is 36.2 inches per year based upon a twenty-year (1961-1980) period (Owenby and Ezell, 1992). The mean annual temperature at Wooster for the same twenty-year period is 48.8 degrees Fahrenheit (Owenby and Ezell, 1992).

Physiography and Topography

Wayne County lies within the Glaciated Allegheny Plateau section of the Appalachian Plateau Province (Frost, 1931; Fenneman, 1938, and Bier, 1956). Broad, flat modern stream valleys overlying buried valley systems, which separate moderately steep, rolling uplands, characterize the county. The topography becomes somewhat steeper to the south as the drift becomes thinner and the topography becomes more bedrock-controlled. The steepest relief is in the areas immediately adjacent to Killbuck Creek northwest of Wooster.

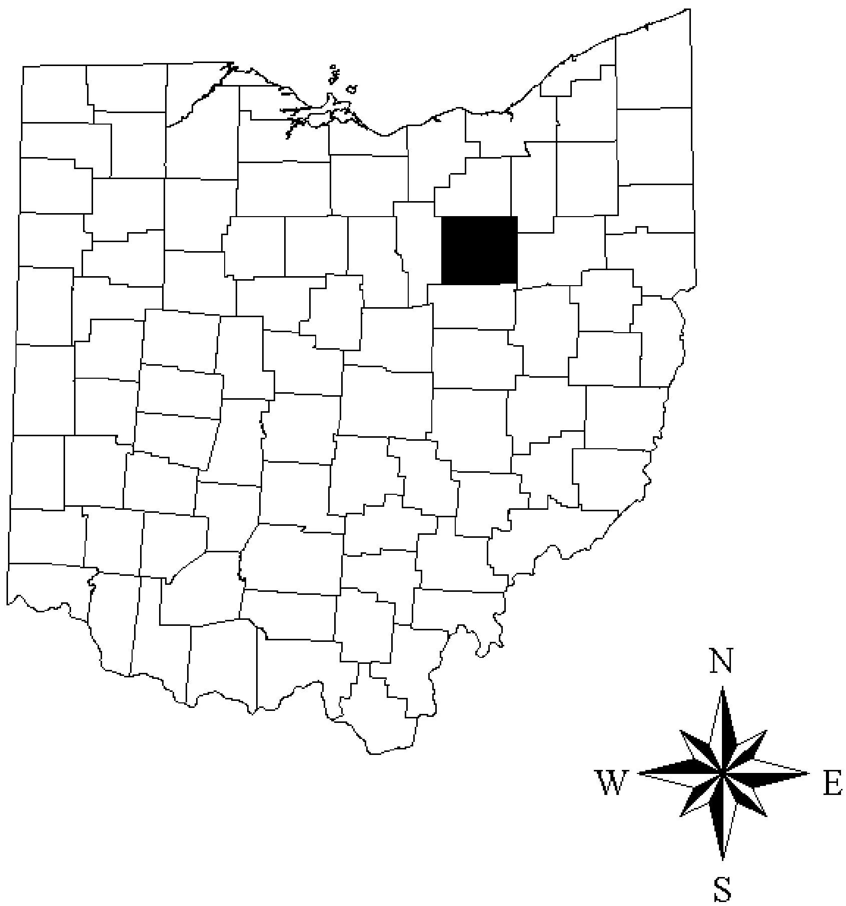


Figure 3. Location of Wayne County, Ohio.

Modern Drainage

Major tributaries of the Tuscarawas River drain all but the westernmost margin of Wayne County. Chippewa Creek and its tributaries drain the northeast corner. Southeastern Wayne County is drained by Sugar Creek. Killbuck Creek and its tributaries drain central Wayne County, including Apple Creek and Salt Creek. Muddy Fork of the Mohican River drains the western margin of the county. Ultimately, all of the streams empty into the Muskingum River in southeastern Ohio.

Pre- and Inter-Glacial Drainage Changes

The drainage patterns of Wayne County have changed significantly as a result of the multiple glaciations. The drainage changes are complex and not yet fully understood. More research and data are necessary in both Wayne County and adjacent counties. Particularly, well log data for deeper wells that penetrate the entire thickness of drift would be helpful in making interpretations.

The Teays River System drained much of Ohio prior to glaciation (Figure 4). Western and central Wayne County were part of the headwaters of the Groveport River, which was the primary eastern tributary of the Teays River (Stout et al., 1943). This tributary flowed to the southwest, eventually merging with the Teays River south of Columbus. There was a major drainage divide which ran roughly from West Salem southeastwards passing the northeast corner of Wooster to west of Mt. Eaton (Stout et al., 1943). Northern Wayne County was drained by Olmstead Falls Creek, which flowed due north (Stout et al., 1943). The southeastern corner drained into the Dover River, which flowed northward (Stout et al., 1943 and DeLong and White, 1963).

As ice advanced through Ohio during the pre-Illinoian (Kansan) glaciation, the Teays Drainage System was blocked. Flow backed-up in the main trunk of the Teays River Valley as well as in many tributaries, forming several large lakes. These lakes over-topped, creating spillways and cutting new channels. New drainage systems began to evolve (Stout et al., 1943). This downcutting by these new streams was believed to be relatively rapid and, in many places, the new channels were cut over 100 feet deeper than the previous Teays River System valleys. The new drainage system (Figure 5) is referred to as the Deep Stage due to this increased downcutting. In southwestern Wayne County, the drainages became entrenched deeper and eroded northeastward. This system was now referred to as the Utica River, which roughly followed the course of the Groveport River (Stout et al., 1943). The area north and east of the divide was inferred as being ice covered at this time.

The Illinoian ice advance brought further changes to the drainage systems (Figure 6). Most of western and Central Wayne County was drained by Millersburg Creek, an ancestral stream with roughly the same course as Killbuck Creek south of Wooster (Stout et al., 1943). Eastern Wayne County appears to have been drained by a stream roughly following the course of modern Chippewa Creek. This tributary flowed eastward into Stark County.

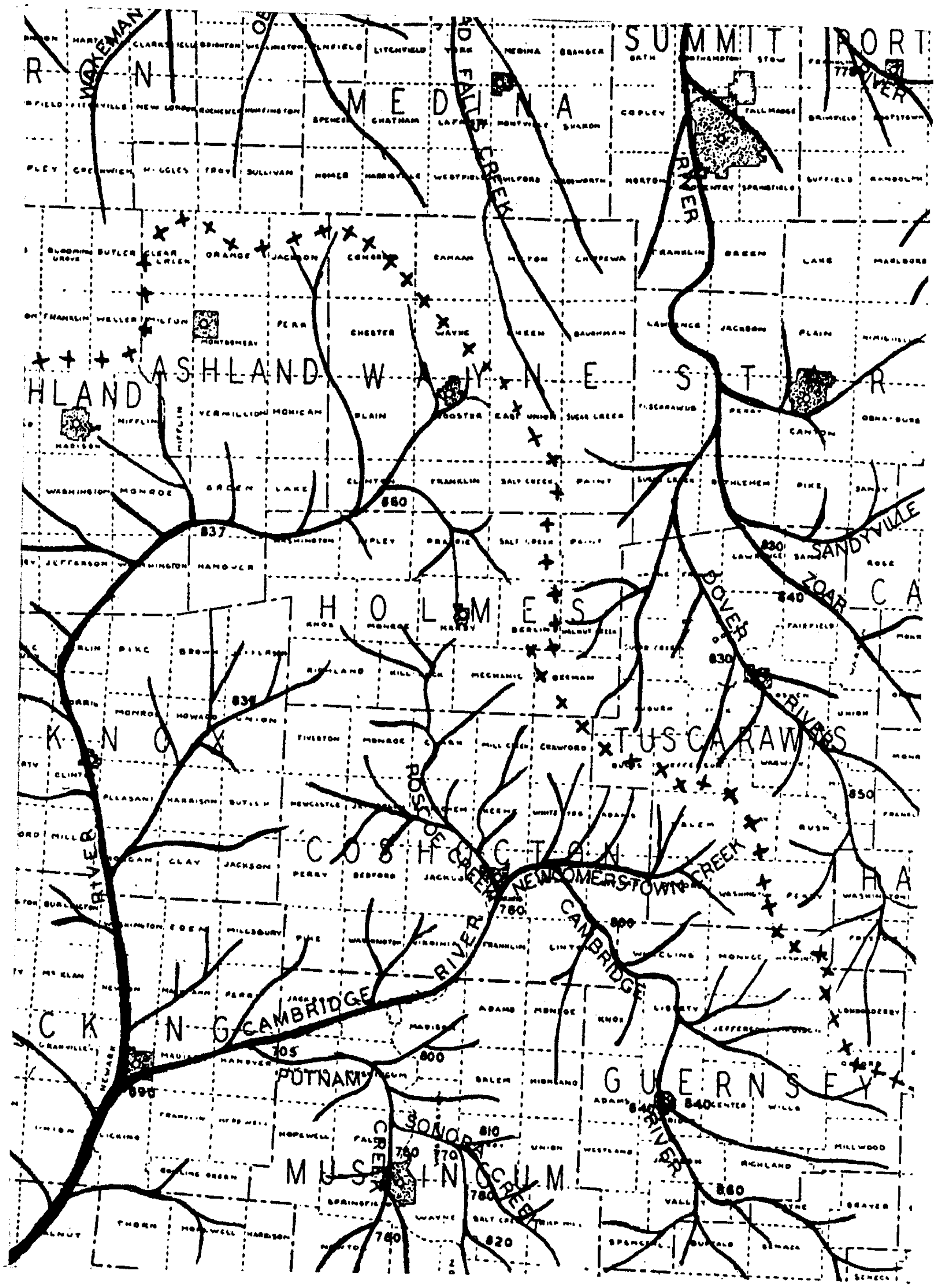


Figure 4. Pre-glacial Teays Stage drainage (after Stout et al., 1943).

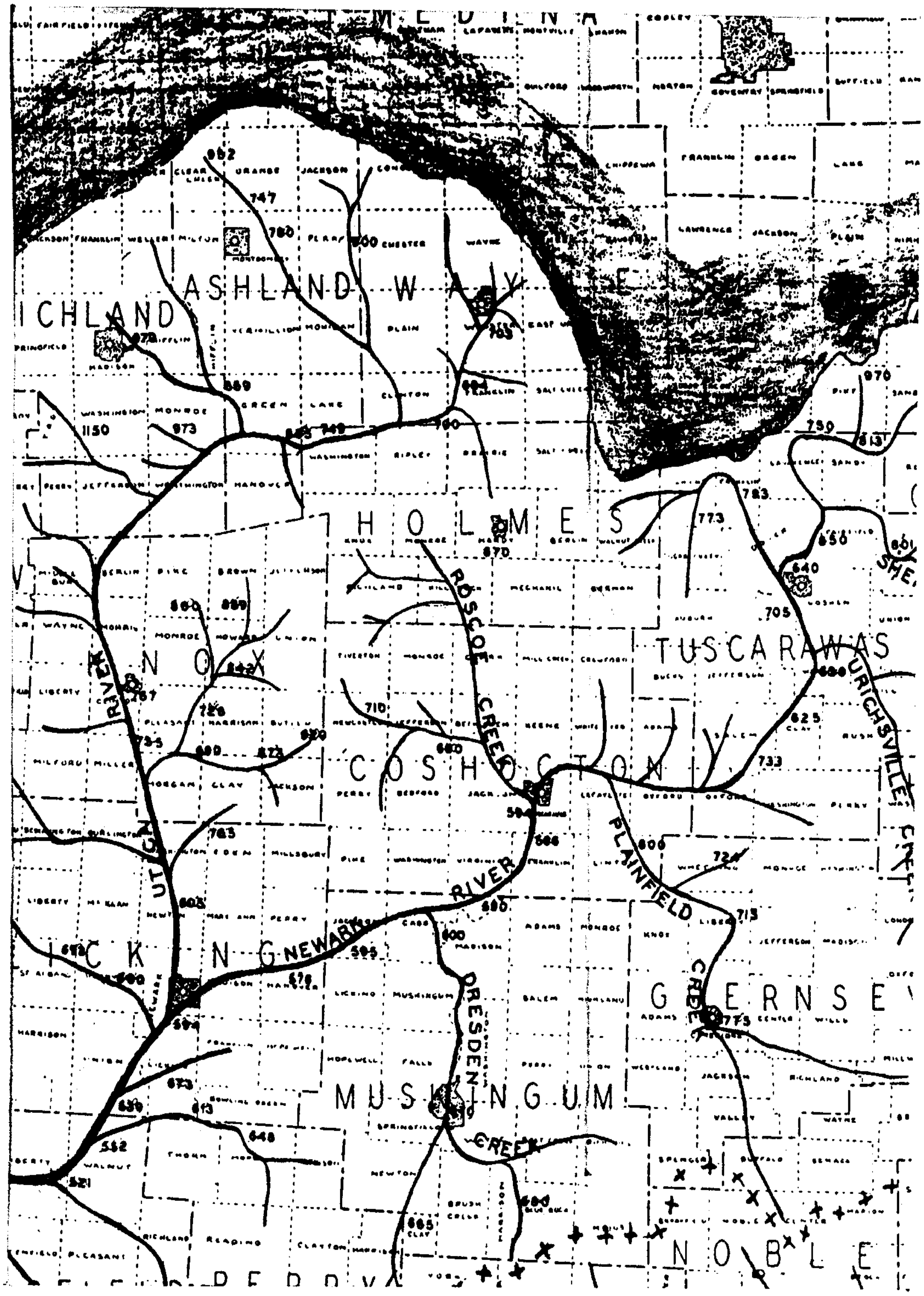


Figure 5. Deep Stage drainage (after Stout et al., 1943).

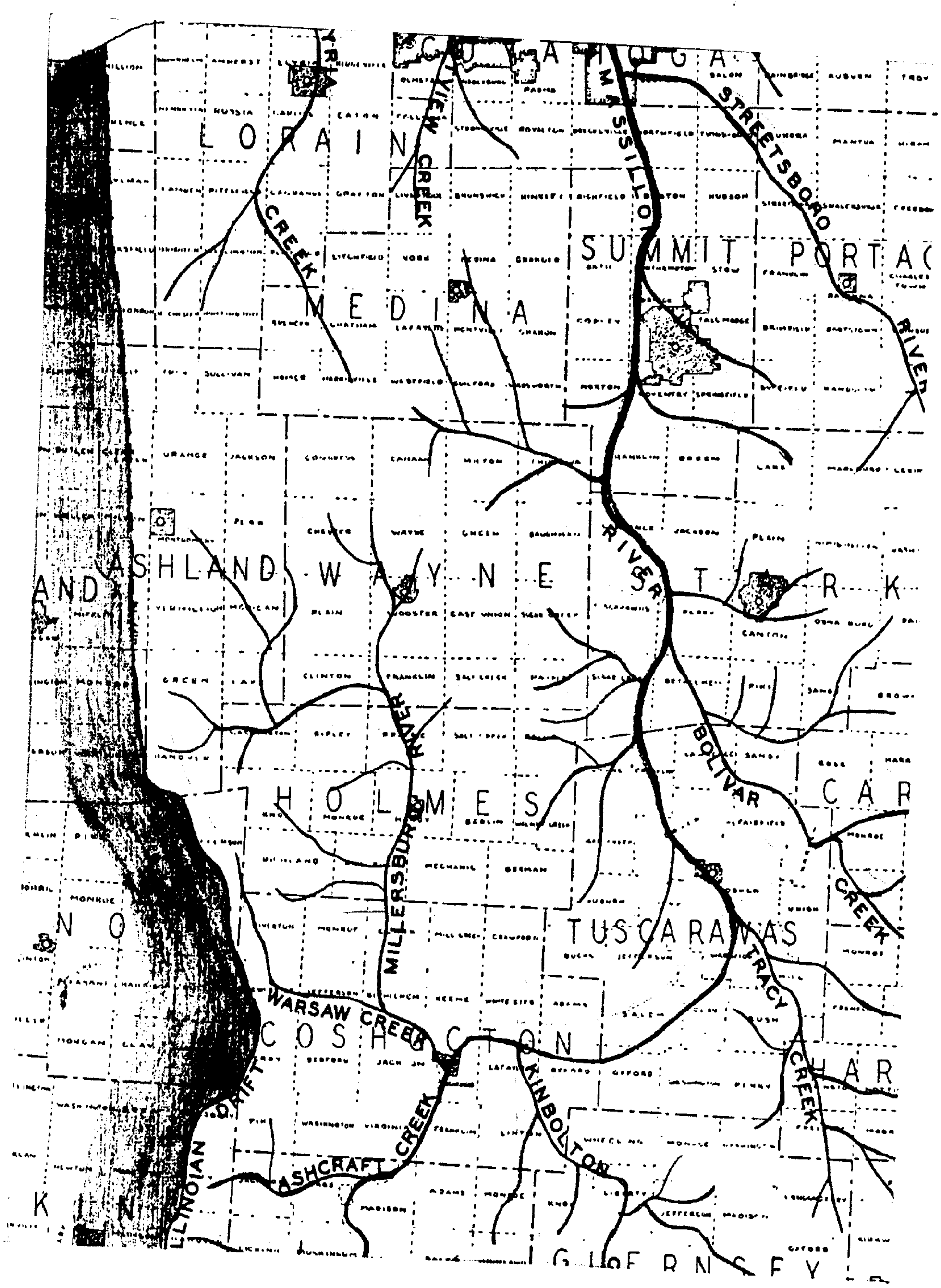


Figure 6. Illinoian-age drainage (after Stout et al., 1943).

Opinions as to the nature of drainage changes as a result of the advancing Illinoian ice front differ and more research is needed.

The most recent ice advance, the Wisconsinan, brought further drainage changes to Wayne County (Stout et al., 1943 and White, 1967). The modern drainage system was slowly created. Southerly-flowing streams tended to become conduits for meltwater discharge and contain thick sequences of sand and gravel outwash along with finer alluvial (floodplain) deposits. Northerly-flowing streams tended to be blocked by the advancing ice, causing the water to pond and the deposition of fine-grained lacustrine or slack water deposits. Some valleys contain both types of deposition as the environments changed over time. Ancestral stream channels that become filled in with glacial drift are referred to as buried valleys.

Glacial Geology

During the Pleistocene Epoch (2 million to 10,000 years before present (Y.B.P.)) several episodes of ice advance occurred in northeastern Ohio. Table 9 summarizes the Pleistocene deposits found in Wayne County. Older ice advances, which predate the most recent (Brunhes) magnetic reversal (about 730,000 Y.B.P.), are now commonly referred to as pre-Illinoian (formerly Kansan). White (1967 and 1982) reports that the Killbuck Lobe of the late Wisconsinan Ice Sheet deposited the surficial till in Wayne County. Pavey et al. (2002) mapped the surficial deposits of northern and eastern Wayne County.

The majority of the glacial deposits fall into four main types: (glacial) till, lacustrine, outwash, and ice-contact sand and gravel (kames). Buried valleys may contain a mix of all of these types of deposits. Drift is an older term that collectively refers to the entire sequence glacial deposits.

Till is an unsorted, non-stratified (non-bedded), mixture of sand, gravel, silt, and clay deposited directly by the ice sheet. There are two main types or facies of glacial till. Lodgement till is "plastered-down" or "bulldozed" at the base of an actively moving ice sheet. Lodgement till tends to be relatively dense and compacted and pebbles typically are angular, broken, and have a preferred direction or orientation. "Hardpan" and "boulder-clay" are two common terms used for lodgement till. Ablation or "melt-out" till occurs as the ice sheet melts or stagnates away. Debris bands are laid down or stacked as the ice between the bands melts. Ablation till tends to be less dense, less compacted, and slightly coarser as meltwater commonly washes away some of the fine silt and clay.

Till has relatively low inherent permeability. Permeability in till is in part dependent upon the primary porosity of the till, which reflects how fine-textured the particular till is. Vertical permeability in till is controlled largely by factors influencing the secondary porosity such as fractures (joints), worm burrows, root channels, sand seams, etc.

Table 9. Generalized Pleistocene stratigraphy of Wayne County, Ohio

Age (years ago)	Epoch	Stage	Killbuck Lobe	Grand River Lobe Northeastern Wayne Co.
25,000 to 70,000	Pleistocene	Wisconsinan	Lake and alluvial deposits	
			Hiram Till Hayesville Till Navarre Till	None
			?	?
70,000 to 120,000		Sangamonian	Lake and alluvial deposits	
120,000 to 730,000		Illinoian	Millbrook Till	Mogadore Till
			Kame deposits	
730,000 to 2,000,000		Pre-Illinoian	Sediments in deep buried valleys	

At the land surface, till accounts for two primary landforms: ground moraine and end moraine. Ground moraine (till plain) is relatively flat to gently rolling. End moraines are ridge-like, with terrain that is steeper and more rolling or hummocky (White, 1967 and 1982). mapped the end moraines in detail for Wayne County; however, in much of the county, the topography is bedrock-controlled due to the overall thin nature of the drift. This makes it difficult to distinguish these features. In many of the upland areas (i.e. areas between the major stream valleys) depth to bedrock is commonly less than 25 feet and is almost always less than 40 feet. Steep stream dissection, particularly along Killbuck Creek north of Wooster, makes it hard to delineate these glacial features. Streams tend to parallel the margins of the moraines, which helps to enhance the relief and steepness of these features. Locally, end moraines commonly serve as drainage divides. The ODNR, Division of Water State Glacial Aquifer Map indicates that the most important end and ground moraine features are in the northwestern corner of the county where the drift is thicker overall.

Illinoian age deposits in Wayne County are limited to subsurface kames and outwash deposits associated with Chippewa Creek and Killbuck Creek south of Wooster. Wisconsinan age till, outwash, or lacustrine deposits overlie these deposits.

Wisconsinan-age Mogadore Till was deposited by ice sheets associated with the Grand River Lobe in the northeastern corner (Chippewa Township) of Wayne County (White 1967). The Mogadore Till is dense, sandy and stony. This till is associated with the Millbrook Till found elsewhere in the subsurface of Wayne County and the Titusville Tills found in the Grand River Lobe east of Akron (White, 1982). The Titusville Till was proposed as being older than 40,000 Y.B.P. based upon radiocarbon (C^{14}) dates from exposures in northwestern Pennsylvania (White et al., 1969). Current thinking (Totten, 1987 and Eyles and Westgate, 1987) suggests that there was probably insufficient ice available in North America for a major ice advance into the Great Lakes area until the Late Wisconsinan Woodfordian sub-stage (approximately 25,000 Y.B.P.). The age of deposits previously determined to be early to mid-Wisconsinan in age is therefore being re-evaluated. The Killbuck Lobe deposited the

Millbrook Till over the remainder of the county. This till is dense, silty, and pebbly. It is the thickest till in the county; however, it has not been reported at the surface. It is found at the base of excavations and stream cuts.

The Navarre Till is the oldest of the Late Wisconsinan Woodfordian tills (White, 1967). This till extends across Wayne County, but is only exposed at the surface in the far southeastern corner. The Navarre Till is friable (loose), non-compact, sandy, and stony. Sand and gravel lenses are common in this till. Many of the surficial kame and outwash deposits found in the county are associated with this till unit (White, 1982).

The Hayesville Till is the surficial till found in most of Wayne County (White, 1967). The Hayesville Till is moderately compact, dense, sparingly to moderately pebbly, and has a clayey-silty texture. To the north and west, the Hayesville Till is thicker and more continuous.

The Hiram Till is the youngest till encountered in Wayne County (White, 1982). It is the surficial till found in the northwestern corner of Wayne County. The Hiram Till is relatively soft, non-compact, sparingly pebbly, and has a silty-clay to clayey texture. The fine texture is probably due to the till eroding and incorporating lacustrine deposits or shale bedrock. The Hiram Till may have been deposited in a fairly wet environment transitional between lacustrine and an ablational environment.

Lacustrine deposits were created as a result of numerous shallow lakes forming. Within stream valleys, the damming of streams by advancing ice sheets formed lakes. Some buried valleys contain appreciable thicknesses of lacustrine deposits (White, 1967). In ground moraine areas, lakes were formed as meltwater was trapped between the melting ice sheet and adjacent, previously deposited moraines. In some low-lying areas, lakes formed as the ice melted quicker then drainage systems could evolve. Deposits from shallow, inter-morainal lakes are also referred to as slack water deposits. Typically, lacustrine deposits are composed of fairly dense, cohesive, uniform silt and clay with minor fine sand. Thin bedding, referred to as laminations, is common in these deposits. Such sediments were deposited in quiet, low-energy environments with little or no current. Thick sequences of lacustrine deposits include the southern margin of Chippewa Creek, Orrville Ditch, and the Killbuck Valley south of Wooster. A widespread lake, referred to as Lake Craigton, stretched along the valley now occupied by the Muddy Fork of the Mohican River (White, 1967).

Outwash deposits are created by active deposition of sediments by meltwater streams. These deposits are generally bedded or stratified and are sorted. Outwash deposits in Wayne County are predominantly located in stream valleys. Such deposits were referred to in earlier literature as valley trains. Sorting and degree of coarseness depend upon the nature and proximity of the melting ice sheet. Braided streams usually deposited the outwash. Such streams have multiple channels, which migrate across the width of the valley floor, leaving behind a complex record of deposition and erosion. As modern streams downcut, the older, now higher elevation remnants of the original valley floor are called terraces. White (1967) has delineated some of the major terraces in the county. All of the surficial terraces were reported as being Wisconsinan in age (White, 1967). Areas of extensive outwash deposits include the western end of the Chippewa Creek valley, parts of Sugar Creek near the headwaters, Little Chippewa Creek, Killbuck Creek, Apple Creek near the junction with Killbuck Creek, Salt Creek at Fredericksburg and portions of the Muddy Fork of the Mohican River.

Kames and eskers are ice contact features. They are composed of masses of generally poorly sorted sand and gravel with minor till, deposited in depressions, holes, tunnels, or other cavities in the ice. As the surrounding ice melts, a mound of sediment remains behind. Typically, these deposits may collapse or flow as the surrounding ice melts. These deposits may display high angle, distorted or tilted beds, faults, and folds. In Wayne County, the majority of the kames are deposited along the margins or flanks of valleys, particularly within the headwaters of the drainage systems. These kames tend to coalesce together along the valley margins. Such features are referred to as kame terraces. They represent deposition of materials between the melting ice sheet and the bedrock and till slopes flanking the ice-filled valleys. Areas with abundant kame deposits include the Muddy Fork of the Mohican River, Killbuck Creek west and south of Wooster, Chippewa Creek and Little Chippewa Creek, the headwaters of Sugar Creek, and Salt Creek north of Fredericksburg.

Peat and muck are organic-rich deposits associated with low-lying depression areas, bogs, kettles, and swamps. Muck is a dense, fine silt with a high content of organics and a dark black color. Peat is typically brownish and contains pieces of plant fibers, decaying wood, and mosses. The two deposits commonly occur together, along with lacustrine or slack water clays and silts. The majority of these deposits are found along lower-lying portions of valley floors including margins of floodplains and terraces. Killbuck Creek has large areas of swampy conditions south of Wooster.

Wayne County also has some minor deposits of loess, particularly in the eastern portions of the county (White, 1967). Loess is a deposit formed by wind-blown silt. Loess is derived from the wind picking up fine silt-sized (to very fine-grained sand) particles covering the floodplains of the wide outwash or lacustrine valley floors. Loess is commonly found capping uplands and higher kames to the east (upwind) of major river valleys. Thickness of loess averages a few feet. Loess is particularly important to the development of soils in these upland and terrace areas.

Bedrock Geology

Bedrock exposed at the surface in Wayne County belongs to the Mississippian and Pennsylvanian Systems. Table 10 summarizes the bedrock stratigraphy found in Wayne County. Multer (1967) gives a thorough review of the bedrock stratigraphy of Wayne County. The ODNR, Division of Geological Survey, has Open-File Reconnaissance Bedrock Geological Maps done on a 1:24,000 USGS topographic map base available for the entire county. The ODNR, Division of Water, has Open File Bedrock State Aquifer mapping available for the county also. Chowdhury (1995) and Jost (1994) also summarized the bedrock stratigraphy of northeastern Wayne County in their theses.

Table 10. Bedrock stratigraphy of Wayne County, Ohio

System	Group/Formation (Symbol)	Lithologic Description
Pennsylvanian	Allegheny-Upper Pottsville (Pa-up)	Thin brown to gray sandstones, siltstones, shale, and coal. Local thickness <100 feet. Poor to moderate aquifer yielding 5-25 gpm. Found throughout southeastern Wayne County.
	Massillon through Sharon Formations (Pm-s)	The Massillon Formation is a coarse to medium-grained gray-white cross-bedded sandstone. The Sharon is a loosely cemented, cross-grained, gray to tan sandstone with conglomerate zones. This aquifer exceeds 100 feet in thickness. It is the best bedrock aquifer in the area, with yields ranging from 5 to 100 gpm. Found in upland areas in eastern Wayne County.
Mississippian	Logan and Black Hand Formations (Mlb)	The Logan consists of reddish-brown fine-grained sandstones interbedded with siltstones and shales. The Black Hand is a massive, coarse-grained sandstone yellow to brown in color. Thickness exceeds 100 feet. Yields range from 5 to 100 gpm. Found in western and central Wayne County.
	Cuyahoga Formation (Mcg)	Gray to brown shale with thin sandstone and siltstone interbeds. Thickness is commonly less than 100 feet. Yields range from 5 to 25 gpm. Limited to western Wayne County
	Berea Sandstone (Mb)	Fine- to medium-grained light greenish-gray to brown sandstone. Thickness is typically <100 feet. Yields average 5-25 gpm. Found in northern Wayne County.

The Mississippian Berea Sandstone is encountered in the subsurface by a limited number of deep wells along the northern boundary of Wayne County (Rau, 1969), Szmuc (1957 and 1970) and Angle (1995). Interbedded sandstones, siltstones, and shales of the Mississippian age are encountered at the surface of much of western, central, and northern Wayne County.

The oldest rocks belong to the Cuyahoga Formation. These interbedded, fine-grained sandstones and shales typically are found along the margins of buried valleys and stream valleys. The lower portions of the Cuyahoga Formation are typically fine-grained shales referred to as the Armstrong Member, Burbank, Meadville Shale, and Wooster Shale Members. Overlying these units are the sandstones and conglomerates of the Black Hand Sandstone. Drillers commonly refer to these sandstones as the “Big Injun”. Overlying the Black Hand Sandstone are the members of the Logan Formation. The Logan is composed of sandstones, conglomerates, and shales. Farther to the east and southeast in Wayne County, these formations become deeper and tend to be encountered in the subsurface.

The Mississippian rocks were deposited by a series of deltas, bars, and shoreline environments. The transition between shales and sandstones reflects the transition between coarser and finer stream deposition. The gradation also reflects the relative position of the shoreline over time, with coarser deposition closer to land and finer-grained sediments more distal from the shore. Szmuc (1957 and 1970), Rau (1969) and Bork and Malcuit (1979) discuss Mississippian depositional systems in detail.

Pennsylvanian System rocks are present in the upland areas of southern and eastern Wayne County (Multer, 1967). Pennsylvanian rocks fall into two main categories. The basal Pottsville Group contains sandstones and conglomerates of the Sharon Sandstone and Massillon Sandstone. These rocks form moderately steep ridges. Overlying them are interbedded dirty sandstones, shales, siltstones, and thin limestones, clays, and coals of the Pottsville Group and Lower Allegheny Group (Multer, 1967 and Rau, 1970). Steep, high gradient streams and alluvial fans deposited these sediments.

Rau (1970) and Sedam (1973) discuss the depositional environments of the coarse-grained Sharon Sandstone and Massillon Sandstone. Weedman (1990) provides an excellent account of the complex depositional environments, which created the rocks of the Pennsylvanian System, particularly of the Allegheny Group. These highly transitional environments included both terrestrial ("land-based") and marine-derived sediments. The terrestrial environment was dominated by large river systems featuring broad alluvial plains upland from coastal areas. Stream channels and point bar deposits were the source of sandstones and conglomerates. Shales and siltstones were derived from fine-grained floodplain deposits. Freshwater limestones were deposited in shallow, rapidly evaporating lakes and ponds found on the alluvial plain. The terrestrial environment was highly transitional with a marine environment over time. The position of the shoreline and the depth of water varied with the rate of sediment input into the basin, sea level, and the rate of subsidence. Subsidence refers to an uneven "settling" during the relatively rapid accumulation of sediments. In the Allegheny Group, sandstones and shales represent deltaic/shoreline environments. Marine limestones formed in slightly deeper waters, which lacked clastic input from rivers and deltas. Coal and clay were deposited in two different environments. Coal was deposited in either a "back-barrier" environment along the shoreline or in "deltaic-plain" environment in swamps formed in abandoned river channels (Horne et al., 1978). Similarly, clay was deposited in either quiet lagoonal areas directly behind the shoreline or in abandoned "oxbow" river channels (Ferm, 1974).

Ground Water Resources

Ground water in Wayne County is obtained from both unconsolidated (glacial-alluvial) and consolidated (bedrock) aquifers. Glacial aquifers are primarily associated with the buried valleys and thicker alluvial deposits. In upland areas where the drift is sufficiently thick, water is obtained from sand and gravel lenses interbedded in the glacial till. Such areas are primarily in the northwestern part of the county and adjacent to the major buried valley systems.

Yields from 100 to 500 gpm and yields exceeding 500 gpm are obtainable from the coarse, well-sorted sand and gravel outwash deposits in the Chippewa River Valley, in the Killbuck Creek Valley south of Wooster, and in the vicinity of Orrville (ODNR, Div. Of Water Open File, Glacial State Aquifer Map and Crowell, 1979). Test drilling or geophysical methods are recommended to help locate the higher yielding zones. Proper well construction and development is also needed to insure the high sustainable yields capable from these larger diameter wells. Smaller diameter wells should be suitable for serving domestic/farm needs within this aquifer. Yields of 25 to 100 gpm are obtained from wells drilled along the margins of the above-mentioned valleys, in the Sugar Creek Valley southeast of Orrville, in the Muddy Fork of the Mohican River Valley south of New Pittsburgh, Killbuck Creek northwest of Wooster, and along Apple Creek. Thin lenses of sand and gravel interbedded with thick sequences of fine-grained materials in buried valleys underlying the northern part of the Muddy Fork of the Mohican River, Little Chippewa Creek, and other minor tributaries of the Tuscarawas River in eastern Wayne County yield 5 to 25 gpm (ODNR, Div. Of Water Open File, Glacial State Aquifer Map and Crowell, 1979). Yields of 5 to 25 gpm are obtained from thin lenses of sand and gravel interbedded with glacial till where the drift is of adequate thickness, especially in northwestern Wayne County (ODNR, Div. Of Water Open File, Glacial State Aquifer Map and Crowell, 1979).

Yields from the consolidated, bedrock aquifers throughout the county are variable. Overall, yields tend to be better adjacent to stream valleys and poorer along ridge tops. Crowell (1979) reports yields from highly fractured zones of the Sharon Sandstone and Massillon Sandstone yielding over 100 gpm. These zones are in the vicinity of Smithville and Orrville. These highly productive sandstone aquifers are overlain by sand and gravel outwash deposits, which provide additional recharge and increased yields to the bedrock. Wells developed in the Mississippian Black Hand Sandstone, coarser units of the Logan Formation, the Sharon Sandstone, and the Massillon Sandstone Formation have yields ranging from 25 to 100 gpm in many portions of the county (Crowell, 1979 and ODNR, Div. of Water, Bedrock State Aquifer Map). Yields ranging from 10 to 25 gpm are associated with the interbedded shales, fine-grained sandstones, and siltstones of the Cuyahoga Formation and parts of the Logan Formation (Crowell, 1979 and ODNR, Div. of Water, Bedrock State Aquifer Map). Yields from wells developed in the dirty sandstones, shales, siltstones, coals, and thin limestones of the Allegheny Group in the south central part of Wayne County usually range from 3 to 10 gpm (ODNR, Div. of Water, Open File, Bedrock State Aquifer Map). Deep wells completed in the fine-grained Berea Sandstone typically yield in the 5 to 10 gpm range.

The yield in any particular area is dependent upon the number and type of formations drilled. Wells drilled in bedrock often intersect several aquifers or water producing zones. Sandstones and conglomerates tend to be water-bearing units whereas underclays, mudstones, siltstones, thin limestones, and shales tend to be aquitards, which impede the flow of water. Water tends to "perch" or collect on top of lower permeability units (e.g. shale) and move laterally along the base of an overlying unit with higher permeability (e.g. sandstone). Springs and seeps mark where these contacts meet the slope or land surface. Peffer (1991) demonstrated that shales could provide sufficient water to serve domestic needs and still behave as an aquitard.

The number of fractures and bedding planes intersected by the well also influences yields. The amount of fracturing tends to increase along hill slopes and valleys. This increase may be related to stress relief, as shown by Wyrick and Borchers (1981) and Kipp et al. (1983). The net result is that there is usually a decrease in the depth to water (i.e. a shallower static water level) and slightly higher yields. Fracturing is also an influence on the direction of ground water flow (Schubert, 1980) and affects the amount of recharge.

Strip and Underground Mined Areas

The pollution potential of strip-mined and abandoned underground mined areas were not evaluated in Wayne County. Although *DRASTIC: A Standardized System for Evaluating Ground Water Pollution Using Hydrogeologic Settings* (Aller et al., 1987) does identify mining as a possible source of ground water contamination, it does not discuss a methodology to evaluate the vulnerability of aquifers to contamination in these areas.

Many geologic and hydrogeologic changes occur in areas that have undergone or are undergoing mining and reclamation activities (Bonta et al., 1992 and Razem, 1983). The extent of these changes may not be known or may have a high degree of variability from one location to another.

Mining and reclamation activities have the ability to affect all DRASTIC parameters. Tables 11 and 12 list the DRASTIC parameters and the possible impacts that mining may have on rating the parameters in strip-mined and underground mined areas. These tables are not meant to be a comprehensive listing of the impacts of mining on ground water systems. They are provided to illustrate the uncertainty of evaluating the pollution potential of mined areas.

Although the pollution potential of strip and abandoned underground mined areas were not evaluated, they were delineated. Only the most prominent and conspicuous mined areas were delineated on the Pollution Potential Map of Wayne County. Delineations of mined areas were made using information from the *Soil Survey of Wayne County* (Bureau et al., 1984), abandoned underground mine maps (ODNR, Division of Geological Survey, open file maps), and the Wayne County portion of U.S.G.S. 7-1/2 minute quadrangle maps. Site-specific information for mined area can be obtained from the ODNR, Division of Geological Survey and Division of Mineral Resources Management.

Preliminary DRASTIC Mapping

The ground water pollution potential was previously evaluated using the DRASTIC system for portions of northeastern Wayne County. Two University of Akron students (Jost, 1994 and Chowdhury, 1995) did this mapping in the early 1990's. Their worked proved to be very useful in mapping these areas.

Table 11. Potential factors influencing DRASTIC ratings for strip mined areas

Parameter	Impact of Activity/Effects on DRASTIC Ratings
Depth to water	Removal of material overlying the aquifer will decrease the depth to water (i.e. increase DRASTIC rating); removal of uppermost aquifer will increase the depth to water (i.e. decrease DRASTIC rating)
Net Recharge	Mineral extraction and reclamation could increase the degree of fracturing, increase the permeability of the vadose zone and soils and therefore increase the amount of recharge (i.e. increase DRASTIC rating); compaction of fine grained spoils could decrease the amount of recharge to the aquifer (i.e. decrease DRASTIC rating)
Aquifer media	Mineral extraction could remove the uppermost aquifer
Soil media	Removal of soils will provide less of a barrier for contaminant transport (i.e. increase soil rating); reclaimed soils may have a lower permeability than the original cover (i.e. decrease soil rating)
Topography	Strip mining can change the contour of the land surface making delineation of this parameter virtually impossible
Impact of the vadose zone	Fracturing of vadose zone media could increase the permeability (i.e. increase rating); compaction of spoils during reclamation could decrease the permeability (i.e. decrease rating)
Hydraulic Conductivity	Fracturing of aquifer media could increase the conductivity (i.e. increase DRASTIC rating)

Table 12. Potential factors influencing DRASTIC ratings for underground mined areas

Parameter	Impact of Activity/Effects on DRASTIC Ratings
Depth to water	Collapse of underground mines has the potential to fracture overlying confining units, therefore causing a dewatering of overlying aquifers (i.e. decrease rating)
Net Recharge	Fracturing of overlying strata can increase amount of recharge to the aquifer (i.e. increase rating)
Aquifer media	Upper aquifers could be dewatered and underground mine could become the aquifer
Soil media	Fractures may extend to the land surface
Topography	This factor will not be affected unless severe subsidence occurs
Impact of the vadose zone	Fracturing and air shafts in the vadose zone could increase the permeability and provide a direct conduit for contamination (i.e. increase rating)
Hydraulic Conductivity	Upper aquifers not dewatered as a result of fracturing or subsidence would have higher conductivity values; underground mines serving as the aquifer media will have high conductivity values (i.e. higher rating)

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APPENDIX A

DESCRIPTION OF THE LOGIC IN FACTOR SELECTION

Depth to Water

This factor was primarily evaluated using information from water well log records on file at the Ohio Department of Natural Resources (ODNR), Division of Water, Water Resources Section (WRS). Approximately 16,200 water well log records are on file for Wayne County. Data from roughly 10,000 located water well log records were analyzed and plotted on U.S.G.S. 7-1/2 minute topographic maps during the course of the project. Static water levels and information as to the depths at which water was encountered were taken from these records. The *Ground Water Resources of Wayne County* (Crowell, 1979) provided generalized depth to water information throughout the county. Depth to water trends mapped in adjoining Stark County (Williams, 1991) and Medina County (Angle, 1994) were used as a guideline. The preliminary work of Jost (1994) and Chowdhury (1995) proved helpful in northeastern Wayne County. Topographic and geomorphic trends were utilized in areas where other sources of data were lacking.

Depths to water of 5 to 15 feet (9) were typical of areas associated with floodplains of major streams. Depths of 15 to 30 feet (7) were used for stream terraces adjacent to major streams and along smaller tributaries. Depths of 30 to 50 feet (5) were utilized for upland areas, particularly with areas of thinner drift. Depths to water of 50 to 75 feet (3) were utilized for higher ridges in the uplands and in deeper buried valleys, which lack modern surficial streams. Depths to water greater than 100 feet (1) were applied to isolated areas where deep, confined sandstone aquifers were evaluated as being limited to very high, isolated ridge tops.

Net Recharge

Net recharge is the precipitation that reaches the aquifer after evapotranspiration and run-off. This factor was evaluated using many criteria, including depth to water, topography, soil type, surface drainage, vadose zone material, aquifer type, and annual precipitation. General estimates of recharge provided by Pettyjohn and Henning (1979) and Dumouchelle and Schiefer (2002) proved to be helpful Recharge ratings from adjoining Medina County (Angle, 1994) and Stark County (Williams, 1991) proved helpful. The preliminary work of Jost (1994) and Chowdhury (1995) was valuable in the Chippewa Creek area.

Recharge values of 7 to 10 inches per year (8) were assigned to floodplains adjacent to modern streams overlying outwash buried valley deposits. These areas contain highly permeable soils, vadose, and aquifer materials, have shallow depths to water, gentle slopes, and surficial streams. These areas are limited to terraces and floodplains underlain by coarse-grained outwash deposits. Values of 4 to 7 inches per year (6) were used for areas with moderate recharge. These areas include margins of buried valleys and uplands. These areas tend to have moderately shallow depths to water and lower permeability soils, or areas with moderate depths to water and moderately permeable soils, vadose, and aquifers. Values of 2 to 4 inches per year (3) were utilized for some upland areas and some buried valley areas lacking modern overlying streams. Greater depths to water, lower permeability soils, lower permeability glacial till, and finer-grained bedrock characterize the low recharge areas. In upland areas, higher amounts of run-off due to steeper slopes were a factor for assigning the low recharge values. Values of recharge less than 2 inches per year (1) were utilized for steep ridge tops and slopes. These areas have moderate to great depths to water, soils are thin or absent and slopes are very steep which contribute to very high run-off. A recharge value of 2 to 4 inches per year (1) was selected for the deep sandstone areas, which were evaluated as being confined.

Aquifer Media

Information on evaluating aquifer media was obtained from the reports or maps of Layne Ohio Co. (1956), White (1967, 1982), Multer (1967), Rau (1969), The Ohio Drilling Co. (1971), Sedam (1973), Crowell (1979), Springer (1987 and 1990), Iqbal (1990), Jost (1994), Chowdhury (1995), Breen et al. (1995), and Pavey et al. (2002). Mapping in adjoining Medina County (Angle, 1994) and Stark County (Williams, 1991) proved useful as a guideline for evaluating aquifers. Open File Bedrock Reconnaissance Maps and Open File Bedrock Topography Maps, based upon U.S.G.S. 7-1/2 minute topographic maps from the ODNR, Division of Geological Survey proved helpful. The ODNR, Division of Water, Glacial State Aquifer Map and Bedrock State Aquifer Map were important sources of aquifer data. Water well log records on file at the ODNR, Division of Water, were the primary source of aquifer information.

An aquifer rating of (8) was designated for the high-yielding sand and gravel outwash deposits underlying Chippewa Creek and Killbuck Creek. An aquifer rating of (7) was assigned to thinner, less continuous sand and gravel outwash deposits associated with margins of buried valleys and terraces flanking floodplains. The rating of (7) was selected for parts of Chippewa Creek, Killbuck Creek north of Wooster, Muddy Fork of the Mohican River south of New Pittsburgh, Apple Creek, Sugar Creek and adjoining areas around Orrville. An aquifer rating of (5) was used for some thinner sand and gravel deposits associated with tributaries and margins of the major buried valleys and trunk portions of the Muddy Fork of the Mohican River in northwestern Wayne County and Little Chippewa Creek. An aquifer rating of (5) was used for the thin sand and gravel lenses interbedded with thick sequences of fine-grained glacial till in uplands and adjacent to buried valleys.

An aquifer rating of (6) was assigned to limited areas of the Sharon Sandstone, Massillon Sandstone, and Pottsville-Allegheny Group bedrock adjacent to Stark County. Wells developed in these aquifers may include some overlying interbedded shales, siltstones, and thin coals and limestones. An aquifer rating of (5) was utilized for interbedded sandstones and shales of the Mississippian Black Hand Sandstone, Logan Formation, and some units of the Cuyahoga Formation and the Pennsylvanian Pottsville Group. An aquifer rating of (4) was designated for some units of the Cuyahoga Formation containing abundant shales along the northern boundary of Wayne County and the interbedded dirty sandstones, shales, thin limestones, and coals of the Allegheny Group in southern and far eastern Wayne County. The Berea Sandstone was given a rating of (4) where this deep unit was evaluated as the aquifer in the northeastern corner of the county. An aquifer rating of (2) was assigned to portions of the Cuyahoga Formation, which were composed of almost entirely shale. These limited occurrences of shale are found along the northern boundary of Wayne County.

Soils

Soils were mapped using the data obtained from the *Soil Survey of Wayne County* (Bureau et al., 1984). Each soil type was evaluated and given a rating for soil media. Evaluations were based upon the texture, permeability, and shrink-swell potential for each soil material. The soils of Wayne County showed a high degree of variability. This is a reflection of the parent material. Table 13 is a list of the soils, parent materials, setting, and corresponding DRASTIC values for Wayne County.

Soils were considered to be thin or absent (10) along many steep ridge tops and slopes where bedrock was exposed. Soils were rated as being a peat (8) for limited organic soils in depressions or kettles on floodplains. These areas are primarily found along Chippewa Creek and Killbuck Creek south of Wooster. Sandy loams (6) were selected for soils overlying outwash terraces, plains, and kames overlying buried valleys. Sandy loam soils (6) were also selected for steep, residual sandstone ridges throughout the county. Loam soils (5) were designated for coarser soils associated with ablational glacial terrain. Silt loam (4) soils were evaluated for loamy glacial till found in much of Wayne County. Silt loam (4) was also selected for silty alluvial and lacustrine deposits on floodplains. Clay loam (3) soils were evaluated for areas with clay-rich glacial till.

The Rittman-Wadsworth Soils, which are associated with the Hayesville Till in much of northern and central Wayne County, and the Ravenna-Canfield-Wooster soils that are associated with the Millbrook and Navarre Tills in southern Wayne County, contain fragipans. A fragipan is a dense, impermeable zone found within certain loamy, till-derived soils. Fragipans may notably restrict the downward movement of water (Bureau et al., 1984 and Williams, 1990). The net effect of the fragipan is to reduce the overall permeability of a soil within a given textural range (Aller et al., 1987). Hence, a soil with a loam (5) texture would be evaluated as a silt loam (4), and a soil with a silt loam (4) texture would be evaluated as a clay loam (3) due to the presence of a fragipan (see Table 13).

Table 13. Wayne County soils

Soil Name	Parent Material or Setting	DRASTIC Rating	Soil Media
Alexandria	Till	3	Clay loam
Bennington	Till	3	Clay loam
Berks	Thin till over sandstone, shale	10	Thin or absent
Bethesda	Strip mine	NR	
Bogart	Outwash, kame	6	Sandy loam
Canfield*	Loamy till	4	Silt loam
Cardington	Till	3	Clay loam
Carlisle	Bogs, depressions	8	Peat
Chili	Outwash, kames	6	Sandy loam
Condit	Till	3	Clay loam
Coshocton	Shale, siltstone bedrock	3	Clay loam
Dekalb	Thin till over sandstone	10	Thin or absent
Euclid	Alluvium, floodplain	4	Silt loam
Fairpoint	Strip mine	NR	
Fitchville	Stream, lacustrine	4	Silt loam
Glenford	Stream, lacustrine	4	Silt loam
Haskins	Thin outwash over till	4	Silt loam
Jimtown	Outwash, kame	6	Sandy loam
Killbuck	Alluvium, floodplain	4	Silt loam
Linwood	Bogs, depression	8	Peat
Lobdell	Alluvium, floodplain	4	Silt loam
Loudonville	Thin till over sandstone	4	Silt loam
Luray	Lacustrine, slack water	4	Silt loam
Mechanicsburg	Thin till over shale	4	Silt loam
Melvin	Floodplain, alluvium	4	Silt loam
Mitiwanga	Sandstone bedrock	10	Thin or absent
Orrville	Coarse alluvium	6	Sandy loam
Oshtemo	Outwash	6	Sandy loam
Ravenna*	Loamy till	4	Silt loam
Riddles	Loess over till	3	Clay loam
Rittman*	Till	3	Clay loam
Sebring	Lacustrine, alluvium over till	3	Clay loam
Tioga	Outwash	6	Sandy loam
Tiro	Ablational, lacustrine	4	Silt loam
Wadsworth*	Till	3	Clay loam
Wallkill	Lakebed, depression	4	Silt loam
Wooster*	Loamy till	4	Silt loam
Wooster-Riddles*	Loess over till	4	Silt loam

*denotes a soil containing fragipan

Topography

Topography, or percent slope, was evaluated using U.S.G.S. 7-1/2 minute quadrangle maps and the *Soil Survey of Wayne County* (Bureau et al., 1984). Slopes of 0 to 2 percent (10) and 2 to 6 percent (9) were selected for flat-lying floodplains, valley floors, and terraces. Slopes of 0 to 2 (10) and 2 to 6 percent (9) were also used for flat lying ground moraine or till plain areas on the uplands. Slopes of 6 to 12 percent (5) were also used for less steep bedrock-controlled topography and for areas of end moraines. Slopes of 12 to 18 percent (3) and greater than 18 percent (1) were selected for steeper slopes in higher relief, upland areas. These areas have bedrock-controlled topography and drift is thin or absent. These areas are primarily found flanking Killbuck Creek Valley northwest of Wooster and parts of the southern and southeast corner of the county underlain by Pennsylvanian Pottsville-Allegheny Group bedrock.

Impact of the Vadose Zone Media

Information on evaluating vadose zone media was obtained from the Layne Ohio Co. (1956), White (1967, 1982), Multer (1967), Rau (1969), The Ohio Drilling Co. (1971), Sedam (1973), Crowell (1979), Springer (1987 and 1990), Iqbal (1990), Jost (1994), Chowdhury (1995), Breen et al. (1995), and Pavey et al. (2002). Mapping in adjoining Medina County (Angle, 1994) and Stark County (Williams, 1991) proved useful as a guideline for evaluating vadose zone materials. Open File Bedrock Reconnaissance Maps based upon U.S.G.S. 7-1/2 minute topographic maps from the ODNR, Division of Geological Survey proved helpful. The ODNR, Division of Water, Glacial State Aquifer Map and Bedrock State Aquifer Map were important sources of vadose zone media data. Information on parent materials derived from the *Soil Survey of Wayne County* (Bureau et al., 1984), also proved useful in evaluating vadose zone materials. Water well log records on file at the ODNR, Division of Water, were the primary source of information on vadose zone media for the county.

Vadose zone media was given ratings of (7) and (8) for sand and gravel interbedded with silt and clay layers for outwash terraces, kames, and coarse alluvium overlying buried valleys. Vadose zone media ratings of (5) and (6) were selected for sand and gravel interbedded with silt and clay layers for deposits overlying buried valleys and alluvium. These ratings depend upon the proportion of coarse, well-sorted outwash to the finer-grained alluvial and lacustrine deposits. Sand and gravel with silt and clay was also evaluated for some upland areas containing ablational materials or materials that the well logs were not detailed enough to allow for more positive identification. Silt and clay with ratings of (4) and (5) were selected for vadose zone media for floodplains in many tributary valleys containing predominantly finer-grained alluvial and lacustrine deposits.

Till with a rating of (5) was utilized for loamy glacial tills associated with the Mogadore Till in the northeastern corner of the county and the Navarre Till found in the southeastern corner of the county. Till was also given a rating of (5) where the till was relatively thin, weathered, and presumably fractured through much of its extent. Till with a rating of (4) was used for more clayey-textured tills and for tills of significant thickness in which the majority of the till would be unweathered and less fractured.

A vadose zone media rating of (6) was selected for the Sharon Sandstone, Massillon Sandstone, and Pottsville-Allegheny Group bedrock adjacent to Stark County. A vadose zone media rating of (5) was selected for bedrock comprised of interbedded sandstones and shales of the Mississippian Black Hand Sandstone, Logan Formation and coarser units of the Pennsylvanian Pottsville-Allegheny Group. Vadose zone media were assigned ratings of (4) for the interbedded sandstone, shales, limestones, and coals of the Pennsylvanian Pottsville-Allegheny rocks. A vadose zone rating of (4) was also selected for the Berea Sandstone in northern Wayne County. Ratings of (3) and (4) were selected for the interbedded, fine-grained predominantly shale bedrock of the Cuyahoga Group in ridge tops and higher slopes.

Hydraulic Conductivity

Published data for hydraulic conductivity for Wayne County included the reports of the Layne Ohio Co. (1956), Rau (1969), The Ohio Drilling Co. (1971), Sedam (1973), Springer (1990), Iqbal (1990), Jost (1994), Chowdhury (1995), and Breen et al. (1995). Mapping in adjoining Medina County (Angle, 1994) and Stark County (Williams, 1991) and the ODNR, Division of Water, Glacial State Aquifer Map and Bedrock State Aquifer Map proved valuable. The preliminary mapping of Jost (1994) and Chowdhury (1995) was utilized in northeastern Wayne County. Water well log records on file at the ODNR, Division of Water, were the primary sources of information. Textbook tables (Freeze and Cherry, 1979, Fetter, 1980, and Driscoll, 1986) were useful in obtaining estimated values for hydraulic conductivity in a variety of sediments.

Values for hydraulic conductivity correspond to aquifer ratings; i.e., the more highly rated aquifers have higher values for hydraulic conductivity. For sand and gravel aquifers with an aquifer rating of (8), hydraulic conductivity values of 1,000-2,000 gallons per day per square foot (gpd/ft^2) (8) or 700-1,000 gpd/ft^2 (6) were selected. These high values were limited to the clean outwash deposits of Chippewa Creek, Killbuck Creek south of Wooster, and the vicinity of Orrville. The values depended upon how clean and coarse the sediments were. For sand and gravel deposits associated with buried valleys with an aquifer media rating of (7), hydraulic conductivities of 700-1000 gpd/ft^2 (6) and 300-700 gpd/ft^2 (4) were chosen. For sand and gravel deposits with an aquifer rating of (6) or (5), hydraulic conductivity values ranged from 300-700 gpd/ft^2 (4) to or 100-300 gpd/ft^2 (2). In these deposits, thin sand and gravel lenses are interbedded with thicker sequences of finer-grained materials.

Bedrock aquifers with an aquifer rating of (6) have been assigned a hydraulic conductivity rating of 100-300 gpd/ft^2 (2). These rocks tend to be coarser-grained, more porous, and more highly fractured. Bedrock aquifers with an aquifer rating of (5) and (4) were given hydraulic conductivity ratings of 1-100 gpd/ft^2 (1). All of the shale aquifers with an aquifer rating of (2) were given a hydraulic conductivity rating of 1-100 gpd/ft^2 (1) due to the low permeability of these rocks.

APPENDIX B

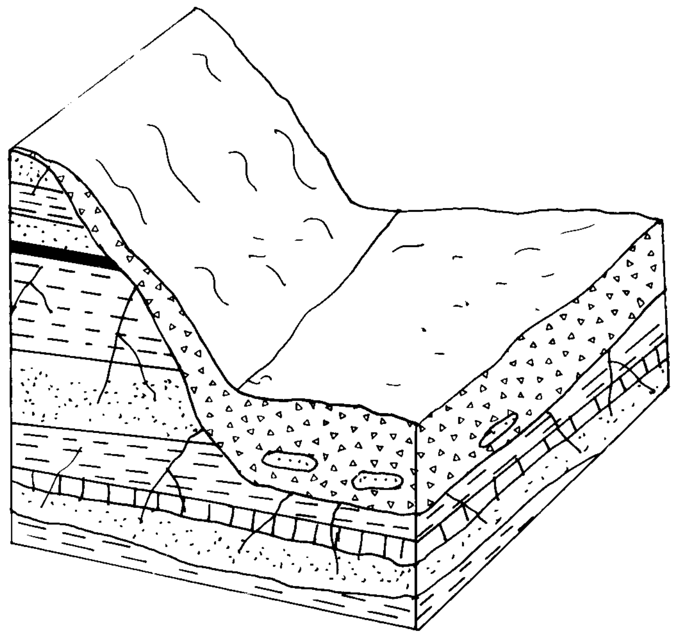
DESCRIPTION OF HYDROGEOLOGIC SETTINGS AND CHARTS

Ground water pollution potential mapping in Wayne County resulted in the identification of 10 hydrogeologic settings within the Glaciated Central Region. The list of these settings, the range of pollution potential index calculations, and the number of index calculations for each setting are provided in Table 14. Computed pollution potential indexes for Wayne County range from 56 to 187.

Table 14. Hydrogeologic settings mapped in Wayne County, Ohio

Hydrogeologic Settings	Range of GWPP Indexes	Number of Index Calculations
7Aa-Glacial till over bedded sedimentary rocks	73-119	83
7Ad-Glacial till over sandstone	56-117	16
7Ae-Glacial till over shale	79-101	6
7Af-Sand and gravel interbedded in glacial till	85-122	6
7Ba-Outwash	148	1
7Bb-Outwash over bedded sedimentary rocks	92-134	6
7D-Buried valley	85-187	120
7Ec-Alluvium over bedded sedimentary rocks	102-134	11
7Ed-Alluvium over glacial till	129-133	2
7G-Thin glacial till over bedded sedimentary rocks	73-111	32

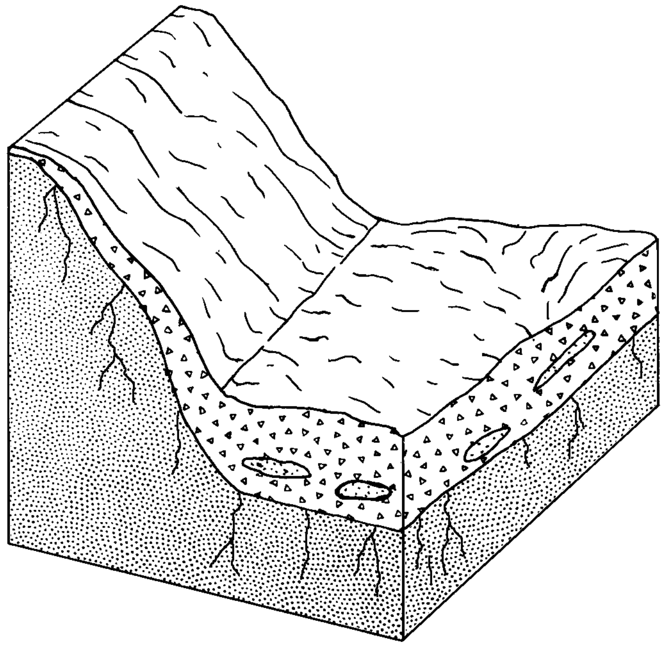
The following information provides a description of each hydrogeologic setting identified in the county, a block diagram illustrating the characteristics of the setting, and a listing of the charts for each unique combination of pollution potential indexes calculated for each setting. The charts provide information on how the ground water pollution potential index was derived and are a quick and easy reference for the accompanying ground water pollution potential map. A complete discussion of the rating and evaluation of each factor in the hydrogeologic settings is provided in Appendix A, Description of the Logic in Factor Selection.



7Aa Glacial Till Over Bedded Sedimentary Rocks

This hydrogeologic setting is variable and widespread across Wayne County. This setting is associated with upland areas featuring bedrock-controlled topography. Topography varies from rolling, moderate relief areas in the northern portion of the county to steeper, higher relief areas in the southern and eastern parts of the county. The aquifer consists of thin interbedded shales, sandstones, siltstones, limestones, clay, and coal of the Pottsville Group and Allegheny Group and sandstones and conglomerates of the Sharon Formation and Massillon Formation of the Pennsylvanian System in southern and eastern Wayne County. The aquifer consists of interbedded shale, siltstones, and fine-grained sandstones of the Mississippian Cuyahoga Formation, Logan Formation, Berea Sandstone, and Black Hand Sandstone in western, central, and northern Wayne County. Yields range from 3 to 25 gpm for wells completed in rocks of the Allegheny Group and Cuyahoga Formation to yields locally over 100 gpm for massive, fractured sandstones in the Pottsville Group. Varying thicknesses of glacial till typically overlie the aquifer. This setting also contains numerous small areas where the till is overlain by thin, clay-rich lacustrine or slack water deposits or windblown loess deposits. The till cover has a typical thickness of 20 to 30 feet in ground moraine areas, and may reach thicknesses of 70 feet within end moraines. The various till units commonly weather into either silt loams or clay loams. The depth to water is variable, averaging from 15 to 30 feet in areas adjacent to streams to 50 to 75 feet for steeper, isolated ridges. Recharge is typically low due to low permeability soils, moderate to steep slopes, thickness of the till cover, and depth to water.

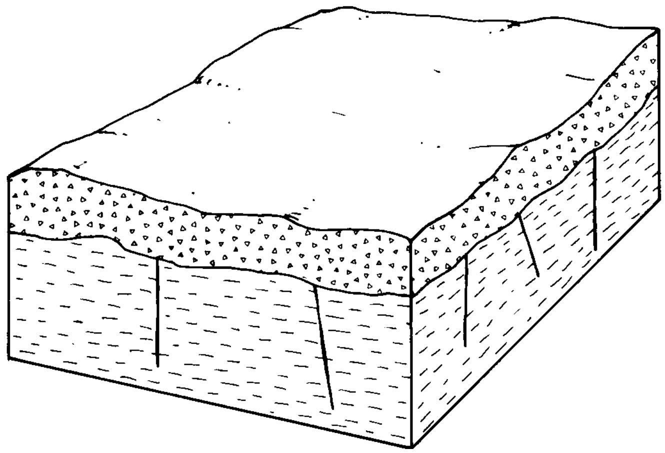
GWPP index values for the hydrogeologic setting of glacial till over bedded sedimentary rocks range from 73 to 119, with the total number of GWPP index calculations equaling 83.



7Ad Glacial Till over Sandstone

This hydrogeologic setting is found in the northeastern part of the county along the Medina County boundary. This setting is characterized by glacial till overlying Berea Sandstone or perhaps some deep Black Hand Sandstone. Well logs in these areas show that wells are not open to shales or siltstones interbedded with the sandstone aquifer. In some of these areas the aquifer is considered confined due to great thicknesses of lower permeability till and sometimes shales overlying the sandstone aquifer. Depths to water vary considerably depending on whether the areas are adjacent to stream valleys or on isolated ridge tops. Soils are clay loams or silt loams derived from tills. The vadose zone varies from glacial till to sandstone depending upon the drift thickness. Yields are commonly 5 to 10 gpm as these sandstones are fine-grained. Recharge is commonly low due to low permeability soils and vadose, depth to water, and moderately steep slopes.

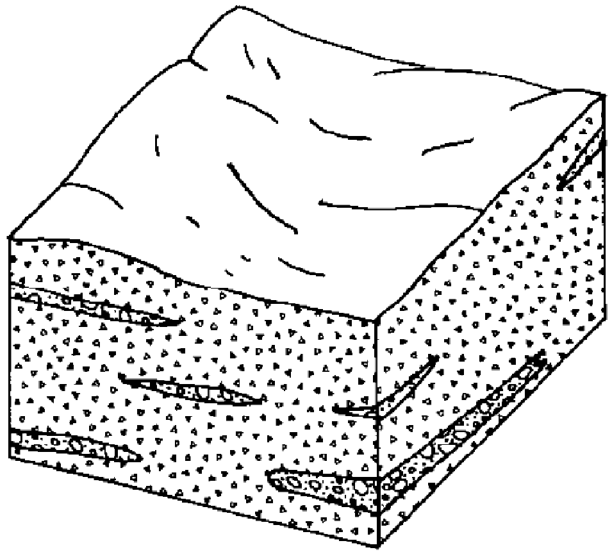
GWPP index values for the hydrogeologic setting of glacial till over sandstone ranges from 56 to 117, with the total number of GWPP index calculations equaling 16.



7Ae Glacial Till over Shale

This hydrogeologic setting is limited to the north central and northwestern part of the county along the Medina County boundary. This setting is characterized by clayey glacial till overlying shaley bedrock of the lower Cuyahoga Formation. Wells are completed in the shale and siltstone bedrock. Yields are commonly less than 5 gpm. Topography is typically flat lying to gently rolling. Soils are clay loams and silt loams and the vadose zone media is clayey glacial till. Depths to water vary from shallow to moderate depending upon how thick the drift overlying the shale is. Recharge is low due to the low permeability of the soils, vadose, and aquifer media itself.

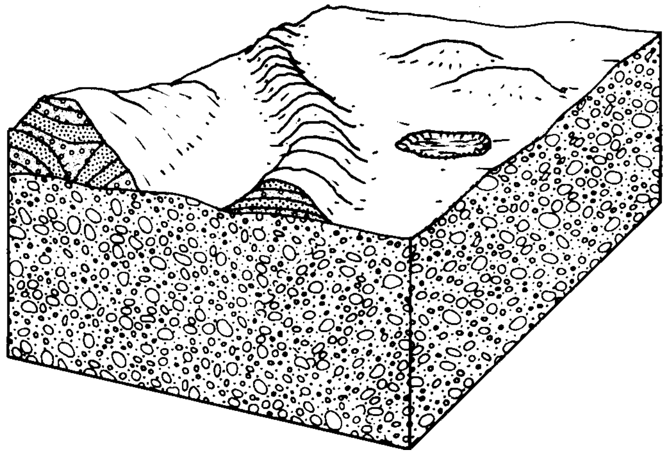
GWPP index values for the hydrogeologic setting of glacial till over shale ranges from 79 to 101, with the total number of GWPP index calculations equaling 6.



7Af Sand and Gravel Interbedded in Glacial Till

This hydrogeologic setting occurs in northern Wayne County. The setting encompasses areas where sand and gravel lenses interbedded within till are the aquifer. The total thickness of drift in these areas is substantially less than that found in the 7D - Buried Valley hydrogeologic setting. Drift is commonly thicker than in settings with bedrock aquifers. Soils are usually clay loams. The sand and gravel aquifers are typically thin, discontinuous, lenses. Yields average 10 to 25 gpm and are adequate for domestic purposes. Till is the vadose zone media. Depth to water is moderate, averaging from 30 to 50 feet. Recharge is moderate to low due to the low relief, moderate to great depths to the water table, moderate thickness of the till, and low permeability soils.

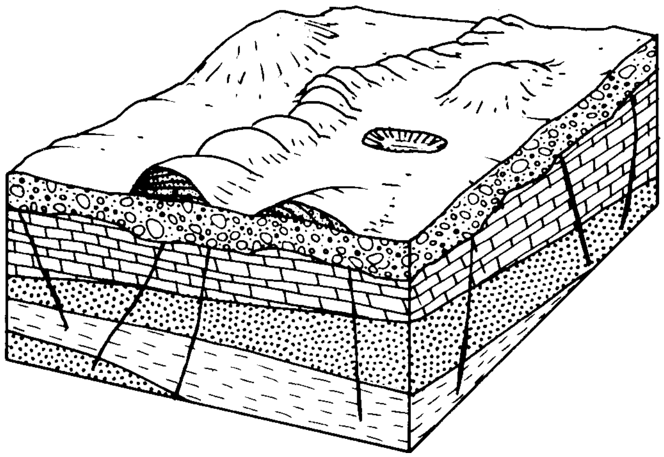
GWPP index values for the hydrogeologic setting of sand and gravel interbedded in glacial till range from 85 to 122, with the total number of GWPP index calculations equaling 6.



7Ba Outwash

This hydrogeologic setting consists of an area of outwash and kames, which does not overlie buried valleys. This setting is an ablational area adjacent to buried valleys along the border with Stark County. This setting is characterized by rolling topography and low relief. The aquifer consists of sand and gravel outwash deposits. Yields average 10 to 25 gpm with maximum local yields up to 100 gpm. Test drilling may be necessary to locate higher-yielding areas. Vadose zone media consists of bedded sandy to gravelly outwash interbedded with varying thicknesses of glacial till. Depth to water is moderate and the aquifer may be in direct hydraulic connection with overlying streams. Soils are sandy loams. Recharge is moderately high due to the relatively flat topography, relatively permeable soils and vadose media, and the shallow depth to water.

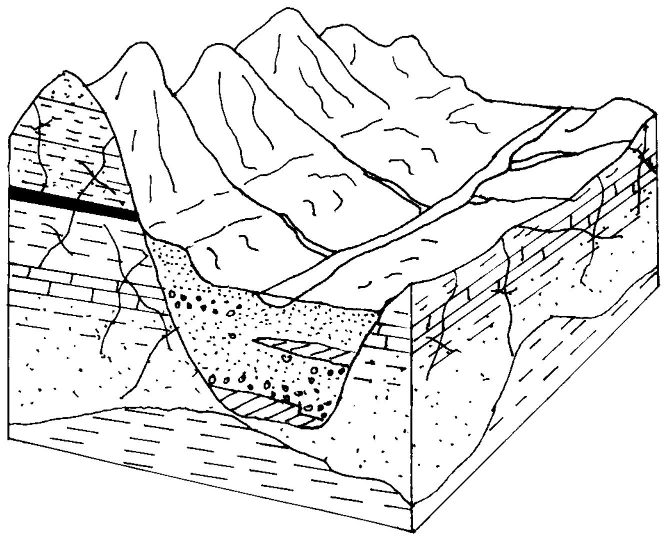
GWPP index values for the hydrogeologic setting of outwash are 148, with the total number of GWPP index calculations equaling 1.



<u>7Bb Outwash over Bedded Sedimentary Rocks</u>

This hydrogeologic setting consists of relatively small, high-level outwash terraces deposited on top of bedrock benches. These terraces are limited to the margins or tributaries to the buried valleys. The total thickness of drift is not adequate to be considered buried valleys. Relief is low and the flat to rolling terraces occurs at higher elevations than the modern floodplain. Vadose zone media consists of bedded sandy to gravelly outwash interbedded with finer alluvial deposits. Soils vary from silt loam to sandy loam, depending upon whether fine alluvial material is capping the coarser outwash. The outwash terraces are not thick enough to comprise the aquifer; underlying fractured, interbedded sandstones, shales, limestones, and coals of the Mississippian and Pennsylvanian Systems serve as the aquifer. Yields average 10 to 25 gpm. The overlying terraces are typically in direct contact with the underlying bedrock aquifer. Depth to water is typically shallow to moderate and is usually less than 50 feet. Recharge is moderately high due to the relatively permeable soils and vadose, moderate to shallow depth to water, and relatively flat to rolling topography.

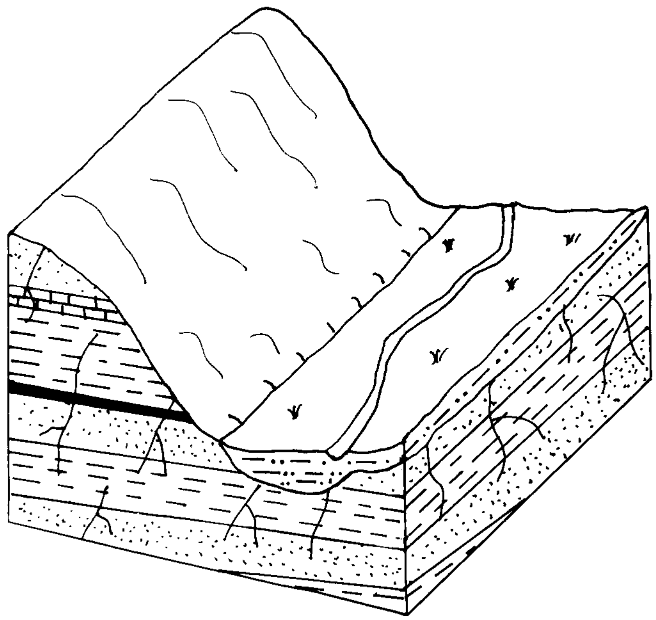
GWPP index values for the hydrogeologic setting of Outwash over Bedded Sedimentary Rocks range from 92 to 134, with the total number of GWPP index calculations equaling 6.



7D Buried Valley

This hydrogeologic setting is widespread throughout Wayne County. All of the major trunk streams and many modern tributaries overlie buried valley deposits. There are also former drainage ways overlying buried valleys that lack modern streams. Broad, flat-lying floodplains and gently sloping terraces characterize the setting. Depths to water are variable; they are typically less than 30 feet in valleys containing modern streams and are commonly over 45 feet in valleys lacking modern streams. Aquifers are composed of variable thicknesses of sand and gravel interbedded with finer-grained alluvium, till, and lacustrine deposits. The modern streams may be in direct hydraulic connection with the underlying aquifer. Yields up to 500 gpm have been reported for some of the coarser, thicker, more continuous sand and gravel outwash in the Chippewa Creek and Killbuck Creek south of Wooster. Yields up to 100 gpm are developed in Sugar Creek, Killbuck Creek northwest of Wooster, Muddy Fork of the Mohican River south of New Pittsburgh, and lower Apple Creek. Some valleys, including Muddy Fork of the Mohican River in the northwestern corner of the county and Little Chippewa Creek, contain thin lenses of sand and gravel interbedded with much thicker sequences of finer-grained alluvial and lacustrine deposits. Soils on terraces are typically sandy loams derived from outwash; soils on floodplains are silt loams derived from modern alluvium. Recharge is typically relatively high due to the flat-lying topography, shallow depth to water, high permeability of the soils and vadose zone materials, and presence of modern overlying streams. Recharge tends to be less in valleys lacking modern streams, having greater depths to water, and less permeable soils and vadose media.

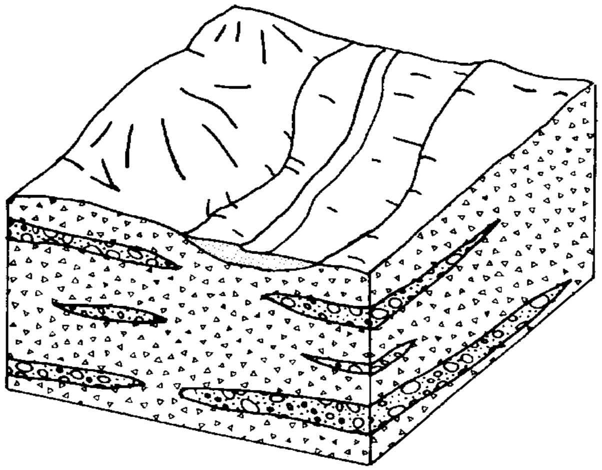
GWPP index values for the hydrogeologic setting of Buried Valley range from 85 to 187, with the total number of GWPP index calculations equaling 120.



7Ec Alluvium Over Bedded Sedimentary Rock

This hydrogeologic setting is found in upland areas throughout Wayne County. This setting consists of the headwaters of small tributary streams in upland areas with thin glacial cover. The setting is characterized by narrow, flat-bottomed stream valleys, which are flanked by rolling to steep bedrock-controlled uplands. The aquifer consists of fractured, interbedded sandstones, shales, limestones and coals of the Pennsylvanian System and interbedded shales, siltstones, and fine-grained sandstones of the Mississippian System. Yields developed from the fractures and bedding planes of the bedrock range from 10 to 25 gpm. Soils vary but are usually silt loams. Vadose zone media is typically either silty alluvium or fractured bedrock depending upon the thickness of the drift locally. The depth to water is commonly shallow, averaging from 10 to 35 feet. The alluvium is commonly in direct hydraulic connection with the underlying aquifer. Recharge is moderately high due to the shallow depth to water, flat-lying topography, proximity of modern streams, and the moderately low permeability of the soils, alluvium, and bedrock.

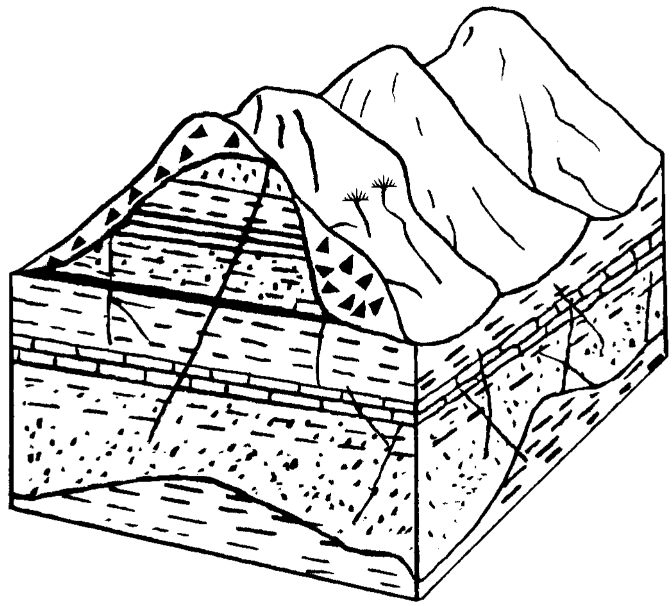
GWPP index values for the hydrogeologic setting of alluvium over bedded sedimentary rocks ranges from 102 to 134 with the total number of GWPP index calculations equaling 11.



7Ed Alluvium Over Glacial Till

This hydrogeologic setting is comprised of flat-lying floodplains and stream terraces containing thin to moderate thicknesses of modern alluvium. This setting is similar to the 7Af - Sand and Gravel Interbedded in Glacial Till setting except for the presence of the modern stream and related deposits. The setting is similar to the 7Ec Alluvium over Bedded Sedimentary Rocks except that the drift is thicker. This setting is found in upland areas of the southeastern corner of the county where drift is moderately thick. The stream may or may not be in direct hydraulic connection with the underlying sand and gravel lenses, which constitute the aquifer. The surficial, silty alluvium is typically more permeable than the surrounding till. The alluvium is too thin to be considered the aquifer. Soils are sandy loams or silt loams. Yields commonly range from 10 to 25 gpm. Depth to water is typically shallow with depths averaging less than 30 feet. Recharge is moderate due to the shallow depth to water, flat-lying topography, and the moderate permeability of the glacial till and alluvium.

GWPP index values for the hydrogeologic setting Alluvium Over Glacial Till range from 129 to 133, with the total number of GWPP index calculations equaling 2.



7G Thin Glacial Till Over Bedded Sedimentary Rock

This hydrogeologic setting is characterized by rolling to steep bedrock-controlled topography and deposits of thin, patchy glacial till overlying alternating layers of fractured sedimentary rock. This setting is common in the southeastern part of the county, in the Doylestown area in northeastern Wayne County, and along the steeply incised valley of Killbuck Creek northwest of Wooster. The till is less than 25 feet thick and consists of varying amounts of unsorted clay, silt, and sand with minor pebbles and cobbles. Ground water is obtained from the underlying, fractured Mississippian or Pennsylvanian bedrock. Depth to water varies greatly depending whether the setting is close to a stream valley or consists of an isolated ridge top. Soils are silt loams or clay loams except along steep faces where soils are evaluated as thin or absent. Recharge is low due to depth to water, relatively steep slopes, and relatively impermeable nature of these soils.

GWPP index values for the hydrogeologic setting of Thin Glacial Till Over Bedded Sedimentary Rock range from 73 to 111, with the total number of GWPP index calculations equaling 32.

Table 15. Hydrogeologic Settings, DRASTIC Factors, and Ratings

Setting	Depth To Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% Slope)	Vadose Zone Media	Hydraulic Conductivity	Rating
7Aa01	50-75	2-4	interbedded ss/sh/ls/thin	Clay Loam	2-6	till	1-100	77
7Aa02	50-75	2-4	interbedded ss/sh/ls/thin	Clay Loam	2-6	interbedded ss/sh/ls/thin	1-100	77
7Aa03	50-75	2-4	interbedded ss/sh/ls/thin	Clay Loam	0-2	interbedded ss/sh/ls/thin	1-100	78
7Aa04	50-75	2-4	interbedded ss/sh/ls/thin	Clay Loam	0-2	till	1-100	78
7Aa05	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	2-6	till	1-100	87
7Aa06	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	till	1-100	79
7Aa07	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	interbedded ss/sh/ls/thin	1-100	89
7Aa08	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	interbedded ss/sh/ls/thin	1-100	79
7Aa09	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	interbedded ss/sh/ls/thin	1-100	75
7Aa10	50-75	2-4	interbedded ss/sh/ls/thin	Clay Loam	6-12	till	1-100	73
7Aa11	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	till	1-100	75
7Aa12	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	interbedded ss/sh/ls/thin	1-100	85
7Aa13	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	till	1-100	89
7Aa14	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	0-2	interbedded ss/sh/ls/thin	1-100	90
7Aa15	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	till	1-100	85
7Aa16	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	0-2	till	1-100	80
7Aa17	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	0-2	till	1-100	90
7Aa18	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	0-2	interbedded ss/sh/ls/thin	1-100	80
7Aa19	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	12-18	till	1-100	86
7Aa20	50-75	2-4	interbedded ss/sh/ls/thin	Clay Loam	2-6	till	1-100	80
7Aa21	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	0-2	till	1-100	91
7Aa22	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	2-6	interbedded ss/sh/ls/thin	1-100	95
7Aa23	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	6-12	interbedded ss/sh/ls/thin	1-100	91
7Aa24	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	0-2	interbedded ss/sh/ls/thin	1-100	96
7Aa25	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	2-6	till	1-100	90

Setting	Depth To Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% Slope)	Vadose Zone Media	Hydraulic Conductivity	Rating
7Aa26	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	0-2	till	1-100	88
7Aa27	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	6-12	till	1-100	83
7Aa28	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	0-2	interbedded ss/sh/ls/thin	1-100	88
7Aa29	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	2-6	interbedded ss/sh/ls/thin	1-100	90
7Aa30	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	2-6	interbedded ss/sh/ls/thin	1-100	87
7Aa31	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	0-2	till	100-300	97
7Aa32	50-75	2-4	interbedded ss/sh/ls/thin	Clay Loam	2-6	interbedded ss/sh/ls/thin	1-100	85
7Aa33	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	12-18	till	1-100	84
7Aa34	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	12-18	interbedded ss/sh/ls/thin	1-100	89
7Aa35	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	18+	interbedded ss/sh/ls/thin	1-100	87
7Aa36	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	6-12	till	1-100	86
7Aa37	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	interbedded ss/sh/ls/thin	1-100	87
7Aa38	50-75	2-4	interbedded ss/sh/ls/thin	Clay Loam	0-2	till	1-100	81
7Aa39	15-30	2-4	interbedded ss/sh/ls/thin	Silty Loam	0-2	interbedded ss/sh/ls/thin	1-100	108
7Aa40	15-30	2-4	interbedded ss/sh/ls/thin	Silty Loam	0-2	till	1-100	103
7Aa41	15-30	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	till	1-100	102
7Aa42	5-15	2-4	interbedded ss/sh/ls/thin	Silty Loam	0-2	till	1-100	113
7Aa43	5-15	2-4	interbedded ss/sh/ls/thin	Silty Loam	0-2	interbedded ss/sh/ls/thin	1-100	118
7Aa44	15-30	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	interbedded ss/sh/ls/thin	1-100	107
7Aa45	15-30	2-4	interbedded ss/sh/ls/thin	Clay Loam	2-6	till	1-100	100
7Aa46	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	interbedded ss/sh/ls/thin	1-100	97
7Aa47	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	0-2	interbedded ss/sh/ls/thin	1-100	98
7Aa48	5-15	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	interbedded ss/sh/ls/thin	1-100	117
7Aa49	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	0-2	interbedded ss/sh/ls/thin	1-100	88
7Aa50	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	12-18	interbedded ss/sh/ls/thin	1-100	83
7Aa51	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	12-18	interbedded ss/sh/ls/thin	1-100	73
7Aa52	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	interbedded ss/sh/ls/thin	1-100	83

Setting	Depth To Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% Slope)	Vadose Zone Media	Hydraulic Conductivity	Rating
7Aa53	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	interbedded ss/sh/ls/thin	1-100	88
7Aa54	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	12-18	interbedded ss/sh/ls/thin	1-100	81
7Aa55	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	interbedded ss/sh/ls/thin	1-100	93
7Aa56	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	12-18	interbedded ss/sh/ls/thin	1-100	91
7Aa57	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	0-2	till	1-100	83
7Aa58	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	till	1-100	82
7Aa59	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	interbedded ss/sh/ls/thin	1-100	78
7Aa60	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	12-18	till	1-100	76
7Aa61	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	till	1-100	78
7Aa62	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	till	1-100	92
7Aa63	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	till	1-100	88
7Aa64	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	0-2	till	1-100	93
7Aa65	30-50	4-7	interbedded ss/sh/ls/thin	Silty Loam	2-6	sd+gvl/silt-clay	100-300	115
7Aa66	30-50	4-7	interbedded ss/sh/ls/thin	Sandy Loam	2-6	sd+gvl/silt-clay	100-300	119
7Aa67	30-50	4-7	interbedded ss/sh/ls/thin	Clay Loam	6-12	sd+gvl/silt-clay	100-300	109
7Aa68	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	till	1-100	93
7Aa69	15-30	2-4	interbedded ss/sh/ls/thin	Clay Loam	2-6	interbedded ss/sh/ls/thin	1-100	105
7Aa70	50-75	2-4	interbedded ss/sh/ls/thin	Clay Loam	0-2	interbedded ss/sh/ls/thin	1-100	86
7Aa71	50-75	2-4	interbedded ss/sh/ls/thin	Clay Loam	6-12	till	1-100	76
7Aa72	15-30	2-4	interbedded ss/sh/ls/thin	Clay Loam	6-12	till	1-100	96
7Aa73	15-30	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	till	1-100	107
7Aa74	15-30	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	interbedded ss/sh/ls/thin	1-100	103
7Aa75	30-50	4-7	interbedded ss/sh/ls/thin	Clay Loam	2-6	sd+gvl/silt-clay	100-300	113
7Aa76	30-50	4-7	interbedded ss/sh/ls/thin	Clay Loam	0-2	till	100-300	114
7Aa77	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	0-2	till	1-100	88
7Aa78	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	till	1-100	97
7Aa79	15-30	2-4	interbedded ss/sh/ls/thin	Silty Loam	0-2	till	1-100	108

Setting	Depth To Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% Slope)	Vadose Zone Media	Hydraulic Conductivity	Rating
7Aa80	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	till	1-100	87
7Aa81	30-50	4-7	interbedded ss/sh/ls/thin	Sandy Loam	6-12	till	100-300	115
7Aa82	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	0-2	till	1-100	98
7Aa83	15-30	2-4	interbedded ss/sh/ls/thin	Clay Loam	0-2	till	1-100	101
7Ad01	30-50	2-4	sandstone	Clay Loam	2-6	till	1-100	87
7Ad02	15-30	2-4	sandstone	Clay Loam	2-6	till	1-100	97
7Ad03	30-50	2-4	sandstone	Silty Loam	6-12	till	1-100	85
7Ad04	30-50	2-4	sandstone	Clay Loam	2-6	sandstone	1-100	87
7Ad05	15-30	2-4	sandstone	Silty Loam	6-12	sandstone	1-100	95
7Ad06	5-15	2-4	sandstone	Silty Loam	2-6	till	1-100	114
7Ad07	30-50	2-4	sandstone	Silty Loam	2-6	till	1-100	94
7Ad08	50-75	2-4	sandstone	Silty Loam	2-6	sandstone	1-100	79
7Ad09	50-75	2-4	sandstone	Silty Loam	2-6	till	1-100	79
7Ad10	50-75	2-4	sandstone	Silty Loam	6-12	sandstone	1-100	75
7Ad11	15-30	2-4	sandstone	Silty Loam	2-6	till	1-100	104
7Ad12	15-30	2-4	sandstone	Silty Loam	2-6	till	1-100	107
7Ad13	5-15	2-4	sandstone	Silty Loam	2-6	till	1-100	117
7Ad14	100+	0-2	sandstone	Silty Loam	2-6	interbedded ss/sh/ls/thin	1-100	56
7Ad15	50-75	0-2	sandstone	Silty Loam	6-12	sandstone	1-100	67
7Ad16	30-50	2-4	sandstone	Silty Loam	2-6	sandstone	1-100	89
7Ae1	30-50	2-4	shale	Clay Loam	2-6	till	1-100	81
7Ae2	15-30	2-4	shale	Clay Loam	2-6	till	1-100	91
7Ae3	15-30	2-4	shale	Clay Loam	0-2	till	1-100	92
7Ae4	5-15	2-4	shale	Clay Loam	2-6	till	1-100	101
7Ae5	30-50	2-4	shale	Silty Loam	6-12	till	1-100	79
7Ae6	30-50	2-4	shale	Silty Loam	2-6	till	1-100	83
7Af1	30-50	4-7	sand and gravel	Clay Loam	0-2	till	300-700	112
7Af2	15-30	4-7	sand and gravel	Clay Loam	0-2	till	300-700	122
7Af3	30-50	2-4	sand and gravel	Clay Loam	2-6	till	1-100	90
7Af4	50-75	2-4	sand and gravel	Clay Loam	2-6	till	300-700	89
7Af5	50-75	2-4	sand and gravel	Clay Loam	6-12	till	300-700	85
7Af6	30-50	4-7	sand and gravel	Clay Loam	2-6	till	300-700	111

Setting	Depth To Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% Slope)	Vadose Zone Media	Hydraulic Conductivity	Rating
7Ba1	30-50	7-10	sand and gravel	Sandy Loam	6-12	sd+gvl/silt-clay	700-1000	148
7Bb1	30-50	4-7	interbedded ss/sh/ls/thin	Sandy Loam	2-6	sd+gvl/silt-clay	1-100	110
7Bb2	15-30	4-7	interbedded ss/sh/ls/thin	Sandy Loam	0-2	sd+gvl/silt-clay	1-100	121
7Bb3	15-30	4-7	interbedded ss/sh/ls/thin	Sandy Loam	0-2	sd+gvl/silt-clay	1-100	129
7Bb4	15-30	4-7	interbedded ss/sh/ls/thin	Sandy Loam	0-2	sd+gvl/silt-clay	1-100	124
7Bb5	30-50	2-4	interbedded ss/sh/ls/thin	Sandy Loam	12-18	sd+gvl/silt-clay	1-100	92
7Bb6	5-15	4-7	interbedded ss/sh/ls/thin	Sandy Loam	0-2	sd+gvl/silt-clay	1-100	134
7D01	15-30	7-10	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	300-700	148
7D002	15-30	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	300-700	152
7D003	15-30	7-10	sand and gravel	Peat	0-2	silt/clay	300-700	146
7D004	30-50	4-7	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	300-700	131
7D005	30-50	4-7	sand and gravel	Sandy Loam	6-12	sd+gvl/silt-clay	300-700	126
7D006	30-50	4-7	sand and gravel	Sandy Loam	2-6	sd+gvl/silt-clay	300-700	130
7D007	30-50	4-7	sand and gravel	Clay Loam	2-6	till	300-700	111
7D008	50-75	2-4	sand and gravel	Clay Loam	2-6	sd+gvl/silt-clay	300-700	89
7D009	15-30	4-7	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	300-700	129
7D10	15-30	4-7	sand and gravel	Clay Loam	2-6	sd+gvl/silt-clay	300-700	121
7D011	15-30	4-7	sand and gravel	Silty Loam	2-6	sd+gvl/silt-clay	300-700	128
7D012	15-30	7-10	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	300-700	140
7D013	15-30	7-10	sand and gravel	Clay Loam	2-6	sd+gvl/silt-clay	300-700	137
7D014	15-30	7-10	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	300-700	145
7D015	30-50	7-10	sand and gravel	Clay Loam	0-2	sd+gvl/silt-clay	300-700	128
7D016	30-50	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	300-700	139
7D017	30-50	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	300-700	142
7D018	30-50	4-7	sand and gravel	Clay Loam	2-6	sd+gvl/silt-clay	300-700	117

Setting	Depth To Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% Slope)	Vadose Zone Media	Hydraulic Conductivity	Rating
7D019	30-50	4-7	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	300-700	120
7D020	30-50	4-7	sand and gravel	Clay Loam	2-6	sd+gvl/silt-clay	300-700	114
7D021	30-50	7-10	sand and gravel	Sandy Loam	2-6	sd+gvl/silt-clay	300-700	133
7D022	50-75	2-4	sand and gravel	Silty Loam	2-6	sd+gvl/silt-clay	300-700	91
7D023	30-50	4-7	sand and gravel	Silty Loam	2-6	till	300-700	113
7D024	30-50	4-7	sand and gravel	Clay Loam	6-12	till	300-700	107
7D025	15-30	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	300-700	141
7D026	5-15	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	300-700	162
7D027	5-15	7-10	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	300-700	158
7D028	5-15	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	700-1000	173
7D029	5-15	7-10	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	700-1000	169
7D030	30-50	7-10	sand and gravel	Sandy Loam	2-6	sd+gvl/silt-clay	300-700	138
7D031	5-15	7-10	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	300-700	155
7D032	30-50	7-10	sand and gravel	Sandy Loam	2-6	sd+gvl/silt-clay	300-700	141
7D033	30-50	4-7	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	300-700	122
7D034	15-30	7-10	sand and gravel	Peat	0-2	sd+gvl/silt-clay	300-700	146
7D035	30-50	7-10	sand and gravel	Sandy Loam	2-6	sd+gvl/silt-clay	300-700	130
7D036	15-30	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	300-700	149
7D037	15-30	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	300-700	144
7D038	15-30	4-7	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	300-700	133
7D039	5-15	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	300-700	159
7D040	5-15	7-10	sand and gravel	Silty Loam	0-2	silt/clay	300-700	155
7D041	50-75	2-4	sand and gravel	Clay Loam	0-2	till	300-700	93
7D042	50-75	2-4	sand and gravel	Clay Loam	2-6	till	300-700	92
7D043	50-75	2-4	sand and gravel	Clay Loam	6-12	till	300-700	88
7D044	5-15	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	300-700	154
7D045	15-30	7-10	sand and gravel	Sandy Loam	2-6	sd+gvl/silt-clay	300-700	143

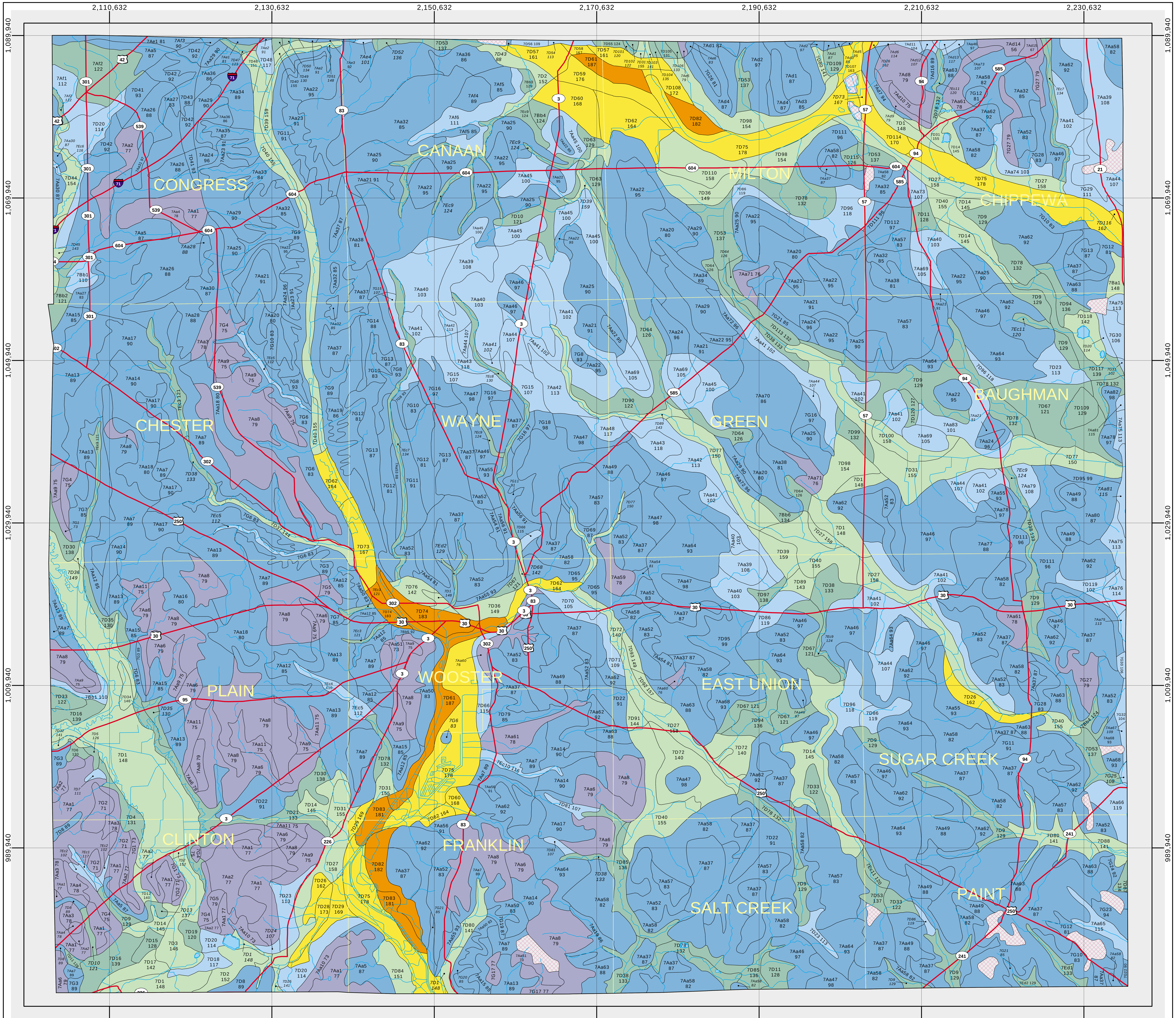
Setting	Depth To Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% Slope)	Vadose Zone Media	Hydraulic Conductivity	Rating
7D046	5-15	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	300-700	151
7D047	30-50	4-7	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	300-700	123
7D048	15-30	4-7	sand and gravel	Clay Loam	2-6	sd+gvl/silt-clay	1-100	117
7D049	5-15	4-7	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	1-100	130
7D050	5-15	4-7	sand and gravel	Clay Loam	0-2	sd+gvl/silt-clay	100-300	134
7D051	5-15	7-10	sand and gravel	Clay Loam	0-2	sd+gvl/silt-clay	300-700	148
7D052	5-15	4-7	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	100-300	136
7D053	15-30	4-7	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	300-700	137
7D054	30-50	2-4	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	100-300	113
7D055	15-30	4-7	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	1-100	124
7D056	30-50	2-4	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	100-300	109
7D057	15-30	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	700-1000	161
7D058	15-30	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	1000-2000	167
7D059	5-15	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	700-1000	176
7D060	5-15	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	700-1000	168
7D061	5-15	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	1000-2000	187
7D062	5-15	7-10	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	700-1000	164
7D063	15-30	4-7	sand and gravel	Clay Loam	2-6	till	300-700	129
7D064	15-30	4-7	sand and gravel	Clay Loam	2-6	till	300-700	126
7D065	50-75	2-4	sand and gravel	Silty Loam	6-12	till	300-700	95
7D066	30-50	4-7	sand and gravel	Silty Loam	12-18	till	300-700	115
7D067	30-50	4-7	sand and gravel	Silty Loam	2-6	till	300-700	121
7D068	5-15	4-7	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	300-700	142
7D069	50-75	2-4	sand and gravel	Silty Loam	6-12	till	300-700	87
7D070	30-50	2-4	sand and gravel	Silty Loam	6-12	sd+gvl/silt-clay	300-700	105
7D071	30-50	2-4	sand and gravel	Silty Loam	2-6	sd+gvl/silt-clay	300-700	109
7D072	15-30	4-7	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	300-700	140

Setting	Depth To Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% Slope)	Vadose Zone Media	Hydraulic Conductivity	Rating
7D073	5-15	7-10	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	700-1000	167
7D074	5-15	7-10	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	1000-2000	183
7D075	5-15	7-10	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	1000-2000	178
7D076	15-30	7-10	sand and gravel	Silty Loam	2-6	till	300-700	142
7D077	5-15	7-10	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	300-700	150
7D078	15-30	4-7	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	300-700	132
7D079	50-75	2-4	sand and gravel	Silty Loam	12-18	till	300-700	85
7D080	15-30	4-7	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	300-700	141
7D081	30-50	2-4	sand and gravel	Silty Loam	0-2	till	300-700	107
7D082	5-15	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	1000-2000	182
7D083	5-15	7-10	sand and gravel	Peat	0-2	sd+gvl/silt-clay	1000-2000	181
7D084	15-30	7-10	sand and gravel	Clay Loam	2-6	till	700-1000	151
7D085	15-30	4-7	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	300-700	136
7D086	30-50	4-7	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	300-700	119
7D087	30-50	4-7	sand and gravel	Sandy Loam	2-6	sd+gvl/silt-clay	700-1000	134
7D088	15-30	4-7	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	700-1000	141
7D089	5-15	4-7	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	300-700	143
7D090	15-30	4-7	sand and gravel	Clay Loam	0-2	till	300-700	122
7D091	15-30	7-10	sand and gravel	Silty Loam	2-6	sd+gvl/silt-clay	300-700	144
7D092	5-15	7-10	sand and gravel	Silty Loam	2-6	sd+gvl/silt-clay	300-700	157
7D093	5-15	7-10	sand and gravel	Silty Loam	2-6	sd+gvl/silt-clay	300-700	149
7D094	15-30	4-7	sand and gravel	Silty Loam	2-6	sd+gvl/silt-clay	300-700	136
7D095	50-75	2-4	sand and gravel	Silty Loam	2-6	sd+gvl/silt-clay	300-700	99
7D096	30-50	4-7	sand and gravel	Silty Loam	2-6	sd+gvl/silt-clay	300-700	118
7D097	5-15	4-7	sand and gravel	Silty Loam	2-6	sd+gvl/silt-clay	300-700	138
7D098	15-30	7-10	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	700-1000	154
7D099	15-30	7-10	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	300-700	132

Setting	Depth To Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% Slope)	Vadose Zone Media	Hydraulic Conductivity	Rating
7D100	5-15	7-10	sand and gravel	Peat	0-2	sd+gvl/silt-clay	300-700	158
7D101	15-30	4-7	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	1-100	120
7D102	15-30	4-7	sand and gravel	Loam	0-2	sd+gvl/silt-clay	1-100	122
7D103	5-15	4-7	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	100-300	141
7D104	15-30	4-7	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	100-300	135
7D105	15-30	4-7	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	100-300	131
7D106	15-30	4-7	sand and gravel	Loam	0-2	sd+gvl/silt-clay	100-300	133
7D107	5-15	7-10	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	300-700	163
7D108	15-30	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	1000-2000	172
7D109	30-50	4-7	sand and gravel	Silty Loam	2-6	sd+gvl/silt-clay	300-700	129
7D110	15-30	7-10	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	700-1000	158
7D111	50-75	2-4	sand and gravel	Silty Loam	2-6	till	300-700	96
7D112	50-75	2-4	sand and gravel	Silty Loam	0-2	till	300-700	97
7D113	15-30	4-7	sand and gravel	Sandy Loam	2-6	sd+gvl/silt-clay	300-700	132
7D114	5-15	7-10	sand and gravel	Peat	0-2	sd+gvl/silt-clay	700-1000	170
7D115	30-50	4-7	sand and gravel	Silty Loam	2-6	sd+gvl/silt-clay	300-700	126
7D116	15-30	7-10	sand and gravel	Sandy Loam	2-6	sd+gvl/silt-clay	700-1000	162
7D117	5-15	4-7	sand and gravel	Silty Loam	0-2	sd+gvl/silt-clay	300-700	139
7D118	5-15	4-7	sand and gravel	Peat	0-2	silt/clay	300-700	142
7D119	30-50	2-4	sand and gravel	Silty Loam	0-2	till	300-700	102
7D120	15-30	4-7	sand and gravel	Clay Loam	0-2	sd+gvl/silt-clay	300-700	127
7Ec01	15-30	4-7	interbedded ss/sh/ls/thin	Silty Loam	0-2	sd+gvl/silt-clay	1-100	117
7Ec02	30-50	4-7	interbedded ss/sh/ls/thin	Silty Loam	0-2	silt/clay	1-100	102
7Ec03	15-30	4-7	interbedded ss/sh/ls/thin	Sandy Loam	0-2	sd+gvl/silt-clay	1-100	121
7Ec04	30-50	4-7	interbedded ss/sh/ls/thin	Sandy Loam	2-6	sd+gvl/silt-clay	1-100	110
7Ec05	15-30	4-7	interbedded ss/sh/ls/thin	Silty Loam	0-2	silt/clay	1-100	112

Setting	Depth To Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% Slope)	Vadose Zone Media	Hydraulic Conductivity	Rating
7Ec06	15-30	4-7	interbedded ss/sh/ls/thin	Sandy Loam	0-2	silt/clay	1-100	116
7Ec07	5-15	4-7	interbedded ss/sh/ls/thin	Sandy Loam	0-2	sd+gvl/silt-clay	1-100	134
7Ec08	5-15	4-7	interbedded ss/sh/ls/thin	Silty Loam	0-2	interbedded ss/sh/ls/thin	1-100	130
7Ec09	15-30	4-7	interbedded ss/sh/ls/thin	Sandy Loam	0-2	sd+gvl/silt-clay	1-100	124
7Ec10	15-30	4-7	interbedded ss/sh/ls/thin	Silty Loam	2-6	silt/clay	1-100	116
7Ec11	15-30	4-7	interbedded ss/sh/ls/thin	Silty Loam	0-2	sd+gvl/silt-clay	1-100	120
7Ed1	15-30	4-7	sand and gravel	Sandy Loam	0-2	sd+gvl/silt-clay	300-700	133
7Ed2	15-30	4-7	interbedded ss/sh/ls/thin	Silty Loam	0-2	sd+gvl/silt-clay	300-700	129
7G01	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	12-18	interbedded ss/sh/ls/thin	1-100	73
7G02	50-75	2-4	interbedded ss/sh/ls/thin	Clay Loam	12-18	interbedded ss/sh/ls/thin	1-100	71
7G03	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	interbedded ss/sh/ls/thin	1-100	89
7G04	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	interbedded ss/sh/ls/thin	1-100	75
7G05	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	interbedded ss/sh/ls/thin	1-100	79
7G06	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	12-18	interbedded ss/sh/ls/thin	1-100	83
7G07	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	interbedded ss/sh/ls/thin	1-100	85
7G08	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	interbedded ss/sh/ls/thin	1-100	93
7G09	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	18+	interbedded ss/sh/ls/thin	1-100	89
7G10	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	interbedded ss/sh/ls/thin	1-100	83
7G11	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	12-18	interbedded ss/sh/ls/thin	1-100	91
7G12	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	12-18	interbedded ss/sh/ls/thin	1-100	81
7G13	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	interbedded ss/sh/ls/thin	1-100	87
7G14	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	0-2	interbedded ss/sh/ls/thin	1-100	88
7G15	15-30	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	interbedded ss/sh/ls/thin	1-100	107
7G16	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	interbedded ss/sh/ls/thin	1-100	97
7G17	50-75	0-2	interbedded ss/sh/ls/thin	Thin or Absent Gravel	12-18	interbedded ss/sh/ls/thin	1-100	77

Setting	Depth To Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% Slope)	Vadose Zone Media	Hydraulic Conductivity	Rating
7G18	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	0-2	interbedded ss/sh/ls/thin	1-100	98
7G19	30-50	0-2	interbedded ss/sh/ls/thin	Thin or Absent Gravel	12-18	interbedded ss/sh/ls/thin	1-100	87
7G20	30-50	0-2	interbedded ss/sh/ls/thin	Thin or Absent Gravel	18+	interbedded ss/sh/ls/thin	1-100	85
7G21	50-75	0-2	interbedded ss/sh/ls/thin	Thin or Absent Gravel	12-18	interbedded ss/sh/ls/thin	1-100	85
7G22	50-75	2-4	interbedded ss/sh/ls/thin	Clay Loam	12-18	interbedded ss/sh/ls/thin	100-300	90
7G23	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	interbedded ss/sh/ls/thin	100-300	94
7G24	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	12-18	interbedded ss/sh/ls/thin	100-300	92
7G25	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	2-6	interbedded ss/sh/ls/thin	100-300	108
7G26	30-50	2-4	sandstone	Silty Loam	18+	sandstone	1-100	81
7G27	50-75	2-4	interbedded ss/sh/ls/thin	Silty Loam	18+	interbedded ss/sh/ls/thin	1-100	79
7G28	50-75	0-2	interbedded ss/sh/ls/thin	Thin or Absent Gravel	18+	interbedded ss/sh/ls/thin	1-100	83
7G29	15-30	2-4	interbedded ss/sh/ls/thin	Thin or Absent Gravel	18+	interbedded ss/sh/ls/thin	1-100	111
7G30	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	2-6	interbedded ss/sh/ls/thin	100-300	106
7G31	30-50	2-4	interbedded ss/sh/ls/thin	Clay Loam	6-12	interbedded ss/sh/ls/thin	100-300	102
7G32	30-50	2-4	interbedded ss/sh/ls/thin	Silty Loam	6-12	interbedded ss/sh/ls/thin	100-300	104



Ground Water Pollution Potential of Wayne County

by
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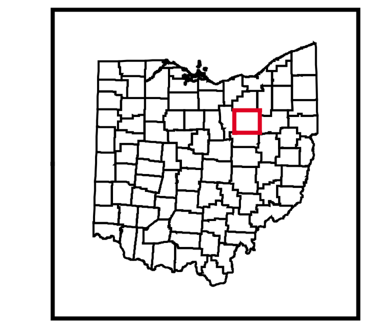
Ohio Department of Natural Resources



Ground Water Pollution Potential maps are designed to evaluate the susceptibility of ground water to contamination from surface sources. These maps are based on the DRASTIC system developed for the USEPA (Aller et al., 1987). The DRASTIC system consists of two major elements: the designation of mappable units, termed hydrogeologic settings, and a relative rating system for determining the ground water pollution potential within a hydrogeologic setting. The application of DRASTIC to an area requires the recognition of a set of assumptions made in the development of the system. The evaluation of pollution potential of an area assumes that a contaminant with the mobility of water is introduced at the surface and is flushed into the ground water by precipitation. DRASTIC is not designed to replace specific on-site investigations.

In DRASTIC mapping, hydrogeologic settings form the basis of the system and incorporate the major hydrogeologic factors that affect and control ground water movement and occurrence. The relative rating system is based on seven hydrogeologic factors: Depth to water, net Recharge, Aquifer media, Soil media, Topography, Impact of the vadose zone media, and hydraulic Conductivity. These factors form the acronym DRASTIC. The relative rating system uses a combination of weights and ratings to produce a numerical value called the ground water pollution potential index. Higher index values indicate higher susceptibility to ground water contamination. Polygons (outlined in black on the map at left) are regions where the hydrogeologic setting and the pollution potential index are combined to create a mappable unit with specific hydrogeologic characteristics, which determine the region's relative vulnerability to contamination. Additional information on the DRASTIC system, hydrogeologic settings, ratings, and weighting factors is included in the report.

Description of Map Symbols

Hydrogeologic Region → 7D24 ← Hydrogeologic Setting
170 ← Relative Pollution Potential

Legend

Colors are used to depict the ranges in the pollution potential indexes shown below. Warm colors (red, orange, yellow) represent areas of higher vulnerability (higher pollution potential indexes), while cool colors (green, blue, violet) represent areas of lower vulnerability to contamination (lower pollution potential indexes).

Map Symbols	Index Ranges
Roads	Not Rated
Streams	Less Than 79
Lakes	80 - 99
Townships	100 - 119
	120 - 139
	140 - 159
	160 - 179
	180 - 199
	Greater Than 200

Black grid represents the State Plane South Coordinate System (NAD27, feet).

0 1 2 3 4 5
Miles

0 1 2 4 6 8
Kilometers

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