

**GROUND WATER POLLUTION POTENTIAL  
OF PICKAWAY COUNTY, OHIO**

**BY**

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## ABSTRACT

A ground water pollution potential mapping program for Ohio has been developed under the direction of the Division of Water, Ohio Department of Natural Resources, 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 form the basis of the system and incorporate the major hydrogeologic factors that affect and 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 mapping in Pickaway County resulted in a map with symbols and colors which illustrate areas of varying ground water contamination vulnerability. Ten hydrogeologic settings were identified in Pickaway County with computed ground water pollution potential indexes ranging from 83 to 195.

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 Pickaway 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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## INTRODUCTION

The need for protection and management of ground water resources in Ohio has been clearly recognized. About 42 per cent of Ohio citizens rely on ground water for their drinking and household uses from both municipal and private wells. Industry and agriculture also utilize significant quantities of ground water for processing and irrigation. In Ohio, approximately 700,000 rural households depend on private wells; approximately 4,500 of these wells exist in Pickaway 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 clean up 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 Environmental Protection Agency, 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, Ground Water Resources Section to implement the ground water pollution potential mapping program on a county-wide 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 partly 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 more or less 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 results of 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 Pickaway 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 to assist 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 more or less suitable for land 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.

A pollution potential map can also 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 also 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.

Other beneficial uses of the pollution potential maps will be recognized by individuals in the county who are familiar with specific land use and management problems. Planning commissions and zoning boards can use these maps to help make informed decisions about the development of areas within their jurisdiction. Developments proposed to occur within sensitive 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

The system chosen for implementation of a ground water pollution potential mapping program in Ohio, DRASTIC, was developed by the National Water Well Association for the United States Environmental Protection Agency. 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. The vulnerability of an area 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 which 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 assuming a contaminant with the mobility of water, 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 Pickaway County. Inherent within each hydrogeologic setting are the physical characteristics which 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

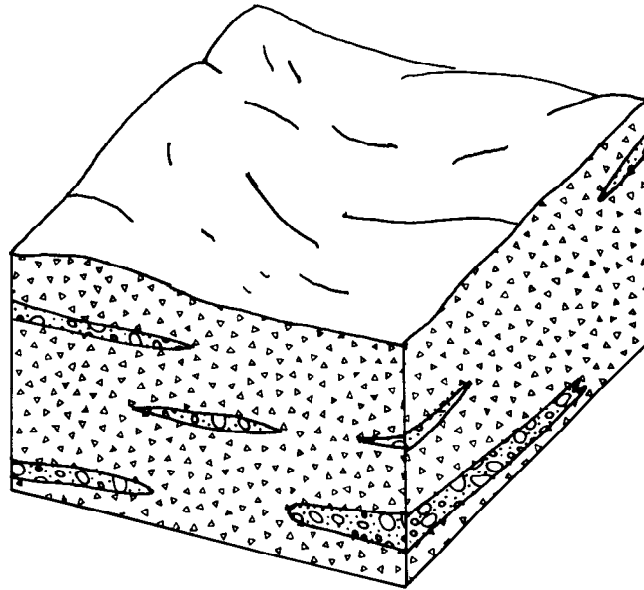
**C** - Conductivity (Hydraulic) of the Aquifer

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 into the aquifer measured in inches per year. Recharge water is available to transport a contaminant from the surface into the aquifer and also 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.



### 7Af Sand and Gravel Interbedded in Glacial Till

This hydrogeologic setting is characterized by low topography with sand and gravel deposits interbedded within glacial till. The till is composed primarily of clay with varying amounts of unsorted silt, sand, and gravel. The sand and gravel may be relatively thin and discontinuous lens-shaped bodies or they may be thick and cover a large area. These units are usually confined to common horizons within the till. Ground-water occurs in both the till and the sand and gravel; however, the sand and gravel serves as the principal aquifer. Recharge to the sand and gravel is primarily due to infiltration of precipitation through the till. Depth to water is highly variable. Soils are typically classified as clay loam.

Figure 1. Format and description of the hydrogeologic setting - 7Af Sand and Gravel Interbedded in Glacial Till.

Soil media refers to the upper six feet of the unsaturated zone that is characterized by significant biological activity. The type of soil media can influence 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.

Topography refers to the slope of the land expressed as percent slope. The amount of slope in an area affects the likelihood that a contaminant will run off from an area 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 significantly impacts 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 judgement. 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 to be used 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. 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 significantly differs.

**TABLE 1. ASSIGNED WEIGHTS FOR  
DRASTIC FEATURES**

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

**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
Massive Shale	1-3	2
Metamorphic/Igneous	2-5	3
Weathered Metamorphic / Igneous	3-5	4
Glacial Till	4-6	5
Bedded Sandstone, Limestone and Shale Sequences	5-9	6
Massive Sandstone	4-9	6
Massive Limestone	4-9	6
Sand and Gravel	4-9	8
Basalt	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
Shrinking and / or Aggregated Clay	7
Sandy Loam	6
Loam	5
Silty Loam	4
Clay Loam	3
Muck	2
Nonshrinking and Nonaggregated 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
Bedded Limestone, Sandstone, Shale	4-8	6
Sand and Gravel with significant Silt and Clay	4-8	6
Metamorphic/Igneous	2-8	4
Sand and Gravel	6-9	8
Basalt	2-10	9
Karst Limestone	8-10	10
Weight: 5	Pesticide Weight: 4	

**TABLE 8. RANGES AND RATINGS FOR HYDRAULIC CONDUCTIVITY**

HYDRAULIC CONDUCTIVITY (GPD/FT <sup>2</sup> )	
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 Pickaway 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 185. 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 Pickaway 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 83 to 195.

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 mapping in Pickaway 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 Pickaway County is included with this report.

## INTERPRETATION AND USE OF A GROUND WATER POLLUTION POTENTIAL MAP

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

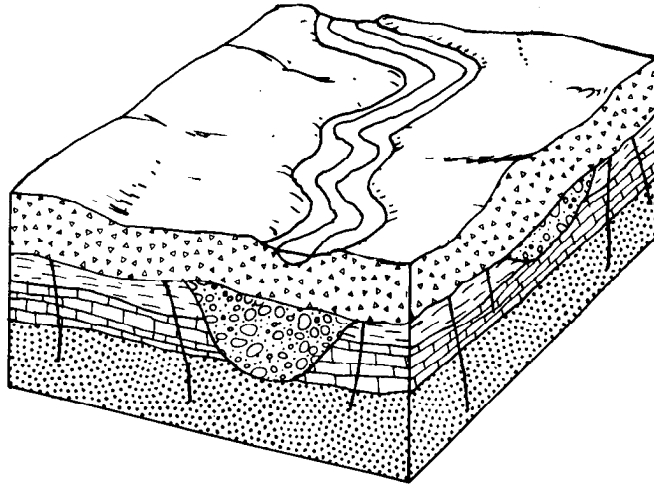
The map accompanying this report displays both the hydrogeologic settings identified in the county and the associated pollution potential indexes calculated for those hydrogeologic settings. The symbols on the map represent the following information:

- 7D1 - defines the hydrogeologic region and setting
- 185 - 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 (185) 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 in an area.

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 map also includes information on the locations of selected observation wells. Available information on these observation wells is referenced in Appendix A, Description of the Logic in Factor Selection. Large man-made features such as landfills, quarries or strip mines have also been identified on the map for reference.



SETTING 7D1		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	NUMBER
Depth to Water	5 - 15	5	9	45
Net Recharge	7 - 10	4	8	32
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Loam	2	5	10
Topography	0 - 2 %	1	10	10
Impact Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	1000-2000	3	8	24
		DRASTIC	INDEX	185

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

## GENERAL INFORMATION ABOUT PICKAWAY COUNTY

Pickaway County is located in the south-central part of Ohio where it occupies an area of approximately 507 square miles (Figure 3). It is bounded on the north by Franklin County, on the east by Fairfield and Hocking Counties, on the south by Ross County, and on the west by Fayette and Madison Counties. The county seat is the city of Circleville, which lies about 25 miles south of Columbus. The population of the county, according to the 1986 Bureau of the Census population estimate, was 44,700 (U.S. Department of Commerce, 1987a). Cropland and pasture accounts for 96 percent of the land use in Pickaway County (Ohio Department of Natural Resources, unpublished data).

### Physiography

The western three-fourths of Pickaway County lies within the Till Plains section of the Central Lowlands physiographic province, while the eastern margin of the county is part of the Glaciated Low Plateau section of the Appalachian Plateau (Fenneman, 1938). The Till Plains slope gently towards the Scioto River providing little topographic expression except where streams have downcut leaving valley walls. The Glaciated Appalachian Plateau section is characterized by rolling hills which provide the greatest topographic relief within the county.

The entire county lies within the Scioto River drainage basin. Major tributaries to the Scioto River within Pickaway County include: Deer Creek; Darby Creek; Scippo Creek; and Salt Creek.

The Central Region of the state has a fifty-year (1931-1980) average annual precipitation of 37.61 inches (U.S. Department of Commerce, 1987b). Data from the U.S. Weather Bureau Station at Circleville showed a thirty-year (1951-1980) average annual precipitation of 38.33 inches and a mean annual temperature of 53.6 degrees Fahrenheit.

### Preglacial Drainage

The earliest recognizable drainage system in Pickaway County can be traced to the Teays River System. This river system existed in Ohio prior to the advent of Pleistocene glaciation. The Teays river originated in the Piedmont region of Virginia and North Carolina and entered Ohio near Wheelersburg, Scioto County; it exited the state in Black Creek Township, Mercer County.



PICKAWAY COUNTY

Figure 3. Location of Pickaway County

As the Teays entered Pickaway County it followed a northerly path, roughly following the present day Scioto River valley to the South Bloomfield area, where it turned west. The river continued on a westerly course entering Madison County just south of Franklin County. The width of the Teays Valley varies from 1 to 2 miles, averaging 1.45 miles (Stout et al., 1943). The valley floor of the Teays just west of South Bloomfield is at about 570 feet (M.S.L.) and has an estimated gradient of .95 feet per mile (Walker et al., 1965).

## Glacial Geology

During the Pleistocene Epoch (2 million to 10,000 years ago), at least four episodes of glaciation occurred in northern North America. In south-central Ohio, evidence exists for two glacial periods; the Illinoian, which occurred at least 120,000 years ago, and the Wisconsinan, which occurred between 70,000 and 10,000 years ago.

Pleistocene glaciation drastically changed the surficial geology in Pickaway County. The entire county is overlain with Wisconsinan glacial drift. Because of the presence of Illinoian drift south of Pickaway County, Illinoian glaciation is assumed to have occurred within the county. Pre-Illinoian glaciation is at least linked to the buried valley system in Pickaway County, but subsequent glacial advances have obscured all trace of these glacial periods.

With the advent of Pleistocene glaciation, the Teays River flow was blocked creating a large lake within its valley. The submerged river valley accumulated thick deposits of predominantly silt and clay sediments. Within Pickaway County subsequent glacial stages totally erased any surficial evidence of the Teays River valley.

Inter- and pre-glacial ancestral streams also had a profound effect on Pickaway County. With the blockage of Teays drainage divides, ponded water eventually found its way over drainage divides creating a new river system. This new drainage system is referred to as Deep Stage. The trunk valley of Deep Stage in Ohio originated in the eastern part of the state and is commonly known as the Newark River (Walker et al., 1965). Following a southern course the Newark River entered Pickaway County north of Ashville roughly following a course similar to the present day Scioto River through the county. Deep Stage drainage is characterized by much deeper erosion than the earlier Teays Stage drainage. At Circleville, the Deep Stage valley floor is 90 feet below Teays level. Within Pickaway County the Deep Stage valley is as wide as eight miles and contains as much as 250 feet of fill (Walker et al., 1965). The fill material is composed of outwash sand, gravel, and clay sediments. These materials represent deposition from debris-laden meltwaters flowing from the glacier front. Outwash was also deposited within the Deer Creek and Darby Creek valleys, but to a much lesser extent.

Most of Pickaway County is covered with a mantle of glacial till deposited directly by glacial ice. Till deposits within the county are composed of poorly sorted clay, silt, sand, gravel, and boulders. Lenses of poorly to moderately sorted sand and gravel are often found interbedded within the till layers. Till thicknesses within the county are normally in the 30 to 150 foot range.

A number of ice contact features (kames, eskers) exist in Pickaway County. A kame is a short ridge or hill composed of stratified glacial drift thought to have been formed where

meltwater deposited sediment within or at the margin of the ice sheet. An esker is a narrow elongated ridge or mound of stratified gravelly and sandy drift deposited by subglacial streams or streams following crevasses in the ice. Ice contact features of this nature can be found in Walnut Township in the vicinity of Little Walnut Creek and Turkey Run. The Scioto River valley has a number of these features, most notably the Circleville esker, located north of Circleville along the Scioto River. Kame deposits are common in the southeast corner of Salt Creek Township on both sides of Salt Creek (Shuster, 1952).

In an area in the southeastern part of the county known as the Prairie, lake bottom silts and clays with interbedded marl zones can be found. The lacustrine deposits were formed as a result of blocked drainage, probably in the southeastern corner of the county. The marl zones represent periods when the area was drained allowing development of vegetation (Quinn and Goldthwait, 1985).

### Bedrock Geology

The bedrock in Pickaway County consists of limestones and dolomites (carbonates) of the upper Silurian and lower Devonian systems, shales from the upper Devonian system, and sandstones and shales from the middle to lower Mississippian system (Table 9). The bedrock formations within the county lie on the eastern flank of the Cincinnati Arch and have an approximate dip of 30 feet per mile to the east (Bain, 1979). Because of the dip of the bedrock, the oldest rocks (Silurian system) are exposed under the till in the western part of the county, while the youngest rocks (Mississippian system) are exposed under the till in the eastern part of the county.

The carbonate units underlie the glacial drift in the western half of the county. The oldest units are from the Salina Group within the upper Silurian system (undifferentiated Salina, Tymochtee, and Greenfield formations). These units are dolomites and limestones and have a total thickness of about 350 feet in

Pickaway County (Bain, 1979). Overlaying the Silurian carbonates are the Devonian carbonates which consist of the Delaware and Columbus Limestones. The Devonian carbonates have a combined thickness of about 50 feet (Bain, 1979).

In the eastern half of the county the carbonate units are overlain by the Olentangy and Ohio Shale from the middle to upper Devonian System. The total thickness of these shales is assumed to be between 380 to 430 feet (Bain, 1979). The Ohio Shale is overlain by the Bedford Shale of Mississippian age. Within Pickaway County the Bedford Shale has a total thickness of about 60 feet (Bain, 1979).

<b>SYSTEM</b>	<b>GROUP</b>	<b>FORMATIONS</b>	<b>DESCRIPTIONS</b>
<b>MISSISSIPPIAN</b>		Cuyahoga	Siltstone and sandstone interbedded with shale
		Sunbury Shale	Black, argillaceous, fissile shale
		Berea Sandstone	Fine-grained gray to brown sandstone to siltstone
		Bedford Shale	Soft, argillaceous, gray to brownish-red shale
<b>DEVONIAN</b>		Ohio Shale	Black to brown, carbonaceous, arenaceous, massive to thinly laminated shale
		Olentangy Shale	Soft argillaceous, blue to gray shale containing limestone concretions
		Delaware Limestone	Thin bedded, blue-gray limestone, occasional shale partings
		Columbus Limestone	Massive, pure to impure brown to gray limestone
<b>SILURIAN</b>	<b>Salina</b>	Undifferentiated	Massive, brown to yellowish-gray to greenish gray dolomite
		Tymochtee	Massive, brown to gray dolomite and limestone
		Greenfield	Massive, light brown to yellowish-brown dolomite and limestone

Table 9. GENERALIZED BEDROCK STRATIGRAPHY OF PICKAWAY COUNTY, OHIO (after Schmidt and Goldthwait, 1958: and Bain 1979, Fred H. Klaer, Jr and Associates, 1971 a and b)

Bedrock near the eastern edge of the county consists of sandstones and shales from the Mississippian System. The formations in ascending order are known as the Berea Sandstone, Sunbury Shale, and Cuyahoga Formation. These formations vary from shales to siltstones to sandstones and generally have a finer grained texture in the southern part of the county. The total thickness of these three formations is about 230 feet in Pickaway County.

## Hydrogeology

Hydrogeologic evaluation of Pickaway County was facilitated by categorizing aquifer materials with similar characteristics. The consolidated bedrock aquifers were divided into the following aquifer categories: carbonate bedrock; shale bedrock; and sandstone and shale bedrock sequences. The unconsolidated or Pleistocene glacial deposits were divided into sand and gravel lenses within glacial till, and outwash sand and gravel aquifer categories.

The carbonate aquifer system roughly covers the western half of Pickaway County. Ground-water yields as high as 1,000 gallons per minute have been recorded from properly constructed production wells (Schmidt, 1980). Domestic wells developed in the carbonate bedrock normally penetrate 10 to 30 feet of the aquifer and produce from 10 to 20 gallons per minute. Ground-water yields to wells within the carbonate system generally increase with greater aquifer penetration; however, ground-water quality usually decreases with depth.

The carbonate aquifer exhibits unconfined to semiconfined characteristics depending on the nature and thickness of overlying drift. Permeability within the carbonate system is dependent on primary and secondary porosity, and the degree of interconnection between the individual pore spaces. Primary porosity refers to original void spaces in the rock, while secondary porosity refers to fracturing of the rock and enlargement of open spaces through solution activity. Solution activity is greatest at or near the water table. Fluctuation of the water table over time has produced zones of increased permeability within the carbonate aquifer.

The shale aquifer category is primarily confined to a north-south band roughly following the Scioto River Valley. This band extends as far west as Deer Creek Reservoir in the southern part of the county. In the northern part of the county the western contact between the shale and limestone is obscured under the Scioto River Valley. Generally, wells are developed in the upper 50 feet of the shale and produce 1 to 2 gallons per minute. The first 10 feet of the shale bedrock tends to be the most productive part of the aquifer; deeper drilling primarily provides additional storage capacity. The shale bedrock's primary porosity is minimal while secondary porosity in the form of fracturing is the most important factor governing ground water yield. This aquifer generally exhibits unconfined characteristics; however, if the overlying till is thick, semiconfining conditions may exist. Sand and gravel within the overlying glacial drift often proves to be a better aquifer than the shale bedrock.

The bedrock aquifer at the eastern edge of the county can be categorized as interbedded sandstone and shale. In this area, ground water yields from 1 to 10 gallons per minute are developed from the bedrock. Variations in ground water yield are a result of changes in

permeability due to changes in primary and secondary porosity. Because of the thin nature of the overlying glacial till, this aquifer is normally unconfined.

Thin lens-shaped sand and gravel units, of limited areal extent, are often found within the glacial till. Ground-water production from these lenses is dependent on the texture of the sand and gravel, the silt/clay content, and the thickness and areal extent of the lens. Within Pickaway County these factors are highly variable and result in a wide range of ground-water yields (0-20 gallons per minute) to drilled wells. The probability of encountering water bearing sand and gravel within the till increases as the till thickness increases. The likelihood of encountering semiconfining to confining aquifer conditions increases as the composition of the till becomes finer grained, fractures in the till decrease, and till thickness increases. In Pickaway County the water bearing sand and gravel lenses are normally under unconfined to semiconfined conditions.

Outwash sands and gravels are primarily confined to the Scioto River, Deer Creek and Darby Creek Valleys. These outwash deposits vary from clay to coarse gravel. The outwash is more extensive, coarser, and has a lower silt/clay content than the sand and gravel lenses found within the till. The outwash aquifers are normally unconfined, but interbedded silt and clay deposits may act as a semiconfining layer. Ground water yields as high as 1,500 gallons per minute have been recorded from properly constructed production wells within the Scioto River Valley outwash deposits (Schmidt, 1980).

The outwash deposits within the Deer Creek and Darby Creek Valleys are not as productive as the Scioto River Valley deposits. This decrease in aquifer productivity is primarily due to smaller aquifer thickness and areal extent. To a lesser extent the lower productivity may be caused by finer grained outwash material.

Regional ground water flow in Pickaway County is generally towards the Scioto River, with a southern trend. The Scioto River, Deer Creek and Darby Creek are major areas of ground water discharge. The flow of ground water into these streams can be reversed locally by lowering the water table below the base level of the streams. Infiltration of precipitation through surficial deposits is the principal source of recharge to the aquifers in Pickaway County.

## REFERENCES

- Aller, L., T. Bennett, J. H. Lehr, R. J. Petty and G. Hackett, 1987. DRASTIC: A standardized system for evaluation ground water pollution potential using hydrogeologic settings. U.S. Environmental Protection Agency EPA/600/2-87-035, 622 pp.
- Allong, A.F., 1971. Hydrogeology of the Scioto Drainage Basin. Unpublished Ph.D. dissertation, Ohio State University, 217 pp.
- Bain, R.C., 1979. The Ground-Water Resources of Pickaway County, Ohio. Unpublished Master's thesis, The Ohio State University, 146 pp., 4 plates.
- Bennett, T.W., 1982. Darbyville, Ohio, Pickaway County Water Supply; Bennett and Gass Inc. Unpublished Report to R.D. Zande and Associates Ltd., 9 pp.
- Fenneman, N.M., 1938. Physiography of the Eastern United States, Prentice - Hall, 604 pp.
- Fred H. Klaer Jr. and Associates, 1971a. Preliminary Report, Well CPBR-31, Central Ohio Project. Unpublished report for Ohio Department of Natural Resources, Division of Water, 11 pp.
- Fred H. Klaer Jr. and Associates, 1971b. Preliminary Report, Well CPBR-34, Central Ohio Project. Unpublished report for Ohio Department of Natural Resources, Division of Water, 9 pp.
- Fred H. Klaer Jr. and Associates, 1972. Preliminary Report, Well CPBR-36, Central Ohio Project. Unpublished report for the Ohio Department of Natural Resources, Division of Water, 9 pp.
- Freeze, R.A. and J.A. Cherry, 1979. Groundwater. Prentice-Hall, 604 pp.
- Hallfrisch, M. and J. Voytek, 1987. Groundwater Pollution Potential of Madison County. Ohio Department of Natural Resources, Division of Water, 32 pp., 1 map.
- Hallfrisch, M., 1987. Investigation of Reported Ground-Water Resources Problems along Darby Creek Road, Pickaway County, Darby Township. Unpublished Report, Ohio Department of Natural Resources, Division of Water, 10 pp.
- Harstine, L., in progress. The Hydrologic Atlas of Ohio. Ohio Department of Natural Resources, Division of Water.
- Kerr, J.W. and R.L. Christman, 1980. Soil Survey of Pickaway County, Ohio. U.S. Department of Agriculture, Soil Conservation Service, 172 pp.

- Morin, R.L., 1986. Production Well 4 Test Pumping Analysis. Unpublished Report to Ross County Water Company, Inc., SIECO, Inc., 15 pp., 1 map.
- Norris, S.E., 1975. The Ground-Water Situation in the Circleville Area, Pickaway County, South-Central Ohio. U.S. Geological Survey, Report of Investigations No. 96, 14 pp.
- Norris, S.E., and T. A. Van Echo, 1986. Evaluation of the Ground-Water Supply Orient Correctional Institute Pickaway County, Ohio; BBC&M Engineers, Inc. Unpublished Report to The Layne-Ohio Company, 26 pp.
- Ohio Department of Natural Resources, 1987. Report on the Ground-Water Supply Problem at the Village of Williamsport, Pickaway County, Deer Creek Township. Unpublished Report, 9 pp.
- Ohio Environmental Protection Agency, 1986. Ground Water Protection and Management Strategy, 67pp.
- Quinn, M.J. and R.P. Goldthwait, 1985. Glacial Geology of Ross County, Ohio. Ohio Department of Natural Resources, Division of Geological Survey, Report of Investigations No. 127, 42 pp., 1 map.
- Ranney Water Systems, 1972a. The Central Ohio Water Development Plan, Ground-Water for Planning in Central Ohio, A Study of the Hydrologic Characteristics of the Carbonate and Sand & Gravel Aquifers. Unpublished Report for the Ohio Department of Natural Resources, 3 pp.
- Ranney Water Systems, 1972b. Preliminary Report, Pumping Test No. 1, Sand and Gravel Aquifer, Central Ohio Project. Unpublished Report for the Ohio Department of Natural Resources, 4pp.
- Ranney Water Systems, 1972c. Preliminary Report, Pumping Test No. 4, Sand and Gravel Aquifer, Central Ohio Project. Unpublished Report for the Ohio Department of Natural Resources, 4 pp.
- Razem, A.C., 1983. Simulations of Non-steady Flow in a Glacial Outwash Aquifer, Southern Franklin County, Ohio. U.S. Geological Survey, Water-Resources Investigations Report 83-4022, 17 pp.
- Razem, A.C. and J.T. deRoche, 1984. Water Quality of a Stream-Aquifer System, Southern Franklin County, Ohio. U.S. Geological Survey, Water Resources Investigations Report 84-4238, 44 p.
- Schmidt, J.J., 1980. Ground-Water Resources of Pickaway County. Ohio Department of Natural Resources, Division of Water, 1 map.

- Schmidt, J.J. and R.P. Goldthwait, 1958. The Ground-Water Resources of Franklin County, Ohio. Ohio Department of Natural Resources, Division of Water, Bulletin 30, 97 pp., 2 maps.
- Shindel, H.L., J.H. Klingler, J.P. Mangus, L.E. Trimble, 1988. Water Resources Data, Ohio, Water Year 1987. U.S. Geological Survey Water-Data Report OH-87-1,V1, 319 pp.
- Shuster, R.L., 1952. The Glacial Geology of Pickaway County, Ohio. Unpublished Master's thesis, The Ohio State University, 74 pp., 1 map.
- Stout, W., K. VerSteeg, and G. F. Lamb, 1943. Geology of Water in Ohio. Ohio Department of Natural Resources, Division of Geological Survey, Bulletin 44, 694 pp., 8 maps, 1 table.
- U.S. Department of Commerce, 1987a. Local Population Estimate. Bureau of Census, U.S. Department of Commerce.
- U.S. Department of Commerce, 1987b. Climatological Data Annual Summary for Ohio. National Oceanic and Atmospheric Administration, National Climatic Data Center, Vols. 62- 93, 1957-1987.
- Walker, A.C., J.J. Schmidt, R.B. Stein, H.L. Pree, N.G. Bailey, 1965. Ground Water for Industry in the Scioto River Valley. Ohio Department of Natural Resources, Division of Water, Buried Valley Investigation No. 1, 29 pp., 3 plates.
- Weiss, E.T. and A.C. Razem, 1980. A Model For Flow Through a Glacial Outwash Aquifer in Southeast Franklin County, Ohio. US Geological Survey, Water-Resources Investigations 80-56, 27 pp.
- Wolf, E.W., T.L. Forsyth, and G.D. Dove, 1962. Geology of Fairfield County, Ohio. Ohio Division of Geological Survey, Bulletin 60, 230 pp., 3 plates.

## UNPUBLISHED DATA

Ohio Environmental Protection Agency. Division of Ground Water, Unpublished open file data.

Ohio Department of Natural Resources. Division of Soil and Water Conservation. Unpublished Ohio Capability Analysis Program land use and land cover data.

Ohio Department of Natural Resources. Division of Water, Ground Water Resources Section, well log drilling reports for Pickaway County.

## APPENDIX A

### DESCRIPTION OF THE LOGIC IN FACTOR SELECTION

#### Depth to Water

This factor was primarily evaluated using information obtained from water well logs on file at the Ohio Department of Natural Resources, Division of Water. Other important sources of information include data collected for the Central Ohio Project, Ohio Department of Natural Resources (Fred H. Klaer Jr. and Associates, 1971a and b, 1972; Ranney Water Systems, 1972 a, b, and c) and consultants reports (Bennett, T.W., 1982; Norris and Van Echo, 1986). In areas with little or no depth to water data, interpretation of surficial geology and topography was important in selecting a value. Ground water levels within till plain areas (west of the Scioto River) and the Scioto River Valley were highly variable, ranging between 5 to 15 feet (9) and 75 to 100 feet (2). Depth to water within stream flood plain areas and the eastern fourth of the county were generally shallow, ranging between 5 to 15 feet (9) and 15 to 30 feet (7).

#### Net Recharge

Precipitation data for Pickaway County indicates that the average annual precipitation varies across the county from 37 inches per year in the southeast to 39 inches per year in the northwest (Harstine, in progress). Based on the state average yearly precipitation of 38 inches, 6 inches was assumed to reach the aquifer as recharge (Shindel et al., 1987). This 6 inches of annual recharge was further adjusted by taking surface slope, soil type, vadose zone, and depth to water into account. As slope decreases, runoff from precipitation decreases, leaving more water to infiltrate into the subsurface. Infiltration rates or permeability will generally increase as soil and vadose zone composition changes from a fine to a coarse material. Furthermore, as the vadose zone thickness increases (i.e. depth to water increases), the amount of unsaturated material that the infiltration water has to pass through increases, leaving less water to recharge the aquifer. Two U.S. Geological Survey reports contained useful estimates of recharge values for Pickaway County (Weiss and Razem, 1980; Norris, 1975). The Scioto River, Deer Creek, and Darby Creek Valleys were assigned a recharge value of 7 to 10 inches per year (8) because the soil and vadose zone materials are relatively permeable combined with a relatively high water table. Till plain areas were given a rating of 4 to 7 inches per year (6) because of higher silt and clay content in the soil and vadose zone. The area north of Deer Creek was given a rating of 2 to 4 inches per year because the vadose zone is thick, combined with a high clay and silt content within the soil and vadose zone. Eastern Pickaway County was given a recharge rating of 4 to 7 inches per year (6) due to the combination of a high silt and clay content in soils and vadose zone, a relatively shallow water table, and an increase in slope.

## Aquifer Media

Determinations of this factor were made using information obtained from The Ohio Department of Natural Resources, Division of Water (well logs and open files); Schmidt (1980); Norris (1975); Walker et al. (1965); Weiss and Razem (1980); Razem and deRoche (1984); Razem (1983); Schmidt and Goldthwait (1958); Wolf et al. (1962); Quinn and Goldthwait (1985); Schuster (1952); Norris and Van Echo (1986); Bain (1979); Bennett (1982); Allong (1971); Hallfrisch (1987); Hallfrisch and Voytek (1987); Ohio Department of Natural Resources (1987); Fred H. Klaser Jr. and Associates (1971a and b, 1972); Ranney Water Systems (1972 a,b, and c); and Morin (1986). In areas where two aquifers are present the first aquifer encountered was evaluated. Aquifer media in the till plain areas (predominantly west of the Scioto River) were evaluated as sand and gravel (thin lenses), and given a rating of (6) due to the relatively high percentage of silt and clay within these deposits. Sand and gravel within the Scioto River, Darby Creek, and Deer Creek Valleys were given a rating of (8) because of the coarse, clean nature of the deposits. An increased percentage of fines within the sand and gravel outwash in the eastern third of Scioto Township lowers the aquifer media rating to (7). Where the glacial till becomes thin, generally less than 40 feet, the aquifer is the underlying bedrock. Near Williamsport on the east and west side of Deer Creek and most of the higher elevations in the eastern quarter of the county were evaluated as shale with a typical rating of (2). The higher elevations in Madison and Walnut Townships (eastern Pickaway County) were evaluated as bedded sandstone and shale sequences and given a typical rating of (6). The aquifer media in the lower elevations in the eastern quarter of the county were usually evaluated as sand and gravel with a rating of (6). North of Deer Creek in Monroe Township, and a small area near the village of Orient were evaluated as solution limestone with a rating of (8).

## Soil Media

This factor was evaluated using soil descriptions from the Soil Survey of Pickaway County (Kerr and Christman, 1980). Each soil was evaluated in terms of textural and organic composition, shrink-swell potential, and permeability. The soil descriptions were examined to determine the most significant unit affecting the pollution potential. The Ohio Department of Natural Resources, Division of Soil and Water Conservation (Ohio Capability Analysis Program) prepared computer generated maps (1:24,000) of Pickaway County soils depicting the rating values assigned to each soil. Stream and river valleys generally have ratings in the silty loam (4) to loam (5) range, but may be as high as sand (9). Outside stream and river valleys the normal soil rating is a clay loam (3).

## Topography

Topography was analyzed by using 7-1/2 minute USGS topographic quadrangle maps and Ohio Department of Natural Resources, Division of Soil and Water Conservation (Ohio Capability Analysis Program), computer generated, percent slope maps (1:24,000) of Pickaway County. In the eastern quarter of the county, slope varies from 0 to 12 percent (5 to 10). Slope in the western three fourths of the county is generally in the 0 to 6 percent range (9 to 10). Some of the valley walls along major streams have slopes as high as 12 percent (5). Ice-contact features predominantly confined to the Scioto River Valley have slopes in the 0 to 12 percent range (5 to 10).

## Impact of the Vadose Zone Media

Determinations about this factor were made using information obtained from the Ohio Department of Natural Resources, Division of Water (well logs and open files), Schmidt (1980); Norris (1975); Walker et al. (1965); Weiss and Razem (1980); Razem and deRoche (1984); Razem (1983); Schmidt and Goldthwait (1958); Wolf et al., (1962); Quinn and Goldthwait (1985); Schuster (1952); Norris and Van Echo (1986); Bain (1979); Bennett (1982); Allong (1971); Hallfrisch (1987); Hallfrisch and Voytek (1987); Ohio Department of Natural Resources (1987); Fred H. Klaer Jr. and Associates (1971 a and b, 1972); Ranney Water Systems (1972 a, b, and c). The vadose zone media for the buried valley areas underlying the Scioto River, Deer Creek and Darby Creek, are primarily sand and gravel with an assigned rating of (8). Within the buried valley setting there are areas that have higher sand, silt, and clay content. These areas are evaluated as sand and gravel with significant silt and clay and given a rating of (6). A rating of (4) was normally given to the till plain areas where the vadose zone media was evaluated as sand and gravel with significant silt and clay. The vadose zone media in areas near Deer Creek and the higher elevations in the eastern fourth of the county were often evaluated as silt and clay with an assigned rating of (3). Lower elevations in the eastern fourth of the county were normally evaluated as sand and gravel with significant silt and clay and given a rating of (4).

## Hydraulic Conductivity

Hydraulic conductivity values were based on Norris (1975); Weiss and Razem (1980); Ranney Water Systems (1972 a, b, and c); Ohio Department of Natural Resources, Division of Water (well logs); Morin (1986); Freeze and Cherry (1979); Fred H. Klaer Jr. and Associates (1971 a and b, 1972); Hallfrisch and Voytek (1987); and Morin (1986). The buried valley aquifer that approximately coincides with the Scioto River Valley was assigned a hydraulic conductivity value in the range of 2,000+ gallons per day per square foot (10). Within Deer Creek and Darby Creek Valleys the buried valley aquifers have a hydraulic conductivity rating in the 1,000 to 2,000 gallons per day per square foot (8). Sand and gravel aquifers in the till plain areas and the lower elevations in the eastern fourth of the county were given hydraulic conductivity values in the range of 300 to 700 gallons per day per square foot (4). Aquifers composed of sandstone and shale sequences, and shale aquifers were given hydraulic conductivity values from 1 to 100 gallons per day per square foot (1). Limestone aquifers were rated at 300 to 700 gallons per day per square foot (4).

## APPENDIX B

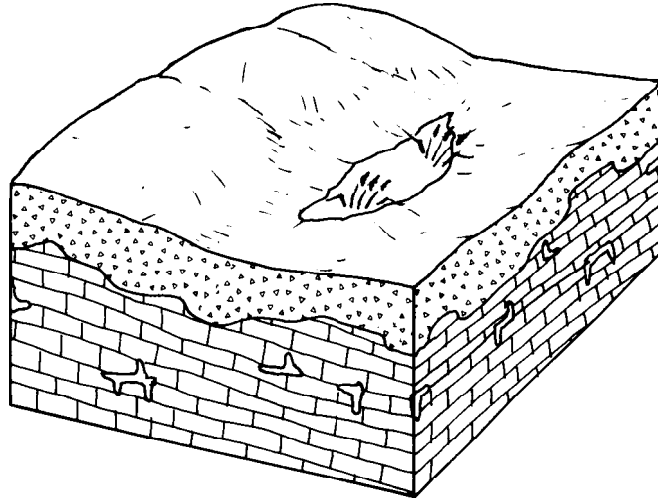
### DESCRIPTION OF HYDROGEOLOGIC SETTINGS AND CHARTS

Pickaway County is divided into 10 hydrogeologic settings, all of which are part of the Glaciated Central Regions according to the DRASTIC manual (Aller et al. 1987). The list of these settings, the range of pollution potential index calculations, and the number of pollution potential index calculations for each setting are provided in Table 10. Computed pollution potential index values range from 83 to 195.

TABLE 10. HYDROGEOLOGIC SETTINGS MAPPED IN PICKAWAY COUNTY, OHIO

Hydrogeologic Settings	Range of GWPP Indexes	Number of Index Calculations
7Ac - Glacial Till Over Solution Limestone	93 - 152	7
7Ae - Glacial Till Over Shale	83 - 113	14
7Af - Sand & Gravel Interbedded in Glacial Till	87 - 157	42
7Ba - Outwash	100 - 130	4
7Bd - Outwash Over Glacial Till	187	1
7D - Buried Valley	139 - 195	66
7Ec - Alluvium Over Sedimentary Rock	100 - 135	4
7Ed - Alluvium Over Glacial Till	109-155	26
7F - Glacial Lake Deposits	135	1
7G - Thin Till Over Bedded Sedimentary Rock	105 - 125	7

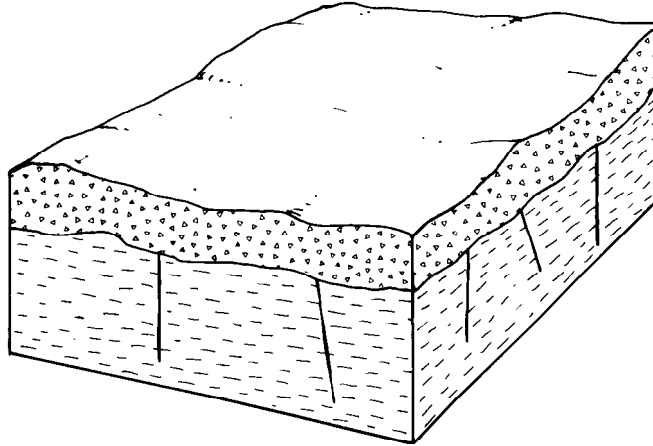
The following information provides a description of each hydrogeologic setting identified in the county, a block diagram illustrating the characteristics of the setting and a listing of the charts for each unique combination of pollution potential indexes calculated for each setting. The charts provide 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.



### (7Ac) Glacial Till Over Solution Limestone

This hydrogeologic setting is characterized by low topography and limestone bedrock covered by varying thicknesses of glacial till. The till consists primarily of clay with varying amounts of silt, sand, and gravel. Sand and gravel layers within the till are extremely thin or nonexistent. The limestone bedrock serves as the aquifer in this setting. Ground water occurs in fractures and solution channels within the formation. The limestone is in direct hydraulic connection with the glacial till and precipitation infiltrating through the till serves as a source of recharge for the underlying limestone. Depth to water is extremely variable depending in part on the thickness of the glacial till, but is usually moderately deep. Soils are typically clay loam.

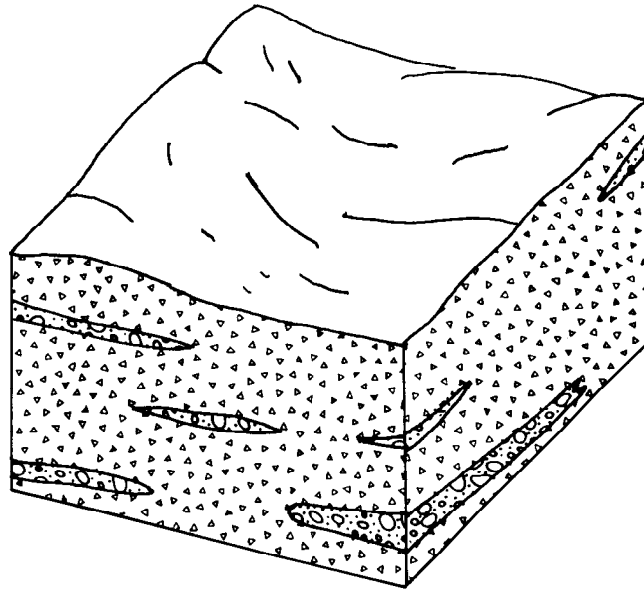
Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topo_graphy	Vadose Zone Media	Hydraulic Conductivity	Rating
7Ac1	30-50	2-4	limestone	Clay Loam	2-6	silt/clay	1-100	94
7Ac2	15-30	4-7	limestone	Silty Loam	2-6	sand and gravel	300-700	152
7Ac3	50-75	2-4	limestone	Clay Loam	0-2	silt/clay	300-700	94
7Ac4	30-50	2-4	limestone	Clay Loam	6-12	silt/clay	300-700	99
7Ac5	30-50	2-4	limestone	Clay Loam	0-2	silt/clay	300-700	104
7Ac6	50-75	2-4	limestone	Clay Loam	2-6	silt/clay	300-700	93
7Ac7	15-30	4-7	limestone	Clay Loam	6-12	s & g w/sl & cl	300-700	126



### (7Ae) Glacial Till Over Shale

This hydrogeologic setting is characterized by low to moderate topography and deposits of thin glacial till overlying fractured shale bedrock. The till consists primarily of clay with little, if any, sand and gravel and does not serve as a source of ground water. Small supplies of ground water are derived from wells developed in the upper portion of the shale. Infiltration of precipitation through the till recharges the aquifer. Water levels are fairly shallow. Soils are typically clay loam.

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating
7Ae1	15-30	4-7	massive shale	Clay Loam	2-6	silt/clay	1-100	98
7Ae2	15-30	4-7	massive shale	Clay Loam	0-2	silt/clay	1-100	99
7Ae3	30-50	4-7	massive shale	Clay Loam	0-2	silt/clay	1-100	89
7Ae4	15-30	4-7	massive shale	Clay Loam	6-12	silt/clay	1-100	94
7Ae5	50-75	4-7	massive shale	Clay Loam	0-2	s & g w/sl & cl	1-100	84
7Ae6	30-50	4-7	massive shale	Clay Loam	2-6	silt/clay	1-100	88
7Ae7	30-50	4-7	massive shale	Clay Loam	2-6	s & g w/sl & cl	1-100	93
7Ae8	50-75	4-7	massive shale	Clay Loam	2-6	s & g w/sl & cl	1-100	83
7Ae9	5-15	4-7	massive shale	Clay Loam	2-6	silt/clay	1-100	108
7Ae10	5-15	4-7	massive shale	Clay Loam	6-12	silt/clay	1-100	104
7Ae11	15-30	4-7	massive shale	Silty Loam	2-6	silt/clay	1-100	100
7Ae12	15-30	4-7	massive shale	Clay Loam	2-6	s & g w/sl & cl	1-100	113
7Ae13	15-30	4-7	massive shale	Clay Loam	2-6	s & g w/sl & cl	1-100	103
7Ae14	5-15	4-7	massive shale	Clay Loam	2-6	s & g w/sl & cl	1-100	113
7Ae15	5-15	4-7	massive shale	Clay Loam	0-2	silt/clay	1-100	109

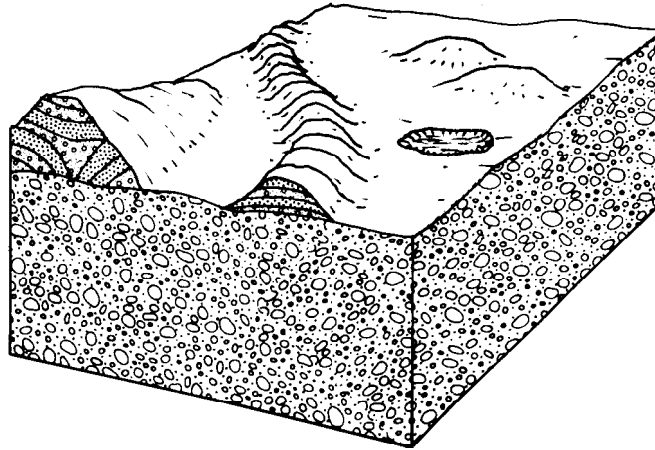


(7Af) Sand and Gravel Interbedded in Glacial Till

This hydrogeologic setting is characterized by low topography with sand and gravel deposits interbedded within glacial till. The till is composed primarily of clay with varying amounts of unsorted silt, sand, and gravel. The sand and gravel may be relatively thin and discontinuous lens-shaped bodies or they may be thick and cover a large area. These units are usually confined to common horizons within the till. Ground water occurs in both the till and the sand and gravel; however, the sand and gravel serves as the principal aquifer. Recharge to the sand and gravel is primarily due to infiltration of precipitation through the till. Depth to water is highly variable. Soils are typically classified as clay loam.

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating
7Af1	50-75	4-7	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	300-700	105
7Af2	30-50	4-7	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	300-700	115
7Af3	15-30	4-7	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	300-700	125
7Af4	5-15	4-7	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	300-700	134
7Af5	5-15	4-7	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	300-700	135
7Af6	15-30	4-7	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	300-700	124
7Af7	30-50	4-7	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	300-700	114
7Af8	5-15	7-10	sand and gravel	Silty Loam	0-2	s & g w/sl & cl	300-700	155
7Af9	15-30	7-10	sand and gravel	Silty Loam	0-2	s & g w/sl & cl	300-700	145
7Af10	15-30	4-7	sand and gravel	Clay Loam	6-12	s & g w/sl & cl	300-700	120

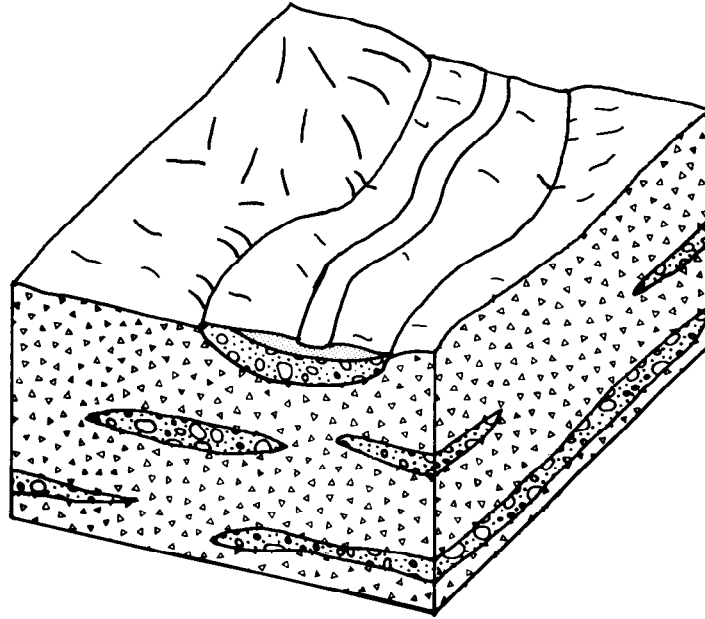
Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating
7Af11	15-30	7-10	sand and gravel	Silty Loam	2-6	s & g w/sl & cl	300-700	144
7Af12	15-30	4-7	sand and gravel	Shrinking and/or Aggregated Clay	0-2	s & g w/sl & cl	300-700	133
7Af13	15-30	4-7	sand and gravel	Silty Loam	2-6	s & g w/sl & cl	300-700	136
7Af14	30-50	4-7	sand and gravel	Clay Loam	6-12	s & g w/sl & cl	300-700	110
7Af15	50-75	4-7	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	300-700	104
7Af16	15-30	7-10	sand and gravel	Silty Loam	0-2	s & g w/sl & cl	300-700	135
7Af17	15-30	7-10	sand and gravel	Silty Loam	2-6	s & g w/sl & cl	300-700	134
7Af18	15-30	4-7	sand and gravel	Silty Loam	2-6	s & g w/sl & cl	300-700	126
7Af19	30-50	4-7	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	300-700	125
7Af20	30-50	7-10	sand and gravel	Silty Loam	0-2	s & g w/sl & cl	300-700	135
7Af21	30-50	7-10	sand and gravel	Silty Loam	2-6	s & g w/sl & cl	300-700	134
7Af22	15-30	4-7	sand and gravel	Silty Loam	0-2	s & g w/sl & cl	300-700	127
7Af23	30-50	2-4	sand and gravel	Clay Loam	0-2	silt/clay	300-700	98
7Af24	50-75	2-4	sand and gravel	Clay Loam	0-2	silt/clay	300-700	88
7Af25	50-75	2-4	sand and gravel	Clay Loam	2-6	silt/clay	300-700	87
7Af26	15-30	2-4	sand and gravel	Clay Loam	2-6	silt/clay	300-700	107
7Af27	15-30	4-7	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	300-700	134
7Af28	15-30	7-10	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	300-700	132
7Af29	30-50	2-4	sand and gravel	Clay Loam	2-6	silt/clay	300-700	97
7Af30	30-50	2-4	sand and gravel	Clay Loam	6-12	silt/clay	300-700	93
7Af31	50-75	4-7	sand and gravel	Clay Loam	6-12	s & g w/sl & cl	300-700	100
7Af32	5-15	7-10	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	300-700	153
7Af33	5-15	7-10	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	300-700	142
7Af34	15-30	4-7	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	300-700	128
7Af35	15-30	4-7	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	300-700	127
7Af36	15-30	4-7	sand and gravel	Silty Loam	2-6	s & g w/sl & cl	300-700	129
7Af37	30-50	4-7	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	300-700	117
7Af38	15-30	7-10	sand and gravel	Sand	2-6	s & g w/sl & cl	300-700	157
7Af39	15-30	4-7	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	300-700	137
7Af40	5-15	4-7	sand and gravel	Clay Loam	6-12	s & g w/sl & cl	300-700	130



### (7Ba) Outwash

This hydrogeologic setting is characterized by moderate to low topography and ice-contact deposits overlying glacial till or fractured sedimentary bedrock. Outwash generally refers to water-lain or ice-contact deposits. Kames and eskers represent typical ice-contact deposits that occur in this setting. A kame is an isolated hill or mound of stratified sediments deposited in an opening within or between ice blocks, or between ice blocks and valley walls. An esker is a sinuous or meandering ridge of well-sorted sands and gravels that are remnants of streams that existed beneath and within the glaciers. These deposits may be in direct hydraulic connection with the underlying till or bedrock. The principal aquifers in this setting are sand and gravel deposits within the till (as described in setting 7Af) or the sedimentary bedrock. Recharge to the aquifer is primarily due to precipitation infiltrating through the surficial deposits. Soils are highly variable, ranging from clay loam to sand. Water levels are highly variable.

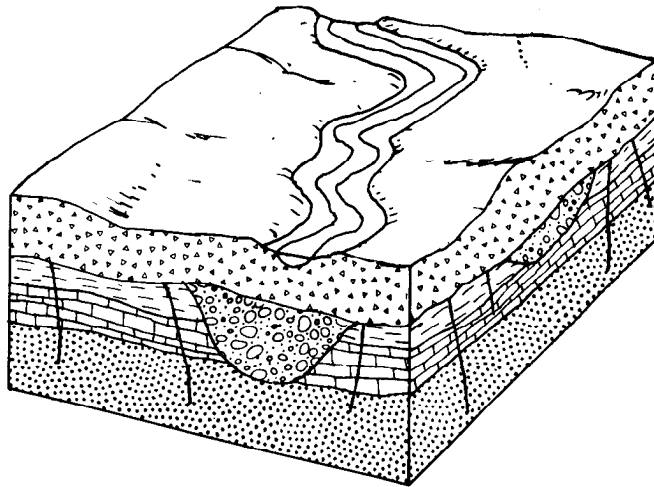
Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating
7Ba1	15-30	4-7	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	300-700	124
7Ba2	15-30	4-7	sand and gravel	Sandy Loam	2-6	s & g w/sl & cl	300-700	130
7Ba3	15-30	4-7	sand and gravel	Silty Loam	2-6	s & g w/sl & cl	300-700	126
7Ba4	15-30	4-7	shale	Sandy Loam	6-12	silt/clay	1-100	100
7Ba5	5-15	4-7	sand and gravel	Sandy Loam	2-6	s & g w/sl & cl	300-700	140
7Ba6	15-30	4-7	sand and gravel	Silty Loam	6-12	s & g w/sl & cl	300-700	122



(7Bd) Outwash Over Glacial Till

This hydrogeologic setting is characterized by low topography and varying thicknesses of outwash sand and gravel deposited over glacial till. Streams fed by water from melting ice cut channels in the till and left behind relatively clean sand and gravel deposits. Present-day streams flowing within these channels are in hydraulic contact with the outwash deposits. A thin layer of alluvium may overlie these deposits at some locations. Where the outwash is thick, drilled wells may yield several hundred gallons per minute. Surficial deposits are usually sand, gravel, or sandy loam. Water levels are shallow in depth. The till deposits are as described in setting 7Af.

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating
7Bd1	5-15	7-10	sand and gravel	Loam	0-2	sand and gravel	700-1000	179



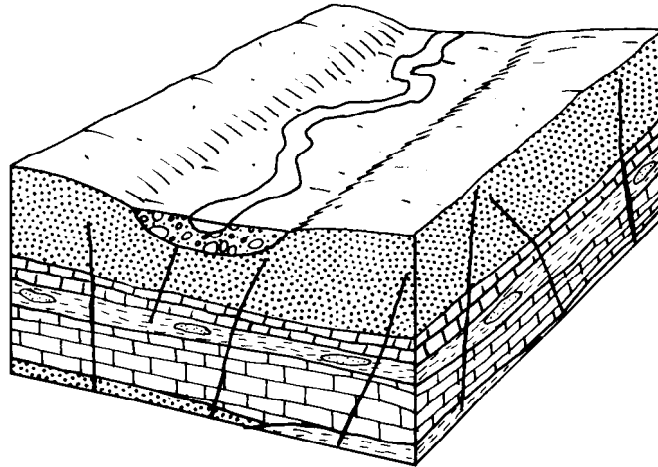
### (7D) Buried Valley

This hydrogeologic setting is characterized by thick deposits of sand and gravel that have been deposited in a former topographic low (a pre-glacial or inter-glacial river valley) by glacial melt waters. These deposits are capable of yielding large quantities of ground water. The deposits may or may not underlie a present-day stream and may or may not be in direct hydraulic connection with a stream. Glacial till or recent alluvium often overlies the buried valley. The sand and gravel deposits are several times more permeable than the surrounding bedrock and till. Soils are highly variable ranging from clay loam to sand, but are typically a silty loam. Static water levels are typically shallow, but may be highly variable depending on surficial deposits. Recharge to the aquifer can be attributed to infiltration of precipitation, and regional ground-water flow from the surrounding till plains and bedrock.

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating
7D1	5-15	7-10	sand and gravel	Loam	0-2	sand and gravel	1000-2000	185
7D2	5-15	7-10	sand and gravel	Sandy Loam	0-2	sand and gravel	1000-2000	187
7D3	5-15	7-10	sand and gravel	Silty Loam	0-2	sand and gravel	1000-2000	183
7D4	15-30	7-10	sand and gravel	Silty Loam	0-2	sand and gravel	1000-2000	173
7D5	15-30	7-10	sand and gravel	Silty Loam	2-6	sand and gravel	1000-2000	172
7D6	30-50	4-7	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	2000+	149
7D7	30-50	4-7	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	2000+	148
7D8	5-15	7-10	sand and gravel	Silty Loam	0-2	sand and gravel	2000+	189
7D9	5-15	7-10	sand and gravel	Loam	0-2	sand and gravel	2000+	191
7D10	15-30	7-10	sand and gravel	Clay Loam	0-2	sand and gravel	2000+	177
7D11	30-50	7-10	sand and gravel	Silty Loam	0-2	sand and gravel	2000+	169
7D12	5-15	7-10	sand and gravel	Shrinking and/or Aggregated Clay	0-2	sand and gravel	2000+	195

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating
7D13	15-30	7-10	sand and gravel	Shrinking and/or Aggregated Clay	0-2	sand and gravel	2000+	185
7D14	30-50	7-10	sand and gravel	Silty Loam	2-6	sand and gravel	2000+	168
7D15	15-30	7-10	sand and gravel	Silty Loam	0-2	sand and gravel	2000+	179
7D16	50-75	7-10	sand and gravel	Silty Loam	0-2	sand and gravel	2000+	159
7D17	15-30	7-10	sand and gravel	Sandy Loam	0-2	sand and gravel	2000+	183
7D18	15-30	7-10	sand and gravel	Silty Loam	2-6	sand and gravel	2000+	178
7D19	30-50	4-7	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	2000+	138
7D20	5-15	7-10	sand and gravel	Loam	0-2	sand and gravel	2000+	191
7D21	5-15	7-10	sand and gravel	Silty Loam	2-6	sand and gravel	2000+	188
7D22	15-30	7-10	sand and gravel	Sand	6-12	sand and gravel	2000+	184
7D23	15-30	7-10	sand and gravel	Clay Loam	2-6	sand and gravel	2000+	176
7D24	15-30	7-10	sand and gravel	Sand	0-2	sand and gravel	2000+	189
7D25	15-30	7-10	sand and gravel	Loam	0-2	sand and gravel	2000+	181
7D26	30-50	7-10	sand and gravel	Sandy Loam	2-6	sand and gravel	2000+	172
7D27	30-50	7-10	sand and gravel	Clay Loam	0-2	sand and gravel	2000+	167
7D28	30-50	7-10	sand and gravel	Clay Loam	2-6	sand and gravel	2000+	166
7D29	30-50	7-10	sand and gravel	Shrinking and/or Aggregated Clay	2-6	sand and gravel	2000+	174
7D30	15-30	7-10	sand and gravel	Silty Loam	0-2	s & g w/sl & cl	2000+	159
7D31	15-30	7-10	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	2000+	157
7D32	15-30	4-7	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	2000+	148
7D33	30-50	7-10	sand and gravel	Sand	6-12	sand and gravel	2000+	174
7D34	75-100	7-10	sand and gravel	Sand	6-12	sand and gravel	2000+	159
7D35	50-75	7-10	sand and gravel	Silty Loam	6-12	sand and gravel	2000+	154
7D36	15-30	7-10	sand and gravel	Loam	2-6	sand and gravel	2000+	180
7D37	15-30	7-10	sand and gravel	Sandy Loam	2-6	sand and gravel	2000+	182
7D38	15-30	4-7	sand and gravel	Silty Loam	0-2	sand and gravel	2000+	171
7D39	30-50	4-7	sand and gravel	Clay Loam	0-2	sand and gravel	2000+	159
7D40	30-50	4-7	sand and gravel	Clay Loam	2-6	sand and gravel	2000+	158
7D41	15-30	4-7	sand and gravel	Clay Loam	0-2	sand and gravel	2000+	169
7D42	30-50	7-10	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	2000+	156
7D43	5-15	7-10	sand and gravel	Sandy Loam	0-2	sand and gravel	2000+	193
7D44	30-50	7-10	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	1000-2000	140
7D45	30-50	7-10	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	2000+	157
7D46	30-50	7-10	sand and gravel	Silty Loam	0-2	s & g w/sl & cl	2000+	159
7D47	15-30	7-10	sand and gravel	Silty Loam	2-6	s & g w/sl & cl	2000+	168
7D48	30-50	7-10	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	2000+	156
7D49	15-30	7-10	sand and gravel	Sand	2-6	s & g w/sl & cl	2000+	178
7D50	30-50	7-10	sand and gravel	Silty Loam	2-6	s & g w/sl & cl	2000+	158
7D51	5-15	7-10	sand and gravel	Clay Loam	0-2	sand and gravel	2000+	187
7D52	15-30	7-10	sand and gravel	Sand	2-6	sand and gravel	2000+	188
7D53	5-15	7-10	sand and gravel	Clay Loam	2-6	sand and gravel	2000+	186

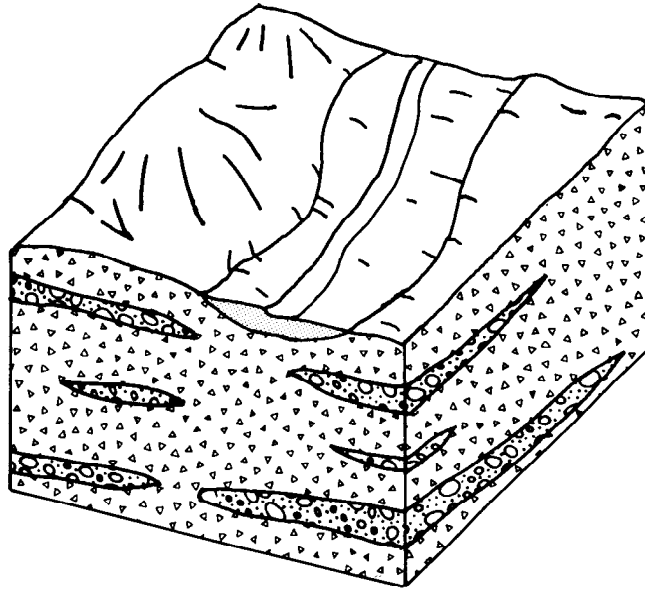
<b>Setting</b>	<b>Depth to Water (feet)</b>	<b>Recharge (In/Yr)</b>	<b>Aquifer Media</b>	<b>Soil Media</b>	<b>Topography</b>	<b>Vadose Zone Media</b>	<b>Hydraulic Conductivity</b>	<b>Rating</b>
7D54	15-30	7-10	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	2000+	167
7D55	5-15	7-10	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	2000+	177
7D56	15-30	4-7	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	2000+	159
7D57	15-30	4-7	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	2000+	158
7D58	15-30	4-7	sand and gravel	Silty Loam	2-6	s & g w/sl & cl	2000+	160
7D59	15-30	7-10	sand and gravel	Silty Loam	0-2	s & g w/sl & cl	2000+	169
7D60	5-15	7-10	sand and gravel	Silty Loam	0-2	s & g w/sl & cl	2000+	179
7D61	15-30	4-7	sand and gravel	Clay Loam	2-6	sand and gravel	2000+	168
7D62	30-50	7-10	sand and gravel	Sand	2-6	sand and gravel	2000+	178
7D63	30-50	4-7	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	2000+	139
7D64	15-30	4-7	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	2000+	149
7D65	15-30	4-7	sand and gravel	Silty Loam	0-2	s & g w/sl & cl	2000+	151
7D66	15-30	4-7	sand and gravel	Silty Loam	2-6	s & g w/sl & cl	2000+	150



**(7Ec) Alluvium Over Sedimentary Rock**

This hydrogeologic setting is characterized by low topography with thin to moderate thicknesses of present-day, stream-deposited alluvium. The alluvium is composed of silt, sand, gravel, and clay. Depth to water is shallow and the stream is usually in hydraulic contact with the alluvial deposits. The alluvial deposits are underlain by fractured sedimentary bedrock, which are described in settings 7Ae, 7G, 7Ac. The bedrock serves as the principal aquifer in this setting. The alluvial deposits may serve as a source of recharge to the bedrock. Water levels are typically shallow. Surficial deposits are usually silty loam.

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating
7Ec1	15-30	4-7	shale	Silty Loam	2-6	s & g w/sl & cl	1-100	105
7Ec2	5-15	4-7	shale	Silty Loam	6-12	silt/clay	1-100	106
7Ec3	15-30	4-7	shale	Silty Loam	2-6	silt/clay	1-100	100
7Ec4	15-30	7-10	limestone	Silty Loam	2-6	silt/clay	300-700	135

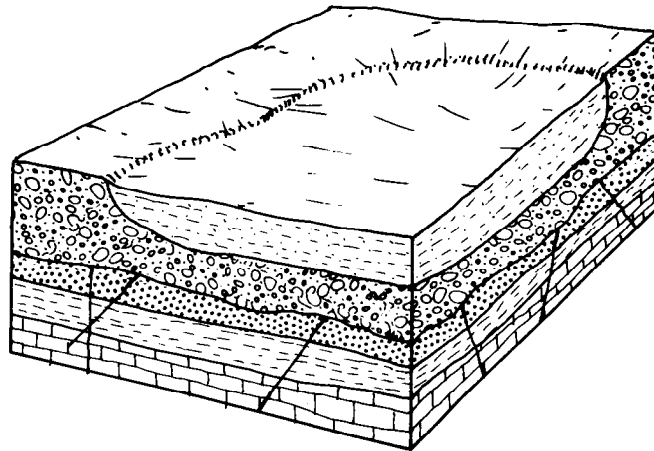


(7Ed) Alluvium Over Glacial Till

This setting is characterized by low topography with thin to moderate thicknesses of present-day, stream-deposited alluvium. The alluvium is composed of silt, sand, gravel, and clay. The underlying sand and gravel lenses within the till serve as the aquifer. The depth to the water table is shallow and the stream is usually in hydraulic contact with the deposits. Soils are usually classified as silty loam. The underlying till deposits are described in setting 7Af. The alluvial deposits serve as a source of recharge to the sand and gravel lenses within the till.

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating
7Ed1	5-15	7-10	sand and gravel	Sandy Loam	0-2	s & g w/sl & cl	300-700	149
7Ed2	5-15	7-10	sand and gravel	Silty Loam	0-2	s & g w/sl & cl	300-700	145
7Ed3	5-15	7-10	sand and gravel	Shrinking and/or Aggregated Clay	0-2	s & g w/sl & cl	300-700	151
7Ed4	15-30	7-10	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	300-700	133
7Ed5	5-15	4-7	sand and gravel	Silty Loam	2-6	s & g w/sl & cl	300-700	136
7Ed6	5-15	4-7	sand and gravel	Loam	2-6	s & g w/sl & cl	300-700	138
7Ed7	15-30	4-7	sand and gravel	Silty Loam	2-6	s & g w/sl & cl	300-700	126
7Ed8	15-30	4-7	sand and gravel	Loam	2-6	s & g w/sl & cl	300-700	128
7Ed9	15-30	4-7	sand and gravel	Sandy Loam	6-12	silt/clay	300-700	126
7Ed10	5-15	4-7	sand and gravel	Silty Loam	0-2	s & g w/sl & cl	300-700	137
7Ed11	5-15	4-7	sand and gravel	Shrinking and/or Aggregated Clay	0-2	s & g w/sl & cl	300-700	143
7Ed12	15-30	7-10	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	300-700	132
7Ed13	15-30	7-10	sand and gravel	Silty Loam	0-2	s & g w/sl & cl	300-700	135
7Ed14	5-15	7-10	sand and gravel	Sand	0-2	s & g w/sl & cl	300-700	155

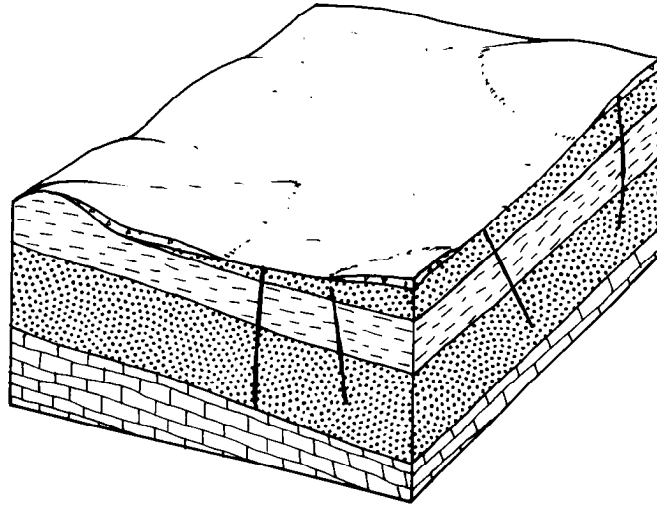
Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating
7Ed15	5-15	7-10	sand and gravel	Silty Loam	2-6	s & g w/sl & cl	300-700	144
7Ed16	15-30	4-7	sand and gravel	Shrinking and/or Aggregated Clay	2-6	s & g w/sl & cl	300-700	132
7Ed17	15-30	2-4	sand and gravel	Silty Loam	2-6	s & g w/sl & cl	300-700	109
7Ed18	50-75	4-7	sand and gravel	Sandy Loam	2-6	s & g w/sl & cl	300-700	110
7Ed19	15-30	4-7	sand and gravel	Sandy Loam	0-2	s & g w/sl & cl	300-700	131
7Ed20	15-30	4-7	sand and gravel	Silty Loam	0-2	s & g w/sl & cl	300-700	127
7Ed21	30-50	4-7	sand and gravel	Silty Loam	6-12	s & g w/sl & cl	300-700	112
7Ed22	30-50	4-7	sand and gravel	Silty Loam	0-2	s & g w/sl & cl	300-700	117
7Ed23	5-15	7-10	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	300-700	143
7Ed24	5-15	7-10	sand and gravel	Clay Loam	2-6	s & g w/sl & cl	300-700	142
7Ed25	15-30	7-10	sand and gravel	Sandy Loam	0-2	s & g w/sl & cl	300-700	139
7Ed26	15-30	4-7	sand and gravel	Silty Loam	6-12	s & g w/sl & cl	300-700	122



(7F) Glacial Lake Deposits

This hydrogeologic setting is characterized by flat topography and varying thicknesses of fine grained sediments that overlie glacial till. The deposits are composed of silts and clays interbedded with fine sand that settled out in a glacial lake environment. As a consequence of the thin, alternating layers there is a substantial difference between the vertical and horizontal permeabilities. Sand and gravel deposits within the underlying till serve as the major source of ground water. Infiltration of precipitation through the fine-grained sediments recharges the sand and gravel aquifers. Soils are typically clay loam. Water levels are generally high.

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating
7F1	5-15	4-7	sand and gravel	Clay Loam	0-2	s & g w/sl & cl	1-100	126



(7G) Thin Till Over Bedded Sedimentary Rock

This hydrogeologic setting is characterized by moderate to low topography and deposits of thin glacial till overlying alternating layers of fractured sedimentary bedrock. The till consists primarily of clay with little, if any, sand and gravel and does not serve as a source of ground water. The sandstone and shale bedrock serves as the principal aquifer. Infiltration of precipitation through the till recharges the aquifer. Water levels vary from moderate to high, and soils typically clay loam.

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating
7G1	15-30	4-7	bedded ss & sh	Clay Loam	2-6	s & g w/sl & cl	1-100	115
7G2	15-30	4-7	bedded ss & sh	Clay Loam	6-12	s & g w/sl & cl	1-100	121
7G3	15-30	4-7	bedded ss & sh	Clay Loam	2-6	s & g w/sl & cl	1-100	125
7G4	30-50	4-7	bedded ss & sh	Clay Loam	6-12	s & g w/sl & cl	1-100	111
7G5	30-50	4-7	bedded ss & sh	Clay Loam	2-6	s & g w/sl & cl	1-100	115
7G6	30-50	4-7	bedded ss & sh	Clay Loam	2-6	s & g w/sl & cl	1-100	105
7G7	15-30	4-7	bedded ss & sh	Clay Loam	2-6	s & g w/sl & cl	1-100	110

