GROUND WATER POLLUTION POTENTIAL
OF CLINTON COUNTY, OHIO

BY

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ABSTRACT

A ground water pollution potential map of Clinton 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 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.

Clinton County lies within the Glaciated Central hydrogeologic region. The county is covered by variable thicknesses of glacial till, lacustrine deposits, and outwash. These unconsolidated glacial deposits are underlain by limestone, shale, and shaley limestone bedrock. Ground water yields are dependent on the type of aquifer and vary greatly throughout the county. Pollution potential indexes are relatively low to moderate in areas of till or lacustrine cover over bedrock. Buried valleys containing sand and gravel aquifers have moderate to high vulnerabilities to contamination.

Ground water pollution potential analysis in Clinton County resulted in a map with symbols and colors which illustrate areas of varying ground water contamination vulnerability. Five hydrogeologic settings were identified in Clinton County with computed ground water pollution potential indexes ranging from 65 to 149.

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 Clinton 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 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 700,000 rural households depend on private wells; 2,000 of these wells exist in Clinton 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 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 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 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 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 Clinton 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 more or less 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 also 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 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 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. 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 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 Clinton 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

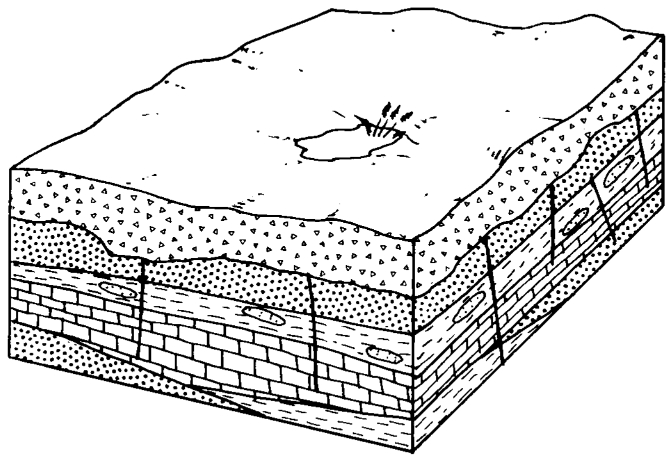
C - Conductivity (Hydraulic) of the Aquifer

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.



7Aa Glacial Till Over Bedded Sedimentary Rocks

This hydrogeologic setting is characterized by low topography and flat-lying, fractured sedimentary rock. The underlying bedrock consists of thick sequences of Ordovician shale interbedded with thin layers of limestone. These sedimentary rock units are covered by varying thicknesses of glacial till. The till layer consists of unsorted deposits of interbedded clay, silt, and sand. Although ground water occurs in both the glacial deposits and the fractured bedrock, bedrock is usually the principal aquifer. The main source of recharge to the bedrock aquifer is from the overlying glacial till. The recharge is low to moderate due to the impermeable nature of the till and soils. Depth to water varies, depending on glacial till thickness, but is usually between 5-15 feet.

Figure 1. Format and description of the hydrogeologic setting - 7Aa Glacial Till Over Bedded Sedimentary Rock.

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. 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
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	

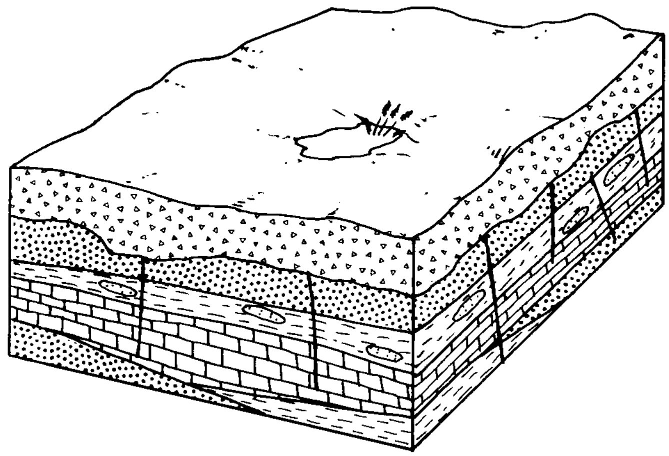
TABLE 8. RANGES AND RATINGS FOR HYDRAULIC CONDUCTIVITY

HYDRAULIC CONDUCTIVITY (GPD/FT^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 7Aa1, Glacial Till Over Bedded Sedimentary Rock, identified in mapping Clinton 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 100. 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 65 to 223. The diversity of hydrogeologic conditions in Clinton County produces settings with a wide range of vulnerability to ground water contamination. Calculated pollution potential indexes for the five settings identified in the county range from 65 to 149.

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 Clinton 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 Clinton County is included with this report.



SETTING 7Aa1		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	NUMBER
Depth to Water	5-15	5	9	45
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		DRASTIC	INDEX	100

Figure 2. Description of the hydrogeologic setting - 7Aa1 Glacial Till Over Bedded Sedimentary Rock.

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 in those hydrogeologic settings. The symbols on the map represent the following information:

7Aa1 - defines the hydrogeologic region and setting
100 - defines the relative pollution potential

Here the first number (7) refers to the major hydrogeologic region and the upper and lower case letters (Aa) refer 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 (100) 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 large man-made features such as landfills, quarries, and upground reservoirs.

GENERAL INFORMATION ABOUT CLINTON COUNTY

Clinton County occupies an area of approximately 403 square miles and is divided into 13 townships. It is bounded on the north by Greene County, to the west by Warren County, to the east by Fayette and Highland Counties, and to the south by Brown and Clermont Counties (Figure 3). The county seat is Wilmington and the population is approximately 35,415 (United States Department of Commerce, 1990).

Physiography

Clinton County lies within the Till Plains section of the Central Lowlands physiographic province (Fenneman, 1938). The county is characterized by gently rolling topography disrupted only by the steeper slopes of glacial end moraines rising more than 30 feet above the surrounding area, and by the erosional patterns of modern drainage systems. Topographic elevations range from a high of 1190 feet above mean sea level (amsl) in Green Township to a low of 790 feet amsl in Vernon Township near Clarksville.

Climate

Average annual precipitation recorded at the National Oceanic Atmospheric Administration (NOAA) weather station in Wilmington for the period from 1961 to 1990 was 41.86 inches. Average temperature at Wilmington for the same period was 50.6 degrees Fahrenheit (United States Department of Commerce, 1992).

Modern Drainage

The greater portion of Clinton County lies within the Little Miami drainage system. Major tributaries to the Little Miami in Clinton County are Anderson Fork, Todd Fork, and East Fork Little Miami River. The extreme eastern portion of the county lies within the Paint Creek Basin, a tributary to the Scioto River drainage system. Minor tributaries to Paint Creek in Clinton County are Rattlesnake Creek and Lees Creek.

Figure 3. Location of Clinton County

Pre-and Inter-Glacial Drainage

The pre-glacial bedrock surface for Clinton County was essentially gently undulating with no deeply incised valleys. The earliest pre-glacial drainage for most of Ohio was controlled by the ancestral Teays River. Headwaters for the Teays were in Virginia and North Carolina. It flowed northwestward to West Virginia towards the valley of the present-day Ohio River, then northward through the south central section of Ohio and northwestward entering Indiana from Mercer County west of Rockford (Figure 4). Monroe Creek, a Teays Stage pre-glacial stream in Clinton County, drained to the south and west, and to the major system of drainage. This ancestral stream, the Hamilton River, flowed to the southwest and joined the Norwood River, a major tributary to the Teays, in Indiana. (Stout et al., 1943)

Each stage of the three recognized glacial stages in Ohio drastically changed the configuration of the bedrock surface. In Clinton County, changes began during post-Kansan / pre-Illinoian time (Figure 5). A major divide was established in the eastern portion of the county and a new drainage basin was established which drained the northern third of the county to the Middletown River. The ice of the Illinoian glacial period covered all of Clinton County, eroding bedrock and damming pre-existing drainage patterns.

Less than 65% of the county was covered by Wisconsinan glaciation, yet essential surface topography was changed and a new bedrock channel was established (Figure 6). Buried valleys in Clinton County exist where ancestral drainage channels have been filled with glacial deposits. Ancestral buried valleys seldom relate to the modern streams and valleys (Teller 1967)

The current bedrock topography of Clinton County is depicted by Figure 7 (Cummins, 1959). The map shows a rather prominent buried valley (ancestral drainage channel) trending southeast-southwest in Clinton County, an extension of the broad south-trending ancestral valley through the western half of Greene County.

Glacial Geology

During the Pleistocene Epoch (two million to 10,000 years age) at least four major episodes (stages) of glaciation occurred in north-central North America. These episodes, in order of increasing age, are: Wisconsinan, Illinoian, Kansan, and Nebraskan. Evidence for the two earliest stages, the Nebraskan and the Kansan (collectively referred to as pre-Illinoian) has not been recognized in Clinton County. However, “Kansan” deposits in the Cincinnati area (Durrell, 1961) indicate that pre-Illinoian glaciers did advance through the county and deposits of this age may be present at depth (Teller, 1967).

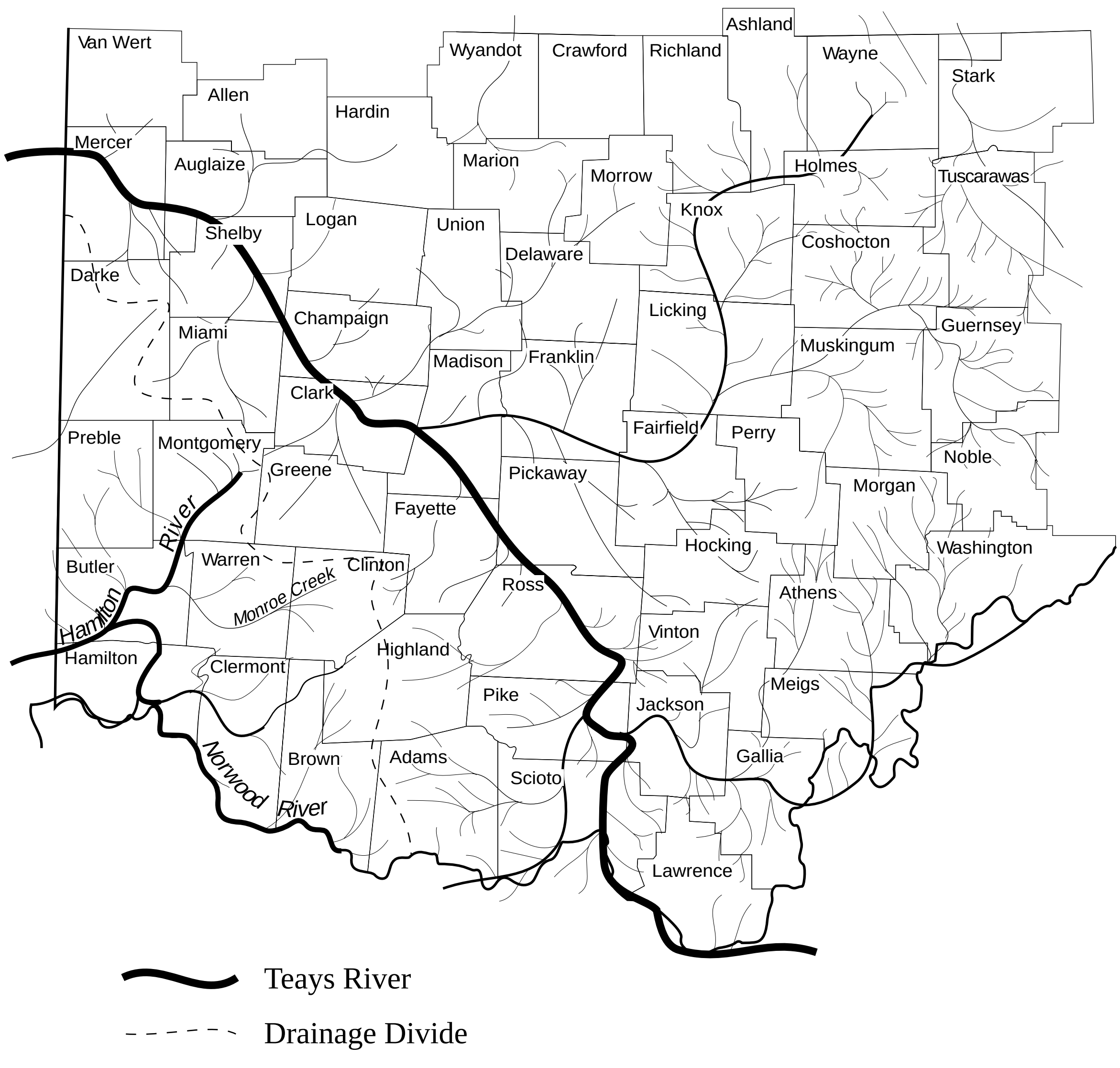


Figure 4. Teays Stage drainage in southwestern Ohio (Modified from Stout et al., 1943)

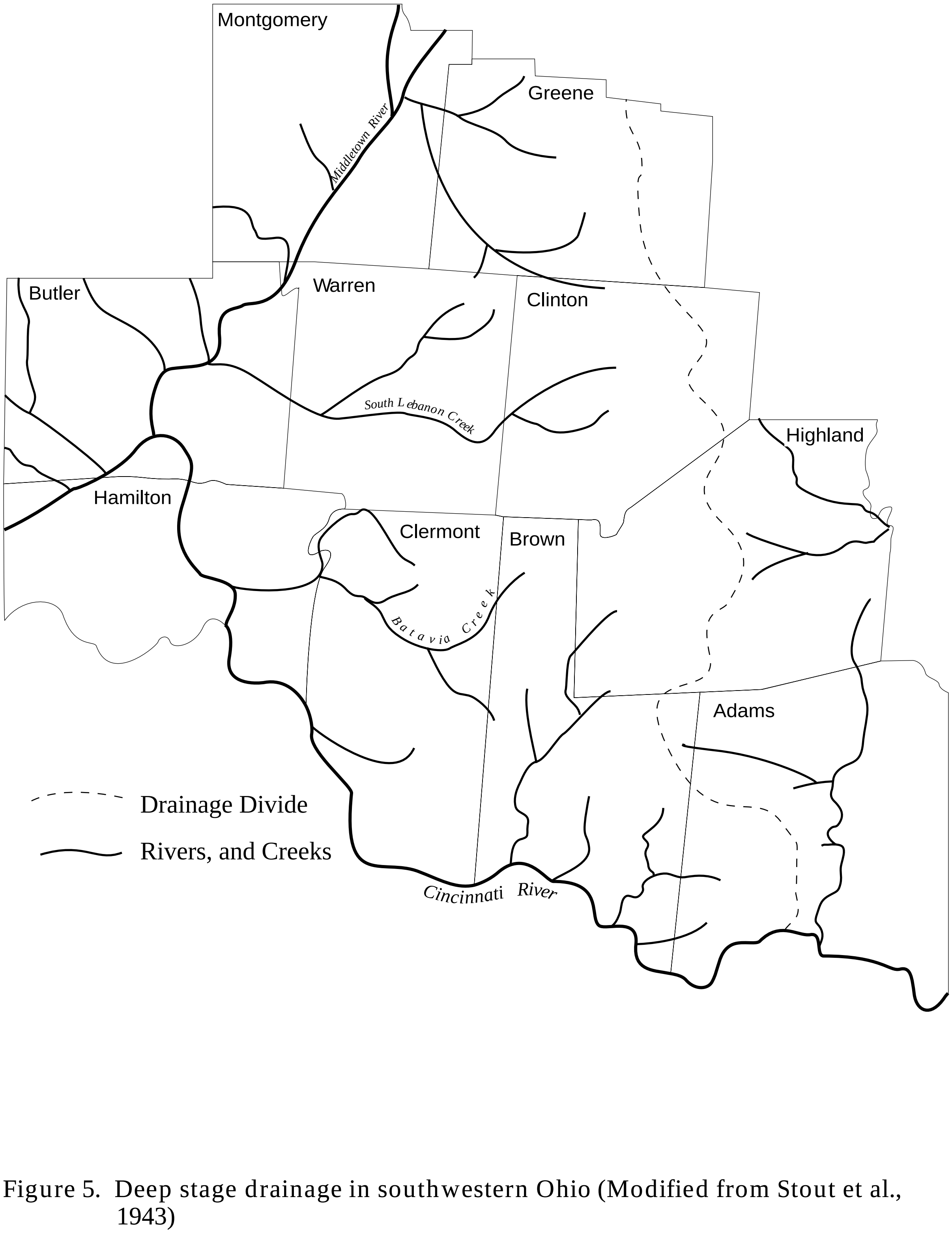


Figure 5. Deep stage drainage in southwestern Ohio (Modified from Stout et al., 1943)

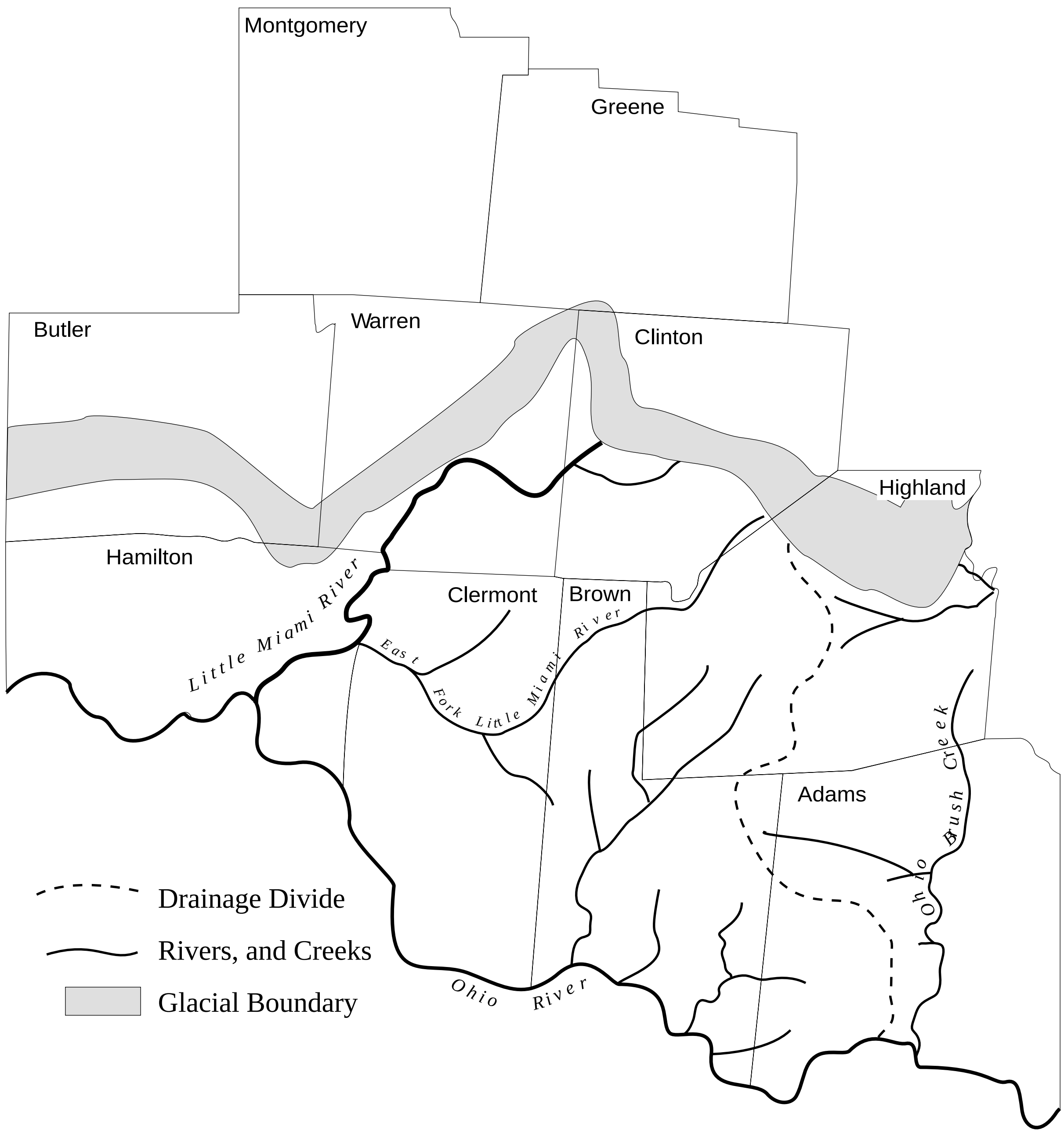


Figure 6. Wisonsinan stage drainage (Modified from Stout et al., 1943)

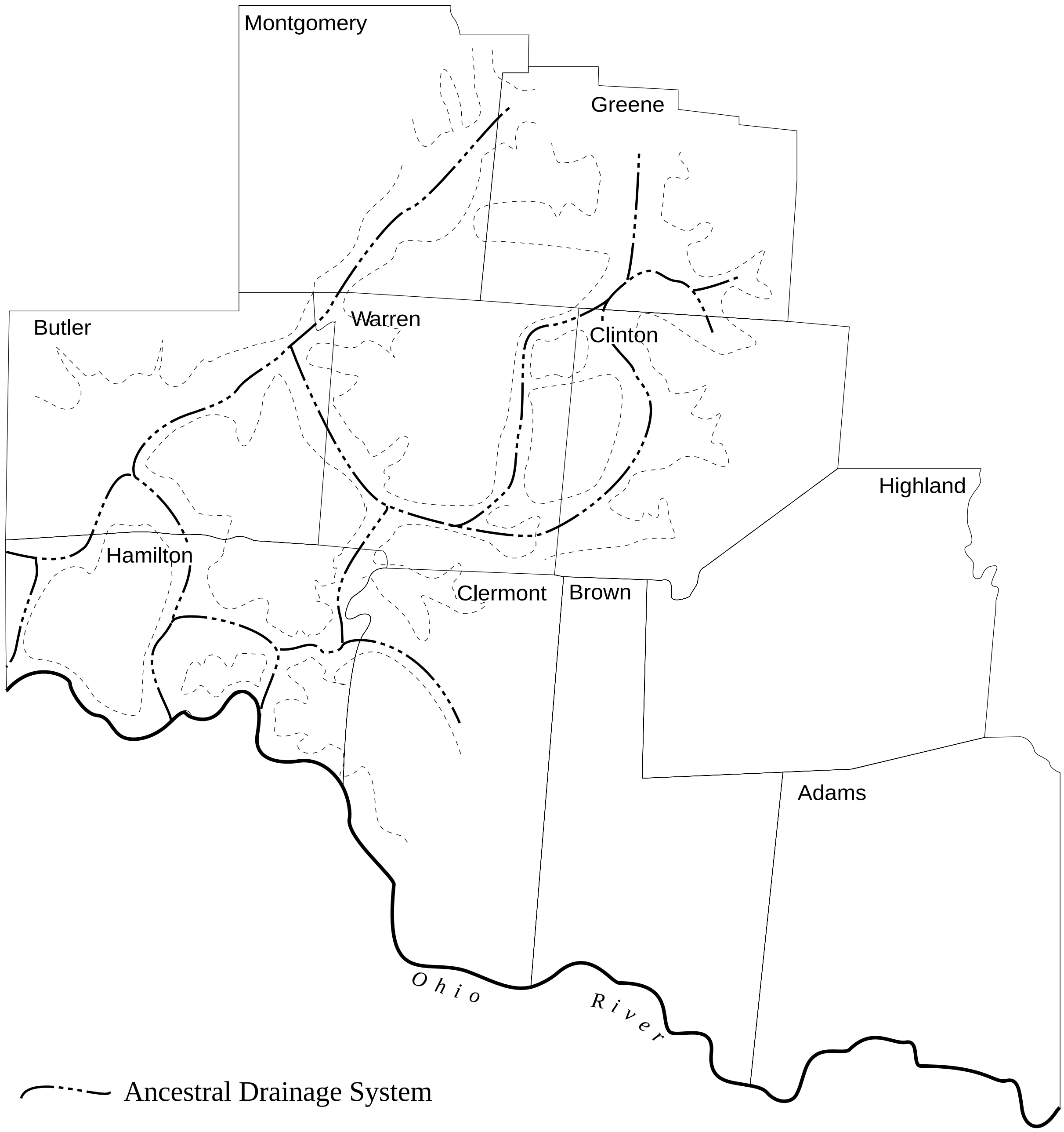


Figure 7. Ancestral drainage channels southwestern Ohio (Modified from Cummins, 1959).

During each stage of glaciation numerous periods of advance and retreats occurred. These periods are often referred to as substages. With each substage, bedrock and previous glacial deposits were eroded and redeposited creating complex changes in the topography and drainage system in the county. However, only the most recent, the Wisconsinan, resulted in drastic surficial and minor bedrock changes in Clinton County.

Illinoian till deposits found at or near the surface form the extensive flat plains of southwestern Clinton County. Till is an unsorted mixture of clay, silt, sand, and gravel. Lodgment till is deposited at the base of an actively moving ice sheet and is relatively dense and well compacted. This type of till has low permeability, with water moving typically through vertical fractures. Till deposited at the base of a melting (stagnating) ice sheet is referred to as ablation or melt till and tends to be less well compacted. Small deposits, called lenses or stringers, of sorted sand, gravel, or silt are commonly found in till deposits.

Illinoian till deposits differ from Wisconsinan till in that the upper portion is much more extensively weathered. The thickness of the Illinoian till varies but is usually less than 30 feet. A mantle of two to five feet of windblown silt (loess) covers the Illinoian till plain (Teller, 1967).

With few exceptions, no "early" Wisconsin drift (till) is recognized in Clinton County. All glacial deposits are "late" Wisconsinan or Woodfordian in age (Frye and Willman, 1960; Teller, 1967).

The most striking Wisconsinan deposits in Clinton County are the somewhat prominent northwest-southeast trending linear ridges. These ridges reflect successive major re-advance limits of ice and are a thickening of glacial deposits. The Cuba and Reesville Moraines are easily recognized. The Vandervort and Wilmington Moraines are less prominent. Figure 8 delineates end moraines and approximate lobe boundaries in Clinton County. As with the Illinoian till, a thin mantle of silt (loess) 10-50 inches thick covers the Wisconsinan-age till in most of Clinton County (Teller 1967).

Bedrock Geology

The bedrock geology of Clinton County consists of Ordovician and Silurian age limestones, dolomites, and shales. The consolidated rock section begins near the base of the Richmond formation of the Cincinnati Series and ends near the top of the Cedarville-Guelph formations of the Niagaran Series. The Richmond formation lies within the western third of the county. Table 9 lists the formations within the county.

The rocks of the Ordovician system contain large quantities of carbonate minerals, consisting of either limestone, dolomite, dolomitic shale, or calciferous shale. The upper strata contains at least 60 % shale . Limestones associated with the shale are thin-bedded, with layers seldom measuring more than one foot thick and commonly measuring only a few inches thick. The deposits are made up of alternate layers of shale and limestone, with limestone forming more than 20 to 50% of the whole (Stout, 1941).

To understand how bedrock forms, it is important to determine from where the sediments came and how they were deposited. During Ordovician time, southwestern Ohio was covered by a shallow inland sea. Sedimentary deposition was controlled by the structural relief of the Cincinnati Arch. The flank of the arch provided a platform for sediment accumulation. As the sea level changed from shallower to deeper, the type of sediments deposited in a particular area changed. This is the reason that the vertical rock record shows a change from one bedrock type to another. The Ordovician bedrock, which was deposited as interbedded limestones and shales, documents these fluctuations in sea level.

Deposition of Silurian bedrock in southwestern Ohio occurred during three separate periods of sedimentation (Horvath and Sparling, 1967). The depositional environment for the Brassfield Limestone is generally believed to be a shallow, gently sloping marine platform adjacent to a low-lying dry land surface. This environment was conducive to the deposition of sediments which eventually formed limestones and dolomites (carbonates). The Brassfield ranges form a highly fossiliferous crystalline limestone to a more shaley limestone with some nodule development (Stout et al., 1943) The lower Brassfield is coarse- grained and massive-bedded. The upper Brassfield is thinner bedded and can be fossiliferous (Horvath and Sparling, 1967).

Sometime after the deposition of the Brassfield, sea levels dropped. The Brassfield was then exposed to the atmosphere and experienced a period of weathering and erosion. A rise in sea level then resulted in a deeper water environment, favorable for the deposition of shale. During this time, the Dayton, Osgood, and Laurel formations were deposited above the Brassfield. A southerly source-area for these land-derived sediments has been suggested by Horvath and Sparling (1967). The Dayton formation, overlying the Brassfield, is a fine-grained, dense limestone or dolomite, which is highly fossiliferous in some exposures (Kleffner and Ausich, 1988) and has been quarried extensively (Horvath and Sparling, 1967). The Osgood shale lies above the Dayton formation. It is a clay-shale and the upper sections have limestone interbedded with shale; the lower sections are exclusively shale (Horavath and Sparling, 1967). Laurel limestone overlies the Osgood shale. It is a medium-grained, dolomitic limestone with residues of clay, silt, chert, pyrite, and glauconite (Horvath and Sparling, 1967).

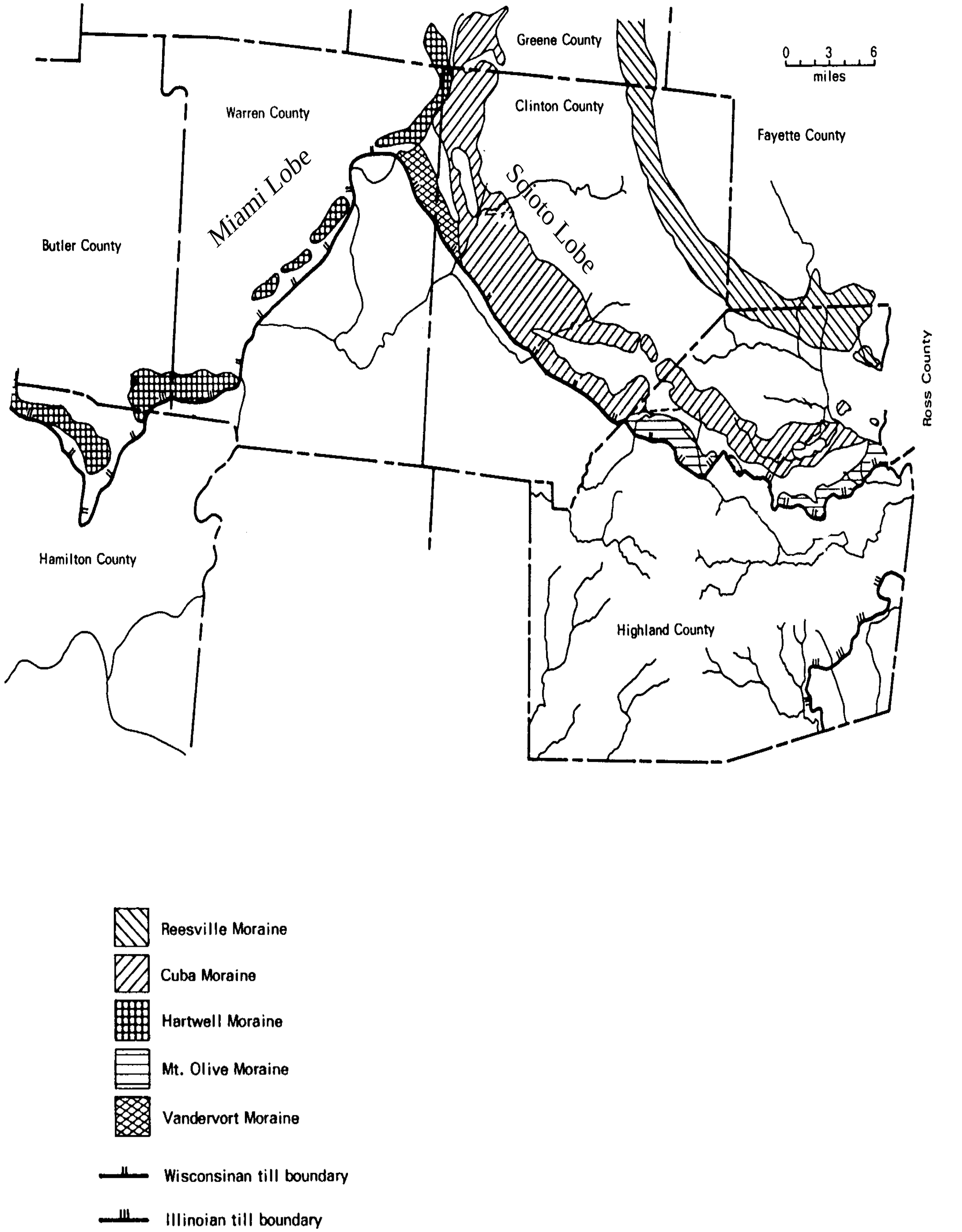


Figure 8. Glacial end moraines in southwest Ohio (After Rosengreen, 1974).

Table 9. Bedrock Stratigraphy of Clinton County, Ohio (Modified from Horvath and Sparling, 1967)

SYSTEM	SERIES	GROUP	FORMATION
SILURIAN	Niagaran	Lockport	Cedarville Dolomite
			Springfield Dolomite
			Euphemia Dolomite
		Sub Lockport	Laurel Dolomite
			Osgood Shale
			Dayton Limestone
	Alexandrian		Brassfield Limestone
ORDOVICIAN	Cincinnatian	Richmond	

The third period of sedimentation resulted in the deposition of the Euphemia, Springfield, and Cedarville units. Sea level changes allowed shelf deposition of carbonate sediments in moderately deep water. The Euphemia is massive and porous, and can be identified by fossils of the various Brachiopod species present (Kleffner and Ausich, 1988). The Springfield formation is light gray, fine-to medium-grained, and even-bedded (Horvath and Sparling, 1967). It is vuggy, porous, and contains a high amount of quartz residue (Stout et al., 1943). The Cedarville is a vuggy, massive, poorly bedded, fossiliferous, porous dolomite (Horvath and Sparling, 1967). These three units (Euphemia, Springfield and Cedarville) correlate well with the carbonate bedrock units of northwest Ohio.

Hydrogeology

The Niagaran group of formations, from the Cedarville dolomite to the Dayton limestone, constitute the best bedrock aquifers in Clinton County. Although yields of as much as 75 gallons per minute are developed from the upper Niagarian formations, a very limited area is underlain with these formations. The eastern third of Wilson and Richland Townships are the only areas suitable for the development of long-term public ground water supplies in Clinton County.

The basal Niagaran group of formations (the Dayton limestone and Laurel dolomite) beneath the western portion of Wilson, Richland, and Wayne Townships provide a regional aquifer for the development of semi-public ground water supplies. Satisfactory yields of as much as 25 gallons per minute can be developed.

The Brassfield limestone (the basal Silurian aquifer) lies beneath the central portion of the county, extending from Chester Township in the northwest through Union, Green, and Wayne Townships in the southeast. Yields are somewhat limited, but provide sufficient supplies for domestic use.

The Ordovician bedrock beneath the remaining half of Clinton County is considered the poorest source for the development of even small domestic supplies. Where the overlying glacial deposits are thin, the fractured, well-weathered surface of the interbedded shaley limestone may provide a very limited quantity of water. Even if the overburden consists of thick glacial deposits, it is often silty clay interbedded with thin layers, or stringers, of sand and gravel, which yield only limited ground water.

In Clinton County ancestral drainage channels (buried valleys) are often filled with thick layers of silty clay interbedded with thin to thick layers of sand and gravel. These sand and gravel deposits are quite variable, often not regionally extensive, and should be considered no more than satisfactory for domestic use.

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APPENDIX A

DESCRIPTION OF LOGIC IN FACTOR SELECTION

Depth to Water

Water-level information was obtained by using water well logs on file at the Ohio Department of Natural Resources, Division of Water. In Clinton County, aquifer characteristics range from unconfined to semi-confined. Aquifers which are present at the ground surface and are not overlain by a geologic unit of significantly lower permeability were considered to be unconfined. Aquifers in which the depth to the bedrock aquifer from the ground surface was less than 10 feet were also considered unconfined. An aquifer overlain by a confining geologic unit of lower permeability than the aquifer, but allowing water to travel downward into the aquifer, was assumed to be semi-confined. The depth to water for the unconfined and semi-confined aquifers in Clinton County was considered to be the distance from the land surface to the surface below the ground where all of the pore spaces are filled with water (Spahr, 1994).

Depth to water in the bedrock aquifers was evaluated as belonging to either the Silurian limestone and dolomite aquifer or the Ordovician interbedded limestone and shale aquifer. Water level data from Well Log and Drilling Reports on file at the Ohio Department of Natural Resources varied slightly according to what depth the well was drilled. Depth to water in the bedrock aquifers for Clinton County ranged from 0 to 100 feet below land surface and was given DRASTIC ratings of (10) to (2).

Water levels in the upland region, in the setting Glacial Till Over Bedded Sedimentary Rock (7Aa), range from 5 to 15 feet below land surface (9) to 75 to 100 feet below the surface (2). Typical values for depth to water in this hydrogeologic setting are 5 to 15 and 15 to 30 feet below land surface (9 and 7, respectively). Localized areas with depths of 30 to 50 feet (5), 50 to 75 feet (3), and 75 to 100 feet (2) were also encountered.

In the areas with Glacial Till Over Limestone (7Ac), water level depths varied from 0-5 feet (10) to 50 to 75 feet below the surface (3). However, most ground water levels were in the 5 to 15 range (7).

The Buried Valley setting (7D) provides a wide range of values for depths to water, as the thickness of drift varies greatly. Value ranges were from 0 to 5 feet (10) to 100+ feet (1), with an average depth of 5 to 15 feet (DRASTIC rating of 9).

The Alluvium Over Limestone setting (7Ec) ranges from 0 to 5 feet (10) to 15 to 30 feet (7), with a majority measuring 5 to 15 below the surface (9).

Nearly all Alluvium Over Glacial Till (7Ed) values for depth to water are 5 to 15 feet below land surface (9). One was 0 to 5 feet (10), yet all values reflect the fact that most of the occurrences of these deposits are associated with modern streams which control the depth to water.

Net Recharge

As used in the DRASTIC methodology, net recharge is defined as the total quantity of precipitation in inches per year, applied to the ground surface that infiltrates to the aquifer (Aller et al., 1987). Net recharge values were obtained and estimated from data and information provided by Spahr (1994), and (Well Log and Drilling Reports for wells located in Clinton County, Ohio).

The average annual precipitation for Clinton County is approximately 37 inches per year. Only a portion of this 37 inches infiltrates into the aquifer. The remainder is lost through withdrawal, evaporation, transpiration, and surficial runoff. The amount of recharge reaching the aquifer is dependent on and influenced by DRASTIC parameters such as topography, vadose zone material, and soil type. As the slope of the land surface becomes steeper, the amount of runoff increases. Therefore, net recharge would be less in steeper areas relative to flatter regions. The amount of recharge to an aquifer system is also influenced by the amount of coarse to fine material found in the soil and vadose zone. Coarser deposits are more permeable than finer deposits and will allow a higher percentage of precipitation to infiltrate the aquifer system (Spahr, 1994).

The average value for recharge state-wide is approximately 6 inches per year (Pettyjohn and Henning, 1979). Areas with thick, clay-rich glacial till have lower recharge rates. In areas where the bedrock is at or near the surface, the recharge rates are higher. The number and size of fractures in the glacial till and in the bedrock also influences rates of recharge.

Areas in Clinton County that have a clay loam soil, a significant thick till as vadose zone, and the Ordovician interbedded limestone and shale as an aquifer were rated as supplying 2 to 4 inches per year of recharge to the aquifer (3). This value was common in portions of Clinton County mapped as Glacial Till Over Bedded Sedimentary Rocks (7Aa).

Net Recharge for the Glacial Till Over Limestone setting (7Ac) was 2 to 4 inches per year (3), 4 to 7 inches per year (6), and 7 to 10 inches per year (8). The variation is controlled mostly by the composition of the vadose zone materials, with higher values reflecting the very shallow permeable (fractured) limestone bedrock conditions within limited areas.

Buried Valley (7D), Alluvium Over Limestone (7Ec), and Alluvium Over Glacial Till (7Ed) settings were estimated to supply 4 to 7 inches per year of (6) recharge to the underlying aquifers.

Aquifer Media

Aquifer Media is defined as the consolidated or unconsolidated rock that yields sufficient quantities of water for use (Aller et al., 1987). Information on aquifer media was derived primarily from Water Well Logs on file at the Ohio Department of Natural Resources, Division of Water; Water Resources Map of Clinton County, Ohio (Schmidt, 1994); Glacial Geology of Clinton County, Ohio (Teller, 1967); Norris and Fidler (1973); and Stout (1941).

DRASTIC ratings are assigned to aquifer media based on the degree of fracturing, solutioning, and bedding planes of the consolidated bedrock aquifers. The degree of sorting and the amount of fine material present determine the rating for sand and gravel aquifers.

The consolidated bedrock aquifers of Clinton County consist of Silurian limestone, limestone and shale, and the Ordovician interbedded limestone and shale formations. The Silurian limestone aquifer was given a DRASTIC rating of (6), the intermediate limestone and shale a rating of (5), and the basal Silurian a rating of (4). The less permeable Ordovician interbedded limestone and shale was given a rating of (3).

Limestone bedrock was evaluated as the aquifer media in areas of the county where the overlying material was clay-rich and did not contain sufficient amounts of sand and gravel to supply water to domestic wells. The aquifer media for all of the Glacial Till Over Limestone (7Ac DRASTIC rating of 3 and 4) setting and Alluvium Over Sedimentary Rocks (7Ec DRASTIC rating of 3 to 5) setting is limestone.

Interbedded limestone and shale was evaluated as the aquifer media for the Glacial Till Over Sedimentary Rocks (7Aa DRASTIC rating of 3) setting.

The unconsolidated glacial till aquifers of Clinton County associated with the Buried Valley (7D) and Alluvium Over Glacial Till (7Ed) settings show a limited range of ratings owing to the consistent nature of the sand and gravel present. Ratings do not exceed (5).

Soil Media

Data for the soils were evaluated from the Soil Survey for Clinton County (Garner et al, 1962). Each soil was evaluated for texture, organic content, permeability, and shrink/swell potential to derive a DRASTIC rating.

Soils in the Glacial Till Over Bedded Sedimentary Rock setting (7Aa) were rated as clay loam (3), shrink/swell clay (7), and loam (5). In the Glacial Till Over Limestone setting (7Ac), soils were rated as clay loam (3), shrink/swell clay (7), and silty loam (4). Soils for the Buried Valley setting (7D) were predominantly clay loam (3), and shrink/swell clay (7), with occasional loam (5), silty loam (4), and sandy loam (6). The Alluvium Over Sedimentary Rocks setting (7Ec) was rated as clay loam (3), shrink/swell clay (7), silty loam (4), and loam (5). Soils in the Alluvium Over Glacial Till setting (7Ed) were rated as shrink/swell clay (7), loam (5), and clay loam, (3). Ratings reflect order of predominance. Table 10 lists the soils of Clinton County and their individual DRASTIC ratings.

Topography

Percent slope was determined using 7-1/2 minute USGS topographic quadrangles. DRASTIC ratings for the greater portion of the topography for Clinton County ranged from (10) to (9), a result of the 0 to 6% slope. Since values are controlled by the amount of dissection, margins of moraines and margins of floodplains developed by present-day drainage systems exhibit a DRASTIC rating of (5) to (3), indicative of a 6 to 18% slope.

Impact of the Vadose Zone Media

Water well logs on file at the Ohio Department of Natural Resources were the basis for the determination of the vadose zone media in Clinton County. The vadose zone media for the greater portion of Clinton County is glacial till composed of silt, clay, sand, and gravel. The DRASTIC value for this media is (3) since it is primarily silt/clay. In some areas where the glacial deposits are thin or absent, the shallow bedrocks were rated as the vadose zone. In the hydrogeologic setting Glacial Till Over Bedded Sedimentary Rock (7Aa), the vadose zone was rated as a (3). In the Glacial Till Over Limestone setting (7Ac), the silt/clay vadose was rated as (3). Where there was a small amount of unconsolidated material above the limestone, the vadose zone was (5, 6, and 7). The Buried Valley setting (7D) has vadose materials of silt and clay with sand and gravel. The vadose was rated as (3). Where sand and gravel are interbedded with silt and clay, the vadose was rated as (4). The Alluvium Over Sedimentary Rock setting (7Ec) has a rating of (3) with minimal regional ratings of (4) for sand and gravel interbedded with significant amounts of silt and clay. The predominant vadose rating for the Alluvium Over Glacial Till setting (7Ed) was (3) because of the presence of silt/clay.

Table 10. Clinton County Soils (after Lerch et al., 1969)

Soil Name	DRASTIC Rating	Soil Media
Algiers	7	shrink/swell clay
Burbeck	4	silty loam
Blanchester	7	shrink/swell clay
Brookston	3	clay loam
Cincinnati	7	shrink/swell clay
Celina	3	clay loam
Casco and Rodman	5	loam
Crosby	3	clay loam
Clermont	7	shrink/swell clay
Delmar	3	clay loam
Edenton	7	shrink/swell clay
Eel	7	shrink/swell clay
Fox and Casco	6	sandy loam
Fincastle	3	clay loam
Fox	5	loam
Genesee	5	loam
Grillied Land	3	clay loam
Hennepin and Miami	3	clay loam
Henshaw	3	clay loam
Kokomo	7	shrink/swell clay
Millsdale	7	shrink/swell clay
Miami	3	clay loam
Milton	3	clay loam
Medway	4	silty loam
Ackley	3	clay loam
Bonpas	3	clay loam
Ragsdale	3	clay loam
Raub	7	shrink/swell clay
Reesville	3	clay loam
Russell	3	clay loam
Rossmayne	7	shrink/swell clay
Ross	4	silty loam
Serdinia	3	clay loam
Shoals	4	silty loam
Sleeth	3	clay loam
Sloan	4	silty loam
Thackery	3	clay loam
Uniontown	3	clay loam
Williamsburg	3	clay loam
Westland	7	shrink/swell clay
Xenia	3	clay loam

Hydraulic Conductivity

Very limited data have been published on the hydraulic conductivity of aquifers in Clinton County. Values were based on the Ground Water Resources of Clinton County (Schmidt, 1994) and the estimated yields determined from the logs of water wells filed with the Ohio Department of Natural Resources. Hydraulic Conductivity values for the Ordovician limestone-shale aquifer in the Glacial Till Over Sedimentary Rocks setting (7Aa) was 1 to 100 gallons per day per square foot (gpd/ft^2). This setting has a DRASTIC rating of (1). The Silurian limestone aquifer was evaluated as having hydraulic conductivity values ranging from 100 to 300 gpd/ft^{2,} to 300 to 700 gpd/ft^2. Flow characteristics of carbonate aquifers reveal little or no intra-granular porosity, but favor secondary porosity including joints, fractures, and solution channeling for greater hydraulic conductivity (Eagon, 1970). The DRASTIC ratings of (2) and (4) for the Glacial Till Over Limestone setting (7AC) reflects the presence of greater porosity for specific limestone formations.

Sand and gravel aquifers associated with the Buried Valley setting (7D) have hydraulic conductivity values ranging from 300 to 700 gpd/ft^2. The DRASTIC rating assigned to this aquifer is (4). The sorting, coarseness, amount of fines, thickness, and areal extent control the hydraulic conductivity for this aquifer.

Range of 1 to 100 and 300 to 700 gpd/ft^{2}with DRASTIC ratings of (1 to 4) are assigned to the Alluvium Over Sedimentary Rocks setting (7Ec). The Alluvium Over Glacial Till setting (7Ed) has a set of hydraulic conductivity values of 1 to 100 and 100 to 300 gpd/ft^2 with DRASTIC ratings of (1 to 2). These values reflect the characteristics of the principal aquifer.

APPENDIX B

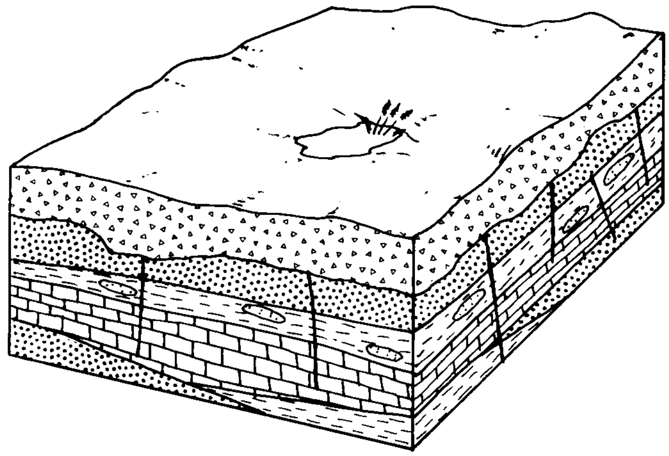
DESCRIPTION OF HYDROGEOLOGIC SETTINGS AND CHARTS

Ground water pollution potential mapping in Clinton County resulted in the identification of five 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 11. Computed pollution potential indexes for Clinton County range from 65 to 149.

Table 11. Hydrogeologic Settings Mapped in Clinton County, Ohio.

Hydrogeologic Settings	Range of GWPP Indexes	Number of Index Calculations
7Aa - Glacial Till Over Bedded Sedimentary Rock	65 - 108	31
7Ac - Glacial Till Over Solution Limestone	74 - 149	42
7D - Buried Valley	82 - 145	40
7Ec - Alluvium Over Sedimentary Rock	102 - 139	20
7Bd - Alluvium Over Glacial Till	113 - 129	11

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 characterized by low topography and flat-lying, fractured sedimentary rock. The underlying bedrock consists of thick sequences of Ordovician shale interbedded with thin layers of limestone. These sedimentary rock units are covered by varying thicknesses of glacial till. The till layer consists of unsorted deposits of interbedded clay, silt, and sand. Although ground water occurs in both the glacial deposits and the fractured bedrock, bedrock is usually the principal aquifer. The main source of recharge to the bedrock aquifer is from the overlying glacial till and soils. Depth to water varies depending on glacial till thickness, but is usually between 15-30 feet.

GWPP index values for the hydrogeologic setting of glacial till over bedded sedimentary rocks range from 65 to 108 with the total number of GWPP index calculations equaling 31.

Setting: 7Aa1		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	100

Setting: 7Aa2		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	90

Setting: 7Aa3		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75	5	3	15
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	70

Setting: 7Aa4		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	89

Setting: 7Aa5		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	80

Setting: 7Aa6		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	75-100	5	2	10
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	65

Setting: 7Aa7		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	85

Setting: 7Aa8		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	79

Setting: 7Aa9		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	99

Setting: 7Aa10		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Shrinking Clay	2	7	14
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	97

Setting: 7Aa11		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	98

Setting: 7Aa12		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	88

Setting: 7Aa13		GENERAL		
FEATURE	RANGE	WEIGHT	Rating	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Shrinking Clay	2	7	14
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	93

Setting:7Aa14		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	108

Setting: 7Aa15		GENERAL		
FEATURE	RANGE	WEIGHT	Rating	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Shrinking Clay	2	7	14
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	107

Setting: 7Aa16		GENERAL		
FEATURE	RANGE	WEIGHT	Rating	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Loam	2	5	10
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	99

Setting: 7Aa17		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Shrinking Clay	2	7	14
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	87

Setting: 7Aa18		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Shrinking Clay	2	7	14
Topography	12-18%	1	3	3
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	91

Setting: 7Aa19		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	12-18%	1	3	3
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	83

Setting: 7Aa20		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75	5	3	15
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	69

Setting: 7Aa21		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75	5	3	15
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	65

Setting: 7Aa22		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	75

Setting: 7Aa23		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Shrinking Clay	2	7	14
Topography	12-18%	1	3	3
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	101

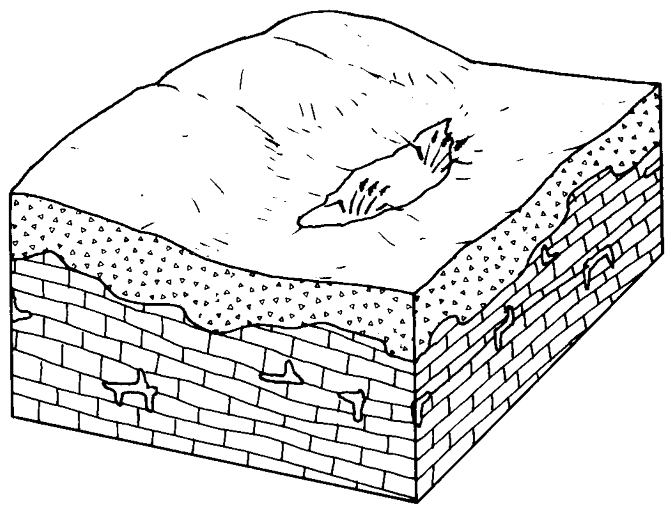
Setting: 7Aa24		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	12-18%	1	3	3
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	73

Setting: 7Aa25		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Shrinking Clay	2	7	14
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	103

Setting: 7Aa27		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Shrinking Clay	2	7	14
Topography	18+%	1	1	1
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	89

Setting: 7Aa28		GENERAL		
	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	12-18%	1	3	3
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	93

Setting: 7Aa31		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	95



7Ac Glacial Till Over Limestone

This hydrogeologic setting is characterized by low relief with limestone or dolomite bedrock covered by varying thicknesses of glacial till. The till is composed of clay, silt, sand, and gravel. Sand and gravel deposits within the till are generally not sufficiently thick to develop as a water supply. The limestone-dolomite bedrock serves as the aquifer in this setting. Ground water occurs in the fractured and solutioned portions of the formation. Recharge for the bedrock is from precipitation infiltration through the glacial till. Depth to water is highly variable, based in part on the thickness of glacial sediments. Soils are typically clay loam.

GWPP index values for the hydrogeologic setting of glacial till over limestone range from 74 to 149 with a total number of GWPP index calculations equaling 42.

Setting:7Ac1		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	96

Setting: 7Ac2		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75	5	3	15
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	76

		GENERAL		
Setting:7Ac3	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	107

Setting: 7Ac4		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	99

Setting: 7Ac5		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	86

Setting: 7Ac6		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75	5	3	15
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	79

Setting: 7Ac7		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	95

Setting:7Ac8		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	6	18
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	130

Setting: 7Ac9		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	121

Setting: 7Ac10		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	6	18
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	120

Setting: 7Ac11		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	109

Setting:7Ac12		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	106

Setting: 7Ac13		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	89

Setting: 7Ac14		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75	5	3	15
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	75

Setting: 7Ac15		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Limestone	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	131

Setting:7Ac16		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Limestone	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	121

Setting: 7Ac17		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Limestone	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	128

Setting: 7Ac18		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Limestone	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	118

Setting: 7Ac19		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	18+%	1	1	1
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	87

Setting: 7Ac20		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	5	15
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	107

Setting: 7Ac21		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	5	15
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	117

Setting: 7Ac22		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	105

Setting: 7Ac23		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	127

Setting: 7Ac24		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Limestone	5	6	30
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	136

Setting: 7Ac25		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	7-10	4	8	32
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Limestone	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	139

Setting: 7Ac26		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	7-10	4	8	32
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Limestone	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	149

Setting: 7Ac27		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	7-10	4	8	32
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Limestone	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	129

Setting: 7Ac28		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Limestone	5	6	30
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	116

Setting: 7Ac29		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	0-5	5	10	50
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Limestone	5	6	30
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	141

Setting: 7Ac30		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	5	15
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Limestone	5	6	30
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	144

Setting: 7Ac31		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	5	15
Soil Media	Silty Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	111

Setting: 7Ac32		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	91

Setting: 7Ac33		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	6	18
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	110

Setting: 7Ac34		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75	5	3	15
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	74

Setting: 7Ac35		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	88

Setting: 7Ac36		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	94

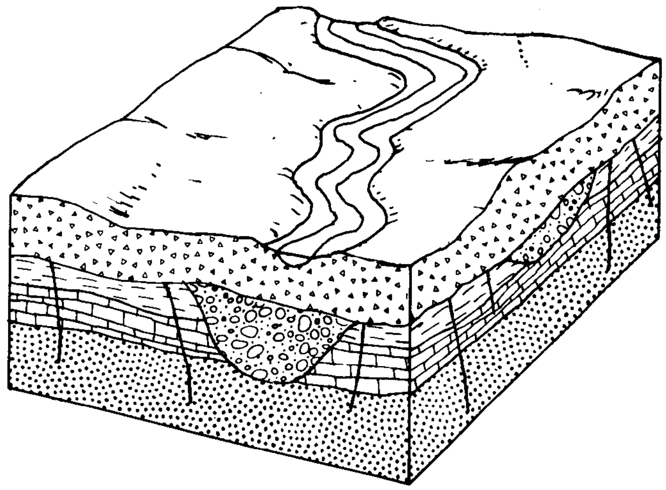
Setting: 7Ac38		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	84

Setting: 7Ac39		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	6	18
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	109

Setting: 7Ac40		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	4	12
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	114

Setting: 7Ac41		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	4	12
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	104

Setting: 7Ac42		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	0-5	5	10	50
Net Recharge	2-4	4	3	12
Aquifer Media	Limestone	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	111



7D Buried Valley

This hydrogeologic setting is characterized by thick deposits of clay, silt, sand and gravel deposited in pre-glacial or interglacial river valleys. These deposits may or may not underlie a present-day stream. There are no thick sand and gravel deposits capable of yielding large quantities of water in Clinton County. Soils are typically silty loam and clay loam. Static water levels are highly variable and depend upon the thickness of the surficial deposits. Recharge to the aquifer may be attributed to infiltration or precipitation and regional ground-water flow from surrounding till plains and limestone bedrock.

GWPP index values for the hydrogeologic setting of buried valley range from 82 to 145 with a total number of GWPP index calculations equaling 40.

Setting: 7D1		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	116

Setting: 7D2				
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	127

Setting: 7D3		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75	5	3	15
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	97

Setting: 7D4		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	117

Setting: 7D5		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	4	20
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	132

Setting: 7D6		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Glacial Till	5	4	20
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	140

Setting: 7D7		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	107

Setting: 7D8		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	126

Setting: 7D9		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	106

Setting: 7D10		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	135

Setting: 7D11		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	125

Setting: 7D12		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75	5	3	15
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt /Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	96

Setting: 7D13		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Glacial Till	5	4	20
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	126

Setting: 7D14		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	118

Setting: 7D15		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Glacial Till	5	4	20
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	130

Setting: 7D16		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Shrinking Clay	2	7	14
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	124

Setting: 7D17		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Silty Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	129

Setting: 7D18		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	75-100	5	2	10
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	92

Setting: 7D19		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	100+	5	1	5
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	86

Setting: 7D21		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	112

Setting: 7D22		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75	5	3	15
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	92

Setting: 7D23		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	0-5	5	10	50
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	140

Setting: 7D24		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	100+	5	1	5
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt /Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	82

Setting: 7D25		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	100+	5	1	5
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	87

Setting: 7D26		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	102

Setting: 7D27		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Glacial Till	5	4	20
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	136

Setting: 7D28		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	122

Setting: 7D29		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	12-18%	1	3	3
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	110

Setting: 7D30		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Sandy Loam	2	6	12
Topography	0-2%	1	10	10
Impact of Vadose Zone	Glacial Till	5	4	20
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	128

Setting: 7D31		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	100+	5	1	5
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	95

Setting: 7D32		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	12-18%	1	3	3
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	100

Setting: 7D33		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	0-5	5	10	50
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Glacial Clay	5	4	20
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	145

Setting: 7D34		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Silty Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	119

Setting: 7D35		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Silty Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Glacial Till	5	4	20
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	134

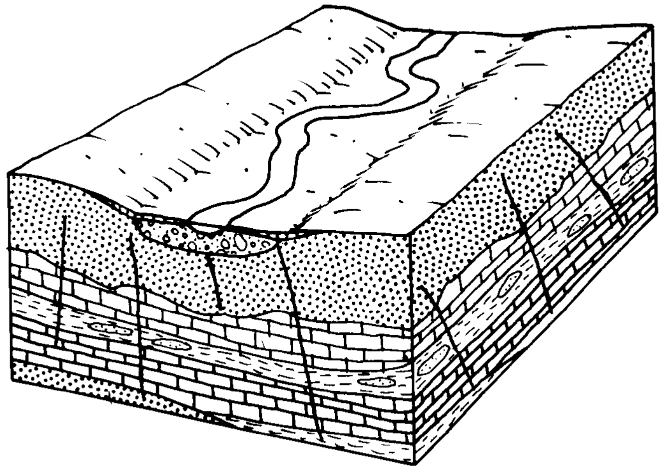
Setting: 7D36		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	12-18%	1	3	3
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	120

Setting: 7D37		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Sandy Loam	2	6	12
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	123

Setting: 7D38		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	131

Setting: 7D39		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50	5	5	25
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	115

Setting: 7D40		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Loam	2	5	10
Topography	2-6%	1	9	9
Impact of Vadose Zone	Glacial Till	5	4	20
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	135



7Ec Alluvium Over Bedded Sedimentary Rock

This hydrogeologic setting is characterized by low topography with present-day alluvium deposits over sedimentary bedrock. The alluvium is composed of clay, silt, sand, and gravel. Depth to water is shallow and the stream is usually in hydraulic connection with the alluvial deposits. The alluvium is underlain by sedimentary bedrock which serves as the principal aquifer in this setting. Recharge occurs by infiltration of precipitation and surface water through the alluvium into the bedrock aquifer. Soils are typically classified as clay loam.

GWPP index values for the hydrogeologic setting of alluvium over bedded sedimentary rocks range from 102 to 139 with the total number of GWPP index calculations equaling 20.

Setting: 7Ec1		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	120

Setting: 7Ec2		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	4	12
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	126

Setting: 7Ec3		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	4	12
Soil Media	Shrinking Clay	2	7	14
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	121

Setting: 7Ec4		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Glacial Till	5	4	20
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	117

Setting: 7Ec5		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	118

Setting: 7Ec6		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Limestone	5	4	20
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	111

Setting: 7Ec7		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	121

Setting: 7Ec8		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Glacial Till	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	123

Setting: 7Ec9		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	GlacialTill	5	5	25
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	122

Setting: 7Ec10		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	112

Setting: 7Ec11		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Silty Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Glacial Till	5	4	20
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	119

Setting: 7Ec12		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Glacial Till	5	4	20
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	121

Setting: 7Ec13		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Glacial Till	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	102

Setting: 7Ec14		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	5	15
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Glacial Till	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	134

Setting: 7Ec15		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	6	18
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Glacial Till	5	3	15
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	138

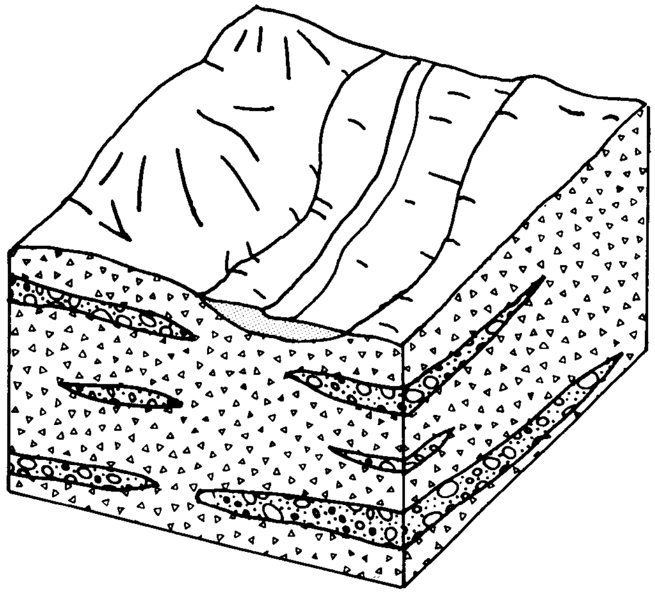
Setting: 7Ec16		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	4	12
Soil Media	Shrinking Clay	2	7	14
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	125

Setting: 7Ec17		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	0-5	5	10	50
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	5	15
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Glacial Till	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	139

Setting: 7Ec18		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Glacial Till	5	4	20
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	125

Setting: 7Ec19		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30	5	7	35
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	106

Setting: 7Ec20		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone and Shale	3	3	9
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	107



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 clay, silt, sand, and gravel. The underlying sand and gravel deposits in the glacial till serve as the primary aquifer. The depth to water is shallow and the stream is usually in hydraulic connection with the deposits. Recharge occurs by infiltration through the alluvium to the sand and gravel within the till. Soils are typically classified as silt loam.

GWPP index values for the hydrogeologic setting of alluvium over glacial till range from 113 to 129 with the total number of GWPP index calculations equaling 11.

Setting: 7Ed1		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	4	12
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	118

Setting: 7Ed2		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	5	15
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	129

Setting: 7Ed3		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	4	12
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	126

Setting: 7Ed4		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	4	12
Soil Media	Shrinking Clay	2	7	14
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	121

Setting: 7Ed5		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	4	12
Soil Media	Shrinking Clay	2	7	14
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	125

Setting: 7Ed6		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	4	12
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Glacial Till	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	127

Setting: 7Ed7		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Limestone	3	5	15
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	125

Setting: 7Ed8		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	3	9
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	120

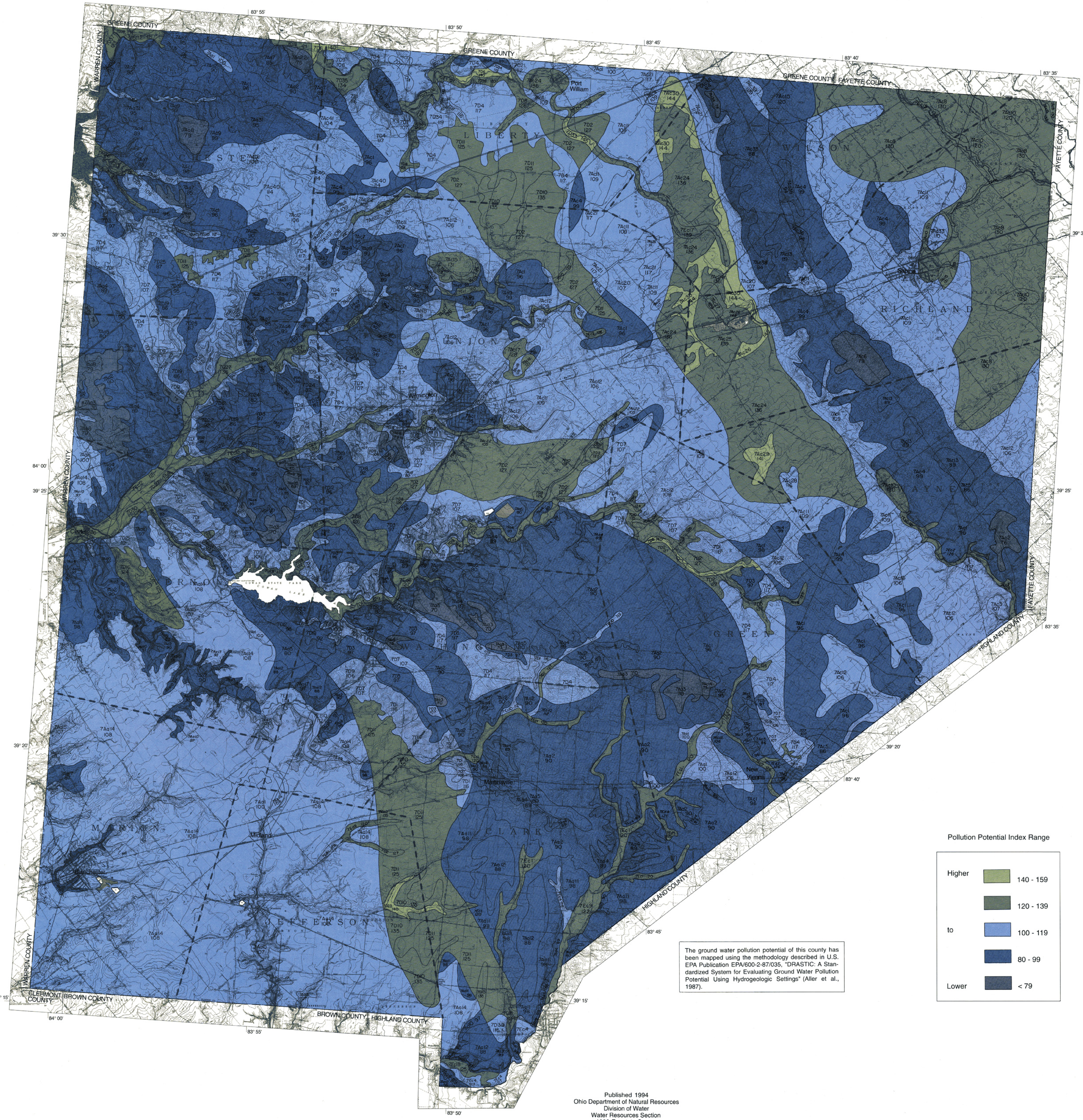
Setting: 7Ed9		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	3	9
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	116

Setting: 7Ed10		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	0-5	5	10	50
Net Recharge	2-4	4	3	12
Aquifer Media	Glacial Till	3	3	9
Soil Media	Shrinking Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	113

Setting: 7Ed11		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15	5	9	45
Net Recharge	4-7	4	6	24
Aquifer Media	Glacial Till	3	3	9
Soil Media	Shrinking Clay	2	7	14
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt/Clay	5	3	15
Hydraulic Conductivity	1-100	3	1	3
		GWPP	INDEX	119

Ground Water Pollution Potential of CLINTON COUNTY

by
James J. Schmidt



Miles

Kilometers

CONTOUR INTERVAL 5 OR 10 FEET

County Line

Township Line

Incorporated City Limit

Gravel Pit / Quarry

Description of Map Symbols

Hydrogeologic Region — 7Ad6 — Hydrogeologic Setting

98 — Relative Pollution Potential

Pollution Potential Index Range

Higher		140 - 159
		120 - 139
to		100 - 119
		80 - 99
Lower		< 79

Hydrogeologic Settings

7Aa – Till Over Bedded Sedimentary Rock

7Ac – Glacial Till Over Limestone

7D – Buried Valley

7Ec – Alluvium Over Sedimentary Rock

7Ed – Alluvium Over Glacial Till

A more detailed description of the hydrogeologic settings and the evaluation of the pollution potential may be found in the publication "Ground-Water Pollution Potential of Clinton County", GWPP Report No. 34, Ohio Department of Natural Resources, Division of Water.

The ground water pollution potential of this county has been mapped using the methodology described in U.S. EPA Publication EPA/600-2-87/035, "DRASTIC: A Standardized System for Evaluating Ground Water Pollution Potential Using Hydrogeologic Settings" (Aller et al., 1987).

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