HYDROGEOLOGIC ATLAS NO. 15
MANCHESTER QUADRANGLE MARYLAND
INTRODUCTION and SLOPE OF LAND SURFACE

By
Edmond G. Otton

INTRODUCTION

This atlas describes the hydrology and geology of the Manchester 7 1/2-minute quadrangle in northern Carroll County, Maryland. It is intended for use by County, State, and Federal officials as well as planners, engineers, health officers, land developers, and the general public as a guide to water supply, waste disposal, and land-use planning. The quadrangle covers an area of about 57 square miles, of which 44 square miles are in Maryland and the remaining 13 square miles are in Pennsylvania. Transportation throughout the area is facilitated by a network of County and State highways, of which Maryland Routes 30, 27, 86, and 496 are the major arterial roads. The only town in the quadrangle is Manchester. Land use is largely agricultural and woodland, although suburban development has taken place north and west of Manchester and at other scattered locations in the area. The topography is undulating to hilly and it features several prominent northeast-trending ridges, of which Dug Hill Ridge is the most notable. The maximum relief in the quadrangle is slightly more than 460 feet. The lowest elevation (580 feet) occurs along Big Pipe Creek in the west-central part of the area and the highest elevation (1,120 feet) occurs near the community of Wentz about 0.8 mile south of the Pennsylvania line. The quadrangle is drained by headwater tributaries of the Gunpowder Falls, Patapsco, and Monocacy Rivers. Figure 1 shows the location of the quadrangle in Maryland.

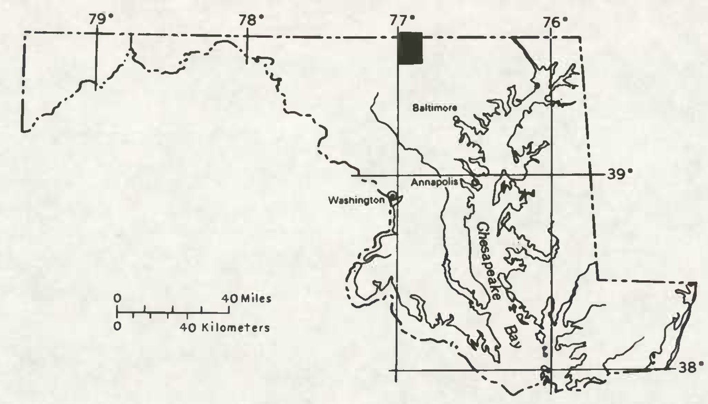


Figure 1. Location of Manchester Quadrangle.

HYDROLOGY

The source of all ground water in the area is the 43 inches of annual precipitation. Hydrologic studies by Meyer (1958, p. 22), based on earlier studies, show that about 28 inches (65 percent) of the annual precipitation in the Maryland Piedmont is returned to the atmosphere by evapotranspiration and the remaining 15 inches (35 percent) becomes runoff to the streams. About 10 inches of the precipitation is discharged from the ground-water reservoirs as ground-water runoff (or base flow of the streams). This is roughly equivalent to 475,000 gallons per day per square mile. The base flow of most streams in the Manchester quadrangle may be somewhat less than this because the weathered zone of the rocks is thin in many places and because of the greater relief than in the area of the study cited by Meyer.

The availability of ground water depends on the permeability and storage capacity of the fractured rock aquifers. In many places the fractures and other voids in the rocks are of sufficient size and extent that wells drilled in them yield at least a few gallons a minute. In some places the rocks are essentially impervious and yield little or no water. Some rocks, such as marble or gneiss, are better aquifers than other rocks, such as phyllite or schist. The yield of individual wells depends also on their topographic position (valley wells are more productive than hilltop wells), the thickness of the weathered zone, and the extent and degree of rock fracturing at the site. Most of the ground water is of suitable chemical quality for domestic use. Some of the water from wells in marble may be moderately hard, and a few wells ending in silicate rocks yield water with an iron content high enough to be objectionable. Generally, water quality is not a problem.

The flow of springs is variable--some of the smaller springs cease to flow during droughts. The temperature of shallow ground water is relatively constant during the year. Meyer (p. 58) reports that the temperature of a spring at Lineboro, Md., ranged from 9.5°C to 15.0°C during an annual cycle, with the mean temperature being 12°C. Lineboro is a small community 1.5 miles east of the Manchester quadrangle.

GEOLOGY

The Manchester quadrangle is in the Piedmont physiographic province. It is underlain by highly metamorphosed sedimentary rocks of early Paleozoic age. In an unpublished geologic map of the quadrangle, dated 1976, W. P. Crowley of the Maryland Geological Survey, mapped three formations which strike northeast-southwest across the quadrangle; these are the Prettyboy Schist of Crowley (1976), the Bachman Valley Formation (unpublished name used by the Maryland Geological Survey), and the Marburg Formation of former usage. The latter two units are roughly equivalent to the Ijamsville Phyllite, the Wakefield Marble, and the Sams Creek Formation described by Fisher (1978) in the New Windsor quadrangle immediately southwest of the Manchester quadrangle. The reader is referred to Fisher's map for more detailed information on the geology of these units.

A mantle of soil and weathered rock material (saprolite) overlies the hard crystalline rocks. The saprolite ranges widely in thickness and may exceed 100 feet in a few places, but probably is 20 to 30 feet thick throughout most of the quadrangle. Alluvium and colluvium overlie both the rock and the saprolite along many of the stream valleys; the thickness of these materials is variable, but may average 5 to 10 feet.

MAPS INCLUDED IN THIS ATLAS

Map 1. Introduction and Slope of land surface, by Edmond G. Otton and Photo Science, Inc.

Map 2. Depth to the water table, by Edmond G. Otton.

Map 3. Availability of ground water, by Edmond G. Otton.

Map 4. Constraints on installation of septic systems, by Edmond G. Otton.

Map 5. Location of wells, springs, and test holes, by John T. Hilleary and Edmond G. Otton.

LIMITATIONS OF MAPS

All the maps of this atlas represent some degree of judgment and interpretation of available data. The boundaries depicted on maps are not to be construed as being final, nor is the information shown intended to supplant a detailed site evaluation by a specialist in the fields of hydrogeology, sanitary engineering, or civil engineering.

CONVERSION OF MEASUREMENT UNITS

In this atlas, figures for measurements are given in inch-pound units. The following table contains the factors for converting these units to metric (System International or SI) units:

Inch-pound unit	Symbol	Multiply by	Metric unit	Symbol
inch	(in.)	25.40	millimeter	(mm)
foot	(ft)	0.3048	meter	(m)
mile	(mi)	1.609	kilometer	(km)
square mile	(mi^2)	2.590	square kilometer	(km^2)
U.S. gallon	(gal)	3.785	liter	(L)
U.S. gallon per minute	(gal/min)	0.06309	liter per second	(L/s)
U.S. gallon per minute per foot	[(gal/min)/ft]	0.2070	liter per second per meter	[(L/s)/m]

REFERENCES

Cleaves, E. T., Edwards, Jonathan, Jr., and Glaser, J. D. (compilers and editors), 1968, Geologic map of Maryland: Maryland Geological Survey, scale 1:250,000.

Crowley, W. R., 1976, The geology of the crystalline rocks near Baltimore and its bearing on the evolution of the eastern Maryland Piedmont: Maryland Geological Survey Report of Investigations No. 27, 40 p.

Fisher, G. W., 1978, Geologic map of the New Windsor quadrangle: U.S. Geological Survey Map I-1037, scale 1:24,000.

Meyer, Gerald, 1958, The ground-water resources, in The water resources of Carroll and Frederick Counties: Maryland Department of Geology, Mines and Water Resources 1/ Bulletin 22, p. 1-228.

Nutter, L. J., 1974, Well yields in the bedrock aquifers of Maryland: Maryland Geological Survey Information Circular 16, 24 p.

Nutter, L. J., and Otton, E. G., 1969, Ground-water occurrence in the Maryland Piedmont: Maryland Geological Survey Report of Investigations No. 10, 56 p.

Otton, E. G., and others, 1979, Hydrogeologic atlas of Westminster quadrangle, Carroll County, Maryland: Maryland Geological Survey Atlas No. 9, 5 maps (scale 1:24,000).

Stose, A. J., and Stose, G. W., 1944, Geology of the Hanover-York district Pennsylvania: U.S. Geological Survey Professional Paper 204, 84 p.

______1946, Geology of Carroll and Frederick Counties, in The physical features of Carroll and Frederick Counties: Maryland Department of Geology, Mines and Water Resources 1/, p. 11-128.

Weigle, J. M., and others, 1980, Littlestown quadrangle, Carroll County, Maryland: Hydrogeology, 5 maps (scale 1:24,000): U.S. Geological Survey Open-File Report 80-1015.

1/ The name of this agency was changed to Maryland Geological Survey in June 1964.

* * * * *

SLOPE OF LAND SURFACE
Prepared by
Photo Science, Inc.

EXPLANATION

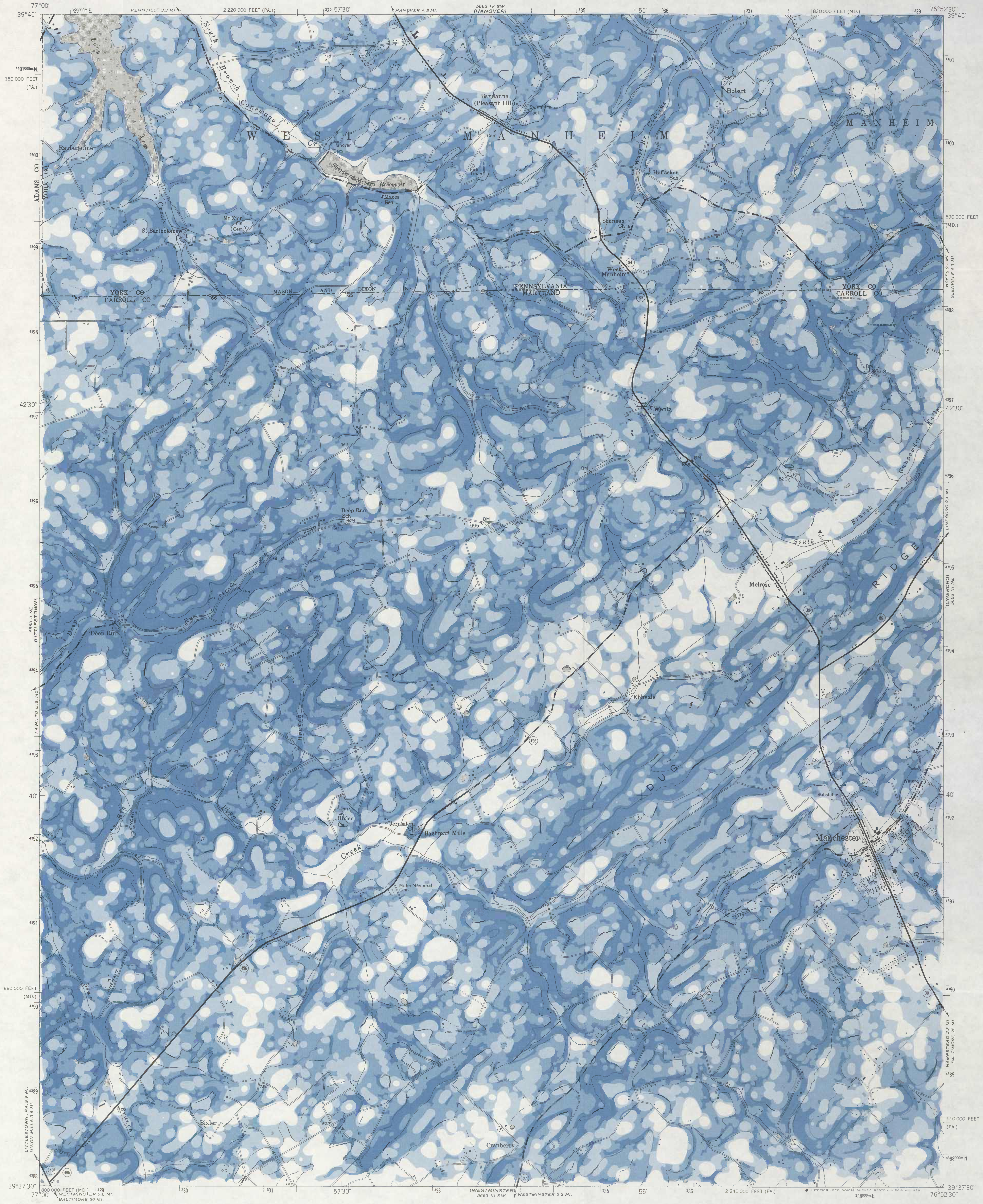
Five slope-area categories are shown on this map by four types of shading and by the absence of shading for the terrain category having a slope of 0 to 8 percent. Terrain having the maximum slope (greater than 25 percent) currently (1980) exceeds the maximum land slope permitted for the installation of domestic sewage-disposal systems (septic tanks) by the Carroll County Health Department. Intermediate terrain categories are used by the County planning agencies in regard to construction activities involving roads and drains.

This map was prepared using topographic contour negatives by a process developed by the U.S. Geological Survey, Topographic Division. The process uses a semiautomated photomechanical process which translates the distance between adjacent contours into slope data. The slope zones on the map are unedited. Proximity of the same contour or absence of adjacent contours may produce false slope information at small hilltops and depressions, on cuts and fills, in saddles and drains, along shores of open water, and at the edges of the map.

MAP 1. SLOPE OF THE LAND SURFACE

HYDROGEOLOGIC ATLAS

Quadrangle Atlas No. 15



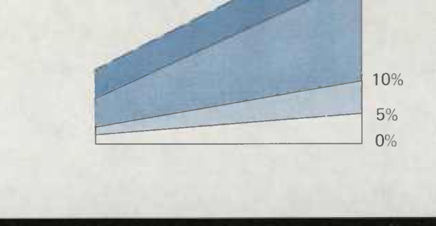
Prepared in cooperation with the United States Geological Survey and the Commissioners of Carroll County

UTM GRID AND 1971 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

Contour interval 100 feet

1981



MAP 2. LOCATION OF WELLS, SPRINGS, AND TEST HOLES

Maryland Geological Survey

Quadrangle Atlas No. 15

MANCHESTER QUADRANGLE: HYDROGEOLOGY

LOCATION OF WELLS, SPRINGS, AND TEST HOLES

By

John T. Hilleary and Edmond G. Otton

EXPLANATION

Information for wells and test holes shown on the map is on file with the U.S. Geological Survey, Towson, Md., and the Maryland Geological Survey, Baltimore, Md. Logs and well-construction records are available for most wells and test holes shown.

Well-numbering system: The wells and springs shown on the map are numbered according to a coordinate system in which Maryland counties are divided into 5-minute quadrangles of latitude and longitude. The first letter of the well number designates a 5-minute segment of latitude; the second letter designates a 5-minute segment of longitude. These letter designations are followed by a number assigned to wells sequentially. This letter-number sequence is the quadrangle designation, which is preceded by an abbreviation of the county name. Thus, well CL-AE 20 is the 20th well inventoried in quadrangle AE in Carroll County. In reports describing wells in only one county, the county prefix letters are frequently omitted from the well number. However, the numbering system currently in use (1980) differs slightly from that used in earlier published reports, such as Meyer (1958). In the 1958 report, well CL-AE 20 was designated as Car-Ae 20. The discontinuance of the use of lowercase letters in the well designation was necessitated by the change to a computer storage and retrieval system for well information in 1970.

Miscellaneous shallow boreholes or auger test holes are designated by a number preceded by a "T". These holes are numbered sequentially within each 7 1/2-minute quadrangle. Geologic and hydrologic records for them were obtained from various local concerns and agencies, chiefly county and State highway departments.

Water wells drilled in Maryland since 1945 also have a permit number (not shown on this map) assigned by the Maryland Water Resources Administration. This number consists of a two-letter county prefix (for example, CL for Carroll County) followed by a two-digit number indicating the State fiscal year in which the permit was issued (for example, -72 for the 1972 fiscal year). A four-digit chronologic sequence number follows the fiscal year designation. Thus, well CL-72-0010 is the 10th well permit issued during the 1972 fiscal year for Carroll County. However, beginning in 1973, metal tags were issued to the drillers to be affixed to the casing of each well. All of these tags bear the number -73-for the fiscal year designation, regardless of the year in which the well was drilled. This is the current situation as of the time of this report (1980).

Records of wells, springs, and boreholes shown on the map are in Meyer (1958, p. 134-169), or are in the files of the District office of the U.S. Geological Survey at Towson, Md.

○ 10 WATER WELL AND NUMBER

4 SPRING AND NUMBER

● T5 AUGER OR TEST HOLE AND NUMBER

SELECTED REFERENCES

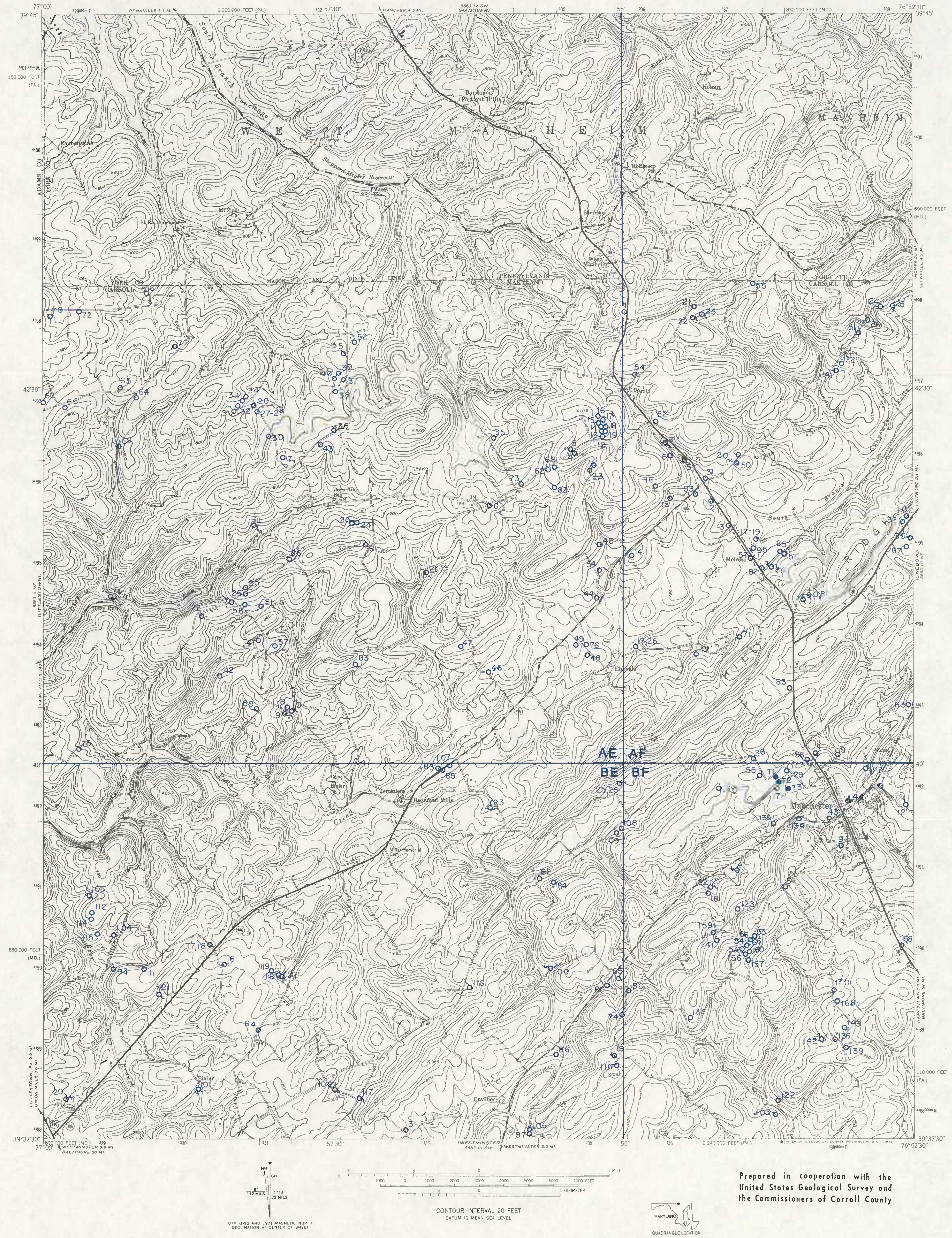
Cleaves, E. T., Edwards, Jonathan, Jr., and Glaser, J. D. (compilers and editors), 1968, Geologic Map of Maryland: Maryland Geological Survey, scale 1:250,000.

Meyer, Gerald, 1958, The ground-water resources, in The water resources of Carroll and Frederick Counties: Maryland Department of Geology, Mines and Water Resources 1/ Bulletin 22, p. 1-228.

1/ The name of this agency was changed to the Maryland Geological Survey in June 1964.

ADDITIONAL NOTE

Records of wells shown on this map are contained in:
Hilleary, J.T. and Weigle, J.M., 1982, Carroll County ground-water information: Well records, spring records and chemical quality data: Maryland Geological Survey, Basic Data Report No. 12, 252 p.



Prepored in cooperotion with the United States Geologicol Survey ond the Commissioners of Corroll County

1981

MAP 3. DEPTH TO THE WATER TABLE

Maryland Geological Survey Quadrangle Atlas No. 15

MANCHESTER QUADRANGLE: HYDROGEOLOGY

DEPTH TO THE WATER TABLE

By

Edmond G. Otton

EXPLANATION

This map shows the depth to the top of the permanent zone of saturation (water table), as indicated by well and spring records. However, in large part, the control for the areas underlain by a shallow water table (0 to 10 ft) was based on the analysis of the character of the drainage network on the topographic quadrangle. Control for the areas having depths to the water table of 35 ft or greater was based primarily on well records and on an analysis of topographic features. In some places temporary, perched zones of saturation may occur above the levels indicated on the map; these are not shown.

Ground-water levels, as measured in wells, fluctuate both seasonally and over longer periods in response to changes in frequency and amounts of infiltrating precipitation. Ground-water levels also fluctuate in response to withdrawal from wells, but, in the Manchester quadrangle, the effect of pumping from domestic wells is not widespread--such effects are normally confined to a few tens of feet from each well. The greatest seasonal fluctuation in the water table occurs beneath hills and uplands and the smallest in valleys and swales.

In general, ground-water levels are lowest in the fall and early winter and highest in the late winter and spring, but in some years the highs and lows may deviate from this pattern. Long-term annual fluctuations also may occur. The duration and magnitude of these fluctuations are shown by a statistical analysis of the 28-year record of the water level of observation well HO-BD 1, at Slacks Corner in Howard County (fig. 1). This well, 48 ft deep and ending in schistose or gneissic rocks, is 3 mi south of Carroll County and about 21 mi south of the boundary of this map. A graphic analysis of the water level in this well shows that several long-term cycles of high and low water levels occurred during the period 1946-74. These levels are the result of cyclic periods of precipitation in the Maryland Piedmont. The figure shows that a relatively dry period in the mid-1960's was followed by a wet period in the early 1970's, climaxed by the water year 1972-73, the wettest year on record in Maryland.

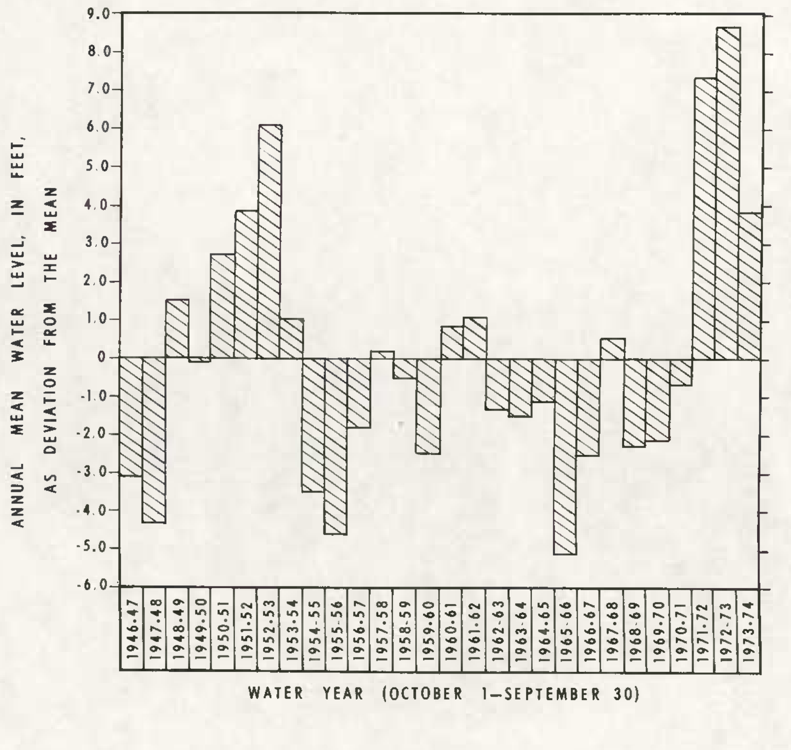


Figure 1. Deviations from mean annual water level during 1946-1976 in observation well HO-BD 1 at Slacks Corner, Md.

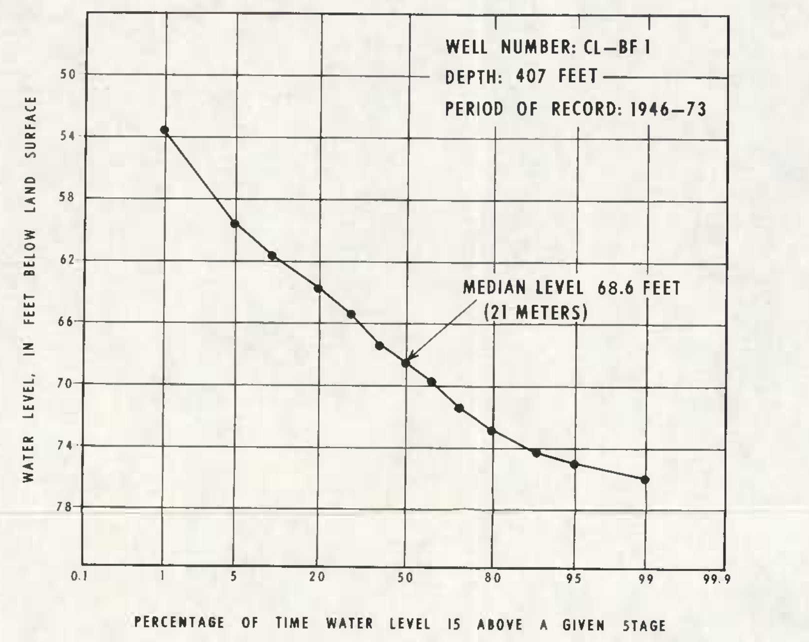


Figure 2. Stage-duration graph of the water level in observation well CL-BF 1 at Hampstead, Md.

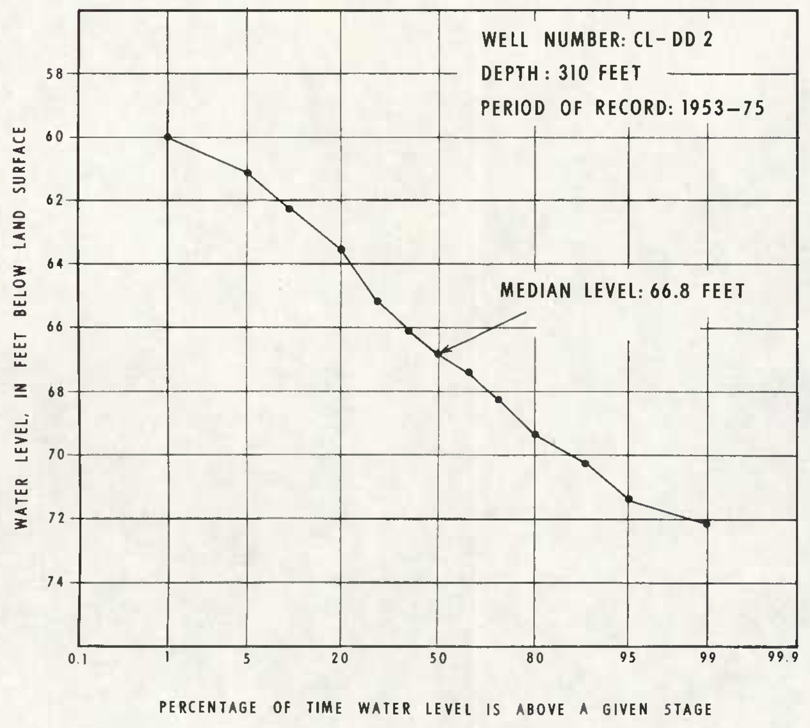


Figure 3. Stage-duration graph of the water level in observation well CL-DD 2 at Winfield, Md.

WATER LEVEL FLUCTUATIONS AT HAMPSTEAD

The magnitude of possible fluctuations in ground-water levels are shown by the record of observation well CL-BF 1 at Hampstead, Md., about 1.5 mi southeast of the southeast corner of the Manchester quadrangle. During the 28-year period 1946-73, the nonpumping water level in this well fluctuated throughout a range of 23.9 ft. The well is situated on a hilltop and yields water from schistose crystalline rocks. Figure 2 is a stage-duration graph of 280 water-level measurements made during the period of record.

WATER LEVEL FLUCTUATIONS AT WINFIELD

That long-term fluctuations in ground-water levels at some places may be somewhat greater or smaller than shown above is indicated by the 23-year record of observation well CL-DD 2 at the Winfield Elementary School, about 12 mi south of the Manchester quadrangle. Nonpumping water levels in this well during 1953-75 fluctuated throughout a range of 12.9 ft. Well CL-DD 2 is 305 ft deep, located on a hilltop, and penetrates crystalline schistose rocks. Figure 3 is a stage-duration graph of 247 water-level measurements during the period of record. Similar fluctuations might be expected in wells in the Manchester quadrangle where the geohydrologic environment is similar to that at the Winfield School.

WATER LEVEL FLUCTUATIONS IN VALLEYS

Much smaller fluctuations in ground-water levels occur in valleys and lowlands. Analysis of the record of observation well BA-EC 43 along a stream valley near Pikesville in Baltimore County showed a range of the nonpumping water level of only 3.4 ft during 1956-73 (Otton, 1975, Atlas Map. No. 6). Similar ranges in ground-water levels in valley and lowland areas may be expected in the Manchester quadrangle.

REFERENCE

Meyer, Gerald, 1958, The ground-water resources, in The water resources of Carroll and Frederick Counties: Maryland Department of Geology, Mines and Water Resources [1/] Bulletin 22, p. 1-228.

Otton and others, 1975, Cockeysville quadrangle: Geology, Hydrology, and mineral resources: Maryland Geological Survey Quadrangle Atlas No. 3, 8 maps, scale 1:24,000.

Richardson, C. A., 1980, Ground water in the Piedmont upland of central Maryland: U.S. Geological Survey Water-Resources Investigations 80-18, 42 p.

1/ The name of this agency was changed to the Maryland Geological Survey in June 1964.

APPROXIMATE DEPTH TO WATER TABLE BELOW LAND SURFACE

1981

Prepared in cooperation with the United States Geological Survey and the Commissioners of Carroll County

MANCHESTER QUADRANGLE: HYDROGEOLOGY
AVAILABILITY OF GROUND WATER

By
Edmond G. Otton

NATURE OF OCCURRENCE

Cround water in Garroll Gounty occurs chiefly in the fractures and other voids in the crystalline rocks; some ground water is present also in the residuum (decomposed rock), or saprolite, which forms a mantle of variable thickness over most of the bedrock. The source of almost all the water in the rocks is local precipitation amounting to about 43 in. per year.

Downward-moving water fills the voids and fractures in the rocks and their residuum forming a zone of saturation at variable depths beneath the land surface. The upper surface of the zone of saturation is the water table, or potentiometric surface. The position of this surface fluctuates with time in response to changes in the rate of replenishment of the saturated zone and to changes in the rate of removal of water from the zone. Ground water is added to the saturated zone by infiltrating precipitation and is removed from it by gravity flow to nearby streams, by pumping from wells, and by evapotranspiration where the roots of vegetation are sufficiently close to the saturated zone.

Where the rocks in the saturated zone are capable of yielding water to wells and springs, they are termed "aquifers." Aquifers differ widely in their ability to yield water. In the Piedmont region, some rocks appear to be better aquifers than others, depending, in part, on the nature and extent of their interconnected fractures and voids. Figure 1 is a generalized sketch showing ground-water occurrence and movement in a region underlain by crystalline rocks.

The yield of individual wells in the Manchester quadrangle depends on factors such as topographic position of the well, nature and thickness of the saprolite, and extent and degree of fracturing of the rocks at the well site. In general, the fractures and voids in the rocks disappear with increasing depth. An analysis of the depth of water-yielding fractures in 100 wells in the area, as reported by drillers, indicates that most of the ground water occurs in the uppermost 100 to 150 ft. The median depth of these wells is 152 ft. In fact, 70 percent of the water-bearing fractures occur in the uppermost 100 ft of the rocks. Figure 2 shows the occurrence of water-yielding fractures in depth intervals down to 350 ft, the greatest depth at which any fracture was reported.

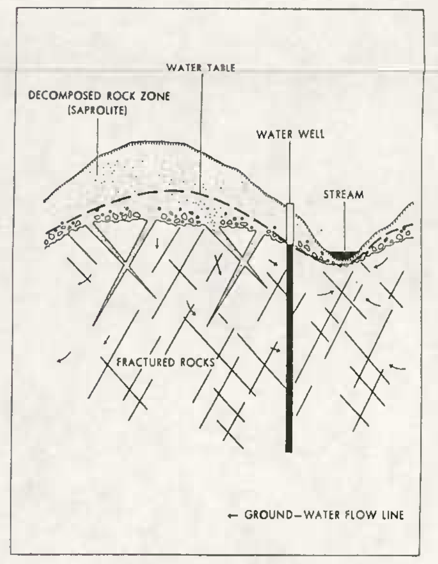


Figure 1. Occurrence and movement of ground water in Piedmont terrain.

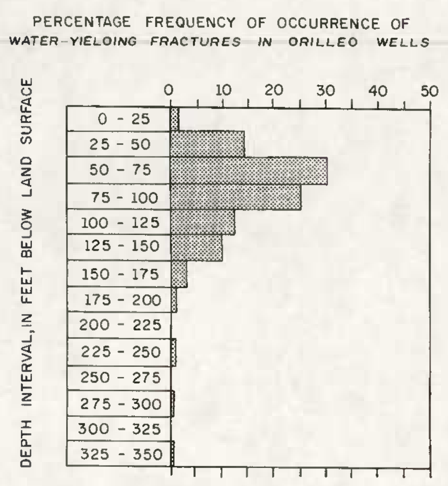


Figure 2. Frequency of water-yielding fractures in drilled wells.

Unfractured and unweathered metamorphic rocks are essentially impermeable and fractures or other voids are of limited extent and distribution. However, those rocks containing several intersecting fractures are more permeable and, therefore, most likely to yield more water. Accordingly, the distribution of fractures is a major factor governing the availability of water in these rocks. An analysis of topographic maps and aerial photographs shows linear features, some of which may trace major zones of rock fracturing. The orientation of many valleys and stream channels seems to be controlled by the zones of rock fracturing. Wells drilled in such zones may be expected to have above-average yields, but the rock permeability may still be relatively localized and of limited areal extent.

EXPLANATION

The rocks of the Manchester quadrangle are divided into three geohydrologic units according to their water-yielding characteristics. Although these units are part of a larger areawide classification scheme, the statistics given for each unit are derived chiefly from data pertaining to the quadrangle and, to some extent, with data from adjoining quadrangles.

GEOHYDROLOGIC UNIT 1, underlain by Coastal Plain sediments, is absent from the Manchester quadrangle, but is present in quadrangles 15 to 20 mi. to the southeast. The mapped units shown here are given in the order of their decreasing productivity, based on the median reported specific capacities of drilled wells. Thus, wells in Geohydrologic Unit 2 are generally more productive than wells in units 3 and 3A.

2

GEOHYDROLOGIC UNIT 2: Area underlain by the Bachman Valley Formation (unpublished name used by the Maryland Geological Survey), chiefly green to greenish-gray phyllite containing fine-grained quartzose laminae. In places, the formation consists of white to gray-streaked marble, and in other places it consists of calcitic phyllite and greenstone. The unit also underlies several narrow valleys underlain by highly weathered marble and thin greenstone and schist layers. These narrow valleys trend northeast-southwest and occur in areas underlain by both the Bachman Valley Formation and the Prettyboy Schist of Crowley (1976). Unit 2 also includes areas designated the Sams Creek Metabasalt on the geologic map of Maryland (Gleaves and others, 1968). Water-well logs show that in places the depth of weathering of the rocks exceeds 200 ft, although the average depth of weathering is much less than this, on the order of 25 to 50 ft.

WELL YIELDS AND DEPTHS: Unit 2 appears to be the most productive aquifer in the quadrangle. The reported yields 1/ of 19 wells range from 2 to 60 gal/min; the median yield is 13 gal/min.

The depths of 30 wells range from 67 to 305 ft and the median is 155 ft.

WELL SPECIFIC CAPACITIES: Reported specific capacities 2/ of 19 wells range from 0.01 to 2.1 (gal/min)/ft and the median value is 0.40 (gal/min)/ft.

Linear features which may be related to major zones of rock fracturing. Wells located on or near linear features may be expected to have yields above average for the geohydrologic unit.

3

GEOHYDROLOGIC UNIT 3: Area underlain by the Prettyboy Schist, a light green to greenish-gray to medium-dark-gray muscovite-chlorite phyllitic schist commonly containing veins and stringers of clear to milky-white quartz. In places, the rocks include minor zones of quartzite; nearly everywhere they sre intensely folded and cleaved. Unit 3 includes areas shown as the Wissahickon Formation (undivided) on the geologic map of Maryland (Cleaves and others, 1968).

WELL YIELDS AND DEPTHS: These rocks are moderately productive aquifers capable of furnishing only domestic supplies in many localities. The reported yields 1/ of 25 wells in the Manchester quadrangle range from 0 to 50 gal/min; the median yield of 25 wells is 6 gal/min. However, the range and median yield given above may not be completely representative as a few wells in the same formstion in the Hampstead area, a few miles southeast of the quadrangle, yield as much as 100 gal/min.

The depths of 63 wells range from 38 to 645 ft and the median depth is 155 ft.

WELL SPECIFIC CAPACITIES: Reported specific capacities of 25 wells range from 0.00 to 1.6 (gal/min)/ft of drawdown and the median value is 0.13 (gal/min)/ft.

3A

CEOHYDROLOGIC UNIT 3A: Area underlain by the Msrburg Formation (of former usage), commonly a greenish-gray to bluish-gray muscovite-chlorite phyllite, commonly contsining lenses and stringers of vein quartz. These rocks are intensely cleaved and folded and, in places, zones of irregularly distributed white quartzite are common. In places, metsconglomerate occurs in the Marburg Formation. Areas underlain by these rocks are characterized by a thin saprolite (weathered zone).

WELL YIELDS AND DEPTHS: Unit 3A appears to be the poorest aquifer in the area. The reported yields 1/ of 33 wells range from 0.5 to 30 gal/min; the median yield of these wells is 3 gal/min.

The depths of 45 wells range from 51 to 351 ft and the median depth is 150 ft, not significantly different from the median depth of wells in units 2 and 3.

WELL SPEGIFIG CAPAGITIES: Reported specific capacities 2/ of 33 wells range from 0.00 to 1.1 (gal/min)/ft of drawdown. The medisn value is 0.03 (gal/min)/ft.

SUMMARY OF GEOHYDROLOGY

In summary, the reported yields of 77 wells in the Manchester quadrangle range from 0 to 60 gal/min and the median is slightly more than 6 gal/min. Specific capacities of 77 wells range from 0.00 to 2.1 and the median value is about 0.10 (gal/min)/ft; depths of these wells range from 38 to 645 ft and the median depth is 152 ft.

The statistics given above may underestimate the maximum capabilities of these units because a large proportion of the data is from domestic wells. Because high yields are not necessary for domestic use, optimum sites are seldom selected. Thus, wells are commonly located on uplands and hilltops where conditions are less fsvorable for more productive wells than they are in valleys and lowlands. Furthermore, not all domestic wells are tested for their maximum capacity. Earlier studies of ground-water conditions in Carroll County (Meyer, 1958, p. 44) have indicated that the aversge yield of valley wells is more than twice as great as hilltop and hillside wells.

The following table summarizes the statistics concerning well characteristics in each of the geohydrologic units in the Manchester quadrangle:

Ceohydrologic unit	Well yields (gal/min)		Specific capacities (gal/min)/ft		Well depths (ft)	
	Range	Median	Range	Median	Range	Median
Unit 2	2-60	13	0.01-2.1	0.40	67-305	155
Unit 3	0-50	6	.00-1.6	.13	38-645	155
Unit 3A	0.5-30	3	.00-1.1	.03	51-351	150

SELECTED REFERENCES

Gleaves, E. T., Edwards, Jonathan, Jr., and Claser, J. D. (compilers and editors), 1968, Geologic map of Maryland: Maryland Geological Survey, scale 1:250,000.

Crowley, W. R., 1976, The geology of the crystalline rocks near Baltimore and its bearing on the evolution of the eastern Maryland Piedmont: Maryland Geological Survey Report of Investigations No. 27, 40 p.

Ferris, J. G., Knowles, B. B., Brown, R. H., and Stallman, R. W., 1962, Theory of aquifer tests: U.S. Geological Survey Water-Supply Paper 1536-E, 173 p.

Meyer, Gerald, 1958, The ground-water resources, in The water resources of Carroll and Frederick Counties: Maryland Department of Geology, Mines and Water Resources 3/ Bulletin 22, p. 1-228.

Nutter, L. J., 1974, Well yields in the bedrock aquifers of Maryland: Maryland Geological Survey Information Circular 16, 24 p.

Nutter, L. J., and Otton, E. G., 1969, Ground-water occurrence in the Maryland Piedmont: Maryland Geological Survey Report of Investigations 10, 56 p.

Stose, A. J., and Stose, C. W., 1946, Geology of Carroll and Frederick Counties, in The physical features of Carroll and Frederick Counties: Maryland Geological Survey, p. 11-128.

1/ Only wells for which the driller reported a yield test of 2 hours duration, or longer, were used in this analysis.

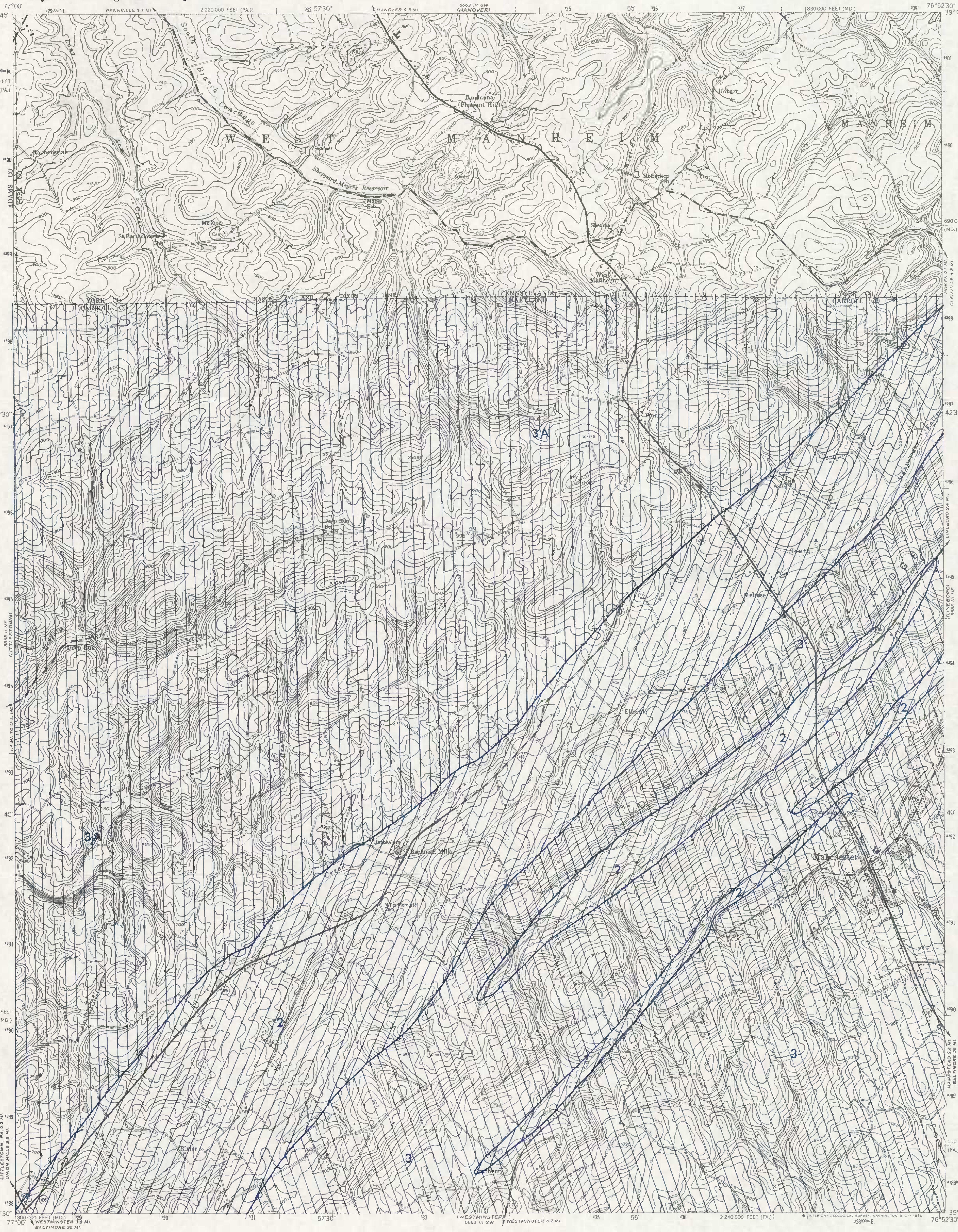
2/ Specific capacity of a well is the yield per foot of drawdown of the water level in the well. No time period is specified for the measurement of this variable, which is commonly expressed in gallons per minute per foot of drawdown [(gal/min)/ft]. For many domestic wells, the period of measurement ranges from 2 to 6 hours. Analyses include only wells tested for 2 hours or longer.

3/ The name of this agency was changed to the Maryland Geological Survey in June 1964.

Maryland Geological Survey

MAP 4. AVAILABILITY OF GROUND WATER

Quadrangle Atlas No. 15



CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL
1981

Prepared in cooperation with the United States Geological Survey and the Commissioners of Carroll County

MAP 5. GEOHYDROLOGIC CONSTRAINTS ON SEPTIC SYSTEMS

Maryland Geological Survey

Quadrangle Atlas No. 15

MANCHESTER QUADRANGLE: HYDROGEOLOGY

GEOHYDROLOGIC CONSTRAINTS ON SEPTIC SYSTEMS

By

Edmond G. Otton

EVALUATION OF UNITS

The units shown on this map differ in their suitability for domestic sewage disposal systems because of differences in flood hazard, depth to the water table, depth to bedrock, land slope, and differences in soil and subsoil infiltration characteristics. These elements are discussed below:

1. Flood hazard: Most valleys in the Manchester quadrangle are subject to periodic flooding. Floods would cause uncontrollable dispersal of sewage and possible physical damage to the disposal system.

2. Shallow water table: The 10-ft depth to the water table used as a constraint in this report is the sum of three component factors. These are: (a) The recommended depth of drain tile fields is 3 ft below the land surface (U.S. Department of Agriculture, Soil Conservation Service, 1971, p. 3); (b) a minimum depth of 4 ft between the base of the tile field (absorption trench) and the underlying water table is recommended (U.S. Public Health Service, 1967, p. 11); and (c) a 3-ft additional depth is suggested to allow for seasonal variations in position of the water table, which commonly fluctuates through at least a 3-ft range in Piedmont valleys.

3. Depth to bedrock: Where bedrock crops out or occurs near the land surface, the construction of underground disposal systems is not feasible; hence, the presence of rock is an obvious geologic constraint. Furthermore, the rapid movement of water through fractures in bedrock limits the opportunity for renovating the liquid sewage effluent.

4. Slope: Steep slopes are considered to be a major contributing cause of the failure of underground sewage disposal systems (U.S. Public Health Service; 1967, p. 18; and U.S. Department of Agriculture, Soil Conservation Service, 1971, p. 8). Land slopes in excess of 25 percent were obtained from a machine-generated slope map (Map 1). Maryland Department of Health regulations (July 1964, Section 1, definitions, part 1.9) do not permit, as of 1980, the installation of underground domestic sewage disposal systems where the slope of the land is in excess of 25 percent.

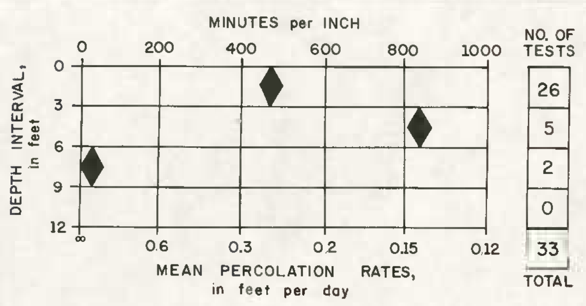
5. Infiltration rate: This factor affects the design of the disposal system. If infiltration into the soil is too slow, drainage will be sluggish and effluent may back up into the septic tank and to the household plumbing. If too fast, renovation of the liquid effluent may be inadequate and the ground water may be subject to pollution. In Maryland, infiltration rates are evaluated at the proposed disposal site by means of percolation tests.[1/]

These five factors are evaluated and synthesized in order to generate three units on the accompanying map. Thus, the terrain is classified according to its constraint or limitation for the installation of domestic underground sewage disposal systems. In the map preparation, considerable use was made of the soil survey of Carroll County (Matthews, 1969).

MAP UNITS

I — UNIT I (Maximum constraints): Disposal systems constructed in this unit face a high probability of failure. The unit includes low-lying valley-bottom areas subject to periodic flooding, areas where the depth to the permanent water table ranges from 0 to 10 ft, and areas where the slope of the land surface exceeds 25 percent. Unit I is underlain by stream alluvium, colluvium, and rocky land underlain by the various crystalline rock formations present in the quadrangle. The thickness of overburden on the steep slopes generally ranges from 0 to 5 ft.

Permanent swampy areas occur along some of the valley bottoms and the water table in these sites is at the land surface. These bottom areas are underlain mainly by Hatboro, Codorus, and Baile soils, consisting chiefly of silt loam and silty clay. Mt. Airy, Manor, and Glenelg soils occur along the steep slopes of the valley sides. Figure 1 shows the approximate mean percolation rates for three depth categories from 0 to 9 ft, based on 33 tests. These relatively few tests show that slow infiltration rates commonly occur at depths above 6 ft, and that much faster rates occur at depths below 6 ft.

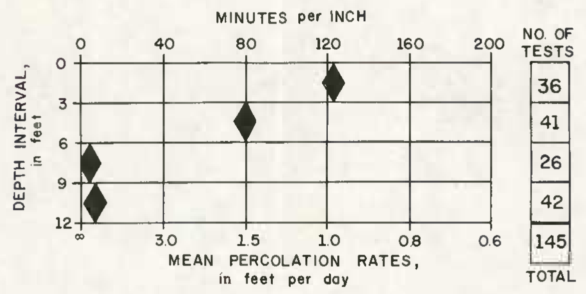


UNIT II: This unit includes areas underlain by maroon to reddish brown shale and siltstone with some sandstone, comprising the New Oxford Formation. It has relatively thin soil and subsoil having low percolation rates. Unit II is not present in the Manchester quadrangle, but is present in quadrangles immediately to the west and southwest.

III — UNIT III (Marginal to variable constraints): The unit includes areas underlain by green to bluish gray phyllite and greenstone with subordinate amounts of quartzite. In some places, white to reddish marble is present in beds several tens of feet thick. The marble and interspersed greenstone characteristically occupy narrow valleys trending northeast-southwest across the area. Unit III is underlain by the Bachman Valley Formation (unpublished name used by the Maryland Geological Survey), and, near Maple Grove and Millers, by deeply weathered rocks (probably marble) in the Prettyboy Schist of Crowley (1976). The Bachman Valley Formation consists of bands of marble interlayered with phyllitic greenstone. Locally, the marble weathers to a dark red clayey loam. The overburden in this unit commonly is a reddish brown to tan clayey loam. Depths of weathering may be several tens of feet, but at a test boring near Millers, the weathered zone was more than 200 ft thick, an exceptional thickness. Depth to the water table commonly ranges from 10 to 35 ft. Slopes of the land surface are generally less than 25 percent and, in some places, less than 15 percent.

Soils in this unit include Baile silt loam, Mt. Airy channery loam, Glenelg channery loam, and Glenville silt loam. Within the overburden of Unit III, a wide range in infiltration characteristics may occur. More than half the percolation tests failed due to infiltration rates that were too slow.

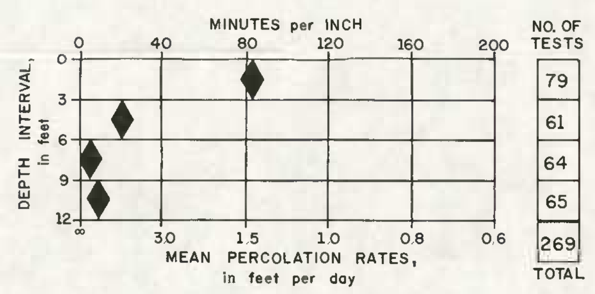
The mean infiltration rates in unit III, as shown in figure 2, indicate that the lowest rates (longest times) are in the clayey loam in the depth interval 3 to 6 ft, and the highest rates (shortest times) are in the permeable, fractured, phyllitic, channery zones in the depth interval from 6 to 12 ft. However, in some of the valleys, poorly permeable clayey loam occurs at depths of more than 10 ft. Figure 2 shows the approximate mean percolation rates for four depth categories in Unit III, based on 145 tests.



IV — UNIT IV (Minimum constraints): This unit includes areas underlain by green to greenish gray phyllite of the Marburg Formation (of former usage), and by gray to bluish gray schist of the Prettyboy Schist. Whitish quartz veins and lenses are common in both formations. These complexly folded, highly metamorphosed rocks strike northeast across the Manchester quadrangle. In places, as along Dug Hill Ridge, the quartzose zones form well-defined ridges and hills. Depths of the weathered zone range from 0 to 225 ft, and average about 25 ft in the Marburg Formation and about 37 ft in the Prettyboy Schist (Meyer, 1958, p. 46).

Soils in Unit IV include the Mt. Airy channery loam, Glenelg loam and Glenelg channery loam, Chester silt loam, Manor gravelly loam, and Glenville silt loam.

Figure 3 shows the mean infiltration rates by depth intervals of the overburden in Unit IV. These rates are similar to those of Unit III, except for the somewhat faster rates (shorter times) for the depth interval, 0-3 ft. About 30 percent of the percolation tests failed due to too slow infiltration rates. The significance of figure 3 is that it shows that most of the percolation tests in the depth interval from 3 to 12 ft permit rapid passage of the effluent into the underlying rocks. Thus, the effectiveness of the subsoil in renovating the effluent before it enters the underlying crystalline-rock aquifers is questionable and the potential exists for pollution of nearby wells and springs.



REFERENCES

Cleaves, E. T., Edwards, Jonathan, Jr., and Glaser, J. D. (compilers and editors), 1968, Geologic map of Maryland: Maryland Geological Survey, scale 1:250,000.

Crowley, W. R., 1976, The geology of the crystalline rocks near Baltimore and its bearing on the evolution of the eastern Maryland Piedmont: Maryland Geological Survey Report of Investigations No. 27, 40 p.

Matthews, Earle D., 1969, Soil Survey of Carroll County, Maryland: U.S. Department of Agriculture, Soil Conservation Service, 95 p.

Meyer, Gerald, 1958, The ground-water resources, in The water resources of Carroll and Frederick Counties: Maryland Department of Geology, Mines and Water Resources [2/] Bulletin 22, p. 1-228.

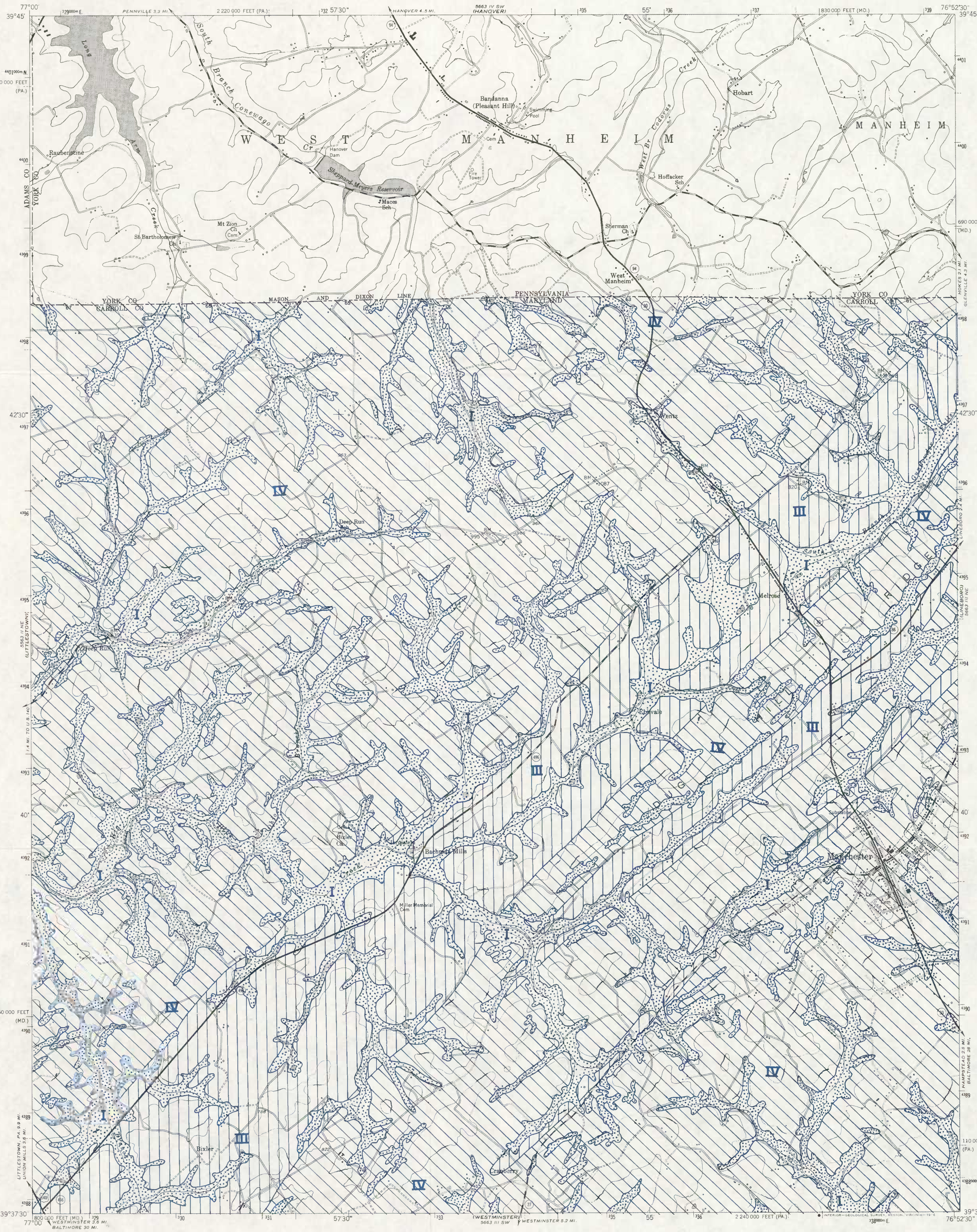
University of Maryland, Maryland State Roads Commission, U.S. Bureau of Public Roads, 1963, Engineering soil map of Carroll County, scale 1:62,500, 1 sheet.

U.S. Department of Agriculture, Soil Conservation Service, 1971, Soils and septic tanks: Agriculture Information Bulletin 349, 12 p.

U.S. Public Health Service, 1967 revised, Manual of septic-tank practice: 92 p.

1/ The standard percolation test in the Maryland Piedmont counties (1979) is performed as follows: A 2- to 3-ft-wide pit is dug to the depth to be tested, and a 1-ft-square hole is hand-excavated on the floor of the pit. The 1-ft deep hole is filled with water, and the time required for the water to drop the second inch of a 2-in. decline is measured. To be rated as "passing" or successful, the rate of drop of the water level must be between 2 and 30 minutes per inch. Declines of the water level at rates too fast or too slow are the basis for rejection of the unit of land sampled by the test. Also, the presence of shallow ground water or rock ledges is an additional basis for rejection of the test site. Where clayey or other nearly impervious materials are encountered in a test pit, the actual test may not be done, based on the judgment of the sanitarian making the test. If a test is unsuccessful, another test may be made at a different depth or at another site on the lot or tract.

2/ The name of this agency was changed to the Maryland Geological Survey in June 1964.



Contour interval 100 feet

UTM GRID AND 1975 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

QUADRANGLE LOCATION

Prepared in cooperation with the United States Geological Survey and the Commissioners of Carroll County

1981