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THE WATER RESOURCES OF ALLEGANY AND WASHINGTON COUNTIES

THE GROUND-WATER RESOURCES

By Turbit H. Slaughter

THE SURFACE-WATER RESOURCES

By John M. Darling

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THE WATER RESOURCES OF ALLEGANY AND WASHINGTON COUNTIES

The Ground-Water Resources

BY

TURBIT H. SLAUGHTER

ABSTRACT

Allegany and Washington Counties have a combined area of 883 square miles and had a population of approximately 175,000 in 1960. The area includes a small part of the Blue Ridge physiographic province, all of the Ridge and Valley province, and part of the Appalachian Plateau province.

The area is underlain by rocks ranging in age from granitic gneiss, metabasalt, and metamorphosed shale and sandstone of the Precambrian and Cambrian systems through limestone, shale, and sandstone of the younger rock systems of Paleozoic age. Thin surficial deposits of the Quaternary and Recent systems are present along the Potomac River and its tributaries. All of the formations are aquifers, at least locally.

The area has been subdivided into seven ground-water provinces (or water provinces) on the basis of differences in physiography and geology. They are from east to west: (1) South Mountain-Elk Ridge, (2) Hagerstown Valley, (3) Hancock-Indian Springs, (4) Warrior-Evitts Mountains, (5) Sideling Hill-Town Creek, (6) Cumberland, and (7) Georges Creek basin.

The area has a humid, temperate climate. The mean annual temperature is 53°F and the mean annual precipitation is about 40 inches.

The average daily use of ground water from wells and springs in 1959 was estimated to have been about 7.2 mgd (million gallons per day), which is less than 2 percent of the ultimate quantity, about 400 mgd, estimated to be available on a sustained basis.

The best aquifers are the limestones of the Hagerstown Valley, where locally wells yield as much as 400 gpm. In other sections sandstone yields as much as 200 gpm and shale as much as 50 gpm to wells. Not everywhere are the rocks good aquifers. In a few places even domestic ground-water supplies are difficult to obtain.

Periodic measurements of water-level fluctuations in observation wells since 1947 have indicated no general declining or rising trend in water levels. As of 1960, no known water-supply problems exist as a result of heavy pumping from aquifers.

The chemical quality of the water is variable but is generally suitable for most purposes. In the areas underlain by limestone the hardness of the water

ranges from 12 to 730 ppm. This water is considered "hard". Locally, the iron content of the water is sufficiently high to necessitate treatment. In the Cumberland and Georges Creek basin water provinces, water containing more than 200 ppm of chloride occurs in some wells deeper than 500 feet. At places in the Georges Creek basin, the pH of the ground water is less than 6.0 and the sulfate and iron contents are high, 455 ppm and 6.5 ppm, respectively, as a result of mine drainage.

The mean temperature of water from shallow sources approximates the mean annual atmospheric temperature of 53°F. Temperature logs of deep wells indicate that the water near the surface is warmer in the western part of the area, than it is in the eastern part. Temperature logs of deep wells indicate that the reciprocal geothermal gradients to depths of about 500 feet range from about 106 feet to 353 feet per °F.

INTRODUCTION

Location of the Area

Allegany and Washington Counties are in western Maryland (fig. 1). They are separated by Sideling Hill Creek. They are bounded on the north by the Pennsylvania State line and on the south by the Potomac River. Allegany County is bordered on the west by Garrett County and Washington County is bordered on the east by Frederick County. The counties lie between north latitudes 39°15′ and 39°45′, and between west longitudes 77°15′ and 79°05′.

Purpose and Scope of Investigation

The investigation was made to obtain information on the occurrence, availability, quantity, and quality of ground water in Allegany and Washington Counties. It is one of a series made by the United States Geological Survey in cooperation with the Maryland Department of Geology, Mines and Water Resources.

The investigation included an inventory of 1,396 wells and 308 springs. Discharge measurements were made of 49 springs by current meters and weirs. Temperature logs were made on 27 wells, and electric log and current-meter surveys were made on three wells. Aquifer tests were conducted to determine the hydrologic properties of the geologic formations. Fluctuations of ground-water levels were measured in 14 wells by continuous water-level recorders or by periodic hand tape measurements.

Chemical analyses of water samples from 94 wells and 24 springs were made by the U. S. Geological Survey. Analyses of water from 9 wells were obtained from other sources.

Previous Investigations

The earliest systematic ground-water investigation of Allegany and Washington Counties was made in 1916 by the Maryland Geological Survey (Clark

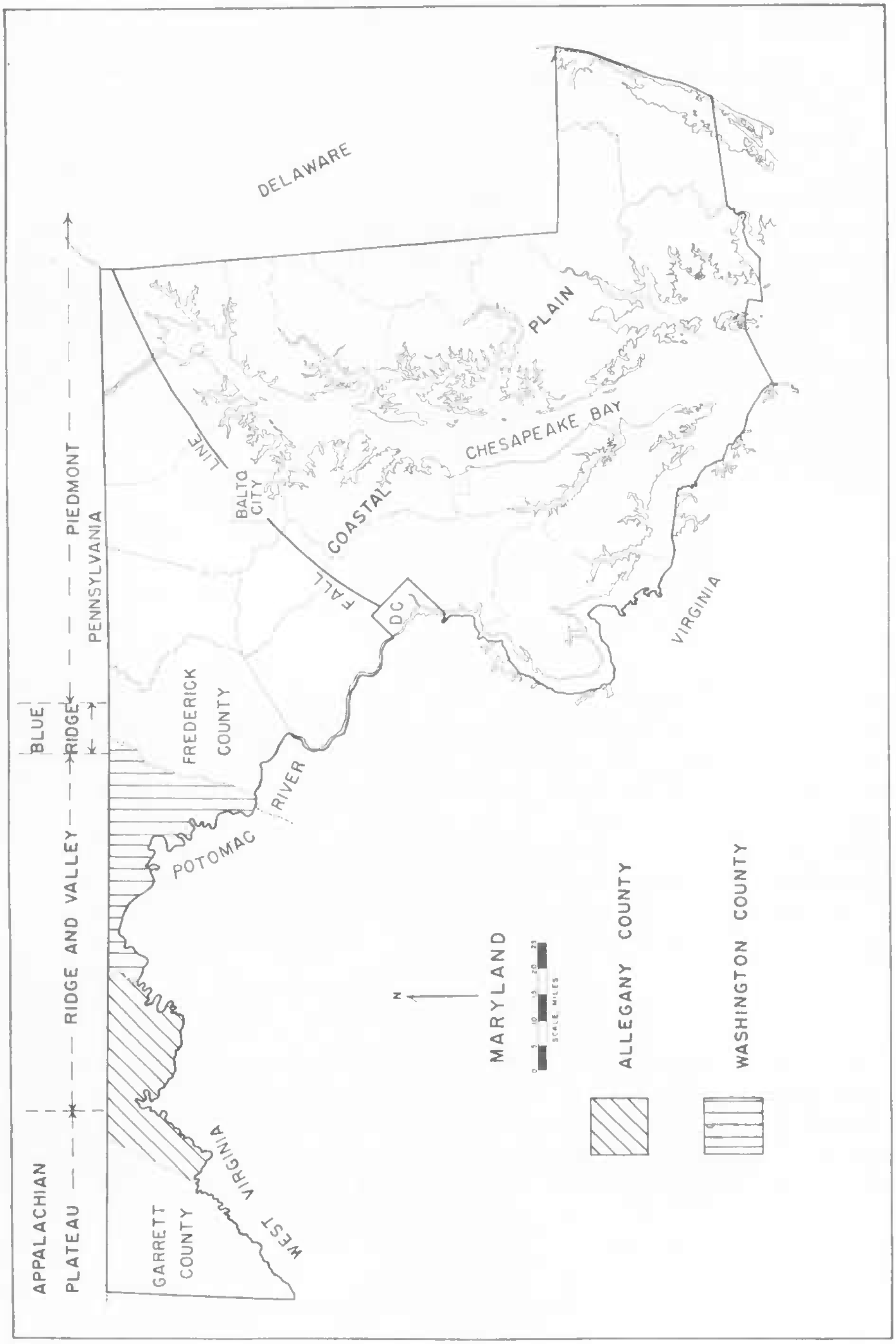

FIGURE 1. Map of Maryland Showing the Physiographic Provinces and the Location of Allegany and Washington Counties

and others, 1918, p. 450–467). Ground water in Washington County was reviewed by Cloos (1951, p. 179–193). Ground-water conditions in the western part of Allegany County are discussed in a memorandum report by Bennett, LeFever, Martin, and Otton (1950).

An investigation of coal beds of Lower Pennsylvanian age in the Georges Creek basin of Allegany County by the U. S. Bureau of Mines (Waagé, 1949) provided information concerning ground-water conditions in this basin. Descriptions of springs flowing from caves in Allegany and Washington Counties are included in a report on the caves of Maryland by Davies (1950).

Additional ground-water data were obtained from investigations by private industrial interests. During 1930–31, the Celanese Corp. of America drilled a 952-foot test well at Cresaptown, Allegany County, to determine the availability of ground water at the plant site. The results were summarized in an unpublished memorandum. In 1948, Patrick prepared a report describing the results of a 2,379-foot test well drilled at Luke, Allegany County, by the West Virginia Pulp and Paper Co. in exploration for salt deposits.

Acknowledgments

The interest and cooperation of individual property owners, well drillers, local industries, town and city officials, county and state health departments, and federal agencies is gratefully acknowledged. Richard C. Willson, Superintendent of the Hagerstown Water Department, greatly facilitated the collection of spring data in Washington County. The assistance by personnel of the Maryland Game and Inland Fish Commission in the construction and operation of a weir at the Beaver Creek Trout Hatchery in Washington County is appreciated.

The investigation was made under the immediate supervision of E. G. Otton, District Geologist, in charge of cooperative ground-water investigations in Maryland. Charles P. Laughlin, engineering aid of the Geological Survey, assisted in the fieldwork.

Population and Economy

The 1960 census showed that Allegany and Washington Counties had a population of about 175,000, divided approximately equally between the counties. Almost 40 percent of the population was in the major city of each county—Cumberland in Allegany County and Hagerstown in Washington County. The U. S. Bureau of the Census figures for 1960 population are:

Allegany County	84,169
City of Cumberland	33,415
Washington County	91,219
City of Hagerstown	36,660

The counties are about equal in size but are dissimilar in forested and farm area, as shown below:

	Allegany County (acres)	Washington County (acres)
Land area (approximate)	272,000	296,000
Forest area, 1949	150,000	77,000
Farm area, 1949	122,000	219,000

The economy of Allegany County is based chiefly on manufacturing and mining, although general farming and fruit growing are also important. In Washington County, the economy is divided between manufacturing, mining, and farming. Most of the manufacturing is in or near the largest city in each county. Table 1 compares some aspects of the economy of the two counties.

In Allegany County, 187,713 net tons of coal, 43,395 net tons of fire clay, and 45,750 tons of glass sand were produced during 1958. In Washington County, approximately 1,500,000 tons of limestone were quarried for crushed stone and manufacture of cement and 82,000 tons of shale were quarried for brick manufacture during 1958.

Allegany and Washington Counties are traversed by a national highway, U. S. Route 40, and by an excellent network of roads carrying traffic north and south to the neighboring states of Pennsylvania, West Virginia, and Virginia. Railroads serve the major industrial areas of both counties. Air transportation is available from Cumberland and Hagerstown on major air lines.

Physiography

Allegany and Washington Counties lie within the Appalachian Highlands division of North America, which from east to west comprises the Blue Ridge, the Ridge and Valley, and the Appalachian Plateau physiographic provinces (fig. 1).

TABLE 1

Economic Statistics of Allegany and Washington Counties

	Allegany County	Washington County
Number of farms, 1950	974	2,025
Number of farms, 1954	864	1,934
Manufactures, 1947	$45,810,000	$26,306,000
Persons employed, 1950		
Agriculture	801	2,685
Mining	674	107
Manufacturing	9,200	10,004
Total employment	28,405	29,925
Forest products, 1949		
Lumber cut in board feet	5,720,551	2,094,089

The Blue Ridge province includes South Mountain, whose crest forms the eastern boundary of Washington County; Elk Ridge, which lies to the west of South Mountain in the extreme southeastern part of Washington County; and Pleasant Valley, which lies between them. The average altitude of South Mountain is about 1,600 feet and of Elk Ridge about 1,400 feet.

The Ridge and Valley province extends from South Mountain and Elk Ridge westward for 65 miles to Dans, Piney, and Little Allegheny Mountains in Allegany County. The Ridge and Valley province is subdivided into the Hagerstown Valley division and the Ridge division.

The Hagerstown Valley lies immediately west of South Mountain and Elk Ridge and extends westward about 18 miles to Fairview and Powell Mountains. The topography of the valley floor is nearly level or consists of low rolling hills and valleys. The altitude ranges from 800 feet in the north to 400 feet in the south, sloping gently toward the Potomac River.

The eastern boundary of the Ridge division is formed by Fairview and Powell Mountains, which are part of a local group of hills known as the Bear Pond Mountains. The altitude of Fairview and Powell Mountains is about 1,500 feet. West of these mountains for about 14 miles, altitude is uniformly about 600 feet. The area of uniform ridge crests begins 5 miles west of Hancock at Sideling Hill (altitude 1,500 feet). The uniform altitude of the tops of the ridges is probably due to erosion nearly to base level of an ancient higher land mass. This ancient surface of slight relief and gentle slopes is called the Schooley peneplain. The ridges lie in a parallel northeastern alignment from the northern to the southern boundary of Allegany County where they are cut through by the North Branch of the Potomac River. Narrow lowlands, the widest of which is between Green Ridge and Warrior Mountain in Allegany County, lie between the ridges. Steep-sided, narrow valleys form the lowlands between Warrior Mountain and the Evitts-Irons Mountains. The next major lowland to the west is the Cumberland Valley, which is bordered on the east by Irons and Evitts Mountains and on the west by Wills Mountain. The Cumberland Valley extends northward into Pennsylvania. The westernmost lowland of the Ridge division lies between Haystack-Wills Mountain and the Dans-Piney-Little Allegheny Mountain chain and continues southward as the broad North Branch of the Potomac River valley between Dans Mountain and Knobly Mountain in West Virginia. A small valley is between Fort Hill and Dans Mountain farther to the west.

The eastern boundary of the Appalachian Plateau province is sharply defined by the tops of Dans, Piney, and Little Allegheny Mountains. In Allegany County, the Appalachian Plateau province is represented by most of the Georges Creek basin. This basin consists of a dissected syncline drained by a tributary of the Potomac River. Altitudes range from less than 1,000 feet near the Potomac River to nearly 2,000 feet near the Pennsylvania line. Altitudes of the Dans Mountain chain range from 2,000 feet in the northern part to 2,700 feet in the southern part. The altitude of Savage and Big Savage Mountains is approximately 2,900 feet. The Appalachian Plateau province extends westward outside the boundaries of Maryland.

Climate

The climate of the counties is temperate and moderately humid. The mean annual temperature is 52.9°F and the mean annual precipitation is 38.78 inches. The climate of the area is influenced by the height and width of the mountain barriers which modify the large air masses moving eastward and is reflected by the character of the soil and the vegetative covering. The average annual precipitation and temperature at weather stations in the area is shown in Table 2. The climate of Washington County has been more fully described by Brancato (1951, p. 254–266).

TABLE 2

Average Annual Precipitation and Temperature Through 1958 for U. S. Weather Bureau Stations in Allegany and Washington Counties

Station	Altitude (feet)	Precipitation		Temperature	
		(inches)	Years of record	°F	Years of record
Cumberland	945	34.65	88	53.0	88
Cumberland Police Barrack	970	40.18	11	51.8	11
Fostburg	2,035	41.37	57	50.9	57
Picardy	1,030	37.18	32	53.2	32
Westernport	1,000	40.24	65	53.9	65
Allegany County average	—	38.72	—	52.7	—
Chewsville	560	37.47	61	52.8	61
Clear Spring	580	40.80	59	52.4	59
Edgemont	905	41.27	20	—	—
Green Spring Furnace[a]	450	37.06	24	53.0	24
Hagerstown	660	38.61	17	54.1	17
Hancock Fruit Laboratory	428	36.09	25	52.9	25
Keedysville	420	38.78	55	54.6	55
Hagerstown reservoir at Smithsburg[b]	800	41.63	14	—	—
Tonoloway[c]	550	37.51	32	52.8	32
Williamsport	360	39.23	20	—	—
Washington County average	—	38.84	—	53.2	—

[a] Record terminated in 1917.
[b] Not a regular reporting station of the U. S. Weather Bureau.
[c] Record terminated in 1957.

Drainage

Allegany and Washington Counties are drained by southerly flowing tributaries of the Potomac River and its North Branch. With the exception of Georges Creek, the major tributaries originate in Pennsylvania. The streasm generally parallel the trend of the ridges, but in some places they cut across the ridges. The most notable example is Wills Creek, which has incised the Cumberland gap through Wills Mountain. The streams which flow across the trend of the ridges and the strike of the rocks probably existed before the Appalachian Mountains were formed. Such streams maintained their courses during the period of mountain building and cut through the rocks as they were uplifted.

Well-Numbering System

The inventoried wells and springs in Allegany and Washington Counties are located by number within 5-minute quadrangles of latitude and longitude (Pls. 1 and 2). The quadrangles are designated alphabetically from the top of the map to the bottom by capital letters and from the left of the map to the right by lower case letters. Wells and springs are assigned consecutive numbers preceded by the alphabetical designation of the quadrangle in which they are located. Where confusion might occur concerning wells located in different counties, an alphabetical abbreviation of the county name is used. For example, well All-Bd 2 is the second well inventoried in the "Bd" 5-minute quadrangle in Allegany County.

Where a second well number is used in the report for a well, it is designated by the prefix "P", such as P 100. This designation is the number of a well permit issued to the driller by the Department of Geology, Mines and Water Resources.

Some places and features to which reference is made in the text of this report, especially in the sections describing the geology, are shown only on Plates 1 and 2.

REGIONAL GEOLOGY

The rocks of the Appalachian Highlands provinces are of Precambrian, Paleozoic, and Quaternary age. The maximum estimated thickness of the Precambrian and Paleozoic rocks is 1,000 and 38,000 feet, respectively. The surficial Quaternary deposits have a maximum known thickness of 140 feet. The geologic formations, their range in thickness, and their water-bearing properties are listed in Table 3. The Precambrian strata consist mainly of highly altered granitic gneisses and volcanic rocks; the Paleozoic strata consist chiefly of shales, sandstones, and limestones. Approximately 50 percent of the surficial rocks in the two counties is shale, 80 percent of which is in Allegany

County and 20 percent in Washington County. About 35 percent of the surficial rocks is limestone and dolomite, of which 14 percent is in Allegany County and 86 percent in Washington County. The remaining 15 percent of the surficial rocks is sandstone, ironstone, and other rock types. Plates 1 and 2 show the distribution of the mappable units. The generalized structural geology of the counties is shown on Plate 4, figure 1.

The two counties are divided into seven "ground-water provinces" based on major physiographic and geologic features. The location and extent of these provinces are shown on figure 2.

Blue Ridge Province

The part of the Blue Ridge physiographic province in Washington County averages about 3 miles in width. It is underlain by highly metamorphosed Precambrian granitic gneiss and metabasalt, and metamorphosed Cambrian shale and sandstone. The principal structural feature in this area is the South Mountain anticline. The anticline is overturned to the west and is a part of the complex South Mountain anticlinorium (Cloos, 1947, p. 857). The structural influence of this feature extends westward some 7 or 8 miles along a line paralleling the general strike of the rocks (Pl. 2 and fig. 5). The segment of the Blue Ridge province lying within Washington County is termed the South Mountain-Elk Ridge water province (fig. 2).

Ridge and Valley Province

The Ridge and Valley physiographic province includes most of Allegany and Washington Counties. This province has been divided from east to west into the following water provinces: Hagerstown Valley, Hancock-Indian Springs, Sideling Hill-Town Creek, Warrior-Evitts Mountains, and Cumberland (fig. 2).

The Hagerstown Valley water province averages about 18 miles in width and is underlain by Cambrian and Ordovician limestone, dolomite, and shale. Its western boundary is at the base of the eastern slope of Fairview and Powell Mountains, and is marked by two major reverse faults that have thrown Upper Cambrian limestones against Ordovician, Silurian, and Devonian formations. The mapping of the Beekmantown group by Sando (1957) shows steeply dipping faults in the limestone and dolomite formations. The Hagerstown Valley water province includes part of the west flank of the South Mountain anticlinorium and the Massanutten synclinorium (Cloos, 1951, p. 124).

The Hancock-Indian Springs water province extends from Fairview and Powell Mountains westward about 19 miles to the base of the eastern slope of Sideling Hill. The Martinsburg shale and the Juniata formation of the Ordovician system and the entire Silurian and the Devonian systems underlie this province. Shales are the most widely distributed rock type; sandstones are

TABLE 3

Water-bearing Properties of Geologic Units in Allegany and Washington Counties

Era	System	Group and series	Geologic unit	Range in thickness (feet)		Lithology	Water-bearing characteristics
				Allegany Co.	Washington Co.		
Cenozoic	Quaternary	Recent and Pleistocene	Mountain wash	—	0–140+	Sand, silt, gravel, cobbles, and boulders	Yields up to 15 gpm locally to drilled wells along west slope of South Mountain.
			River alluvium	0–42±	0–27±	Clay, silt, and fine sand with some gravel	Unimportant as an aquifer. Augering disclosed mostly fine, silty sand of low permeability.
Paleozoic	Permian		Undifferentiated strata	250–370		Shale, siltstone, sandstone, and lenticular limestone	Caps isolated hills in western part of area; unimportant as an aquifer.
	Pennsylvanian		Monongahela formation	370–375		Shale, clayey limestone, sandstone, and coal	Yields up to 20 gpm in valleys and draws; water locally high in iron content.
			Conemaugh formation	900		Shale, clayey limestone, clay, sandstone, and coal	Yields up to 60 gpm; water locally high in iron content and generally hard.
			Pottsville and Allegheny formations undifferentiated	300–600		Shale, sandstone, and coal	Yields up to 170 gpm from deep wells which may obtain water from Conemaugh formation also; units of limited areal extent.
	Mississippian		Mauch Chunk shale	650–700		Shale, mudstone, and sandstone	Unimportant as an aquifer, but yields up to 12 gpm or more in a few wells; formation of small areal extent.
			Greenbrier limestone	240–250		Sandy limestone, shale, mudstone, and sandstone	Unimportant as an aquifer.
			Pocono formation	250–1,750	540+	Sandstone, some shale and mudstone	Yields up to 65 gpm to wells in valleys in Allegany County; unimportant as an aquifer in Washington County.

Paleozoic	Devonian		Hampshire formation	1,630–2,400	2,400–3,800	Shale, mudstone, silt and sandstone	Yields up to 5 gpm in Allegany County and up to 25 gpm in Washington County; quality of water suitable generally for most uses.
			Jennings formation	3,000–4,800	4,000+	Shale, siltstone, and conglomeratic sandstone	Yields up to 50 gpm in Allegany County and up to 40 gpm in Washington County; water generally irony and hard.
			Romney shale	350–1,660	1,650±	Shale, mud, and siltstone	Yields up to 20 gpm in Allegany County and up to 40 gpm in Washington County; water is very irony in places and hard.
			Oriskany sandstone	300–350	50–420	Conglomeratic sandstone and cherty siltstone	Yields up to 120 gpm in Allegany County. In Washington County formation is of small areal extent and water is somewhat hard; largest spring in State issues from this unit.
			Helderberg limestone	350	290+	Limestone and chert, thick bedded	Yields up to 400 gpm in Allegany County where underlying formation is tapped also; yields only 10 gpm in Washington County, but is of limited areal extent; water low in iron content, but is hard and sometimes high in sulfate.
	Silurian		Tonoloway limestone	660	400+	Limestone, thin bedded	Yields up to 170 gpm in Allegany County where wells also tap the underlying Wills Creek shale; yields only 20 gpm in Washington County, and is of limited areal extent; water is low in iron content but hard.
			Wills Creek shale	450	600+	Shale, some limestone, and sandstone	Yields up to 130 gpm in Allegany County and up to 70 in Washington County. In Allegany County water is irony, and high in sulfate and locally in chloride; in Washington County water is hard.
			McKenzie formation	240	160+	Calcareous shale, clayey limestone, and sandstone	Yields up to 5 gpm in Allegany County; yields only 20 gpm in Washington County; is of limited areal extent in both Counties.

TABLE 3—*Continued*

Era	System	Group and series	Geologic unit	Range in thickness (feet)		Lithology	Water-bearing characteristics
				Allegany Co.	Washington Co.		
Paleozoic	Silurian (continued)		Rose Hill formation	550	300–400+	Shale, sandstone, ironstone, and limestone	Yields up to 15 gpm in Allegany County but is unimportant as an aquifer in Washington County; water is generally irony and hard.
			Tuscarora sandstone	380	60+	Sandstone, commonly hard, dense, massive	Yields up to 10 gpm in Allegany County, but is unimportant as an aquifer in Washington County; water is soft and slightly acidic.
	Ordovician		Juniata formation	530	180+	Shale, siltstone, and sandstone	Unimportant as an aquifer in both Counties because of its limited areal extent.
			Martinsburg shale		2,500±	Shale, with carbonaceous and sandy layers	Yields up to 50 gpm; water of variable hardness and suitable for most uses.
			Chambersburg limestone		100–225	Limestone, clayey limestone, thin bedded	Yields up to 20 gpm; unit of limited areal extent; large springs common.
		St. Paul	St. Paul group		400–1,000	Limestone and cherty limestone, thick bedded	Unimportant as an aquifer because of limited areal extent; yields up to 6 gpm.
		Beekmantown	Pinesburg Station dolomite		370–500	Cherty dolomite	Yields up to 25 gpm; of limited areal extent.
			Rockdale Run formation		1,685–2,555	Limestone and dolomitic limestone, some argillaceous limestone	Yields up to 60 gpm; water is commonly hard and low in iron content; locally is high in sulfate and nitrate; large springs common.
			Stonehenge limestone		500–880	Limestone, massive, clayey limestone and thin conglomeratic beds	Yields about 400 gpm from large-diameter wells; water is low in iron content but hard; large springs common.

Paleozoic	Cambrian		Conococheague limestone		2,000–2,600	Limestone, some massive dolomite and conglomeratic sandstone beds	Yields up to 400 gpm from large-diameter wells; water is low in iron and is hard; locally high in sulfate; large springs common.
			Elbrook limestone		2,000–3,000	Limestone, shaly and calcareous shale	Yields up to 35 gpm to wells; water is hard; largest spring in Washington County issues from this formation.
			Waynesboro formation		590–1,000	Shale, sandstone, and interbedded dolomite and shale	Unimportant as an aquifer because of limited areal extent; yields up to 20 gpm to wells; chemical quality of water is good; hardness variable
			Tomstown dolomite		1,000+	Dolomite and limestone, thick to thin bedded	Yields up to 300 gpm; water is hard and iron content variable; large springs common.
			Antietam quartzite		500	Sandstone, hard, dense	Yields only about 5 gpm; wells near the contact of the Antietam and Tomstown formations yield up to 25 gpm.
			Harpers formation		1,200–3,100	Shale and sandstone altered to schist and slate	Yields up to 20 gpm in valleys and draws; water is slightly irony and is of variable hardness.
			Weverton quartzite		200–1,000	Quartzitic sandstone, hard, dense, some conglomeratic beds	Yields up to 10 gpm; the water is low in iron but is of variable hardness; small springs common.
			Loudoun formation		0–200	Quartzose beds, volcanic slates, and conglomeratic beds	Unimportant as an aquifer.
Archeozoic	Precambrian		Catoctin metabasalt		1,000±	Volcanic schistose greenstone, slates, and tuffaceous rocks	Yields up to 60 gpm to large-diameter wells situated in valleys; water low in mineral content and commonly soft; small springs numerous.
			Granitic gneisses			Granite, banded schistose, fine-grained	Yields up to 8 gpm; unit of small areal extent; unimportant as an aquifer.

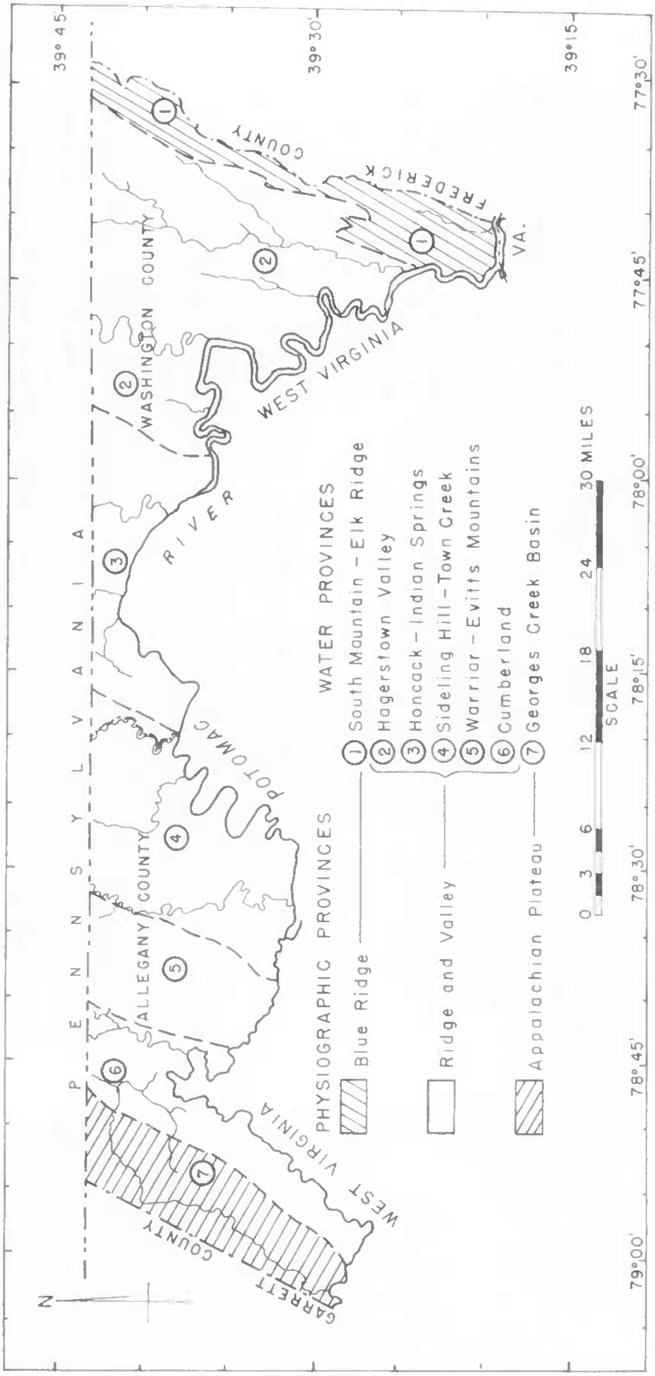

FIGURE 2. Map of Physiographic and Ground-water Provinces in Allegany and Washington Counties

less widely distributed and are chiefly in the eastern part; and only thin bands of limestone occur. Most of the shales are of Devonian age. The eastern part of the Hancock-Indian Springs water province is dominated structurally by the Bear Pond Mountains (Pl. 4, fig. 1), consisting of local anticlines and synclines that form the Foltz anticlinorium (Stose, 1909, p. 14). Large-scale faulting has occurred in the eastern parts of the Foltz anticlinorium. Westward to the east flank of Sideling Hill, the rock structure is controlled by the Meadow Branch synclinorium and the Cacapon Mountain anticlinorium (Stose and Swartz, 1912, p. 17).

The Sideling Hill-Town Creek water province extends from Sideling Hill westward 12 miles to the east flank of Warrior Mountain. This province is underlain almost entirely by shale except for three sandstone ridges. The formations exposed range upward from the Oriskany sandstone (Devonian system) to the Pocono formation (base of the Mississippian system). The Sideling Hill-Town Creek water province is part of a synclinorium which, in this report, is called the Potomac synclinorium.

The Warrior-Evitts Mountains water province extends from Warrior Mountain westward about 7 miles to the base of the western slope of Irons and Evitts Mountains. All of the formations in the Silurian system, and all but the Hampshire formation at the top of the Devonian system, occur in this province. Shales, sandstones, and limestones are distributed equally. The Warrior and Evitts Mountains anticlines are the major structural features in the province (Pl. 4, fig. 1). Subordinate anticlinal and synclinal structures exist between the southern ends of the plunging Warrior and Evitts Mountains structures. The rocks in this province form an anticlinorium called the Allegany anticlinorium in this report.

The Cumberland water province extends from the western slopes of Irons and Evitts Mountains westward to the base of Dans, Piney, and Little Allegheny Mountains. The oldest rocks in the province are those of the Juniata formation, the uppermost unit of the Ordovician system. The Juniata crops out at the base of the Narrows, a gorge cut by Wills Creek through Wills Mountain. All of the Silurian and Devonian formations crop out in the province. Shale is the major rock type. The Wills Mountain anticline, whose southern end plunges beneath the surface at Cresaptown, is the major structural feature. Wills Mountain is sheathed entirely by the very hard, weather-resistant, Tuscarora sandstone. Fort Hill, the west flank of an anticline between Cresaptown and McCoole, is a minor structure composed of weather-resistant Oriskany sandstone, Helderberg limestone, and Tonoloway limestone. Evitts Creek meanders in a shallow syncline formed in the relatively soft shales of the Romney and the Jennings formations of the Devonian system. This structure lies between Irons-Evitts Mountains to the east and Wills Mountain to the west.

Appalachian Plateau Province

The Georges Creek basin, or syncline, is in the Appalachian Plateau physiographic province. About two-thirds of the basin is in western Allegany County. This basin, termed the Georges Creek water province, is underlain by rocks of the Mississippian, the Pennsylvanian, and the Permian systems. Most of the area is underlain by shale and sandstone of the Conemaugh and the Monongahela formations of the Pennsylvanian system. The average width of the province is 7 miles. The basin contains steeply dipping beds on its eastern flank and horizontal beds near its center. The top of the Dans, Piney, and Little Allegheny Mountain chain is capped by a hard, weather-resistant, basal conglomeratic sandstone of the Pottsville formation.

HYDROLOGY

Ground-Water Hydrology

Ground water is water in the zone of saturation. Water in the earth above the zone of saturation is soil water or capillary moisture. All the rocks in Allegany and Washington Counties are ground-water reservoirs. Natural factors contributing to and controlling the amount of ground water available are seasonal and annual precipitation, forest and vegetative cover, thickness and permeability of the soil and subsoil, permeability of the rocks, attitude and degree of local and regional rock deformation, and topography.

Most of the precipitation is returned to the atmosphere in the form of direct evaporation, evaporation from the soil, and transpiration from vegetation; much is disposed of by direct surface runoff; the remainder, approximately 20 to as much as 50 percent of the total, filters through the soil zone into the ground-water reservoirs.

Ground water is retained in the pore spaces between the earth materials. The volumetric ratio of the pore spaces to the solid material is the porosity of a rock, expressed as a percentage. The permeability of a porous material is its property of transmitting water through the pores. Most of the rocks in Allegany and Washington Counties are well consolidated and most of the primary or original pore spaces have been closed or filled in. In these rocks the water circulates mainly through secondary openings such as solution cavities, channels, fractures, and bedding planes. Ground-water movement is usually in the direction of the slope of the hydraulic gradient.

An aquifer is "a rock formation or stratum that will yield water in sufficient quantity to be of consequence as a source of supply" (Meinzer, 1923, p. 52). Ground water may occur in aquifers under both water-table and artesian conditions. Generally in the area of this report the ground water occurs under semiartesian, or modified artesian, conditions.

In water-table aquifers the upper surface of the zone of saturation—the water table—is directly responsive to atmospheric pressure. This surface also fluctuates or responds to changes in storage due to pumping, to natural discharge, or to squeezing or compaction of the grains by loading or unloading. The position of the surface (the water table) is revealed by the level of water standing in wells penetrating the aquifer.

In artesian aquifers, water-saturated permeable rocks are overlain and underlain by less permeable rocks that confine the water under hydrostatic pressure. The water level in a well penetrating a confined aquifer will rise above the saturated zone. Both artesian and nonartesian conditions may occur in the same aquifer. In many places, the distinction between water-table and artesian conditions is not precise or sharp.

Where the hydraulic pressure is great enough to raise the water level above the land surface, the wells flow. In Allegany and Washington Counties there are few flowing wells. Locally the water-table and the artesian aquifers probably are related hydraulically by integrated networks of water-filled openings such as those in Carroll and Frederick Counties described by Meyer (1958, p. 23–25). In the creviced and fractured consolidated rocks underlying most of the area of this report it is unlikely that the hydraulic pressures are transmitted for great distances through the aquifers due to the fact that the fractures are only locally interconnected.

Hydrologic Properties of the Rocks

The water-bearing character of a rock is governed by its porosity and permeability. Porosity determines the capacity of a rock to store water and permeability its ability to transmit water.

Porosity

Porosity is of two types, original (or primary) and secondary (Fraser, 1935). Primary porosity was determined at the time the sediments were deposited or the rocks were formed. Secondary porosity results from later changes, which may increase or decrease the primary porosity. Such changes include cementation, fracturing, and solution.

Except for sandstone, much of the primary porosity of the sedimentary strata of the Appalachian region has disappeared as a result of deep burial and compaction of the rocks. Most of the porosity which the rocks now possess is the result of the dynamic processes of earth movement (fracturing) and rock weathering. Locally, weathering may result in zones or pockets of clay, silt, or sand overlying the hard rocks. Such material may be porous enough to permit the storage of substantial quantities of water where the material lies below the zone of saturation.

Porosities of rocks range widely, usually from less than 1 to slightly more than 50 percent. Clay, although relatively impervious, may have a high porosity, but the water it contains is not mobile. Limestone and dolomite may be in the low range of porosity of earth materials. Unweathered igneous rocks may have porosities which are extremely low. The range in porosity of various rocks is:

Rock type	Geologic system	Material	Porosity range[a] (percent by volume)
Clay	Recent(?)	Ocean bottom sediment	48.6–51.9
	Miocene	Alloway blue clay	38.6
	Pennsylvanian	White flint clay	10.1
Sand	Upper Cretaceous	Mount Laurel sand	44.4
Shale	Pennsylvanian	Stanley shale	2.5–6.8
	Devonian	Hamilton shale	11.3–11.6
Sandstone	Devonian	Speechley sand	4.3–15.4
	Silurian	White Medina sandstone	10.5
Limestone	Devonian	Jefferson dolomite	6.2
	Ordovician	Garden City limestone	.4

[a] Handbook of Physical Constants, Geol. Soc. America, special papers No. 36, 1942, edited by F. Birch, J. F. Schairer, and H. Spicer, p. 17–25.

The structural deformation of the earth's crust during the period of Appalachian mountain building created fractures that range from large-scale crustal displacements to fracture systems of minute size. These fractures constitute the major channels through which the ground water circulates. Current-meter studies and drillers' records from deep wells indicate that fracture porosity generally is negligible below a depth of a few hundred feet in western Maryland. In areas of extreme crustal disturbance, such as the base of the western slope of the overturned South Mountain anticlinorium, large fractures may exist at depths of several hundred feet.

Solution channels and cavities constitute an important (gross or overall) form of secondary porosity in the limestone rocks. In both Allegany and Washington Counties, the largest yields are from wells in the limestone formations. Nearly all the large springs in both Counties issue from creviced limestone or dolomite.

Permeability, Transmissibility, and Storage

The permeability of the rocks in the area of this report is governed largely by the size and degree of interconnection of the fractures, crevices, and solutional openings. Permeability may be defined in several ways. The field coefficient of permeability, as defined by the U. S. Geological Survey (Wenzel, 1942, p. 7), is the number of gallons of water per day that percolates under prevailing conditions through each mile of water-bearing bed under investigation, measured at right angles to the direction of flow, for each foot of thickness of the bed and for each foot per mile of hydraulic gradient, at the prevailing temperature of the water. The field coefficient of permeability is commonly designated "P_f". A more convenient concept is the coefficient of transmissibility (Theis, 1935, p. 520), which describes the gross permeability of a rock formation. The coefficient of transmissibility is the product of the field coefficient of permeability times the saturated thickness of the rocks. Transmissibility, commonly designated by "T", is the number of gallons per day flowing under a unit hydraulic gradient of an aquifer of one foot wide and through a height equal to the thickness of the aquifer. The coefficient of transmissibility is expressed in gallons per day per foot. Coefficients of transmissibility can be determined in the field by conducting aquifer tests. Procedures for analyzing aquifer-test data have been summarized by Brown (1953).

The coefficient of storage, designated by "S", is the volume of water released from, or taken into, storage per unit surface area of the aquifer per unit change in the head component normal to that surface. For water-table aquifers the coefficient of storage is approximately equal to the specific yield. Specific yield is the quantity of water, usually expressed as a percent by volume, that a formation will yield under gravity drainage. Storage coefficients for artesian aquifers are much smaller than those for water-table aquifers.

Lack of observation wells at many of the aquifer-test sites prevented determination of storage coefficients from all aquifer tests. The range of coefficients of storage of the various aquifers is:

Water Province	Range of Coefficient of Storage		
	Metabasalt	Limestone	Sandstone
South Mountain-Elk Ridge	0.002–0.004		
Hagerstown Valley		0.14–0.001	
Cumberland		.04–.002	
Georges Creek basin			0.003–0.0004

The storage coefficients indicate that hydrologic conditions range from water table to artesian. Probably, the average condition is a modified water-table or semiartesian condition which reflects a combination of artesian and water-table conditions. The artesian condition is suggested because the water level in drilled wells commonly rises above the zone in which the water is encountered, probably due to local confinement by clayey soil and subsoil. On the other hand, the source or intake area of the aquifers must be local because the cone of depression resulting from heavy pumping from wells seldom extends beyond a few hundreds of feet.

Springs

Considerable quantities of ground water issue from springs in Allegany and Washington Counties. The Hagerstown Valley water province contains most of the large springs. Periodic discharge measurements were made of springs flowing a few to several hundred gpm in order to determine variations in their rate of flow. Many of the springs in the Hagerstown Valley water province have a relatively constant flow. Some are "flashy" and have short periods of high flow after heavy precipitation. Flow measurements were made with a Price or pygmy current meter, using standard stream-gaging procedure. Where the physical conditions permitted, weirs were installed to facilitate frequent measurements. The large springs are discussed in the section of the report describing the water-bearing characteristics of the aquifers.

A classification of springs according to their rate of discharge suggested by Meinzer (1923, p. 52–53) is:

Magnitude	Average Discharge
First	44,800 gpm or more
Second	4,480 to 44,800 gpm
Third	448 to 4,480 gpm
Fourth	100 to 448 gpm
Fifth	10 to 100 gpm
Sixth	1 to 10 gpm
Seventh	1 pint to 1 gpm
Eighth	less than 1 pint a minute

Other classifications of springs are based on chemical character, temperature, lithologic character of the aquifer, character of the spring openings, rock

TABLE 4

Maximum and Minimum Discharge of Springs in Allegany County

Number (All-)	Name of spring	Method of measurement	Maximum		Minimum		Period during which measurements made
			Date	Discharge[a] (gpm)	Date	Discharge[a] (gpm)	
Bd 34	Cumberland Blue Spring	current meter	4/16/58	1,750	10/8/57	330	10/8/57–5/12/59
Bd 35	Sands	bucket	4/10/57	40	1/29/59	0.6	4/10/57–1/11/60
Bf 1	Murley Branch	current meter	4/9/58	3,000	7/30/59	370	10/8/57–7/30/59
Ce 1	Potomac Blue Spring	do	4/17/58	9,750	10/4/57	3,500	10/4/57–9/18/59
Bc 69	Hoffman drainage[b] tunnel	do	4/17/58	17,500	1/29/59	3,950	4/17/58–8/27/59

[a] Accuracy of methods of measurement is approximately ±5 per cent.

[b] Discharge reported to have ranged from 14,000 to 30,000 gpm prior to 1927.

structure, and permanence of discharge, as, for example, surging and geyser springs. Bryan (1919) proposed a classification based on the occurrence of springs issuing from deep and shallow sources. Springs from shallow sources are classed as 1) depression springs, 2) contact springs, 3) artesian springs, and 4) tubular and fracture springs in impervious rock.

Most of the springs in Allegany and Washington Counties are of the fifth and sixth magnitudes according to Meinzer's system; a few are of the third and fourth magnitudes, and one is nearly of the second magnitude. Springs of every category in Bryan's classification occur in Allegany and Washington Counties. The largest and most numerous are tubular and fracture springs in the Hagerstown Valley. Tables 4 and 5 show the maximum and minimum measured discharges of springs in Allegany and Washington Counties.

TABLE 5

Maximum and Minimum Discharge of Springs in Washington County

Number (Wa-)	Name of spring	Method of measurement	Maximum		Minimum		Period during which measurements made
			Date	Discharge (gpm)[a]	Date	Discharge (gpm)[a]	
Ag 1	Cress Pond	current meter	5/23/58	2,450	1/21/59	360	5/23/58–9/1/59
Ag 2	Cushwa	current meter and weir	5/23/58	1,050	1/5/59	330	5/23/58–1/13/60
Ag 29	Roney	current meter	3/24/59	270	6/23/59	210	2/27/59–9/2/59
Ah 32–33, 76	Keener-Horst	current meter and weir	1/23/59	900	8/5/59	160	11/12/58–1/13/60
Ai 10	Martin	current meter	2/20/59	860	9/2/59	50	10/24/58–9/2/59
Ai 12	Rest Haven	do	4/8/59	300	10/17/58	110	10/17/58–8/31/59
Ak 3	Gelvin	do	2/16/59	2,400	7/30/59	110	6/12/58–8/28/59
Ak 5	Henson	weir	7/3/58	230	10/1/59	100	7/3/58–1/13/60
Bh 28–32	Headwater springs of Marsh Run	current meter	5/21/59	430	2/27/59	140	1/30/59–9/1/59
Bf 3	Big Spring	current meter and weir	5/8/59	1,150	10/1/59	800	4/25/58–10/1/59
Bf 6	Green Spring	current meter	8/19/58	340	3/11/59	140	4/25/58–8/5/59
Bi 33–37	Hagerstown Park Pond	weir	8/7/58	2,600	7/23/59	1,250	8/7/58–10/1/59
Bi 40	Pashen	current meter	5/15/58	2,000	3/12/59	650	5/15/58–3/12/59
Bi 42	Hager House	do	3/19/59	75	7/27/59	30	1/29/59–7/27/59
Bj 4	Beaver Creek Hatchery	current meter and weir	5/21/58	3,600	1/13/60	1,900	5/21/58–3/20/60
Bj 35, 37	English	weir	3/11/59	130	9/2/59	80	2/19/59–10/1/59
Ch 2	St. James	current meter	4/29/59	1,050	7/27/59	410	5/29/58–8/28/59
Ch 7	Harshman	do	4/30/59	340	8/31/59	110	7/22/58–8/31/59
Ch 8	Downey Dairy	do	10/10/58	290	8/31/59	90	11/10/58–8/31/59
Ch 26	C & O	do	6/24/59	1,100	8/31/59	700	12/12/58–8/31/59
Ci 11	Tom's	do	5/20/58	1,050	11/24/58	360	5/20/58–8/25/59
Cj 6	Warrenfeltz	do	8/24/59	160	6/17/59	120	6/17/59–8/24/59
Cj 10	Shank's	do	5/21/58	1,400	8/24/59	610	5/21/58–8/24/59
Di 6	Keedysville	do	5/22/58	2,500	1/15/59	820	5/22/58–8/26/59
Di 8	Sharpsburg	do	8/26/58	400	8/26/59	70	8/26/58–8/26/59
Ej 5	Yourtee	weir	3/10/59	280	6/9/59	140	1/8/59–6/9/59

[a] Accuracy of methods of measurement is approximately ±5 percent.

QUALITY OF GROUND WATER

Source and Significance of Chemical Constituents

The chemical character of the ground water in Allegany and Washington Counties is diverse due to the variations in geology, soils, and local hydrologic conditions.

The relatively pure moisture of the atmosphere absorbs gases as it condenses into water droplets and precipitates. The amount of gas dissolved in rainwater is only a few parts per million by weight. It consists mainly of three gases: carbon dioxide 2 to 3 percent, oxygen 34 percent, and nitrogen 63 to 64 percent (Bunsen, 1855). Carbon dioxide acidifies the water slightly, increasing its ability to dissolve minerals in the earth. The oxygen combines with both mineral and organic matter, but the nitrogen is generally relatively inert.

As rain falls to the earth, minute quantities of other materials such as ammonia, oxides of nitrogen and sulphur, chlorides, and dust particles are collected from the air. The amount and kind of material vary with local atmospheric conditions.

As the water enters the soil it takes up soluble constituents from the soil, which always contains decaying organic matter and carbon dioxide. As the water continues downward, it dissolves minerals in the rocks with which it comes in contact. The mineral composition of the subsoil and the rocks largely determine the chemical character of water at depth.

The rate of movement of ground water through the rocks influences, to some extent, the concentrations of the chemical constituents. According to Hem (1959, p. 4), "The final composition of a water is the result of a number of solutional and decompositional processes." Also, according to Hem (1959, p. 19), "Considerable differences in composition of water may be found both vertically and laterally in ground-water reservoirs."

The chemical character of ground water from sandstone varies. In the absence of calcareous minerals, the water may be expected to be low in calcium and magnesium content. Ground water from shale may be relatively high in dissolved-mineral matter because of the limited ground-water circulation. It may contain traces of the original connate water in the sediments. Hardness of water from carbonate rocks commonly is greater than that from other rock types because of their high content of calcium and magnesium minerals. Water from metamorphic igneous and volcanic rocks is commonly low in mineral content and relatively soft.

The chemical character of ground water from the limestone springs is variable due to variations in the lithology of the rocks contributing the water and to the degree of pollution and contamination of the water.

The significance of the properties and constituents reported in water analyses are discussed by Hem (1959, p. 35–149). Standards pertaining to the quality of potable water supplies adopted by the American Water Works Association and recommended as limitations for public water supplies are, in part:

Allowable limits for potable water (in ppm)

Constituent	Limiting Concentrations
Iron and manganese together	0.3
Magnesium	125
Chloride	250
Fluoride	1.5
Sulfate	250
Dissolved solids	500[a]

[a] 1,000 ppm permitted if no other water is available.

High iron content is one of the most objectionable constituents of the ground water in Allegany and Washington Counties. Iron and manganese content in excess of 0.3 ppm may stain porcelain fixtures, enamel, and fabrics and may necessitate treatment of the water for iron removal.

Hardness of water is the characteristic usually recognized by the increased soap-consuming power of the water. Calcium and magnesium are the principal mineral constituents causing hardness of water. Water is commonly classified according to its degree of hardness as follows (Rainwater, 1959, p. 73):

Hardness (ppm)	Rating and Usability
<60	Soft—suitable for most uses without further softening.
61–120	Moderately hard—usable, except in some industrial applications.
121–200	Hard—softening required by laundries and certain other industries.
>200	Very hard—requires softening for most purposes.

The source and significance of constituents in ground water are summarized in Table 6 (from Walker, 1956, p. 52).

Expression of Water Analyses

The dissolved constituents in water are reported as the number of parts by weight in a million parts by weight of water, or parts per million (ppm). The dissolved constituents in water consist of two groups of electrically charged particles or ions, cations and anions. Iron, calcium, magnesium, sodium, and potassium are the most common metallic ions, or cations. Bicarbonate, sulfate, chloride, and nitrate are the most common non-metallic ions, or anions. Silica, a common constituent of most rocks, may occur in ground water in either the ionic form or in a finely divided colloidal form. Silica content is also expressed as parts per million. Other data commonly reported in water analyses include dissolved solids, hardness (as $CaCO_3$), specific conductance, and pH.

TABLE 6

Elements and Substances Commonly Found in Ground Water

Constituent	Source	Significance
Silica (SiO_2)	Siliceous minerals present in essentially all formations.	Forms hard scale in pipes and boilers. Inhibits deterioration of zeolite-type water softeners.
Iron (Fe)	The common iron-bearing minerals present in most formations.	Oxidizes to a reddish-brown sediment. More than about 0.3 ppm stains laundry and utensils reddish brown, is objectionable for food processing, beverages. Larger quantities impart taste and favor the growth of iron bacteria.
Manganese (Mn)	Manganese-bearing minerals.	Rarer than iron; in general has same objectionable features; brown to black stain.
Calcium (Ca) and magnesium (Mg)	Minerals that form limestone and dolomite and occur in some amount in almost all formations. Gypsum also a common source of calcium.	Cause most of the hardness and scale-forming properties of water; soap consuming.
Sodium (Na) and potassium (K)	Feldspars and other common minerals; ancient brines, sea water; industrial brines and sewage.	In large amounts cause foaming in boilers, and other difficulties in certain specialized industrial water uses.
Bicarbonate(HCO_3) and carbonate (CO_3)	Action of carbon dioxide in water on carbonate minerals.	In combination with calcium and magnesium forms carbonate hardness; decomposes on application of heat with attendant formation of scale and release of corrosive carbon dioxide gas.
Sulfate (SO_4)	Gypsum, iron sulfides, and other rarer minerals; common in waters from coal-mining operations and many industrial wastes.	Sulfates of calcium and magnesium form hard scale.
Chloride (Cl)	Found in small to large amounts in all soils and rocks; natural and artificial brines, sea water, sewage.	Objectionable for various specialized industrial uses of water.

TABLE 6—*Continued*

Constituent	Source	Significance
Fluoride (F)	Various minerals of widespread occurrence, in minute amounts.	In water consumed by children, about 1.5 ppm and more may cause mottling of the enamel of teeth, and as much as 1.5 ppm reduces incidence of tooth decay.
Nitrate (NO_3)	Decayed organic matter, sewage, nitrate fertilizers, nitrates in soil.	Values higher than the local average may suggest pollution. There is evidence that more than about 45 ppm NO_3 may cause methemoglobinemia (infant cynosis) sometimes fatal. Waters of high nitrate content should not be used for baby feeding.[a]

[a] Maxey, K. F., 1950. Report on the relation of nitrate concentrations in well waters to the occurrence of methemoglobinemia: Natl. Research Council, Bull. Sanitary Eng., p. 265, App. D.

TEMPERATURE OF GROUND WATER

Knowledge of the temperature of ground water is useful in order to better understand the occurrence and movement of the water. Vertical temperature measurements, or temperature logs, were made on several wells. The logs were run to aid in locating the depth and thickness of the water-bearing zones and in some places they serve to determine the geothermal gradient, defined as the number of degrees of increase in temperature in the earth per unit of depth. In this report the reciprocal geothermal gradient, or depth per degree increase in temperature, is used. Temperatures of springs were measured to determine seasonal fluctuations. At a well field in Cumberland investigation was made of the effect upon the thermal regime of recharging an aquifer with hot water.

The temperature-measuring device used consisted of a thermal element, or thermistor-type probe, attached to the end of a 500-foot insulated cable. The changes in electrical resistance in the probe due to temperature variations in the well are transmitted to a potentiometer circuit at the land surface. Temperatures are read from a microammeter converted and calibrated to read to a tenth of a degree Fahrenheit.

The temperature logs show that many of the wells measured have dissimilar plots of temperature versus depth due to differing geologic and hydrothermal conditions. Logs were run on abandoned wells, pumping wells, and on wells affected by pumping from nearby wells. In some undisturbed wells the data show relatively stable thermal conditions, but in newly drilled wells and in wells pumped just prior to logging, the measured temperatures of the ground water indicate unstable thermal conditons.

Heat from the interior of the earth is constantly being transmitted outward. The rate of heat flow depends upon the heat potential differences of the inner and outer parts of the earth and the heat conductivity of the earth's strata. Some of the causes of differences of geothermal gradients outlined by Ambronn (1928, p. 266–284) are:

1) Moist rocks are better heat conductors than are dry rocks.
2) Heat conductivity depends upon density and elasticity of rocks.
3) The dip of formations influences the geothermal gradient; the more steeply inclined rocks have a lower gradient, that is, a greater depth interval per unit of temperature change.
4) Surface relief influences the geothermal gradient; near mountains it is large, in or near valleys it is small.
5) The gradient in volcanic regions is small.

C. E. Van Orstrand, states (1934) that relatively high earth temperatures are associated with earth crustal deformation and with the occurrence of struc-

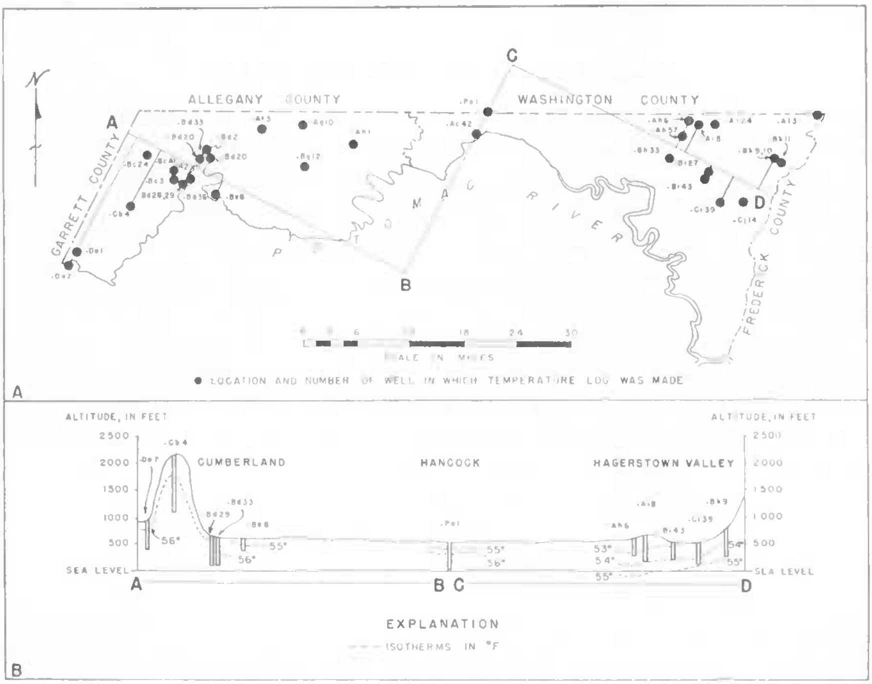

FIGURE 3 A. Map of Allegany and Washington Counties Showing Location of Wells in Which Temperature Logs Were Run. B. Profile of Isotherms across Allegany and Washington Counties.

tures such as faults and anticlines. Probably the most potent source of heat is from the rocks immediately beneath uplifts. He also indicates that two distinct types of normal thermal gradients exist—one for exposed crystalline basement rocks that have been in static or nearly static condition since solidification and one for sedimentary rocks in areas that have undergone uplift, subsidence, erosion, and chemical changes.

The lowest geothermal gradient observed was in well Wa-Ai 8 near Maugansville in the Hagerstown Valley. The gradient was 533 feet per 1°F. This suggests that the limestones at this locality are tight, dense, and relatively impervious.

Figure 3 shows the location of wells in which temperature logs were run and a profile of earth temperatures from west to east across the two counties. The temperature in deep wells is indicated by the approximate position of the ground-water isotherms, or lines of equal temperature. In general the 56°F isotherm approaches the land surface in the mountainous western part of the two-county area and dips well below the land surface in the Hagerstown Valley to the east.

WATER-LEVEL FLUCTUATIONS

Ground-water levels fluctuate in response to different causes; among these are:

1) Frequency and intensity of precipitation sufficient to recharge the ground-water reservoirs.

2) Changes in the rate and amount of evapotranspiration.

3) Changes in the rate and amount of withdrawals of water from the reservoirs due to pumping.

4) Changes in the amount of load, or pressure, on an artesian aquifer.

Other factors affecting the natural fluctuations of water levels in a well are the type of soil, subsoil, or rock, and topographic situation of a well.

Graphic records of water levels, termed hydrographs, from several observation wells are shown on Plate 6. Most of these show an annual cycle of fluctuation, in which the rises in water levels are caused chiefly by recharge to the aquifers from precipitation and the declines are due to losses from evapotranspiration and to natural discharge to the streams. The greatest range in fluctuation of the water table occurs in wells situated on the tops of hills or divides and the least range in wells situated in valleys drained by surface streams.

The rate of precipitation is commonly higher during the summer months than during the other months of the year. However, the rate of evapotranspiration is also higher during the summer months, so that much of the precipitation is intercepted before it reaches the zone of saturation or is removed from the zone of saturation shortly after reaching it. Accordingly, ground-water levels continue to decline during much of the summer and commonly reach

TABLE 7

Range in Water-level Fluctuations in Observation Wells During the Period 1947–60

Well	Depth (feet)	Formation	Water-level fluctuation (feet)
All-Bd 2	100	Tonoloway limestone	10.4
All-Da 1	88	Pottsville and Allegheny	4.3
Wa-Ac 1	86	Romney shale	12.8
Wa-Bh 3	218	Rockdale Run	28.6
Wa-Dh 1	29	Conococheague limestone	10.0

their lowest levels during late summer or early fall. During the winter and early spring when plants are dormant and air and ground temperatures are lower, the rate of evapotranspiration is less so that conditions are most favorable for ground-water recharge and the water levels attain their highest position. Discharge to the streams from the ground-water reservoirs is at a maximum during this part of the year.

The hydrographs on Plate 6 illustrate the character of the water-level fluctuations in various formations, at various depths, and in different topographic situations. The records of the six wells for the period 1947–60 show fluctuations ranging from slightly more than 4 feet to nearly 29 feet. The mean fluctuation was about 13 feet. Table 7 gives the range in water-level fluctuations in the wells shown on Plate 6.

Well Wa-Dj 2 (not included in Table 7) is near the top of South Mountain at Turners Gap and ends in the Weverton quartzite. In 1958 the water level fluctuated 40 feet. Thus, the water level in -Dj 2 had the greatest fluctuation of any of the observation wells. If observation-well records were available from other mountaintop localities, equally great water-level fluctuations probably would be observed.

The range of water-level fluctuations over annual cycles provide a means of determining the storage capacity of the rocks if these data are correlated with streamflow records and evapotranspiration data.

UTILIZATION OF GROUND WATER

Methods of Use

Ground water is obtained from wells and springs in Allegany and Washington Counties. Commonly, drilled wells 6 inches in diameter are used for domestic and farm purposes. Drilled industrial and commercial wells may be up to 10 inches in diameter. Dug wells 3 to 4 feet in diameter are common, but they are gradually being replaced by the more sanitary and easily constructed drilled wells. Wells are commonly drilled by the cable-tool percussion method, although some drillers have adopted the "hammer drill" method, which employs features of both the cable tool and rotary methods.

Well casings are generally placed from the surface down to the top of the hard rock at the base of the weathered zone. In some wells casing is placed throughout most of the depth of the well and the annular space between the casing and rock wall is grouted. This is done to block off water of undesirable character in selected water-bearing zones.

Tests of well yield ranging from a few hours to a few days in duration are made by most drillers. Turbine, cylinder, submersible, and suction pumps are in common use in the wells. Electricity is the common source of power to operate the pumps.

Springs, both improved and unimproved, are an important source of ground water, particularly in the Hagerstown Valley. Some of the large springs have

TABLE 8

Use of Ground Water in Allegany County in 1959 (in mgd.)

Town or area	Type of supply					Total
	Public and institutional		Industrial and commercial	Domestic, farm and irrigation		
	Wells	Springs	Wells only	Wells	Springs	
Barrelville	0.01	—	—	—	—	0.01
Barton	.11[a]	0.01[a]	—	—	—	.12
Cumberland	—	—	0.39	—	—	.39
Frostburg-Eckhart Mines	—	.20[b]	—	—	—	.20
LaVale	.14[a]	.07[a]	—	—	—	.21
Lonaconing	.09[a]	.20[a]	—	—	—	.29
Midlothian, Woodland, Klondike, and Moscow	—	.01	—	—	—	.01
Mount Savage	.05	.10	—	—	—	.15
Rural areas	—	—	.11	0.16	0.20	.47
Totals	0.40	0.59	0.50	0.16	0.20	1.85
Percent of total	21	32	27	9	11	100

[a] Seasonal use, variable.

[b] Includes use of some surface water.

TABLE 9

Use of Ground Water in Washington County in 1959 (in mgd)

Town or area	Type of supply						Totals
	Public and institutional		Industrial and commercial		Domestic, farm and irrigation		
	Wells	Springs	Wells	Springs	Wells	Springs	
Beaver Creek Trout Hatchery	—	3.00[a]	—	—	—	—	3.00
Blue Ridge Summit	0.04	—	—	—	—	—	.04
Boonsboro-Keedysville	—	.14	—	—	—	—	.14
Clear Spring	—	.04	—	—	—	—	.04
Fort Ritchie	.10	.04	—	—	—	—	.14
Hagerstown	—	—	0.38[b]	—	—	—	.38
Smithsburg-Cavetown	—	—	.14	—	—	—	.14
Rural areas	—	—	.18	0.10	0.18	0.40	.86
Totals	0.14	3.22	0.70	0.10	0.18	0.40	4.74
Percent of total	3	68	15	2	4	8	100

[a] Based on minimum discharge of spring Wa-Bj 4, owend by Maryland Game and Inland Fish Commission.

[b] Seasonal use, variable.

been improved by means of concrete catchment basins, filtration and chlorination equipment, and pumps to lift the water to storage tanks.

Quantities Used

The use of ground water in Allegany and Washington Counties in 1959 amounted to an estimated 6.6 mgd (million gallons per day) from inventoried sources. An additional 0.6 mgd is estimated to be used from uninventoried sources. Thus, the total use of ground water is estimated to be 7.2 mgd. About 66 percent of the inventoried use was for public and institutional supplies (including military establishments). About 20 percent was used for industrial and commercial purposes, and the remaining 14 percent was used for domestic, farm, and irrigation purposes. Tables 8 and 9 summarize the uses of ground water in the two counties, from inventoried or known sources.

The uses of ground water for special purposes, such as cooling, industrial processing, and supplemental irrigation probably will increase in the future in those areas where adequate supplies are shown to be available.

GROUND-WATER PROVINCES

Allegany and Washington Counties have been divided into seven ground-water provinces (fig. 2) based on the following characteristics:

Province	Geologic and Physiographic Characteristics
South Mountain-Elk Ridge	Chiefly crystalline rocks; thin soil cover; generally rugged terrain; rapid runoff
Hagerstown Valley	Chiefly limestone rocks; variable soil cover; rolling to undulating terrain; flow of streams sustained largely by springs
Hancock-Indian Springs	Shale, sandstone, and shaly limestone; soil cover thin but variable; mountainous to rolling terrain; rapid runoff; numerous small springs
Sideling Hill-Town Creek	Chiefly sandstone and shale; soil cover thin and rocky; trellis drainage pattern between parallel mountain ridges; rapid runoff
Warrior-Evitts Mountain	Chiefly shale; soil cover thin but variable; hilly to mountainous terrain; rapid runoff
Cumberland	Chiefly shale and limestone; soil cover variable and locally thick along Potomac River; terrain hilly to flat in a few places; runoff variable but generally rapid
Georges Creek Basin	Sandstone and shale; dissected, uplifted structural basin; soil cover variable and locally thin; dendritic drainage; terrain rugged to mountainous; moderately rapid runoff

South Mountain-Elk Ridge Water Province

The South Mountain-Elk Ridge ground-water province includes South Mountain west of the Frederick County line, Pleasant Valley, Elk Ridge, and the belt of metamorphosed silicate rocks immediately west of Elk Ridge (Pl. 2, and fig. 2).

Surface- and Ground-water Relationships

The west slope of South Mountain is drained by numerous small basins with streams in shallow ravines which are fed during dry weather mainly by springs and seeps. The basins collect the runoff and channel it into the Hagerstown Valley at the base of the mountains. The larger of these drainage basins are Raven Rock Hollow, with an area of 3.6 square miles; Falls Creek, 2.6 square miles; and Warner Gap Hollow, 2.2 square miles. An analysis of the runoff characteristics of one of these small basins, Warner Gap Hollow, is pertinent to an understanding of ground-water conditions in the water province (fig. 4).

The city of Hagerstown uses the South Mountain watershed by storing water in the Edgemont Reservoir from small unnamed streams in Raven Rock and Warner Gap Hollows. Daily discharge measurements of the stream in Warner Gap Hollow were made by the Water Department of the city of Hagerstown from 1945 to 1959. Precipitation has been recorded daily at the Edgemont reservoir since 1947. Both precipitation and temperature have been recorded daily at the Smithsburg plant since 1945.

The approximate ground-water runoff in the Warner Gap basin was determined by a study of the flow records of the stream in the basin. Ground-water runoff is approximately equal to base flow—that part of the runoff which has

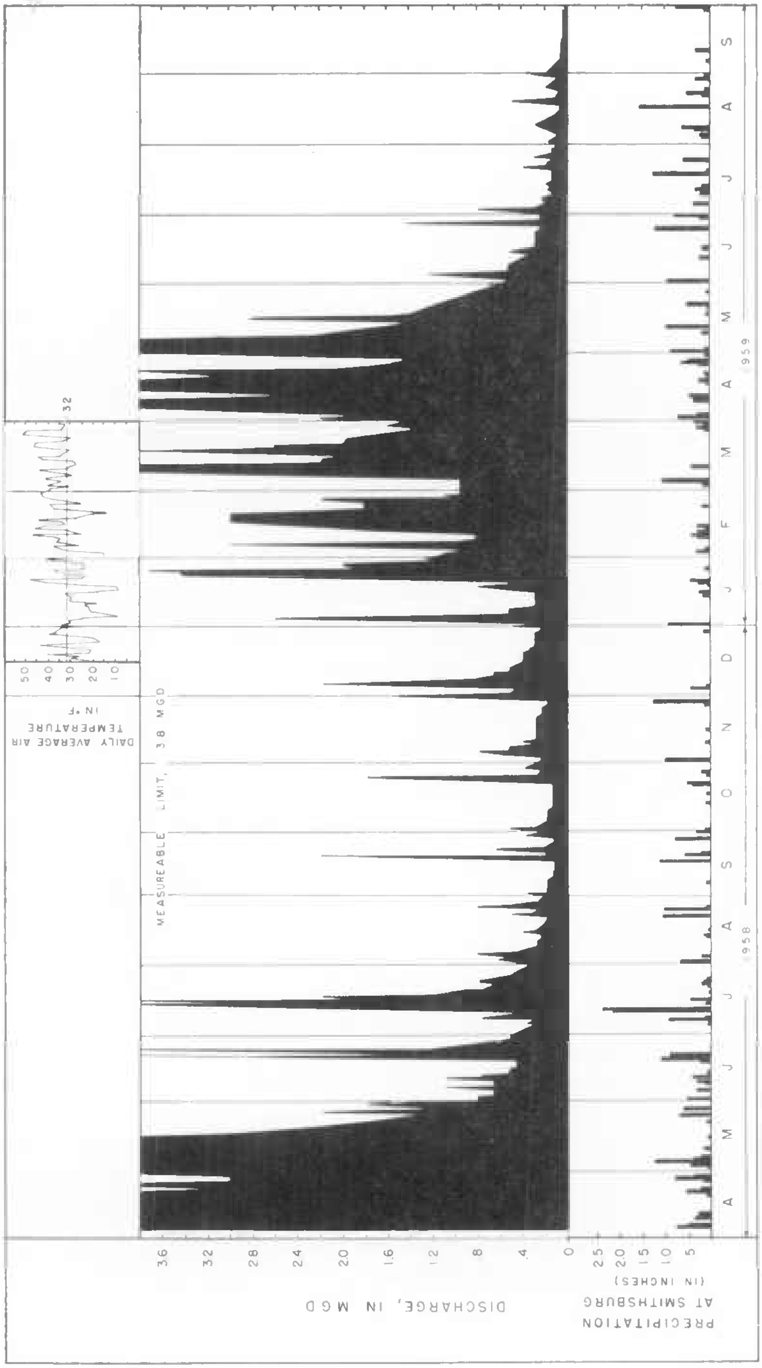

FIGURE 4. Hydrograph of the Small Stream in Warner Gap Hollow and Precipitation and Air Temperature at Smithsburg during Part of 1958–59

passed into the ground, has become ground water, and has been discharged into a stream channel. The ground-water runoff in a drainage basin must equal the recharge minus the evapotranspiration from the ground-water reservoirs. The term "effective recharge" denotes the residue of the total recharge after extraction of water from the water table by evaporation and transpiration. Effective recharge is equivalent to ground-water runoff. This subject has been discussed in detail in a report on the ground-water resources of Salisbury, Maryland (Meyer and Bennett, 1955, p. 184). A value for ground-water runoff, or "effective recharge," is significant because of its importance in approximating, on a unit area basis, the sustained availability of ground water. In most places the sustained yield of wells cannot exceed the effective recharge. In some places the sustained yield may be well below the rate of effective recharge.

Procedures to determine ground-water runoff were described by Houk (1921, p. 65) and Meinzer and Stearns (1929, p. 73–146). The method was employed in Maryland by Dingman and Meyer (1954, p. 39), Meyer and Bennett (1955, p. 190–197), Dingman and Ferguson (1956, p. 47–52) and Rasmussen and Andreasen (1959, p. 56–83).

An analysis of the stream flow at Warner Gap Hollow indicates an annual ground-water runoff of about 300,000 gpd per square mile, principally from the Catoctin metabasalt. The ground-water runoff, or the effective recharge, for the 6-year period, October 1953 through September 1959, was about 17 percent of the annual precipitation. The ground-water runoff in this small basin is probably somewhat smaller than that of larger basins in the report area, where geohydrologic conditions may be more favorable for the retention and storage of ground water.

TABLE 10

Average Annual Precipitation, Total Runoff, Ground-water Runoff, and Evapotranspiration in the Rock Creek Basin, Little Gunpowder Falls Basin, and Warner Gap Hollow Basin

Drainage basin	Little Gunpowder Falls (Baltimore and Harford Counties[a])	Rock Creek (Montgomery County[a])	Warner Gap Hollow (Washington County)
Basin area (sq. mi.)	36.1	62.2	2.2
Length of streamflow record used (years)	17	22	6
Average annual precipitation (mgd/sq. mi.)	2.0	2.1	1.8
Average annual total runoff (mgd/sq. mi.)	.8	.6	.9
Average annual ground-water runoff, base flow part of annual total runoff (mgd/sq. mi.)	.5	.4	.3
Average annual water loss by evapotranspiration (mgd/sq. mi.)	1.2	1.5	.9

[a] Data from Dingman and Ferguson, 1956, p. 50.

Elements of the hydrology of two drainage basins in the Maryland Piedmont, those of Little Gunpowder Falls and Rock Creek, and Warner Gap Hollow basin are compared in Table 10. The two streams in the Maryland Piedmont also drain areas of crystalline rocks. The average annual precipitation was about the same for all three basins, but the total runoff, ground-water runoff, and average annual water loss (evapotranspiration) differed. Total runoff in Rock Creek, on a unit basis, is about 30 percent below that of Warner Gap Hollow, but ground-water runoff in Rock Creek is about 30 percent greater than that in Warner Gap Hollow. Ground-water runoff in Little Gunpowder Falls basin is about 70 percent greater than that for Warner Gap Hollow. Water loss by evapotranspiration is higher in both the Rock Creek and Little Gunpowder Falls basins than in the Warner Gap Hollow basin. The values given are probably correct only to an approximate order of magnitude and the differences may be due partly to subjective factors involved in the hydrologic analyses.

An analysis of the records of stream flow, precipitation, and air temperature at Warner Gap basin (fig. 4) indicates the following with regard to the hydrology of the basin:

a) An increase in the rate of stream discharge begins in November or December.
b) A decline in the rate of discharge begins in April or May.
c) The average summer streamflow is approximately the same each year regardless of normal variations in the quantity and frequency of precipitation during the previous winter and early spring months.
d) During the months of November through March, there is a close relationship between the rate of streamflow and the number of days when the maximum daily temperature is below freezing. The higher the temperature, the greater the stream discharge; the lower the temperature, the smaller the discharge.
e) Ordinary rates of summer precipitation do not reverse the steady decline in the flow of the stream.
f) Heavy summer precipitation results in "flashy" stream discharge, chiefly as overland runoff. Streamflow returns to normal, or base flow, within a few days after cessation of precipitation.

Although the rate of recharge to the Precambrian metabasalt is high, the storage capacity of the rocks is low. The fracture spaces in the rocks rapidly become saturated, especially during the non-growing (winter) season. During the growing (summer) season much of the precipitation is intercepted by the plants or is evaporated from the soil zone and does not appear as additional ground-water or overland runoff. However, heavy summer precipitation does result in saturation of the soil and rocks and causes sharp, rapid rises in the rate of streamflow. Because of the low storage capacity of the rocks, the yield of even the best wells (on the order of 40–50 gpm) will decline during periods of drought or when no ground-water recharge occurs. Thus, the inherent character of the reservoir rocks limits their capacity as dependable sources of large water supplies. The streamflow analysis indicates that the ground-water discharge, or the effective recharge, is on the order of a few hundred thousand gallons a day per square mile.

Structural Geology

The distribution of the Precambrian and Cambrian rocks in the South Mountain-Elk Ridge water province is shown on Plate 2. South Mountain is on the western flank of a large asymmetrical fold, the South Mountain anticlinorium, overturned to the west (fig. 5). The intensity of deformation is greatest along the west flank of the anticlinorium. Variations in the ability of individual beds to support not only their own weight but also the weight of overlying beds resulted in complex fracture systems. The extent and distribution of the fracture systems, including rock cleavage, controls in part the pattern of ground water movement. Cleavage frequently is at an angle to the bedding planes of the rock. Shale is an incompetent rock and may have closely spaced cleavage planes. The more competent beds, such as sandstone, usually have more widely spaced cleavage planes. The cleavage in all the formations of the anticlinorium dips at various angles to the east (Cloos, 1951, p. 126).

Figure 5, a generalized structural section through Smithsburg, Washington

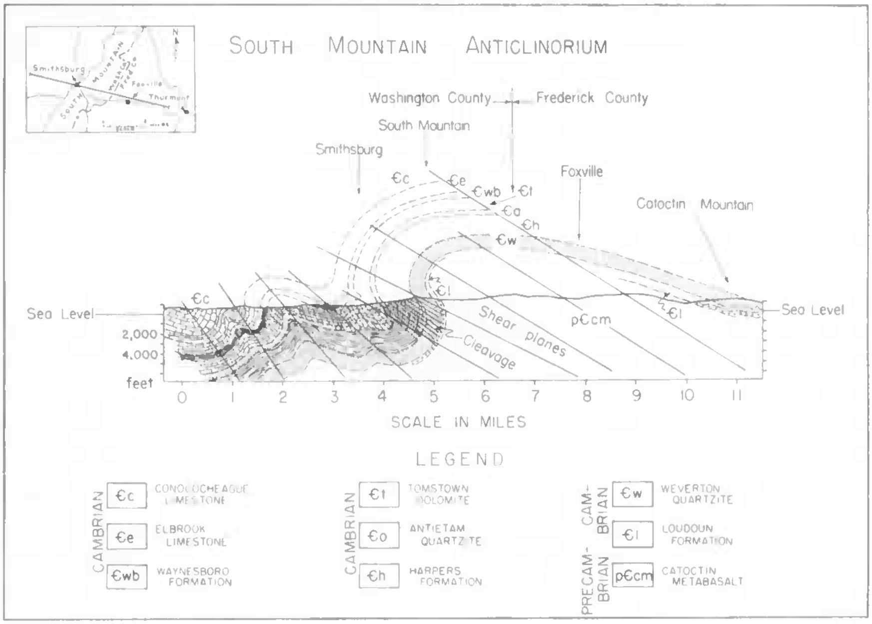

FIGURE 5. Geologic Section across the South Mountain Anticlinorium

County, and Foxville, Frederick County, shows the South Mountain anticlinorium and the structural relations of the formations in part of the South Mountain-Elk Ridge water province. The general structural pattern shown on figure 5 characterizes the west slope of South Mountain from the Pennsylvania line south to Rohrersville at the head of Pleasant Valley (Pl. 2). Faulting of the rocks from the head of Pleasant Valley to the Potomac River has resulted in the normal sequence of beds being repeated westward from the base of South Mountain. Accordingly, Pleasant Valley is underlain by Precambrian granitic gneiss and metabasalt and Elk Ridge is capped, as is South Mountain, with Weverton quartzite. In most places the other formations follow in normal sequence westward.

Geologic Formations and Their Water-Bearing Properties

Precambrian Rocks

Granitic gneiss.—The oldest known rock within the South Mountain-Elk Ridge water province is Precambrian granitic gneiss that occurs only between South Mountain and Elk Ridge in Pleasant Valley (Stose and Stose, 1946, p. 17, 25). The gneiss extends northward up Pleasant Valley about 8 miles from the Potomac River.

The granitic rocks supply only limited quantities of ground water to dug and drilled wells for farm and domestic use. Thirteen drilled wells range in depth from 22 to 216 feet. Reported well yields range from 2 to 8 gpm. Small springs are a common source of water for farm use and have flows of 15 gpm (gallons per minute) or less.

Catoctin metabasalt.—The Catoctin metabasalt occurs in two widely separated areas. The southern area is along the west side of Pleasant Valley extending north to Rohrersville. The northern area extends north from a point east of Pondsville to the Pennsylvania line. The formation is composed of volcanic greenstone, purple slate, and tuffaceous rock.

The best wells in the Catoctin metabasalt are in the Highfield-Cascade area. Nine of these wells are in a basin drained by Falls Creek and are part of the water-supply systems operated by the Blue Ridge Water Company and the U. S. Army at Fort Ritchie. These wells are 8 inches in diameter and range in depth from 187 to 402 feet. Their yields range from about 30 to 60 gpm. The high yield of these wells compared to wells in other sections of the province can be attributed to their topographically low position in a small mountain basin near Falls Creek. The deeper wells are not necessarily the best wells; the deepest well, Wa-Al 8, (402 feet deep) is reported to yield only 33 gpm.

Domestic, 6-inch-diameter wells in the same area yield 8 to 35 gpm and average about 20 gpm. The difference in yield between the 6- and 8-inch wells is in part due to the sizes of the pumps and not to the water-bearing characteristics of the rock.

In the southern part of Pleasant Valley 8 drilled wells range from 44 to 240 feet in depth and their yields range from 2 to 15 gpm.

Cambrian (?) system

Loudoun formation.—Overlying the Precambrian rocks on the west flank of the South Mountain fold is a series of highly altered sandstone and shale beds of Cambrian (?) age. The Loudoun formation is the lowest unit. The Loudoun formation crops out at the surface in two narrow exposures, each about 200 feet wide, at the top of South Mountain. One exposure is about 2 miles south of Smithsburg and one is at Pine Knob. The exposure at Pine Knob is a feldspathic quartzite and tuffaceous slate, containing a coarse basal conglomeratic sandstone (Stose and Stose, 1946, p. 33).

Because of its small areal extent, the Loudoun formation has no importance as a source of ground water.

Weverton quartzite.—The Weverton quartzite forms the crest of South Mountain and Elk Ridge. It is estimated to be 1,000 feet thick at the crests of folds. Cloos (1951, p. 29–30) describes the formation as containing fresh, light colored, partly milky-white quartz grains in a matrix of secondary recrystallized quartz. Bedding is generally prominent.

Because of its mountainous topographic position few wells have been drilled into the Weverton quartzite. Well Wa-Fi 1 at Weverton is 30 feet deep and yielded 10 gpm. Well Wa-Ak 2 at Pen Mar is 227 feet deep and reportedly yielded 11 gpm. The Weverton quartzite is the source of water for some springs whose flow emerges in the stratigraphically higher Harpers formation.

Harpers formation.—The Harpers formation is a series of highly altered shales and sandstones that are exposed west of the Weverton quartzite along South Mountain and Elk Ridge. The thickness of the formation is estimated to range from 1,200 to 3,100 feet.

TABLE 11

Depth, Length of Casing, and Yield of Wells in the South Mountain-Elk Ridge Water Province by Geologic Units

Geologic unit	Well diameter (inches)	Depth (feet)		Number of wells	Length of casing (feet)		Number of wells	Yield (gpm)		Number of wells
		Average	Range		Average	Range		Average	Range	
Antietam quartzite	6	130	50–286	(9)	39	10–86	(8)	4	2–10	(8)
Harpers formation	6	117	40–250	(18)	38	18–86	(13)	7	1–20	(14)
Weverton quartzite	6	158	30–254	(4)	—	18–70	(2)	9	5–11	(4)
Catoctin metabasalt	6 and 8	138	41–402	(27)	32	5–89	(24)	22	2–60	(21)
Granitic gneiss	6	69	22–216	(13)	33	13–52	(7)	4	1–8	(7)

More wells and springs yield water from the Harpers formation than from the Weverton quartzite because the Harpers is exposed over a larger area and occupies a lower topographic position. The depths of 18 drilled wells range from 40 to 250 feet and their yields range from 1 to about 20 gpm. Springs issuing from the Harpers formation are small but numerous. Their estimated flows range from 2 to 10 gpm.

Antietam quartzite.—The Antietam quartzite, the westernmost formation in the water province, crops out along the foothills of South Mountain and Elk Ridge. It may be as thick as 500 feet. The formation is composed of coarse-grained, white to bluish-gray quartzite and sandstone. The grains of quartz are cemented together by a small proportion of carbonate of lime (Bassler, 1919, p. 58–59).

The hilly, rock-strewn outcrops of the formation make it rather undesirable for farms and homesites. Its soil is poor and tends to bake, rendering the formation even less desirable for farming.

The quartzite is not considered to be a good aquifer. The depths of 9 drilled wells range from 50 to 286 feet and their yields range from 2 to 10 gpm. Generally, the deeper wells do not yield much more water than the shallower wells.

Aquifer Tests

Highfield

An aquifer test, summarized in Table 12, was made in the Catoctin metabasalt at Highfield on September 17–19, 1958, to determine the coefficients of transmissibility and storage. Well Wa-Al 5 was the pumped well and Wa-Al 3

TABLE 12

Summary of Hydrologic Coefficients in the South Mountain-Elk Ridge Ground-water Province

Aquifer	Wells used		Time interval (in minutes)		Formula used	Hydrologic coefficients	
	Pumped	Observation	Pumping	Recovery		Transmissibility (gpd/ft)	Storage
Harpers formation	Wa-Bk 11	—	80	56	Recovery (Theis)	500	—
Catoctin metabasalt	Wa-Al 5	Wa-Al 3	2,415	—	Theis	4,400[a] 1,800[b]	0.004 .004
Do	do	do	—	825	do	3,400	.002
Do	do	do	2,415	—	Jacob	2,700	.002
Do	Wa-Al 9	—	2,900	400	Recovery (Theis)	3,200	—

[a] Based on measurements from early part of test.

[b] Based on measurements from late part of test.

was the observation well. The test indicated an average transmissibility of about 3,000 gpd per foot and a storage coefficient of about 0.003, which shows semiartesian conditions. Figure 6 shows the drawdown of the water level in well Wa-Al 3 plotted against time and the computation of the coefficients according to the method described by Jacob (1950). During the period of pumping the data plotted as a straight line, showing no geologic or hydrologic boundary effects. However, the geology of the area suggests that a boundary condition between weathered and unweathered rocks may exist not far from the pumping well. The outcropping Weverton quartzite a few thousand feet to the west might form a boundary.

Also shown in figure 6 is a temperature log of well-Al 3 made in September 1958. On this log a vertical line of constant temperature lies between 150 and 183 feet below the land surface. This zone may be where water is entering the well, and the aquifer test may have afforded a measurement of the permeability of this zone.

The hydrologic coefficients determined from aquifer tests in areas of crystalline rocks probably apply chiefly to a relatively thin zone of weathered and fractured rock within a few tens of feet of the upper limit of the zone of saturation.

Cascade

From September 30 to October 2, 1958, an aquifer test was made at Cascade in the Catoctin metabasalt using wells Wa-Al 9, -Al 10, and -Al 11. The pumped well, Wa-Al 9, is located about 900 feet northeast of Lake Royer; observation wells Wa-Al 10 and -Al 11 are in a straight line, 400 and 900 feet, respectively, northeast from the pumped well. The three wells are on the north side of Falls Creek, 30, 100, and 150 feet from the creek bed. During the test, Falls Creek was flowing an estimated 30 to 50 gpm. The test indicated a complex hydrologic relationship between the pumped well and the observation wells because the water levels in the observation wells rose while the pumped well was discharging. Well -Al 9 was pumped for 2,900 minutes at an average rate of 53 gpm. Although the water level in the pumped well declined in stages of increasing drawdown, the water level in the observation wells rose during the first 1,000 minutes of pumping before declining. Apparently, the influence of the pumping well was not effective at distances of 400 and 900 feet, because the effect of pumping was insufficient to offset a rise in the water table due to natural causes which occurred early in the test. It is also possible that the water-bearing zones of the three wells are hydraulically connected only indirectly and the principal water-bearing zone in the pumped well, Wa-Al 9, may be deeper than the water-bearing zone in the observation wells. Water-level recovery measurements in the pumped well were analyzed according to methods described by Theis (1935) and a transmissibility of 3,200 gpd per feet was obtained (Table 12). This

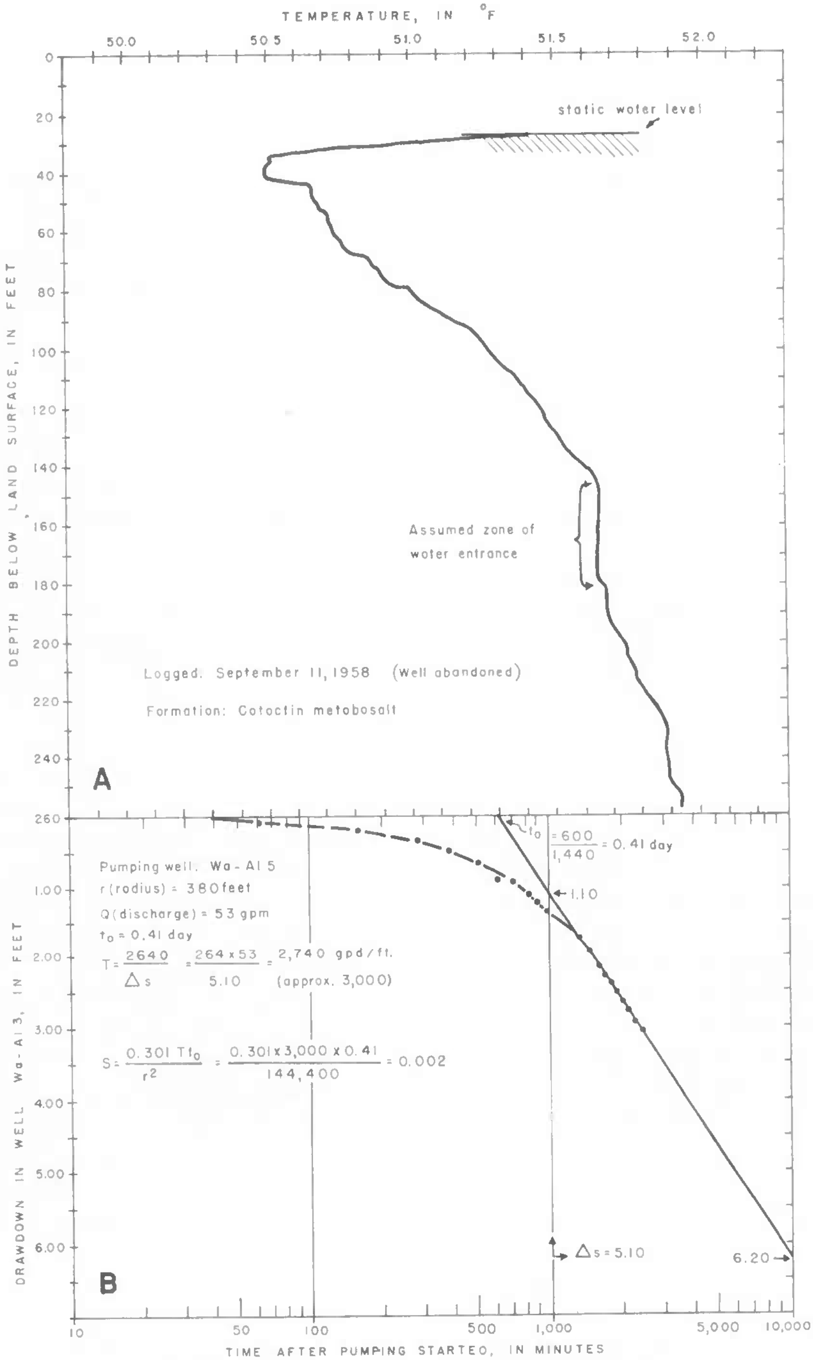

FIGURE 6 A. Temperature Log of Well Wa-Al 3 at Highfield. B. Semi-log Graph of Drawdown in Well Wa-Al 3 Versus Time While Pumping Well Wa-Al 5

value is in general agreement with the results of the Highfield test and with the test in Frederick County described by Meyer (1958, p. 65–68).

Smithsburg

On October 7, 1958, an aquifer test was conducted on well Wa-Bk 11, ending in the Harpers formation (Table 12). Well -Bk 11 is 1 mile east of Cavetown on Maryland Route 64 extended. The altitude of the well is about 970 feet above sea level. It is on the west slope of South Mountain which rises nearly an additional 500 feet. The well is 225 feet deep and is cased with 6-inch steel pipe to an estimated depth of 25 feet. The static water level prior to the test was 92 feet below land surface.

The well was pumped 80-minutes at an average of 26 gpm. Water-level recovery measurements were made for 56 minutes. The data, analyzed by the Theis method, indicated a transmissibility of 500 gpd per foot.

A temperature log of the well made on September 3, 1958, showed three probable water-bearing zones at 100–114 feet, 150–164 feet, and 188–196 feet below the land surface. As the water table slopes eastward up the mountain to an altitude several hundred feet above the well, ground water is moving down-gradient past the well at a relatively rapid rate through the rock crevices. Hence, marked vertical temperature differences were noted in the profile of the well.

Springs

In the South Mountain-Elk Ridge water province, springs are commonly of the contact type, fracture type, or a combination thereof. They occur in all the formations, but the ground water may collect in and move through several formations before emerging as a well-defined spring. The actual point of emergence of many springs is obscured by a covering of loose material and boulders.

Contact springs occur where the permeable weathered zone, composed of soil, boulders and decomposed rock, overlies relatively impermeable fresh rock. The weathered zone, where permeable, constitutes a major zone of ground-water storage. Springs on the mountainsides are fed largely by water draining from this zone. Logs of three wells on or near the top of South Mountain show the thickness of the weathered zone ranges from 36 to 72 feet. The weathered zone ranges greatly in thickness and probably attains its maximum thickness in the undissected uplands. Numerous contact springs occur at the top of South Mountain, particularly along the north prong of the stream in Raven Rock Hollow. During the summer, the discharge of individual springs is only a few gpm, but the combined flow of them in a basin of 2 or 3 square miles is on the order of several tens of gpm (fig. 4).

Fracture springs issue from openings associated with joints, bedding planes, faults, and openings resulting from slaty cleavage and schistosity. Springs along the base of South Mountain are probably a combination of fracture and contact springs.

Most of the springs in this water province are of the fifth magnitude, 10 to 100 gpm, or less. The largest single spring inventoried, the "Yourtee", Wa-Ej 5, is a contact-fracture spring at the base of South Mountain near Brownsville. The Weverton quartzite at the top of South Mountain is probably the principal intake area for the ground water that discharges from Yourtee Spring. The ground water moves downward through the Harpers formation and discharges into a stone-walled collecting basin. The water is then piped by gravity south along Maryland Route 67 to Weverton and east to Brunswick in Frederick County, where it is utilized as public supply. The water is also piped from the line into many homes along Route 67. The measured rates of discharge of Yourtee spring are:

Date	Discharge (gpm)
January 8, 1959	175
March 10, 1959	280
June 9, 1959	145

Discharge records of springs Wa-Ak 6 and -Ak 7 for the period 1954–60 were made available by the Post Engineer at Fort Ritchie. Spring Wa-Ak 6, fed by ground water from the Catoctin metabasalt and the Weverton quartzite, is a "wet weather" type and has little flow during the summer. Spring -Ak 7 issues from the Catoctin metabasalt but its intake area is believed to be principally in the Weverton quartzite which forms the crest of Quirauk Mountain. Spring -Ak 7 has an average summer flow of about 10 gpm and an average winter and early spring flow of 50 to 100 gpm. Figure 7 shows a correlation of the discharge of these springs with precipitation and temperature during 1958. Summer rains of ordinary duration and intensity apparently have little effect on the flow of spring -Ak 7, indicating that recharge to the ground-water reservoirs is not effective at this time of year.

Until 1960 the town of Boonsboro was supplied by four springs, Wa-Cj 12, -Cj 13, -Cj 32, and -Cj 33, near the base of South Mountain a mile east of town. In 1960 Boonsboro supplemented this source by building a pipeline to spring Wa-Di 6 at Keedysville. The springs on South Mountain, probably contact-fracture types, issue from the Harpers formation. Some of the water from them may be derived from the Weverton quartzite which crops out above the Harpers at a higher altitude on the mountainside. In mid-August 1959 the combined discharge of the four springs was estimated to be 80 gpm.

During the winter below-freezing temperatures affect the discharge of springs. The graphs of discharge, precipitation, and temperature of the stream in Warner Gap Hollow (fig. 4) and of springs -Ak 6 and -Ak 7 (fig. 7), respectively, provide evidence for this statement. During the winter when the mean air

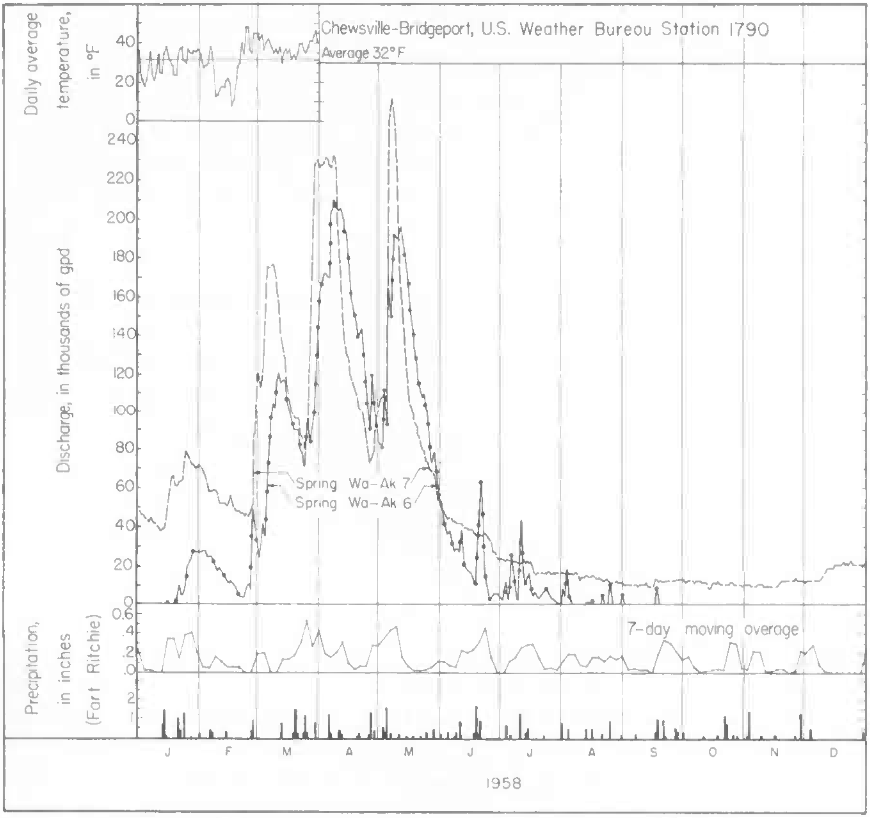

FIGURE 7. Chart Showing Correlation between Discharge from Two Springs and Precipitation at Fort Ritchie in 1958

temperature is above 32°F for about five consecutive days the flow of springs increases after periods of precipitation, but when the mean air temperature is below 32°F for about the same number of days ground freezes to a moderate depth and spring flow shows no increase, even after heavy local precipitation. If the mean air temperature is above 32°F for at least five days, spring flow increases rapidly and then decreases, even when there has been no precipitation. The increased flow is apparently the result of the release of frozen water from the soil zone during the period of thawing.

After the middle of March mean daily temperatures remain sufficiently high so that deep freezing of the ground does not occur and ground-water discharge increases in response to recharge from precipitation. This condition exists until evapotranspiration becomes effective at the beginning of the growing season. The highest possible sustained discharge from springs during the summer months would result from the combination of a relatively mild winter, a higher than average amount of winter precipitation, and at least an average amount of summer precipitation. This combination of conditions is unusual.

Quality of Water

Analyses of ground water from the Cactoctin metabasalt, the Weverton quartzite, the Harpers formation, and the Antietam quartzite are in Table 39.

Twenty-four analyses were made of water from six wells ending in the Cactoctin metabasalt in the Fort Ritchie-Cascade area. The wells are: Wa-Ak 8, -Al 8, -Al 9, -Al 10, -Al 11, and -Al 12. Only a few of these analyses are included in Table 39. The range of values of important chemical constituents and related data of water from these wells are:

Chemical and related data	Range (ppm, except for pH)
Iron (Fe)	0.1–0.9
Calcium (Ca)	6.6–12
Magnesium (Mg)	1.2–7.2
Sulfate (SO_4)	1.0–11
Chloride (Cl)	1.0–14
Dissolved solids	72–124
Hardness as $CaCO_3$	12–54
pH	6.5–6.9

The analyses show that the water is soft water, low in dissolved solids, and slightly acidic. Compared to the analyses of water from the above six wells, the analysis from well -Al 7 showed unusually high calcium, bicarbonate, and carbon dioxide content (Table 39). Hem (1959, p. 72) states that the "presence of large amounts of calcium and bicarbonate in solution is possible when a large amount of carbon dioxide is available". Well -Al 7 is only a few feet from Lake Royer, a body of surface water which absorbs carbon dioxide from the atmosphere. Very likely, water moves from the lake bed into the water-bearing crevices tapped by well -Al 7.

Chemical analyses of water samples from springs Wa-Ak 6 and -Ak 7, issuing from the Catoctin metabasalt, taken at different times over a period of years, show little change in chemical character. Only the analyses of samples collected from the two springs on January 5, 1960, are in Table 39. Water from these springs is similar in chemical character to other waters from the same rocks.

Water from springs Wa-Bk 3 and -Bk 4, issuing from the Harpers formation at the base of South Mountain, is similar in chemical character to the water from springs Wa-Ak 6 and -Ak 7 from the Catoctin metabasalt, except that it has a higher pH.

Summary of Hydrologic Conditions

The only major ground-water development in the South Mountain-Elk Ridge water province is in the Falls Creek drainage basin in the Pen Mar-Fort Ritchie area. Elsewhere wells are used mainly for domestic and farm purposes.

Available data indicate but small differences in the water-bearing capacities of the geologic formations. Differences in their areal extent, in the thickness of the weathered zone, and in their topographic expression result in some diversity of the mean yield and depth of wells in the formations. The available data indicate that only small ground-water supplies are available throughout the water province. Table 11 shows that the yield of 46 wells in the province ranges from 1 to 60 gpm. The mean yield of all the wells is less than 10 gpm. Depths of wells range from about 20 feet to more than 400 feet; the average depth is 104 feet.

Although yields of wells in the Catoctin metabasalt are generally greater than those in other formations, similar yields could be obtained also from the other formations at topographically favorable sites. The comparatively high average yield of wells in the Catoctin metabasalt is due to the productivity of wells in the Cascade-Fort Ritchie area where the wells are commonly of a large diameter and are equipped with turbine pumps of moderate to high capacity.

The coefficients of transmissibility of the Harpers formation and the Catoctin metabasalt, based on aquifer tests, range from about 500 to 4,400 gpd per foot, which is within the usual range for crystalline rocks. Coefficients of storage range from about 0.002 to 0.004, indicating modified water-table or semi-artesian conditions at the test sites. The data obtained from the aquifer tests are summarized in Table 12.

Springs are numerous but generally small; discharges range from less than 10 to about 100 gpm. They occur in all of the geologic formations. However, the Weverton quartzite is the source of many of the larger springs.

The chemical quality of ground water from wells is good and is suitable for most uses. The water from the Weverton and Antietam quartzites is slightly more mineralized than that from the Catoctin metabasalt and the Harpers formation. Spring water is lower in mineral content, but slightly more acidic than well water.

Hagerstown Valley Water Province

The Hagerstown Valley water province (fig. 2) includes the area between South Mountain and Elk Ridge on the east and Fairview and Powell Mountains on the west. It lies wholly within the Ridge and Valley physiographic province and covers an area of about 300 square miles.

The hydrology of the Hagerstown Valley water province is complex because the limestone of the province has been broken and folded. The deformation of the limestone has been partly responsible for the intricate system of solution channels and caverns which have developed within these strata. Ground water moves readily from one limestone formation to another through the channel systems. The large sustained flow of many of the limestone springs in the Hagerstown Valley indicates that the network of channels and cavities supplying only one large spring probably extends throughout several square miles.

Ground-water recharge to the limestone formations occurs chiefly through precipitation moving downward through the soil and subsoil. Some recharge may also occur by means of influent seepage from the small streams draining into the valley from the adjacent mountainsides. Locally, the limestone may be recharged directly from surface wash into sinkholes or crevices.

The storage capacity of the carbonate rocks ranges widely from place to place and no accurate figures are available concerning their overall storage capacity. Generally, the ground water in limestone rocks is stored in solution channels and crevices.

Recharge commonly occurs quickly after periods of heavy precipitation. The water level in well -Ai 8, which bottomed in the Rockdale Run formation at a depth of 500 feet, showed an abrupt rise shortly after the beginning of precipitation on June 2, 1959. The water level rose 1.9 feet as a result of 1.96 inches of rain on June 2. During the same day the water level rose 1.0 foot in well Wa-Bi 27, located a few miles away. Well Wa-Bi 27 is shallower, 103 feet deep, and also ends in limestone rocks. The difference in rise of the water level in both wells suggests that the void space (storage capacity) in the rocks penetrated by well -Ai 8 is somewhat less than that at the site of well -Bi 27. This conclusion is verified by data from aquifer tests.

Figure 2 on Plate 6 shows the monthly water levels in wells Wa-Bh 3 and -Dh 1 ending in limestone rocks. The graphs show annual cyclic water-level trends. The range in fluctuation of the water level in well -Bh 3 near Hagerstown is about 25 feet during a 9-year period of record. The range in fluctuation of the water level in well -Dh 1 at Sharpsburg is about 10 feet during a 13-year period of record. The most noticeable characteristic of the water-level graphs of observation wells in the limestone rocks is the sharp, almost immediate rise of the water level which results from heavy precipitation.

Sinkholes occur in a few small areas in the Hagerstown Valley. The greatest concentration of them is along a belt extending southwest from Fairview Mill to Pinesburg Station. The belt lies immediately west of the outcrop of the Martinsburg shale and attains its maximum width, about half a mile, just north of Pinesburg Station. The sinkhole belt straddles parts of the outcrops of the Pinesburg Station dolomite, the formations of the St. Paul group, and the Chambersburg limestone. The presence of the sinkholes along the belt, and their absence in most of the Hagerstown Valley, is due possibly to the higher solubility of the beds of pure, thin-bedded, fossiliferous limestone that underlie the belt. Other sinkhole localities are near Williamsport, west of Cedar Grove, and along Marsh Run.

Open sinkholes are rare because they are usually filled artificially to prevent human or animal casualties. The type of sinkhole that commonly occurs results from the collapse of earth and soil over water-bearing channelways and cavities.

Sinkholes may be made also by flooding low areas having a relatively thin layer of earth overlying a cavernous limestone. Collapse of the earth cover upon wetting results in a sinkhole. A surface cavern opening of this type is located half a mile northwest of Cedar Grove on the Dellinger Road, 0.4 mile north of the Potomac River. During wet seasons, surface drainage from a few miles to the north pours into this opening and discharges from springs and caverns in the limestone outcrops along the river. This channel cavern system is discussed by Davies (1950, p. 42-43). In general, the role of sinks in recharging the limestone aquifers is localized.

Recharge from Streams

The South Mountain watershed and the Fairview-Powell Mountains watersheds recharge the limestone reservoirs near the base of the mountains. Mountain streams may be influent at certain locations, feeding water directly into outcropping crevices and to subsurface channel systems. Direct surface recharge from a mountain stream occurs along a 1.5 mile stretch of Little Antietam Creek where it crosses Maryland Route 64, 1.5 miles north of Smithsburg. The creek bed is 20 to 30 feet wide, 4 to 6 feet deep, and lined with boulders, cobble, and gravel of sandstone and crystalline rocks, washed down from South Mountain. The stream here is the valley extension of Raven Rock and Warner Gap streams. Because the major part of the discharge of these streams is collected in the Edgemont reservoir, the flow of the creek below the reservoir must come from leaks through the small diversion dam across Raven Rock stream. When the Edgemont reservoir is full and overflowing, it discharges into Little Antietam Creek. On June 13, 1958, the flow of Little Antietam Creek at the bridge on the Smithsburg-Greensburg road was estimated to be about 500 gpm. The flow of the creek diminished westward and the water went underground about 1,500 feet west of the bridge. The creek bed was completely dry west of Route 64. Four potholes or depressions, one of which was almost 4 feet deep and 10 feet in diameter, were observed along the dry portion of the creek bed. At several locations, the creek bed is adjacent to outcrops of the Tomstown dolomite, which strikes southwest and dips at a low angle to the southeast. During the summer of 1958 a reach of dry stream bed appeared to migrate eastward. Not until January 1959 was any flow of water observed in the creek bed westward from the dry reach of the summer of 1958. On January 21, 1959, an oncoming tongue of flood water was observed and photographed as it advanced downstream. In less than 5 minutes the bone dry creek bed was filled and was flowing at an estimated rate of 4,000 to 6,000 gpm under the bridge carrying Route 64. However, on February 27, 1959, no water flowed under the bridge, and by March 5, 1959 the stream bed along the same reach was as dry as when first observed in June 1958. By July 31 the intake reach had migrated eastward 1 mile with a water loss to the ground estimated to be about 150 gpm. The altitude of the influent segment of the creek bed ranges from 800 feet above sea level in the eastern part to 680 feet in the western part.

During the latter part of the summer, Beaver Creek, at a place west of Cavetown and south of Maryland Route 64, was reported to disappear underground into the Tomstown dolomite. The altitude of the stream here is 660 to 680 feet above sea level.

The major direction of ground-water movement in the Hagerstown Valley is southward to the Potomac River. Most of the ground water enters the river via seeps and springs along the several tributary streams draining the valley.

Piezometric Surface and Ground-Water Movement

Plate 3 shows areas of high and low water levels and the general direction of ground-water movement. Altitudes of water levels in wells and of points of emergence of springs were used in the construction of the map. The contours indicate the altitude of the water table, or the piezometric surface, in feet above sea level. The depth to the water table at any point may be approximated from the piezometric map by subtracting the altitude of the piezometric surface from the altitude of the land surface. The map shows that the water-table surface in the Hagerstown Valley is a subdued replica of the topography that reflects the position of the major drainage systems. The center of the valley near the Pennsylvania line is occupied by a narrow, south-pointing, arrow-shaped divide. The water surface at the Pennsylvania line on U. S. Route 11 is about 750 feet above sea level. Less than a mile east of Downsville the water level is at an altitude of 500 feet.

All springs are located at points where the piezometric surface intersects the land surface. The position and spacing of the water-table contours above a spring provide some information concerning its source or drainage area. For example, spring Wa-Bj 4 is at the base of a piezometric swale southwest of Cavetown and Smithsburg. The water-table contours and data on its flow suggest this spring drains an extensive area.

In general the movement of ground water is normal to the direction of the water-table contours and to the point of lowest head. At any point, however, the direction of movement is controlled by fracture and channel patterns and local variations in permeability of the rocks.

Limestone Channels

Recent studies of the development of solution caves in folded limestone rocks reveal certain general principles that may be applied to ground-water conditions in the Hagerstown Valley. W. E. Davies (1950, 1957, 1958, 1959, 1960), who made observations in about 500 caves in the Appalachian Mountains from Pennsylvania to Tennessee, discusses the occurrence of limestone channel systems. The following significant factors summarized by Davies (1960) may be applicable to the development of channels in the limestone of the Hagerstown Valley water province:

1. Rock solution takes place beneath the zone of saturation.
2. Solutional development is closely controlled by the gradient of the piezometric surface; solution is most rapid along lines of rock weakness; solutional openings develop along with continuing stress conditions in the rocks.
3. Maps of most caves in folded rocks reflect local rock structure; passages are strike-joint controlled; faults exert very little influence; where the beds dip from 15 to about 80 degrees, the cave passages show little influence of bedding.
4. Passages of a cave branch and become more numerous as the distance from adjacent surface valleys increases; development of caves approximates that of surface drainage in a dendritic or trellis pattern.
5. The number of wells encountering water-filled channels increases away from the valleys but the yield per well decreases.
6. Large caves are confined mainly to the upper parts of drainage systems; the number of caves in headwater areas is greater than in the lower part of drainage basins.
7. The slope of passages commonly shows the gentle gradient of a former piezometric surface towards major surface valleys.

The largest of the caves in Washington County that have been described by Davies (1950, p. 36–49) occur in the Tomstown dolomite. Spring Wa-Bj 4 emerges from a cave opening in the Elbrook limestone, and spring Wa-Ag 1 from a cave in the Chambersburg limestone.

The yield of wells in the limestone formations seems to be related in a complex manner to the occurrence and distribution of individual beds that are more susceptible to solution by ground water than adjacent beds. In the Hagerstown Valley, where the beds are complexly folded and faulted, the location of individual favorable strata is difficult, especially where outcrops are scarce.

Figure 8 illustrates the complexity of the geohydrologic conditions in the limestone terrain of the Hagerstown Valley. At some localities in the valley clusters of poor wells, including some "dry holes," occur where strata dip steeply. Hypothetical well 1 on figure 8 represents conditions in such a locality. Drilling such a well to great depth may afford little or no improvement in its yield, which is dependent chiefly on the number and size of the solutional crevices encountered. Where the geohydrologic conditions are similar to those shown at well site 4 in the figure, a deep well might be warranted, providing

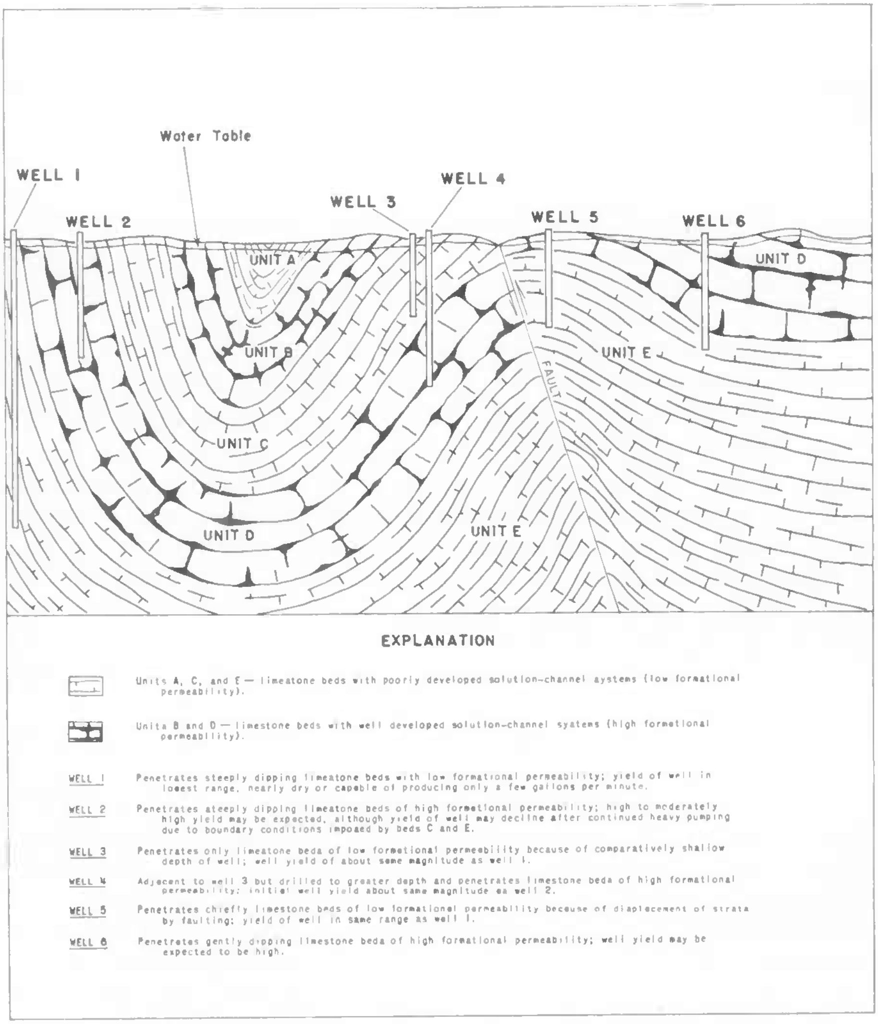

FIGURE 8. Diagram Showing Wells Penetrating Limestone Beds of Different Water-bearing Characteristics

the depth at which the bed containing the extensively developed crevice system could be predicted.

Discharge Measurements

The discharge of Marsh Run basin was measured periodically in order to obtain information on the hydrology of limestone rocks. Marsh Run rises at springs Wa-Bh 28-32 at the southwest edge of Hagerstown and flows south-

southwest to empty into the Potomac River about 0.7 mile west of Mercersville. Stream measurements made at the Sprecher Road bridge about a half mile southwest of Grimes are:

Date	Discharge (gpm)
April 25, 1958	7,300
August 27, 1958	5,200
January 1, 1959	3,240
March 25, 1959	3,300
May 5, 1959	4,360
June 6, 1959	2,600
June 24, 1959	1,970
July 28, 1959	1,660
August 8, 1959	1,280

The drainage area above the point of measurement is about 19 square miles. The highly folded surface rocks are principally those of the Conococheague limestone. The Stonehenge and the Rockdale Run formations cross the northeast edge of the basin. The formations are bounded by strike faults and cut by cross faults.

Fifteen springs were inventoried in the basin. The combined discharge of springs -Bh 28 to -Bh 32 was measured periodically from January 1, 1959 to September 1, 1959; spring -Ch 2 was measured periodically from May 29, 1958 to July 28, 1959; spring -Ci 20 was measured once on January 30, 1959. During the low-flow summer season almost all of the water discharged by Marsh Run is from springs. On July 28, 1959, the combined flow of the measured springs in Marsh Run basin was 730 gpm. The remaining 930 gpm of the total flow of 1,660 gpm in Marsh Run is assumed to have come from other springs in the basin. The flow of Marsh Run on July 28 was about 125,000 gpd per square mile, or almost three times the flow of Warner Gap stream on approximately the same date (42,000 gpd on July 30, 1959). The last rainfall prior to the July 28 measurement was on July 24. A comparison of the flow of Warner Gap stream, draining an area of crystalline silicate rocks, with the flow of Marsh Run, draining an area of limestone rocks, indicates either that the limestone rocks have a much higher storage capacity than the crystalline rocks or that the area of the limestone basin is much greater than shown on the topographic maps. Possibly both factors account, in part, for the greater flow per square mile of Marsh Run than the Warner Gap stream because the channel systems in the subsurface may extend beyond the limits of the surface drainage basin. The piezometric map (Pl. 3) indicates that some ground water may move into the upper reaches of the basin from the northeast and northwest.

No aquifer tests to determine the coefficients of storage and transmissibility were made in the Marsh Run basin. To be of value, such tests should be conducted over a long period of time.

Structural Geology

The Hagerstown Valley water province is part of the Massanutten synclinorium (Cloos, 1951, p. 148) which extends from the western limit of the South Mountain anticlinorium to the base of Fairview and Powell Mountains. Figure 1 on Plate 4 shows the geology of the synclinorium.

The geology and structure of the formations have been discussed by Cloos (1951). The Stones River group was revised by Neuman (1951). A stratigraphic study of the Elbrook and the Conococheague formations was made by Wilson (1952), and the Beekmantown limestone was mapped by Sando (1957) as a group of three formations. The distribution and extent of the geologic formations in the water province are shown on Plate 2.

The structural geology of the Hagerstown Valley includes many folds of varying size and complexity and many steeply dipping faults. Sando (1957, p. 8) states, "Although cross faults slightly outnumber strike faults, the latter are by far the more important in stratigraphic throw and lateral extent."

Based on studies in the limestone valleys in Tennessee and Kentucky, Moneymaker (1948, p. 95) states that "Bedrock solution is controlled rigidly by the geologic structure. In the Tennessee Valley the structure is of much greater importance than the chemical purity of the rock. The extensively jointed Fort Payne formation, which is 33 percent chert in the vicinity of Kentucky Dam, is much more cavernous than the less jointed pure limestone formations a few miles away; the highly deformed impure argillaceous members of the Chickamauga limestone at Chickamauga Dam are much more extensively dissolved than the flat-lying pure limestone members a hundred feet away. Solution is initiated along joints, bedding planes, uncomformities, faults, and the crests of anticlines, and in its early stages the resulting cavities are narrow openings along these structures. As solution progresses, enlarging the cavities, the structural control becomes less obvious, and continued cavern development may result in the complete loss of evidence of structural control." The concept outlined by Moneymaker also applies to the limestone rocks in the Hagerstown Valley, and the most extensively developed solution channels may be expected to occur in areas of extensive rock deformation, especially on the east side of the valley near South Mountain. Such areas should be favorable for developing large ground-water supplies.

Geologic Formations and Their Water-Bearing Properties

Cambrian System

Tomstown dolomite.—The outcrop of the Tomstown dolomite of Early Cambrian age ranges from 1 to 3 miles in width. The formation is composed principally of alternating massive and thin beds of dolomite and limestone, some shale beds, and in the Eakles Mills-Locust Grove area, white and pinkish marble. The thickness of the formation is estimated to be about 1,000 feet. Structurally the formation shows numerous shallow folds and intense eastward dipping cleavage (Cloos, 1951, p. 40). Near the contact with the Antietam quartzite, the Tomstown is probably highly fractured and probably contains many solution channels. The well logs of Wa-Bk 10 and -Bk 18 (Table 44), located in the Tomstown near its contact with the Antietam at Smithsburg, show many voids which are either solution cavities or large fracture openings.

The Tomstown dolomite is one of the most productive aquifers in the water province. Although there is a wide range in the yield of wells, 2 to 300 gpm, no "dry" holes have been reported. The greatest number of wells are for farm and domestic use, but a few are for industrial and commercial purposes.

The depths of farm and domestic wells in the Tomstown range from 25 to 250 feet, but most wells are less than 150 feet deep and the average is about 90 feet. Industrial wells at Smithsburg are from 90 to 500 feet deep.

The yields of drilled wells, excluding those for industrial use, range from 2 to 40 gpm. Well Wa-Bk 10, drilled for the Doubleday Printing Co. at Cavetown, produced about 300 gpm; well Wa-Bk 22, located about 6 feet from -Bk 10 (500 feet deep) yielded 100 gpm; well Wa-Bk 9, about 900 feet southwest of -Bk 10 (also 500 feet deep) yielded only 10 gpm. A wide range in yield of nearby wells is typical of the limestone aquifers. Dug wells are common and range in depth from 24 to 58 feet.

In 1960 the water for Keedysville and Boonsboro was being supplied by spring Wa-Di 6 issuing from the Tomstown dolomite. The town of Sharpsburg may also soon be supplied by that spring.

Waynesboro formation.—The Waynesboro formation of Early Cambrian age extends from the Pennsylvania line to the Potomac River, except for a small part of the formation removed by faulting 1 mile northeast of Benevola. The thickness of the formation is about 600 feet (Cloos, 1951, p. 42–43). Its width of outcrop is greater at some localities than others due to variations in its angle of dip. The formation consists of a lower unit of interbedded dolomite, shale, and some sandstone, and an upper unit of shale and sandstone. The formation has undergone intense folding and some faulting and many structural irregularities occur in the outcrop area.

Because the unit crops out along ridges and does not provide good farm land, it is sparsely settled and ground-water data are scanty. Well depths range from 36 to 164 feet and well yields range from 3 to 20 gpm. The best well, Wa-Ci 7, yielding 20 gpm, is near the contact with the Tomstown dolomite at Benevola.

Elbrook limestone.—The Elbrook limestone of Middle and Late Cambrian age occurs in two belts: an area east of the Conococheague Creek valley which ranges from 0.3 mile to 2 miles wide and an area west of Conococheague Creek, where it is 0.3 to 0.6 mile wide and faulted against the Martinsburg shale. Due to deformation and the lack of complete stratigraphic sections, the exact thickness of the Elbrook is not known. It is estimated to range from 2,000 to 3,000 feet. Stose (1909) described the formation as a series of light-blue and gray shaly limestones and calcareous shales. The shales constitute the upper part. The middle part consists of siliceous limestones and massive beds of dolomite. The Elbrook limestone is greatly deformed, occurring as part of gently plunging or overturned folds.

No large capacity wells were reported in either belt of the Elbrook limestone. In the eastern belt, the Elbrook may be a site of potential wells of large capacity near its contact with the Waynesboro formation. In the western belt, the best wells are near the contacts with the adjacent formations. The reason for this is not known.

The depths of drilled wells in the eastern belt range from 62 to 290 feet. Yields range from 5 to 35 gpm. In the western belt, the depths of drilled wells range from 45 to 212 feet, and yields range from 2 to 24 gpm. The average yield of 15 wells in both belts is about 12 gpm.

Dug wells, which are common in both outcrop belts, range in depth from 26 to 135 feet and average about 55 feet. The depth of dug wells is governed in part by the depth of the weathered zone, in which the wells can be dug readily. Some of the shallower wells are reported to go dry after a few months of drought.

Conococheague limestone.—The Conococheague limestone, the youngest unit of the Cambrian system in the province, is widely distributed in the eastern part of the Hagerstown Valley. Plate 2 shows the areal distribution of the Conococheague limestone east and west of the shale belt in the Conococheague Creek valley.

Wilson (1952) describes the formation as a silty, laminated, dark slate-blue limestone, with interbedded dolomites in a basal sandy part. Estimated thicknesses of the formation are 2,000 feet (Wilson, 1952, p. 307) and 2,600 feet (Long, 1953). The formation has been complexly folded into numerous small anticlines and synclines, and its normal sequence, underlying the Beekmantown group of formations, has been interrupted by faulting (Pl. 2).

Wells in the Conococheague limestone yield from 0 to nearly 400 gpm. There are many wells that produce more than 20 gpm, and a few are reported as "dry" holes. The wells of greatest capacity are industrial and commercial wells in the Hagerstown area.

Because of its wide areal distribution, the Conococheague is the source of many wells and springs. A comparison of the location of wells and springs yielding more than 20 gpm with the areal and structural geology, topography, and the water-table surface enables some of the more productive areas to be defined. However, within these productive areas, local unproductive areas yield little or no water to wells.

In the eastern part of the valley, drillers report "no drawdown" in many wells in the 5-minute quadrangles Wa-Ai, -Aj, and -Bj, indicating the presence of extensive solution zones. Springs and wells of large capacity are located principally in the western outcrop belt along the eastern side of the highland that divides the valley. Poor wells, yielding in the range of 1 to 3 gpm, are common south of the area of large springs and high-yielding wells. Some of the wells of low capacity in the southern part of the valley are situated on or near the crests of sharp local anticlines.

Depths of drilled wells in the eastern outcrop belt range from 41 to 527 and average 140 feet. Well depths of more than 400 feet are uncommon. Lengths of well casing, indicating the thickness of the weathered rock, range from 2 to 127 and average 35 feet. The yields of wells, except a few large-capacity wells such as Wa-Ai 16 and -Bi 28, range from 0 to 50 and average 13 gpm.

The well data for the belt west of the Conococheague Creek are similar to those of the eastern belt, but fewer data are available. Depths range from 53 to 240 and average 114 feet. Lengths of well casing range from 8 to 55 and average 28 feet. No large-capacity wells are in this belt. However, large ground-water supplies may be developed because extensive solution zones exist. Well yields range from 0.5 to 30 and average 10 gpm.

Dug wells throughout the eastern and western belts range in depth from 9 to 54 feet and average 29 feet.

The water supply of the town of Clear Spring, named for spring Wa-Bf 24, is furnished by springs 1.2 miles west of town, near the base of Fairview Mountain. The supply of these springs is limited and many inhabitants use cisterns to collect water for domestic use. The inhabitants of Sharpsburg obtain water from drilled wells, dug wells, and springs in the Conococheague limestone. About half the populace of Sharpsburg depend on cisterns as a source of water.

Ordovician system

Stonehenge limestone (*Beekmantown group*).—The Beekmantown group includes the Stonehenge limestone, the Rockdale Run formation, and the Pinesburg Station dolomite. These three units crop out along belts totaling about 90 square miles, east and west of Conococheague Creek. Sando (1957, p. 18) gives a thickness of about 3,600 feet for the group. The water-bearing properties of the formations are similar, and such differences as exist are probably due chiefly to differences in the lithology of individual beds rather than to the character of the formations as a whole.

The Stonehenge limestone, the basal unit of the Beekmantown group, contains massively bedded clayey limestone at its base and thin conglomeratic beds in its upper part. It ranges in thickness from 500 to 880 feet and covers a large part of the eastern belt.

The Stonehenge limestone compares favorably with the Conococheague limestone in water-yielding characteristics, and has the greatest number of wells that have produced or are producing more than 100 gpm. The highest-yielding wells, in the Hagerstown area, yield water from massive basal beds which form a small synclinorium through the eastern part of Hagerstown (Pl. 2). Although some wells yield less than 1.5 gpm, none were reported to be "dry holes". The disparity between yields of nearby wells such as Wa-Bi 13 and -Bi 9 illustrates the erratic character of production from the carbonate rocks. Well -Bi 13, 910 feet deep, yields 1 gpm; well -Bi 9, 281 feet deep and less than 200 feet distant, yields 200 gpm.

In the eastern belt, the basal member of massive algal limestone is reported by Sando (1957, p. 20) to be 192–366 feet thick. Locally the algal limestone may be a good aquifer.

The depths of drilled 6-inch diameter wells in the eastern belt range from 30 to 360 (excluding well -Bi 13) and average 155 feet. Lengths of casing range from 2 to 90 feet. Six-inch diameter wells yield from 1 to 265 and average 55 gpm—a high average for limestone rocks. Eight-inch diameter wells (largely commercial and industrial) range in depth from 60 to 305 and average 132 feet. Yields of these wells range from 60 to 385 and average 204 gpm. Well Wa-Ai 11, 305 deep, the best well in the formation, yields approximately 400 gpm. It is in rocks that dip 40 degrees.

The high average yield of wells in the Hagerstown area does not provide an accurate estimate of the water-bearing character of the entire formation, because it was not possible to determine the nature and extent of the favorable geohydrologic conditions responsible for the high yield.

Rockdale Run formation (*Beekmantown group*).—The Rockdale Run formation is the most extensively exposed formation of the Beekmantown group. It is exposed in two belts in the Hagerstown Valley. The eastern belt is the more extensive. Its outcrops cover an area of 58 square miles, or nearly twice the area covered by the Stonehenge limestone. The formation is a heterogeneous sequence of limestone and dolomite beds. Its thickness ranges from about 1,680 to 2,550 feet. The basal part of the formation is marked by a cryptozoon chert zone 100–200 feet thick. The lower two-thirds of the formation consists of silty limestone that contains layers of algal rocks; the upper one-third consists of dolomite (Sando, 1957, p. 21).

In the eastern belt, the depths of drilled wells range from 19 to 760 feet. Casing lengths range from 1 to 75 feet. Yields of 73 wells range from 0 to 60 gpm.

In the western belt, 91 drilled wells range in depth from 40 to 200 feet. Casing lengths range from 4 to 61 feet, and yields of 14 wells range from 0 to 30 gpm.

The best well, Wa-Ah 73, yielded 60 gpm. It is only a few feet away from well Wa-Ah 72, which was a "dry hole." Considering the number of reported dry holes, the Rockdale Run formation would seem to be a poor aquifer. However, numerous small springs near sites of unsuccessful wells in the eastern belt, indicate that locally the formation may be a better aquifer than is suggested by the well data. There are unsuccessful wells in both the eastern and western belts, but the greatest number are in the eastern belt in the outcrop area north of U. S. Route 40 and east of the Conococheague Creek valley. In some places, well failure may be attributed to the temporary "drying up" of shallow solution crevices during prolonged droughts.

Maugansville, a growing suburban community about 1.5 miles northwest of Hagerstown, is supplied by individual domestic wells drilled into the Rockdale Run, although all drilled wells are not successful.

Pinesburg Station dolomite (Beekmantown group).—The Pinesburg Station dolomite is a cherty, laminated dolomite whose thickness ranges from 370 to 500 feet. It crops out primarily in a belt west of Conococheague Creek and covers an area of only 2.5 square miles. In its outcrop area the formation occurs in thin, steeply dipping bands.

The well data are insufficient for an adequate evaluation of the water-bearing properties of the formation. However, its water-yielding capacity seems to be similar to that of the Rockdale Run formation in its western outcrop belt.

Wells Wa-Bh 34, -Bh 35, -Bh 37, and -Bh 42 range in depth from 51 to 110 feet. Casing lengths range from 21 to 55 feet, and yields range from 8 to 27 gpm. Because of its limited areal extent, the Pinesburg Station dolomite is unimportant as an aquifer.

St. Paul group.—The St. Paul group consists of the lower Row Park limestone, and the overlying New Market limestone. The Row Park is an impure, cherty limestone. The New Market is a fine-grained, light-gray, laminated limestone. These formations are exposed in narrow outcrops on the west side of the Conococheague Creek valley and in a small area along the northeastern edge of the valley (Neuman, 1951). The group ranges in thickness from 400 feet near the Potomac River to about 1,000 feet at the Pennsylvania line. The beds dip steeply and in some locations are nearly vertical or overturned. Strike and cross faults are common.

The few inventoried wells penetrating the rocks of this unit range in depth from 50 to 508 feet. Casing lengths range from 5 to 18 feet. Yields of wells range from 2 to 6 gpm. Because of its small areal extent the St. Paul group is not an important aquifer.

Chambersburg limestone.—The Chambersburg limestone of Middle Ordovician age crops out as narrow bands on both sides of the Conococheague Creek valley. The maximum width of its outcrop belt is 0.5 mile near Hicksville a few miles south of the Pennsylvania line. The thickness of the formation is estimated to be 100 to 225 feet. The formation is a thin-bedded, argillaceous limestone with clayey partings. It is greatly disturbed by complex folding, overthrusting, and normal faulting.

Depths of wells in the unit range from 94 to 150 feet. Length of casings range from 6 to 43 feet, and the yields from 2 to 20 gpm. Because of its small areal extent, the formation is not important as an aquifer.

Martinsburg shale.—The Martinsburg shale of Middle and Late Ordovician age crops out along a belt about 2.5 miles wide in the central part of Washington County. A much narrower belt crops out from St. Paul Church northward to Fairview. The meandering Conococheague Creek is entrenched within the Martinsburg. According to Bassler (1919, p. 157) the formation is more than 2,500 feet thick and consists of a lower section of thin black limestone and calcarerous shale and an upper section of light-colored, sandy shale and sandstone. Structural deformation of the shale has been intense.

Wells ending in the Martinsburg shale are not known to yield more than 50 gpm. No failures or "dry holes" were reported. Of approximately 60 wells inventoried, 11 produced 20 gpm or more. A plot of well yields versus topographic locations showed a random scattering of large- and small-capacity wells rather than a systematic pattern.

The depths of drilled wells range from 35 to 300 feet. Casing lengths range from 10 to 50 feet. The yields of 49 wells range from 2 to 50 gpm. The mean yield of the wells is 13 gpm.

Quaternary Sedimentary Rocks

Mountain wash (alluvial fans).—The distribution of the Quaternary sedimentary rocks is shown on the map of Washington County (Pl. 2). The sources of the sediments are South Mountain to the east and Fairview and Powell Mountains to the west.

Along the foothills of South Mountain, the alluvium generally overlies the contact of the Antietam quartzite and the Tomstown dolomite along a belt 0.5 to 0.75 mile wide. On the north side of U.S. Route 40, southeast from Mount Lena towards South Mountain, there are excellent exposures of the alluvium. The sediments are a mixture of sand, silt, clay, rounded gravel, and boulders.

At the base of Fairview and Powell Mountains, the mountain wash occurs in alluvial fans, which are distributed over the Martinsburg, Elbrook, Conococheague, Stonehenge, and Rockdale Run formations.

According to the logs of wells Wa-Bj 27 and -Cj 18, the mountain wash deposits in the eastern part of the province range in thickness from 53 to more than 140 feet. In the western part of the province, the sediments may be thinner. The well log of Wa-Ag 8 shows only 40 feet of mountain wash overlying the Conococheague limestone.

Well data show that the alluvial mountain wash is a water-bearing formation in the eastern part of the province only. Water is produced from drilled and dug wells and an occasional small spring. The depths of drilled wells range from 53 to 140 feet. The casings in most wells penetrate almost the entire thickness of the sediments. Reported yields of 5 wells range from 3 to 16 gpm. Dug wells range in depth from 20 to 56 feet.

Potomac River alluvium.—River terrace deposits of Recent and Pleistocene age occur chiefly in the flood plain of the Potomac River. The largest area underlain by the deposits extends from Pinesburg Station to Williamsport, a distance of about 2 miles, and is about 0.5 mile wide. Two auger holes bored in the deposits at the Hagerstown water plant near Williamsport indicated that the deposits consist chiefly of brown, poorly sorted, fine to medium sand and silt, with some gravel. Bedrock was encountered at 21 feet in one hole and at 27 feet in the other. Because of their relative imperviousness and thinness, the terrace deposits do not appear to be an aquifer. Locally, a few farm wells may obtain meager water supplies from them.

Aquifer Tests

Smithsburg (Doubleday and Co.)

On September 16–17, 1958, an aquifer test utilizing well Wa-Bk 9 was conducted in the Tomstown dolomite at Smithsburg. Well -Bk 9 is 500 feet deep, 6 inches in diameter, and cased to 72 feet. The driller reported that the producing zone was a small "vein" of water at a depth of 140 feet. The well was pumped for 612 minutes at an average rate of 11 gpm, and was allowed to recover for 1,965 minutes. The total drawdown was approximately 210 feet. The coefficient of transmissibility, computed using the Theis recovery formula, was between 30 to 45 gpd per foot (Table 18). The very low transmissibility indicates a relatively impervious reservoir rock. A temperature log of the well showed a probable producing or fracture zone between 155 and 185 feet.

On August 20–21, 1958, another aquifer test was made using well Wa-Bk 10 which also taps the Tomstown dolomite. Well -Bk 10, about 600 feet from -Bk 9, is reported to be 94 feet deep and cased with 18 feet of 8-inch pipe and 55 feet of 6-inch pipe inside the larger pipe. The log of the well is in Table 44. Pumping was continued for 2,895 minutes, at an estimated average rate of 200 gpm. Drawdown was estimated to be about 27 feet. Recovery measurements were made for 8,520 minutes. The coefficient of transmissibility ranged from 18,200 gpd per foot, based on the early part of the recovery curve, to 4,300 gpd per foot, based on the late part of the curve. Although well -Bk 10 is only about 600 feet from well -Bk 9, its elevation is 30 feet lower and it is in a valley. During the test, the water level in -Bk 9 was not affected by the pumping of -Bk 10, indicating no direct hydraulic connection between the wells.

Subsequent to the test, a turbine pump was installed on well -Bk 10, and difficulty was experienced in obtaining clear water when pumping at a rate greater than 50 gpm. A slug of muddy water appeared each time the pump was started, and the water ran clear only at rates of 30 to 50 gpm. The well was subsequently packed with gravel and it finally produced clear water. During the early development stage of the well, the water was discharged to a nearby drainage area and a cave-in of the land surface resulted at the disposal site.

The altitude of the stream bed of Beaver Creek, less than 100 feet south of -Bk 10, is about 4 feet lower than the altitude of the land surface at the well. The static water level in -Bk 10 on March 23, 1959, was 16.3 feet below land surface, about 12 feet below the creek bed. This difference in elevation suggests that Beaver Creek is recharging water to the rocks or that the creek bed is impervious and the well is not hydraulically connected with the creek.

Hagerstown

On October 17, 1958, a recovery test was conducted on well Wa-Ai 16, 0.5 mile north of Hagerstown, which bottomed in the Conococheague limestone. The well is 12 inches in diameter, 300 feet deep, and cased to 61 feet. The well was pumped for 1,681 minutes at an average rate of 373 gpm. After 1,445 minutes of pumping, the water level had lowered 118 feet.

On the basis of computations using the Theis recovery formula for the first 14 minutes of recovery, the coefficient of transmissibility was 19,000 gpd per foot. For the following 115 minutes of recovery, the transmissibility was 2,200 gpd per foot. Probably the true transmissibility of the rocks near the well is indicated by the earlier part of the test. These coefficients are similar to those of the test on the Tomstown dolomite at Smithsburg (well Wa-Bk 10, Table 18). The large yield of the pumped well is attributed to numerous solution cavities or channels penetrated in the well (see log in Table 44).

Hagerstown (Victor Products Co.)

The direct connection between ground water in wells and some springs in limestone rocks was established by a comparison of the water levels in well Wa-Bi 26 and in spring -Bi 31 during an aquifer test at a factory in Hagerstown. The well and the spring are about 700 feet apart. During a dry period in September 1958 the discharge of the spring was 22 gpm. but at the time of the subsequent aquifer test it had no noticeable flow. Well Wa-Bi 26 (115 feet deep), 192 feet from -Bi 27 and about 800 feet from spring -Bi 31, was pumped at an estimated rate of 200 gpm. The effect of pumping well -Bi 26 was noticeable immediately both in well -Bi 27 (103 feet deep) and in spring -Bi 31.

The water-level measurements obtained during the test on December 21 and 22, 1958, were used in computing the approximate values of coefficients of transmissibility and storage for the Stonehenge limestone in this area. Table 18 lists the coefficients and formulas used in the computations. Average values of the hydrologic coefficients are 200,000 gpd per foot for transmissibility and

0.018 for storage. The coefficient of storage indicates that the ground water in this area occurs under modified water-table conditions.

Maugansville

On October 8, 1958, a recovery test was made on well Wa-Ai 8, 500 feet deep, 12 inches in diameter, and cased to 40 feet. At the end of the 35-minute period of pumping at an average rate of 30 gpm, the water-level had lowered 93 feet. Recovery measurements were made for 121 minutes. The coefficient of transmissibility, using the Theis recovery formula, was computed to be 45 gpd per foot, indicating very tight or nearly impervious rocks at the well site.

On March 17, 1959, a brief recovery test was conducted on well Wa-Ai 9, 400 feet deep, 6 inches in diameter, and cased to 23 feet. At the end of an 80-minute period of pumping at an average rate of 10 gpm, the water-level had lowered about 350 feet. Recovery measurements were made for 265 minutes. Using the Theis recovery formula, the coefficient of transmissibility of the Rockdale Run formation at this locality is 10 gpd per foot, an extremely low value.

Cearfoss

On June 11, 1959, an aquifer test was made on well Wa-Ah 63 near Cearfoss. Well -Ah 63, is 23 feet from -Ah 57, which was used as an observation well. Well Wa-Ah 57 is 50 feet deep, 6 inches in diameter, cased to 17 feet, and ends in the Rockdale Run formation. Well -Ah 63 is 25 feet deep, 6 inches in diameter and cased to 6 feet. It was pumped at an average rate of 49 gpm. Apparently, an extensive system of shallow solution openings is present at the test site, as the wells are reported nearly to fail during drought periods. The coefficient of transmissibility averages about 127,000 gpd per foot and the coefficient of storage is about 0.14. The storage coefficient indicates the existence of water-table conditions at the locality of the test.

Troupe Springs

On October 29, 1958, a recovery test was conducted on well Wa-Ah 31, 50 feet deep and cased to 22 feet. The well was pumped for 178 minutes at an average rate of 7.2 gpm, which lowered the water level about 21 feet. Recovery measurements were made for 80 minutes. The coefficient of transmissibility, computed by the Theis recovery formula, was about 220 gpd per foot, indicating that the Martinsburg shale at the test site is tight or nearly impervious.

Williamsport

On October 24, 1958, a recovery test was conducted on well Wa-Bh 22. This well is 48 feet deep and also ends in the Martinsburg shale. It was pumped for 29.5 minutes at an average rate of 1.7 gpm, and recovery measurements of the water level were made for 35 minutes. The coefficient of transmissibility is about 75 gpd per foot, a low value. This well is old and possibly partly clogged. The test may not have been representative of the true hydrologic conditions at the site.

The tests at Troupe Springs and a Williamsport indicate a low order of permeability of the Martinsburg shale at those localities. Additional tests at other sites underlain by the formation are needed to evaluate the ground-water potential of the formation as a whole. The low values of transmissibility obtained from the aquifer tests do not correspond entirely with the moderately high yields reported for some of the wells ending in the shale.

Springs

Spring records are in Table 43 and their locations are on Plate 2. The maximum and minimum measured discharge of springs in Washington County is in Table 5.

Springs occur throughout the Hagerstown Valley water province. They were inventoried in every geologic formation except the Pinesburg Station dolomite. The openings from which most springs emerge are covered by rock debris, but a few discharge from exposed openings. The largest spring, Wa-Bj 4 at the Beaver Creek Trout Hatchery, flows from a large cavern in the Elbrook limestone. Others in which the openings are clearly defined, though not as large, are -Ag 1, -Ag 2, -Bf 3, and -Di 6. Table 13 groups the large springs according to the formation in which they occur and by magnitude of mean discharge during August 1959.

Fluorescein dye was used in an unsuccessful attempt to trace the movement of ground water from a well to a spring in a small drainage basin 1.5 miles east

TABLE 13

Number of Major Springs in the Geologic Units According to Their Mean Flow During August 1959

Geologic unit	Discharge in gpm						Total
	25–100	100–200	200–400	400–700	700–1,200	2,000–3,000	
Chambersburg limestone				1			1
Rockdale Run formation		1	1				2
Stonehenge limestone	2	1	1				4
Conococheague limestone	1			1	2		4
Elbrook limestone			1			1	2
Tomstown dolomite	1	2		1	1		5
Total	4	4	3	3	3	1	18

of Clear Spring Station. On May 6, 1959, dug well Wa-Bf 19, 20 feet deep, had water moving through it near the bottom of the well. The well was injected with a strong solution of dye to determine whether this water issued from spring Wa-Bf 20, about 3,100 feet south of well -Bf 19. The spring is 90 feet lower than the land surface at the well. The spring was flowing an estimated 400 gpm. Although the spring was checked for a period of 4 hours, there was no visible sign of the dye in the water. The dye may have been so diluted by the ground water that its presence could not be detected at the spring.

Spring Wa-Ch 27, about a mile west of Downsville, is an underground cavern uncovered by digging an 8- by 12-foot pit 12 feet deep. This spring discharged an estimated 100 gpm on December 17, 1958. It is a good site for a tracer test using colored dye.

By plotting the discharge of different types of springs in various topographic and geologic locations, an appraisal of general ground-water conditions can be made. Plate 7 shows the discharge of seven springs in the eastern section of the province; figure 9 shows discharge of seven springs in the central section; and figure 10 shows the discharge of three springs in the western section. Precipitation records also are shown in the figures.

The spring discharge graphs show that in the normal yearly cycle maximum discharge occurs in early spring and minimum discharge occurs during the late fall and early winter. Within this general pattern there are individual variations. The minimum discharges are reasonably accurate, but the maximum discharges are only approximate because of errors in measuring peak flows. The minimum flow occurs gradually and lasts longer than the period of peak flow which usually occurs rapidly but is relatively short.

The ratio between low and high flows during the period from January to May 1959 varied for individual springs, and order of magnitude of flow does not seem to be a decisive factor in determining the ratio. Spring Wa-Ak 5 had a ratio of 1:1.7 (115/200 gpm); spring Wa-Bj 4 had a ratio of 1:1.8 (2000/3,500 gpm). Springs with sustained "warm weather" discharge, again regardless of magnitude, had a minimum-maximum discharge ratio as high as 1:3 (Wa-Ag 1), but the "cold weather" type had a much higher ratio, at least 1:8 (Wa-Ah 32, -Ah 33, -Ah 76, and -Ai 10). The sustained flow of "warm weather" springs is apparently dependent upon a steady rate of ground-water recharge. The "wet weather" types are apparently recharged locally by direct movement of water into the crevice systems in places where the storage capacity of the soil and subsoil is small. Their flow is similar to that of certain types of surface streams. Springs Wa-Ah 32, -Ah 33, -Ah 76, and -Ai 10 are of this type.

In the eastern and central sections of the province, comparison of spring discharge, precipitation, and mean air temperature for the months of January, February, and March shows the following:

1. The discharge of most springs (except "wet weather" springs) was greater

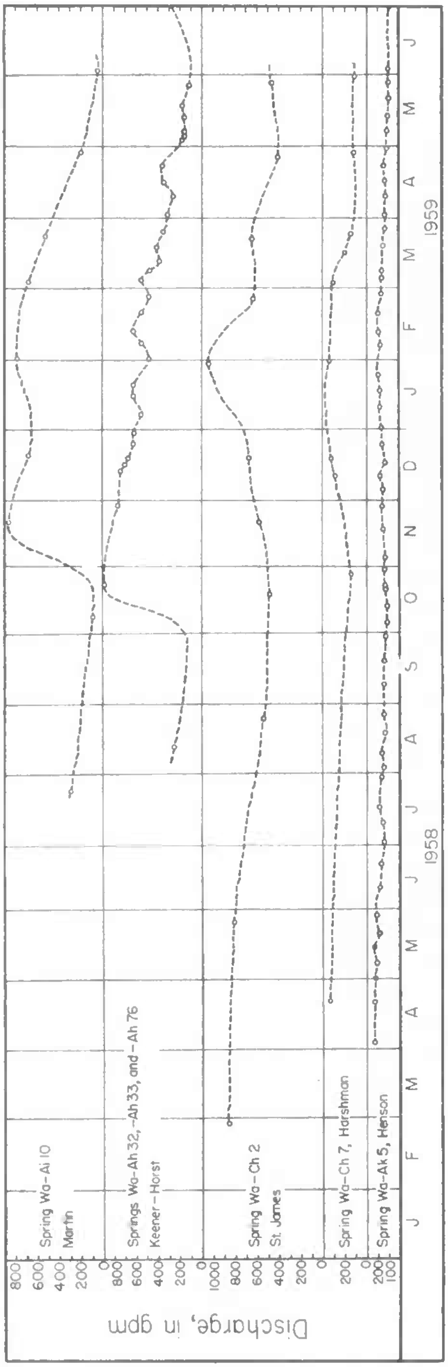

FIGURE 9. Graphs of Discharge of Seven Springs in Central Part of Hagerstown Valley

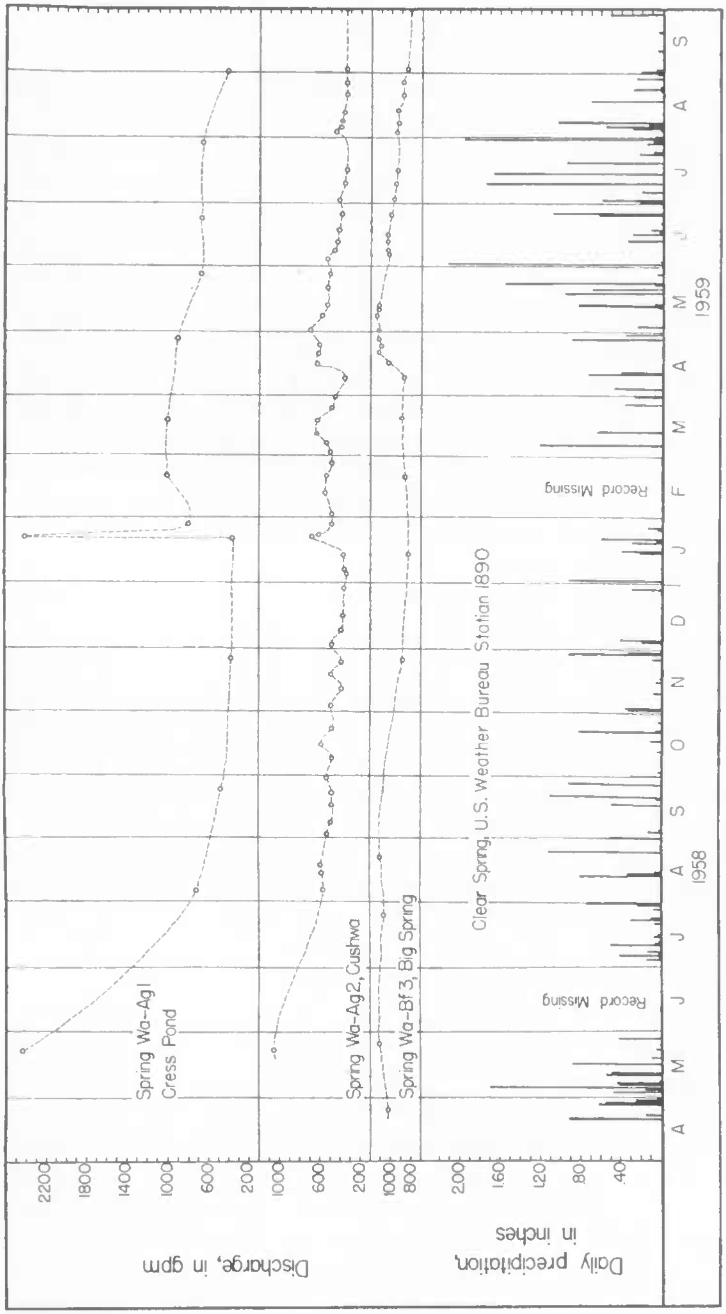

FIGURE 10. Graphs of Discharge of Three Springs in Western Part of Hagerstown Valley

in March than in January although there was more precipitation in January.

2. Average mean air temperature was about 32°F during January and February and was 40°F in March.
3. Precipitation during February 9–15 did not increase the flow of most springs. The mean air temperature at this time was about 35°F.

Thus, an increase of spring flow in late winter depends upon the amount of moisture in the soil zone, the depth of the freezing or frost line, and the time when the mean air temperature begins to average more than 32°F for a period long enough to melt the frozen ground. As pointed out by Schneider (1958, p. 3) the initial source of ground-water recharge in early spring is largely frost-melt, and this occurs only when the average air temperature is above 32°F. From the end of February to the middle of April 1959, the flow of spring Wa-Bj 4 at the Beaver Creek trout hatchery increased approximately 2,500 gpm. During this interval precipitation was only moderate, amounting to slightly more than 3.5 inches. Much of the water discharging from the spring probably came from thawing soil on the slopes of South Mountain.

Spring Wa-Ag 1 in the western part of the province is at times "flashy". During flood stages of Conococheague Creek and Rockdale Run, surface water infiltrates the cavernous openings in the Chambersburg limestone where it is exposed along Conococheague Creek. Thus, during flood stages, water may enter the crevice system and emerge at points of lower elevation, augmenting the normal subsurface drainage system. On January 22, 1959, after heavy rains on the previous day, spring Wa-Ag 1 flowed an estimated 2,400 gpm of muddy red-brown water similar in color to that in Conococheague Creek and Rockdale Run. Before the rain on January 21 it flowed 360 gpm of clear water.

The flow of spring Wa-Bf 3, which is very uniform, was unaffected by the rain of January 21; its flow apparently did not increase and no change in color of the water was observed.

Quality of Water

Ground water from the carbonate rocks of the Hagerstown Valley water province is mildly alkaline and sufficiently hard to cause scale. Water-softening units are commonly used.

As the solution channels through which the ground water circulates in the limestone rocks have little or no filtering properties, there is the likelihood of pollution of the water from organic sources. Such pollution may be indicated by a high concentration of nitrate in the water. Although no limits have been set on nitrate content of drinking water by the U. S. Public Health Service, most cases of infant methemoglobinemia (cyanosis) have been associated with the consumption of water having a nitrate content in excess of 50 ppm (Welsh and Thomas, 1960, p. 298). Samples of ground water from several sources in the Hagerstown Valley contain nitrate in excess of 50 ppm. The nitrate content of ground water from the limestone ranges from 0.8 to 87 ppm and the mean is 26 ppm.

The analysis of water from well Wa-Bi 19 (318 feet deep and cased to 38 feet) indicates chemical contamination of the ground water at that site. The concentrations of some of the constituents are anomalous: total iron, 35 ppm; sulfate 2,560 ppm; and pH, 3.0. This analysis was omitted from Table 15.

Dissolved solids content, in nine analyses of ground water from the limestone, ranges from 201 to 464 ppm, and the mean is 314 ppm (exclusive of the analysis from well Wa-Bi 19).

The hardness of 26 samples of limestone ground waters ranges from 18 to 730 ppm, and the mean is 245 ppm. The softest water of these samples is the water from well Wa-Di 11, ending in the Waynesboro formation. This well, a 13-foot dug well owned by the town of Antietam, may not penetrate any calcareous strata. The hardest water was from spring Wa-Bh 19, just north of Williamsport, which issues from the Rockdale Run formation. The sulfate content of water from this spring is 679 ppm, suggesting that this spring drains gypsum-bearing beds.

A comparison of water analyses from two wells situated within a few feet of each other but differing greatly in depth indicates that the concentration of some chemical constituents also differs greatly. The iron content of water from well Wa-Ci 33, 74 feet deep, is 1.8 ppm, but that from well -Ci 21, 303 feet deep, is only 0.02 ppm. The concentrations of the other constituents in these waters do not differ greatly.

The chemical character of water from a given source may remain relatively constant. During the period from December 1956 to January 1960, five water samples from well Wa-Ci 21, which is drilled into the Conococheague limestone near Tilghmanton, were analyzed. Minor variations in the important constituents in the five analyses are shown in Table 14.

With a few exceptions, iron content of the ground water in the province is

TABLE 14

Variations in Important Chemical and Related Data in Analyses from Well Wa-Ci 21 in the Conococheague Limestone

(Results in ppm, except for pH)

Date of collection	Total iron (Fe)	Chloride (Cl)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$	pH
12/26/56	0.07	5.0	22	239	193	7.6
9/23/57	.01	4.4	20	226	189	7.6
11/5/58	.03	9.7	6.3	367	204	7.6
7/9/59	.00	7.4	17	269	203	7.3
1/4/60	.02	7.8	18	264	164	7.6

TABLE 15

Range of Important Chemical and Related Data in the Aquifers of the Hagerstown Valley Water Province

Aquifer	Source of water	Number of samples	Chemical data	Range (in ppm except for pH)
Tomstown dolomite	6 wells and 1 spring (Wa-Bj 2, -Ci 12, -Cj 8, -Cj 21, -Di 10, -Ei 1, -Bj 7)	7	Hardness as $CaCO_3$ Total iron (Fe) Sulfate (SO_4) Nitrate (NO_3) Chloride (Cl) pH	87–372 .00–1.3 0.6–72 0.8–67 2.0–28 6.8–8.0
Waynesboro formation	Dug and drilled well (Wa-Bj 1, -Di 11)	2	Hardness as $CaCO_3$ Total iron (Fe) Sulfate (SO_4) Nitrate (NO_3) Chloride (Cl) pH	18–220 .00–.00 4.4–14 12–14 4.5–5.0 5.9–7.7
Conococheague limestone	6 wells and 2 springs (Wa-Ai 4, -Aj 2, -Bg 14, -Ci 16, -Ci 21, -Ci 33, -Bf 3, -Bg 14)	8	Hardness as $CaCO_3$ Total iron (Fe) Sulfate (SO_4) Nitrate (NO_3) Chloride (Cl) pH	148–340 .00–1.8 8.4–60 2–34 2.8–14 7.4–8.1
Stonehenge limestone	3 wells and 1 spring (Wa-Ai 20, -Bi 16, -Bi 27, -Ag 2)	4	Hardness as $CaCO_3$ Total iron (Fe) Sulfate (SO_4) Nitrate (NO_3) Chloride (Cl) pH	146–375 .00–.04 10–83 10–57 3.1–12 7.2–7.9
Rockdale Run formation (eastern belt only)	4 wells and 2 springs (Wa-Ai 2, -Ai 19, -Bh 17, -Ch 9, -Bh 19, -Ch 7)	6	Hardness as $CaCO_3$ Total iron (Fe) Sulfate (SO_4) Nitrate (NO_3) Chloride (Cl) pH	102–730 .00–.07 13–679 2.6–87 0.0–17 7.0–8.2
Martinsburg shale	4 wells (Wa-Ah 8, -Bh 1, -Bg 2, Cg 3)	4	Hardness as $CaCO_3$ Total iron (Fe) Sulfate (SO_4) Nitrate (NO_3) Chloride (Cl) pH	21–234 .00–.00 12–51 11–21 4.3–23 6.0–8.1
Mountain Wash (alluvial fans)	2 wells (Wa-Cj 16, -Cj 18)	2	Hardness as $CaCO_3$ Total iron (Fe) Sulfate (SO_4) Nitrate (NO_3) Chloride (Cl) pH	26–103 .01–.11 0.6–1.0 0.6–2.0 0.0–1.2 6.6–7.8

below 0.3 ppm, which is the limit for combined iron and manganese recommended by the U. S. Public Health Service (1946). The concentrations of other chemical constituents are relatively uniform throughout the water province. When free of pollution and treated to reduce hardness, the ground water is suitable for nearly all purposes.

Chemical analyses of water samples from the aquifers in the Hagerstown Valley water province are given in Table 39. The range of important chemical and related data in the aquifers in the Hagerstown Valley province is shown in Table 15.

Temperature of Water

The locations of wells in the water province in which vertical profiles of ground-water temperature (temperature logs) were made are shown on figure 3A. The temperatures measured are given in Table 16.

The temperature logs show that in the deeper wells the coldest water occurs from depths of 150 to 250 feet below the land surface. In wells less than 100 feet deep, the water temperature ranges widely and seems to be related to the depth of the water table below the land surface and to the time of the year when the temperature is measured. The temperature of the ground water at a depth of 50 feet below the land surface ranges from about 50°F to 56°F. The mean temperature of the shallow ground water is 53°F to 54°F, or approxi-

TABLE 16

Temperature Range of Ground Water in Wells in Washington County (in °F.)

Well no. (Wa-)	Date of measurement	Altitude above mean sea level (feet)	Temperature at depth indicated						Well status at time of measurement	Water-bearing formation
			50 feet	100 feet	200 feet	300 feet	400 feet	500 feet		
Ac 42	5/22/59	560		54.2	54.2	55.3			nonpumping[a]	Wills Creek shale
Ah 6	4/29/58	590	53.1	52.6	52.7	53.1			nonpumping	Rockdale Run formation
Ah 57	6/11/59	510	50.3						pumping	Do.
Ai 8	8/28/58	690	52.9	53.1	52.8	53.0	53.3	53.7	nonpumping	Do.
Ai 8	3/18/59	690	53.6	53.1	52.8	53.0	53.3	53.9	do	Do.
Ai 24	4/10/59	625	53.1	52.7					nonpumping[a]	Conococheague limestone
Al 3	9/11/58	1,360	50.6	51.2	51.7				nonpumping	Catoctin metabasalt
Bh 33	5/15/59	475	55.3	55.0	54.5				nonpumping[a]	Rockdale Run formation
Bi 27	9/31/58	510	55.7						nonpumping	Stonehenge limestone
Bi 43	3/18/59	535	53.0	53.2	53.6	53.7			nonpumping[a]	Do.
Bk 9	10/9/58	792		53.7	53.8	54.0	54.3	54.6	nonpumping	Tomstown dolomite
Bk 10	3/23/59	762	52.7						do	Do.
Bk 11	9/3/58	940		52.4	52.9				do	Harpers formation
Ci 39	6/10/59	525		54.5	53.9	53.9	54.3		nonpumping[a]	Conococheague limestone
Cj 14	9/3/58	560		53.8					do	Tomstown dolomite
Pa-1	7/25/58	555	53.6	54.4	55.6	56.6	57.0	57.4	nonpumping	Tonoloway limestone

[a] Well drilled a short time before temperature logged; temperature may not be stabilized.

mately the same as the mean annual air temperature. Figure 3B shows the approximate altitude of three isotherms, or lines of equal temperature, based on measurements in certain deep wells. The 55°F isotherm lies near sea level in the valley, but at Hancock, 24 miles to the west, it is about 400 feet above sea level. The other isotherms slope upward correspondingly.

The reciprocal geothermal gradient for well Wa-Ai 8 (500 feet deep) is 533 feet and for well Wa-Bk 9 (500 feet deep) it is 421 feet per °F; these are abnormally high values. In order to check the constancy of ground-water temperature at different times of the year, well Wa-Ai 8 was logged on August 28, 1958 and again on March 18, 1959. The results (Table 16) show little or no change in temperatures measured.

The temperature of ground water issuing from springs ranges from 51.5°F to 55°F and averages about 53°F, which is the mean annual air temperature of the Hagerstown Valley water province. The temperature of ground water from springs varies cyclically. Highest temperatures occur between August and November and lowest temperatures between February and May. The temperature graph of a spring may be as distinctive as its discharge graph. "Wet weather" springs appear to have the greatest temperature range. Based on 1½ years of record, springs Wa-Di 8 and -Bf 3 have a temperature range of about 1.5°F. Figure 11 shows the temperature graph of six springs during the period from May 1958 to October 1959.

Summary of Hydrologic Conditions

The limestone and dolomite that underlie the Hagerstown Valley water province not only furnish large ground-water supplies at present but also have a potentiality for increased development in the future. The heaviest industrial ground-water use is concentrated in the vicinity of Hagerstown, where wells yield as much as 400 gpm from the Conococheague and Stonehenge limestones. As a result of industrial requirements, a few wells have been constructed in the Cavetown-Smithsburg area and these produce as much as 300 gpm from the Tomstown dolomite. The Elbrook limestone is largely untested but it may be capable of yielding more ground water than it now does. The Rockdale Run formation may also be capable of yielding large supplies of ground water, although it is unproductive in some areas.

The western belts of the Pinesburg Station formation, the St. Paul group, and the Chambersburg formation, all thin and steeply dipping, are not expected to produce large quantities of ground water, although the data on these formations are not adequate to determine their capacities as aquifers.

The Martinsburg shale belt in which the meandering Conococheague Creek is entrenched has no reported "dry holes," and about 16 percent of the drilled wells produce 20 gpm or more, a relatively high rate of yield from shale.

The wells yielding the largest amounts of water in the Hagerstown Valley water province range in depth from 190 to 300 feet. Few wells are drilled below

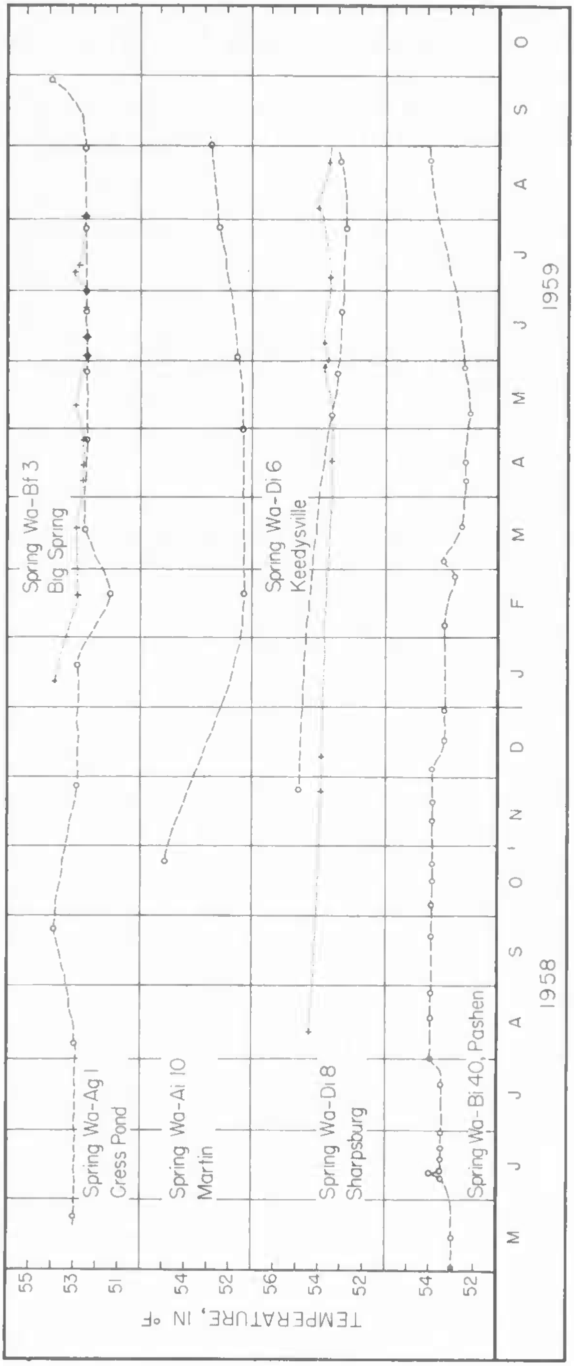

FIGURE 11. Temperature Graphs of Six Springs in Washington County

400 feet. The average depth of drilled wells is 126 feet. Length of casings averages 33 feet, and the average yield (excluding 8- and 12-inch diameter wells) is 14 gpm.

Table 17 shows the range of depth, the average depth, length of casing, and yield of wells in the Hagerstown Valley water province by geologic units.

TABLE 17

Depth, Length of Casing, and Yield of Drilled Wells in the Hagerstown Valley Water Province by Geologic Units

Geologic unit	Well diameter (inches)	Depth (feet)		Number of wells	Length of casing (feet)		Number of wells	Yield (gpm)		Number of wells
		Average	Range		Average	Range		Average	Range	
Quaternary mountain wash	6	62	38–140	(7)	77	53–130	(5)	9	3–16	(5)
Martinsburg shale	6	85	35–300	(59)	26	10–50	(47)	13	2–50	(49)
Chambersburg limestone	6	122	94–150	(2)	24	6–43	(2)	11	2–20	(2)
St. Paul group	6	221	54–508	(3)	10	5–18	(3)	5	2–6	(3)
Pinesburg Station dolomite	6	73	51–110	(4)	33	21–55	(4)	15	8–27	(4)
Rockdale Run formation										
(Eastern belt)	6	145	19–760	(91)	18	1–75	(57)	12	0–60	(73)
(Western belt)	6	128	40–200	(17)	23	4–61	(14)	7	0–30	(14)
Stonehenge limestone										
(Eastern belt)	6	155	30–360	(34)	26	2–90	(20)	55	1–265	(31)
	8	132	60–305	(5)	17	12–20	(3)	204	60–385	(5)
Conococheague limestone										
(Eastern belt)	6	140	41–527	(78)	35	2–127	(49)	13	0–50	(53)
	8	—	190	(1)	—	—	—	—	235	(1)
	12	—	300	(1)	—	61	(1)	—	400	(1)
(Western belt)	6	114	53–240	(13)	28	8–55	(11)	10	.5–30	(10)
Elbrook limestone										
(Eastern belt)	6	193	62–290	(12)	35	11–73	(5)	14	5–35	(7)
(Western belt)	6	139	45–212	(9)	42	12–90	(7)	10	2–24	(8)
Waynesboro formation	6	100	36–164	(9)	47	20–100	(6)	7	3–20	(6)
Tomstown dolomite	6	90	25–501	(29)	35	14–85	(21)	15	2–300	(20)

Although springs of moderately high flow (400 to 700 gpm) occur throughout the water province, the largest are within or near the watershed of South, Fairview, and Powell Mountains. During August 1959, 7 of the 24 springs whose flow was measured periodically during this investigation had a range in discharge from about 400 to 2,000 gpm.

The combined low flow of springs in the water province is estimated to be about 30 mgd. The use of ground water from wells in the Hagerstown Valley in 1960 was estimated to be about 0.7 mgd or about 2 percent of the approximate low flow of the springs.

The chief objectionable property of the ground water from the limestone is its hardness, which ranges from 18 to 730 ppm. Softeners are in common use. Iron content is commonly low, ranging from 0.00 to 1.8 ppm. Calcium content ranges from 22 to 218 ppm and magnesium from 3.2 to 59 ppm. Where these elements combine with the sulfate ion, boiler scale may be formed. Nitrate content ranges from 0.8 to 87 ppm. High nitrate content may indicate organic pollution of the ground water. This is quite common owing to the poor filtering qualities of limestones. Ground water from limestone is almost always mildly alkaline (pH slightly above 7.0).

Below a depth of 100 feet, the coldest water in wells is about 53°F, and it occurs at depths of from 150 to 250 feet. The temperature of ground water at a depth of 50 feet is in the range of 50 to 56°F.

The best aquifers in the area of this report are the limestones of the Hagerstown Valley, although they are not productive everywhere. Coefficients of transmissibility range from less than 100 to 270,000 gpd per foot. Coefficients of storage range from 0.0014 to 0.145. Ground water occurs chiefly under water-table conditions. The hydrologic coefficients obtained from the aquifer tests are summarized in Table 18.

There are no major water-supply problems resulting from heavy pumping of existing wells. Development of large ground-water supplies should be preceded by exploratory drilling. Aquifer tests should be conducted to determine optimum well spacing and expected rates of yield.

Hancock-Indian Springs Water Province

The Hancock-Indian Springs water province includes Fairview and Powell Mountains and extends westward to the base of the eastern slope of Sideling Hill (fig. 2).

Shale is the predominant rock type in this province, cropping out in broad belts (Pl. 2). Ground-water recharge is low, compared with that to limestones in the Hagerstown Valley. Although well drained, the soils derived from the shale are generally poor, and have a low to moderate moisture-holding capacity (Hershberger and Long, 1951, p. 233–235). Direct surface runoff is relatively high from the shaly soils.

Figure 2 on Plate 6 shows water-level changes during 1947 to 1960 in well

TABLE 18

Summary of Hydrologic Coefficients in the Hagerstown Valley Water Province

Aquifer	Wells used		Time interval (in minutes)		Formula used	Hydrologic coefficients	
	Pumped	Observ.	Pumping	Recovery		Transmissibility (gpd/ft.)	Storage
Martinsburg shale	Wa-Ah 31	—	177	80	Recovery (Theis)	220	—
Do	Wa-Bh 22	—	30	35	do	75	—
Rockdale Run formation	Wa-Ai 8	—	35	121	do	45	—
Do	Wa-Ai 9	—	80	265	do	10	—
Do	Wa-Ah 63	—	240	122	do	270,000[a] 140,000[b]	— —
Do	—	Wa-Ah 57	240	—	Theis	120,000[b]	0.132
Do	—	do	240	—	Jacob	120,000[b]	.145
Stonehenge limestone	Wa-Bi 26	—	540	—	—	—	—
Do	do	Wa-Bi 27	540	—	Theis Jacob	230,000 230,000	.028 .026
Do	do	(Spring) Wa-Bi 31	540	—	Theis	174,000	.0014
Do	do	Wa-Bi 27	540	—			
Do	do	(Spring) Wa-Bi 31	540	—	Thiem	170,000	—
Conococheague limestone	Wa-Ai 16	—	1,681	836	Recovery (Theis)	19,000[a] 2,200[b]	— —
Tomstown dolomite	Wa-Bk 9	—	612	1,965	do	30[a]	—
Do	do	—	612	1,965	do	45[b]	—
Do	Wa-Bk 10	—	2,895	3,052	do	18,200[a] 4,300[b]	— —

[a] Based on measurements from early part of test.
[b] Based on measurements from late part of test.

Wa-Ac 1, 86 feet deep and ending in the Romney shale. The maximum water-level fluctuation was 11.8 feet. The magnitude of the annual cyclic change of water level suggests a limited recharge capacity for the formation, although the water level rises rapidly in response to precipitation. An analysis of the hydrograph of well -Ac 1 during the period 1947–51 shows that the cumulative net rise of the water level was 62.5 feet. During the same 5-year period the cumulative precipitation at Hancock was 187.8 inches (or 15.65 ft.). Accordingly, the unit rise of water level was 0.25 foot per 0.08 foot (1 inch) of precipitation. If the specific yield of the Romney shale is assumed to be 5 percent, then about 16 percent of the precipitation effectively recharges the aquifer at the well site or is sufficient to cause a temporary increase in ground-water storage.

The method of computation is:

$$\frac{\text{unit rise in water level (ft.)} \times \text{specific yield (percent)}}{\text{unit precipitation (ft.)}}$$

$$= \frac{0.25 \times 0.05}{0.08} = 0.16 \text{ (effective recharge as proportion of precipitation)}$$

Most of the dug and shallow drilled wells encounter ground water under water-table conditions. The depth to water in wells, ranges from 8 to 100 feet and the mean depth is 30 to 40 feet. Locally, artesian conditions are encountered, as at wells Wa-Ac 33 and -Ac 34. These wells, ending in a limestone and a shale, respectively, flowed about 10 gpm each at the time of observation in 1958. Artesian conditions occur also in well Wa-Ac 39 at Hancock. This well penetrates about 430 feet of Wills Creek shale and 10 feet of steeply dipping Oriskany sandstone at a depth of 430 to 440 feet. The well is cased to 430 feet. The water in the sandstone is under artesian head and is derived from an outcrop of the aquifer on Cove Ridge about 0.2 mile west of the well. The water level in the well was 37.6 feet below the land surface in August 1958. The well was reported to have yielded 200 gpm in 1912 when it was drilled.

The movement of ground water through the shales is controlled by fracture systems and by the hydraulic head. The rocks have been highly deformed and fractured in some areas and the resulting permeability allows moderately high rates of ground-water movement locally. The best wells penetrate saturated fracture zones in the valleys and draws.

The water-bearing capacities of the Helderberg and Tonoloway limestones and the Oriskany sandstone, all of small areal extent, are not reliably known. The high reported yield of well Wa-Ac 39 indicates that at least locally, the sandstone is a good aquifer. The small intake or recharge area of the strata suggests that the geohydrologic conditions are unfavorable for large-capacity wells of sustained yield. The steep dip of the formations along the southern end of the plunging anticline at Fairview Mountain restricts the area of direct ground-water discharge into these units.

Springs commonly issue from limestone and sandstone, but small springs also issue from shale.

Structural Geology

The generalized structural geology of the Hancock-Indian Springs water province is shown in figure 1 on Plate 4. From east to west are the Foltz anticlinorium, the Meadow Branch synclinorium, and the Cacapon Mountain anticlinorium. Local folding and faulting has affected the rocks throughout the water province, but these features are more prevalent in the complex structures of the eastern part. General features of the geologic structure have been reviewed by Cloos (1951, p. 151–153).

Folded and faulted beds of shale interlayered with thin-bedded to massive sandstone beds are the major rock types in the province. Commonly the shale is more or less broken by joints and bedding planes along which the water may move. In the soft shale the joints may be sealed and little water can pass through the rocks. In hard, brittle shales, sometimes called "slates" by the drillers, the water may move more freely. Probably below depths of 300 to 400 feet most of the larger openings along the joints and partings in the rock are closed by the pressure of the overlying rocks and the shales will function chiefly as confining layers.

Geologic Formations and Their Water-Bearing Properties

Ordovician System

Martinsburg shale.—The Martinsburg shale crops out along three belts in the eastern part of the province (Pl. 2). The central and largest belt forms the top of the southern end of Fairview Mountain and the northern end of Blair Valley. It is the exposed core of an anticline. The eastern belt occurs along the east slope of Powell Mountain. The western belt covers less than 1 square mile and is part of Hearthstone Mountain.

Few wells have been drilled into the shale because the areas underlain by shale are rugged and sparsely populated. In Blair Valley ground water from the shale comes mainly from shallow dug wells and small springs. The formation is capable of yielding sufficient water for ordinary domestic use from wells favorably situated in valleys. An especially favorable site is in Blair Valley near Little Conococheague Creek.

Juniata formation.—The Juniata formation of Late Ordovician age occurs only in the eastern part of the province. Its areas of outcrop are restricted to the base of the east flank of Powell Mountain, the base of the southern end of Fairview Mountain, the base of the east side of Sword Mountain, the base of the west side of Rickards Mountain, and the southern rim of the Punch Bowl. The formation is at least 180 feet thick and consists of massive sandstone, red mudstone, and coarse conglomerate (Cloos, 1951, p. 68). The Juniata and the overlying Tuscarora sandstone of Silurian age form the ridges of the Bear Pond Mountains.

No ground-water data are available for the Juniata formation because of its small outcrop area and its elevated topographic position. Apparently no wells are drilled in it.

Silurian System

Tuscarora sandstone.—The Tuscarora sandstone of Early Silurian age overlies the Juniata formation in the eastern part of the water province. It is at least 60 feet thick, and crops out in a prong-shaped area about 1.8 miles wide in the Bear Pond Mountains. The Tuscarora is a hard, dense, white quartzite massively bedded in places and resistant to weathering, that forms high ridges in the Bear Pond Mountains. No ground-water data are available for the Tuscarora sandstone.

Rose Hill formation.—The formation is at least 300 feet thick in the Bear Pond Mountains, the major outcrop area of the unit. There are also two small outcrop areas to the west and southwest of Hancock.

Because of its small areal extent and its high topographic position few wells penetrate the formation. Data are available for only two drilled wells, one 60 and the other 80 feet deep. The 60-foot well has a yield of 5 gpm. Probably the formation would yield domestic supplies of ground water in most places. Small springs are common.

McKenzie formation.—The McKenzie formation of Middle Silurian age is exposed in the Bear Pond Mountains and in small outcrops west and southwest of Hancock (Pl. 2). The formation is at least 160 feet thick, and is composed of interbedded calcareous shale and argillaceous limestone.

The outcrop area of the McKenzie formation is small and is sparsely populated; therefore, ground-water data are scarce. Water is obtained from dug wells, drilled wells, and small springs. Dug wells range from 12 to 18 feet in depth and drilled wells from 28 to 45 feet in depth. Well yields range from 7 to 20 gpm. Drilled wells in draws and valleys should yield sufficient water for ordinary farm and domestic purposes.

Wills Creek shale.—The Wills Creek shale is the most widespread formations of Silurian age. It crops out in the Bear Pond Mountains in a small area north of Elbow Ridge and in a wide belt between Cove and Tonoloway Ridges. The Wills Creek is at least 600 feet thick and is composed of calcareous shale, calcareous mudstone, argillaceous limestone, and some sandstone beds (Cloos, 1951, p. 78). The Bloomsburg red beds at the base of the formation consist mainly of shale and sandstone. The sandstone is massive in the lower part of the formation.

Wells that end in the thin limestone beds are likely to yield more water than those ending in shale. The larger springs also probably originate in the limestone beds. The most productive wells are generally in draws near the contact with the overlying Tonoloway limestone. The least productive wells are commonly in or near the Bloomsburg red beds.

Flowing wells Wa-Ac 33 and -Ac 34 were reported to yield 25 to 70 gpm when drilled in 1956 and 1955. By June 1958 well -Ac 34 was flowing only about 10 gpm. These wells are near the contact between the Wills Creek and Tonoloway formations. The reason for the decline in the flow of -Ac 34 is not known.

Drilled wells range from 40 to 330 feet deep. Lengths of casing range from 13 to 64 feet. Yields of 13 wells range from 2 to 70 gpm. Springs are common.

Two pumping tests in the Wills Creek shale were conducted, one at Camp Singewald and the other at Fort Tonoloway. These tests are discussed later in the report.

Tonoloway limestone.—The Tonoloway limestone crops out along a narrow belt at the southern end of Fairview Mountain and on Stone Quarry Ridge, Moore Knob, Elbow Ridge, Cove Ridge, and Tonoloway Ridge. The formation is more than 400 feet thick and consists of finely laminated, fine-grained limestone (Cloos, 1951, p. 79). An outcrop at Grasshopper Run described by Swartz (1923, p. 162) shows an upper calcareous shale, a middle limestone, and a lower calcareous shale and shaly limestone. The log of well Pa-1 (Table 44), a mile north of the Maryland-Pennsylvania line just east of U. S. Route 522, shows the character of the formation in the subsurface.

Because the Tonoloway is found on ridges, it is not generally habitable, and information on wells is meager. Available data show that the wells range from 80 to 154 feet deep. Well yields range from 9 to 20 gpm. One of the larger springs in the water province (Wa-Ac 13) issues from this formation. It had an estimated flow of 200–300 gpm in May 1958.

The water-yielding capacity of the formation has not been adequately determined in this water province. In draws, valleys, and other favorable sites wells in the formation may produce more than 100 gpm.

Devonian System

Helderberg limestone.—The Helderberg limestone of Early Devonian age lies above the Tonoloway, except for a narrow belt of the Helderberg that extends across Washington County between Moore Knob and Coon Ridge. The Helderberg is about 300 feet thick. The lower part of the formation contains massive, rather pure, limestone; the upper part, shaly, less pure limestone.

Because it forms prominent rugged, forested ridges, the Helderberg is sparsely settled and few well data are available. Small springs are common. The largest spring inventoried, Wa-Ae 20, had an estimated flow of 400–500 gpm in July 1958. The Helderberg has not been sufficiently explored by drilled wells to determine its ground-water potential. Because the formation lies on or near the mountain crests, conditions are unfavorable for the retention of ground water in the rocks.

Oriskany sandstone.—The Oriskany sandstone of Early Devonian age overlies the ridge-making Tonoloway and Helderberg limestones. The largest area of exposure is in the eastern part of the province near Indian Springs. The formation varies greatly in thickness, but in Washington County it is estimated to average about 400 feet thick.

The formation is a coarse-grained, quartz sandstone. An exposure on U. S. Route 40 across Tonoloway Ridge has weathered to a clean, white and tan sand. Fresh exposures are hard and dense.

Ground water in sufficient quantity for domestic and farm use is obtained from wells and springs. Depths of six 6-inch diameter wells range from 64 to 202 feet. Yields range from 4 to 200 gpm. The maximum yield is from well Wa-Ac 39 near Hancock. This well is 8 inches in diameter and is 440 feet deep.

The water-yielding capacity of the Oriskany sandstone has not been adequately determined. The Oriskany is probably a better aquifer than is apparent from the limited information available concerning the yields of domestic and farm wells tapping it.

Romney shale.—The Romney shale of Middle Devonian age is present in the water province along a series of northeast southwest-trending bands on the flanks of the major structures. The formation is more than 1,600 feet thick and is composed chiefly of dark-gray to black, sandy shale. There are some argillaceous limestone beds in the lower part of the formation and some arenaceous shale and argillaceous sandstone in the upper part. The Romney shale commonly is well dissected and chiefly underlies the valleys.

The Romney shale is a satisfactory source of ground water for most farm and domestic users.

The more productive wells are at low altitudes and are usually near streams; drilled wells at Big Pool and at Ernstville along the Potomac River are reported to produce from 20 to 25 gpm and at Pecktonville, near Licking Creek, some wells yield as much as 40 gpm.

The depths of wells range from 25 to 187 feet. Lengths of casing range from 7 to 69 feet. The yields of drilled wells range from 1 to 40 gpm. Only moderate supplies of ground water are available from the formation.

Jennings formation.—The Jennings formation of Late Devonian age occurs in three belts, ranging from 1 to 2 miles wide. The belts trend northeastward and extend into Pennsylvania on the north and West Virginia on the south. The strata are commonly inclined and fractures and bedding planes are numerous. The formation is over 4,000 feet thick and consists of alternating shale and sandstone beds. Shale predominates in the lower part.

The more productive wells are usually in valleys or draws near small streams, and the less productive wells are on ridges or isolated hills. Well Wa-Ad 44 located about 1 mile northwest of Millstone, is 109 feet deep and reportedly yields 40 gpm. It is the best well in the formation. Its log shows that it ends in limestone and the well may bottom in argillaceous limestones in the lower part of the Romney. Solution cavities in the limestone may account for the relatively high yield.

The depths of drilled wells range from 35 to 225 feet. Casings range from 13 to 59 feet. Yields of wells range from 2 to 40 and average 10 gpm.

The water-yielding capacity of the Jennings formation is small, but sufficient water for domestic and farm use is obtainable in most places. Small springs are common.

Hampshire formation.—The Hampshire formation of Late Devonian age occurs in two broad belts in the Hancock-Indian Springs water province. The belt east of Hancock is about 2 miles wide and forms the center of the Timber Ridge syncline; the belt east of Sideling Hill is about 1 mile wide and forms the eastern flank of the Sideling Hill syncline. The formation is about 3,800 feet thick. It contains brownish-red sandstone alternating with thick beds of red shale and thin bands of greenish shale.

Ground water from the Hampshire formation is obtained from wells and small springs. The best wells appear to be along a belt east of Sideling Hill. The depths of drilled wells range from 38 to 251 feet. Casing lengths range from 14 to 39 feet. Yields range from 2 to 25 gpm and the mean yield of 14 domestic and farm wells is 8 gpm. The Hampshire formation is one of the least productive aquifers, although it furnishes sufficient water for most domestic wells.

Quaternary System

Potomac River alluvium.—In the Hancock-Indian Springs water province, river terrace deposits of Recent and Pleistocene age occur in the valleys of the larger creeks that flow into the Potomac River and in the flood plain of the Potomac River. The largest area underlain by the deposits extends from Park Head to McCoys Ferry, a distance of about 8 miles. The area ranges from about 0.1 to 1 mile wide.

Auger holes bored in the Potomac River alluvium at four sites in the Park Head-McCoys Ferry area ranged in depth from 13 to 27 feet and bottomed in bedrock. The borings indicate that the alluvium consists of brown, red, tan, and gray silt, sand, and gravel. There are also granules of shale and, at one site, a 6-inch layer of gray-black peaty soil.

Because the deposits are thin, poorly sorted, and silty, they are unimportant as an aquifer, although small quantities of ground water may be available for domestic wells.

Aquifer Tests

Camp Singewald

Well Wa-Af 2 at Camp Singewald is 40 feet deep. The well was pumped for about 33 minutes at an average rate of 2.3 gpm, which lowered the water level 14.3 feet. Recovery measurements were made for 50 minutes. The coefficient of transmissibility was 70 gpd per foot for the last 40 minutes of water-level recovery.

Fort Tonoloway

Well Wa-Ac 42 at Fort Tonoloway is 330 feet deep, contains 6-inch casing to 64 feet, and ends in the Wills Creek shale. During the test, which was made by the driller in May 1959, the well was pumped for 21.5 minutes at an average rate of 12 gpm, which lowered the water level from 100 to 218 feet below the land surface. A plot of the decline in water level against the pumping time showed that if the water level continued to decline at the same rate as it did on the test, it would be almost at the bottom of the well (330 feet) in less than 3.5 hours. The coefficient of transmissibility was computed as 30 gpd per foot. Inasmuch as the static water level was 100 feet below land surface and the main source of water was reported to be from 286 to 320 feet, the water is entering the well under artesian pressure.

The tests indicate that the shale strata in the Wills Creek formation have low transmissibilities and probably in general are capable of yielding only small quantities of water. These tests, however, do not indicate the water-bearing characteristics of limestone members of the Wills Creek, which are shown by yield data to be more productive than the shale members.

Fort Frederick

On January 11, 1959, a recovery test was conducted on well Wa-Be 24 ending in the Romney shale at Fort Frederick. The well was pumped for 1,450 minutes at an average rate of 17.5 gpm. The coefficient of transmissibility, computed from the Theis formula after 300 minutes of water-level recovery, was 2,400 gpd per foot. Although conclusions regarding the overall hydrologic properties of the Romney shale should not be based on one test, the order of magnitude of the coefficient of transmissibility is consistent with the reported yields of wells in this formation.

Springs

Springs occur in all of the formations in the Hancock-Indian Springs water province. They are mainly gravity springs, although solution and fracture springs occur in Helderberg and Tonoloway limestones. Contact springs are

TABLE 19

Spring Discharges by Formations in the Hancock-Indian Springs Water Province

Formation	Number of springs	Average discharge (in gpm)	Range of discharge (in gpm)
Hampshire	2	—	5–20
Romney shale	2	—	20–30
Oriskany sandstone	2	—	45–140
Helderberg limestone	6	82	2–400
Tonoloway limestone	1	—	200–300
Wills Creek shale	11	22	2–75
McKenzie formation	1	—	5
Rose Hill formation	2	—	10–20
Tuscarora sandstone	1	—	30
Martinsburg shale	5	3	1–10

present locally at the contact of the Oriskany and Helderberg formations, and fracture and contact springs are common in shale and sandstone. The springs in the Wills Creek shale have small flows, averaging not more than 30 gpm. The largest inventoried spring, Wa-Ae 20, which flowed about 300 to 400 gpm in July 1958, issues from the Helderberg limestone about 1 mile northeast of Pecktonville on the north side of Licking Creek. Most of the larger springs are in the Helderberg and the Tonoloway limestones.

Table 19 lists spring discharges by formations in the Hancock-Indian Springs water province.

Spring Wa-Bf 6, known as Green Spring, issues from the Oriskany sandstone. It is about 0.4 mile north of Green Spring Furnace. Measurements of its flow are:

Date	Discharge (gpm)	Temperature (degree F)
April 25, 1958	235	54.5
August 19, 1958	345	—
January 14, 1959	175	—
March 11, 1959	140	54
May 1, 1959	220	—
June 8, 1959	260	53.5
August 5, 1959	200	54
Average	225	54

The relatively uniform flow of spring -Bf 6 suggests a source area of moderately high ground-water storage and infiltration capacity. The wooded southern end of the plunging anticlinal Fairview Mountain presumably is the intake area.

The water supply for the town of Clear Spring comes from two springs, numbered collectively Wa-Bf 2, about 1.3 miles west of the town and north of U. S. Route 40. The springs are at the base of Fairview Mountain and issue from the Oriskany sandstone near its contact with the Helderberg limestone. The total flow of the springs could not be measured because part of the water is diverted for the Clear Spring public supply, but the overflow is more than 60 gpm at times.

Quality of Water

Water samples for chemical analysis were collected from the Martinsburg shale, the Wills Creek shale, the Oriskany sandstone, the Romney shale, the Jennings formation, and the Hampshire formation. Except for the iron content and the hardness, the chemical character of the ground water in the province is generally satisfactory. The maximum iron content (4.3 ppm) was in a sample from well Wa-Ad 3, ending in the Romney shale. Table 20 shows the ranges of some chemical constituents, of hardness, and of pH of water in the aquifers.

TABLE 20

Range of Important Chemical and Related Data in the Aquifers of the Hancock-Indian Springs Water Province

Aquifer	Source of water	Number of samples	Chemical data	Range (in ppm, except for pH)
Martinsburg shale	dug well (Wa-Af 12)	1	Hardness as $CaCO_3$	156
			Total iron (Fe)	1.8
			Sulfate (SO_4)	46
			Nitrate (NO_3)	9.4
			Chloride (Cl)	22
			pH	7.2
Wills Creek shale	drilled well (Wa-Bf 5)	1	Hardness as $CaCO_3$	171
			Total iron (Fe)	.07
			Sulfate (SO_4)	15
			Nitrate (NO_3)	—
			Chloride (Cl)	8.1
			pH	7.4
Oriskany sandstone	2 wells and one spring (Wa-Ac 2, -Be 29, -Bf 2)	3	Hardness as $CaCO_3$	69-312
			Total iron (Fe)	.02-.68
			Sulfate (SO_4)	1.0-28
			Nitrate (NO_3)	0.8-78
			Chloride (Cl)	1.3-7.0
			pH	7.4-7.8
Romney shale	3 drilled wells (Wa-Be 3, -Be 5, -Be 24)	3	Hardness as $CaCO_3$	32-115
			Total iron (Fe)	0.03-0.8
			Sulfate (SO_4)	4-30
			Nitrate (NO_3)	0.1-0.5
			Chloride (Cl)	1.2-3.5
			pH	6.1-8.1
Jennings formation	3 drilled wells (Wa-Ad 3, -Ae 15, -Bb 2)	3	Hardness as $CaCO_3$	76-136
			Total iron (Fe)	0.0-4.3
			Sulfate (SO_4)	0.4-4.6
			Nitrate (NO_3)	0.0-1.5
			Chloride (Cl)	2.0-4.2
			pH	6.8-8.0
Hampshire formation	drilled well and spring (Wa-Ab 5, -Ab 32)	2	Hardness as $CaCO_3$	13-90
			Total iron (Fe)	0.0-0.0
			Sulfate (SO_4)	5.4-7.4
			Nitrate (NO_3)	7.8-18
			Chloride (Cl)	0.6-1.4
			pH	7.0-7.0

One of the least desirable waters was from well Wa-Ac 2, 2.5 miles west of Hancock on Tonoloway Ridge, which is along the contact zone between the Oriskany sandstone and the Helderberg limestone. The analysis showed that the hardness of this water was 312 ppm and the nitrate content was 78 ppm. The high nitrate content is indicative of organic pollution.

Temperature of Water

A temperature log was run on well Wa-Ac 42, ending in the Wills Creek shale at Fort Tonoloway. From a depth of 200 feet to the bottom of the well at 330 feet the reciprocal geothermal gradient is 85 feet per degree F. A temperature log also was run on well Pa.-1, ending in the Tonoloway limestone. Based on measurements from 200 feet to the bottom of the well at 500 feet, the reciprocal geothermal gradient was 162 feet per °F. Apparently the higher reciprocal gradient in the limestone is due to the fact that the limestone affords an oppor-

TABLE 21

Depth, Length of Casing, and Yield of Drilled Wells in the Hancock-Indian Springs Water Province by Geologic Units

Geologic unit	Well diameter (inches)	Depth (feet)		Number of wells	Length of casing (feet)		Number of wells	Yield (gpm)		Number of wells
		Average	Range		Average	Range		Average	Range	
Hampshire formation	6	112	38–251	(28)	22	14–39	(9)	8	2–25	(14)
Jennings formation	6	101	35–225	(50)	34	13–59	(21)	10	2–40	(26)
Romney shale	6	81	25–187	(58)	31	7–69	(37)	11	1–40	(36)
Oriskany sandstone	6 8	130 —	64–202 440	(6) (1)	— —	— 430	— (1)	6 —	4–10 200	(3) (1)
Helderberg limestone	6	—	70	(1)	—	19	(1)	—	10	(1)
Tonoloway limestone	6	102	80–154	(4)	—	—	—	15	9–20	(3)
Wills Creek shale	6	114	40–330	(23)	36	13–64	(8)	15	2–70	(13)
McKenzie formation	6	36	28–45	(2)	27	26–28	(2)	14	7–20	(2)
Rose Hill formation	6	70	60–80	(2)	—	30	(1)	—	5	(1)
Tuscarora, Juniata, and Martinsburg formations[a]	—	—	—	—	—	—	—	—	—	—

[a] No data on drilled wells available, due to small areal extent of units.

tunity for circulation of ground water to a greater depth than is afforded by the shale. The geothermal gradients determined in these wells are in the normal range found elsewhere.

The temperature of ground water from springs does not vary greatly during the year. The springs with a more uniform flow appear to have a smaller temperature range. The temperature of spring Wa-Bf 6, measured periodically from April 1958 to August 1959, fluctuated between 53.5 and 54.5°F. The water temperature of several springs ranged from 50°F to 56°F and averaged about 54°F. The mean annual air temperature is about 53°F.

Summary of Hydrologic Conditions

Although the extensive shales in the Hancock-Indian Springs water province ordinarily supply water in sufficient amounts for domestic and farm use, their transmissibility and storage capacity is inadequate for large ground-water production. The water-yielding capacity of the ridge-forming limestones and sandstones has not been adequately tested. These rocks may be better aquifers than is apparent from the available data. Table 21 summarizes by geologic units the depth, length of casing, and yield of drilled wells in the Hancock-Indian Springs water province.

Springs are a common source of ground water throughout the water province and small springs and seeps are especially common in the shale. The large springs, discharging as much as 400 gpm, generally issue from limestone and sandstone.

The results of three aquifer tests using wells ending in shale show a range in the coefficient of transmissibility of from less than 100 to 2,400 gpd per foot, indicating that the formations tested are rather poor aquifers. Table 22 summarizes the hydrologic coefficients obtained from the aquifer tests.

TABLE 22

Summary of Hydrologic Coefficients in the Hancock-Indian Springs Water Province

Aquifer	Wells used		Time interval (in minutes)		Formula used	Hydrologic coefficients	
	Pumped	Observation	Pumping	Recovery		Transmissibility (gpd/ft.)	Storage
Romney shale	Wa-Be 24	Wa-Be 24	1,450	300	Recovery (Theis)	2,400[b]	—
Wills Creek shale	Wa-Af 2	Wa-Af 2	32	50	do	170[a]	—
						70[b]	—
Do	Wa-Ac 42	Wa-Ac 42	21.5	None	Jacob	30[c]	—

[a] Based on measurements from early part of test.
[b] Based on measurements from late part of test.
[c] Based on drawdown being reverse image of recovery.

The quality of ground water from the formations is suitable for most purposes, although in some places the hardness of the water may be in excess of 300 ppm and the iron content may be more than 4 ppm. Most of the water is slightly alkaline. Water treatment may be required locally for softening or iron removal.

The temperature of the ground water ranges from about 54°F in shallow wells to more than 57°F in deep wells. The mean temperature of water from springs is about 54°F.

Sideling Hill-Town Creek Water Province

The Sideling Hill-Town Creek water province. (fig. 2) is bounded on the east by Sideling Hill and on the west by Town Creek. The province is underlain chiefly by shale of the Devonian and Mississippian systems.

The ground-water reservoirs in the water province are recharged chiefly by local precipitation. The quantity and amount of recharge is governed in part by the capacity of the soil and rocks to receive and transmit water. Shale commonly has a low permeability and storage capacity. Movement of water through it occurs chiefly by means of small interconnected fractures and parting planes. The soils derived from the underlying shales have a low moisture-holding capacity. They tend to bake or form a hard surface crust which impedes the downward movement of water.

During the winter when the soil is frozen, much of the precipitation is prevented from moving downward into the rocks. During part of the summer the water demands of the plants take up much of the precipitation. Thus much of the ground-water recharge occurs during periods of heavy precipitation in the late fall or early spring.

Few data are available concerning the storage capacity, or specific yield, of shale in this area but it is believed to be low (probably less than 5 percent).

The water table in the province parallels the topography in a subdued fashion. The water table in the flood plain of Town Creek slopes from 812 feet at the Maryland-Pennsylvania line to 520 feet above sea level at the Potomac River. The southerly gradient of the flood plain and of the shallow water table beneath it is about 21 feet per mile.

Water levels range from 2 to 110 feet below the land surface. The depth to water is greatest on the tops of ridges and isolated hills and least near the valley floors of the major streams. Ground water occurs chiefly under water-table conditions, although locally artesian and semi-artesian conditions exist. One well flows, and the water levels in several wells rise to near land surface. Small springs occur in all of the formations.

Structural Geology

Most of the water province is underlain by a wide, shallow synclinorium, which in this report is called the Potomac synclinorium (Pl. 4, fig. 1). Sideling

Hill and Town Hill are erosional remnants of synclines, capped by erosion-resistant sandstones of the Pocono formation. Stratford Ridge, capped by the erosion-resistant Oriskany sandstone, is a small anticline. The shales of the Romney, Jennings, and Hampshire formations locally are folded into small anticlines and synclines. In the eastern part of the water province between Sideling Hill and Town Hill is a low anticlinal structure called the Orleans anticline (O'Harra, 1900, p. 132). The areal distribution of the geologic units is shown in Plate 1.

Geologic Formations and Their Water-Bearing Properties

Devonian System

Oriskany sandstone.—The outcrop area of the Oriskany sandstone of Early Devonian age is restricted to Stratford Ridge in the south-central part of the province and to a small knob-like outcrop about 1 mile southeast of Oldtown on the Potomac River. The lower part of the formation is a highly calcareous, cherty siltstone, and the upper part is a calcareous, coarse-grained, locally conglomeratic sandstone. Only the upper part is exposed at the surface. The thickness of the sandstone at Stratford Ridge is not known, but the thickness of the formation in the central part of Allegany County ranges from 300 to 350 feet.

Because of its small areal extent along the crest of Stratford Ridge, no wells have been drilled in the formation. The one spring inventoried (All-Cg 11) flowed an estimated 15 gpm in June 1957. It is likely that deep drilled wells would yield sufficient water for domestic purposes.

Romney shale.—The Romney shale of Middle Devonian age lies on the flanks of the Stratford Ridge anticline and extends from the Potomac River to a point 10.5 miles northeast. The Romney is an olive-gray and black shale, interbedded with argillaceous limestone in the lower part, black shale in the middle part, and silty mudstone and siltstone in the upper part. The thickness of the formation in Allegany County ranges from 350 to 1,660 feet.

Ground water is obtained from the Romney shale in quantities generally sufficient for domestic and farm use. Wells yielding as much as 15 gpm are exceptional. The greatest concentration of drilled wells is in the Oldtown area.

The depths of drilled wells in the Romney shale range from 22 to 162 feet. Casing lengths range from 6 to 59 feet. The depths of dug wells range from 10 to about 20 feet. Yields of 28 wells range from 1 to 15 gpm. Valley localities and localities in which the dip of the rocks is toward the drainage are probably the most productive.

Jennings formation.—The Jennings of Late Devonian age is the most widespread of the shale formations. The Jennings formation is a dark-gray to black, platy shale in the lower part; a platy, siliceous shale with interbedded siltstone in the middle part; and a siliceous shale with interbedded siltstone and conglomeratic sandstone in the upper part. The uppermost conglomeratic sandstone forms Green Ridge and Polish and Ragged Mountains. The thickness of the unit in Allegany County ranges from 3,000 to 4,800 feet.

Ground water is obtained from drilled wells, dug wells, and small springs. Well yields range from 0.2 to 36 gpm; many wells are in the range of 5 and 10 gpm. Drilled well All-Bi 12, 55 feet deep and ending in the Jennings formation, has the highest reported yield of any well in this water province producing from a shale. When this well was drilled in November 1957 its reported yield was 36 gpm. In June 1958 it was flowing with a head about 5 feet above land surface. Some of the more productive drilled wells are in draws or valleys near major streams. Depths of drilled wells range from 26 to 200 feet. Average depth, length of casing, and yield of wells in the Jennings formation are similar to those of the Romney shale. One of the best wells in the Jennings is -Ah 7, situated on top of Green Ridge where it penetrates conglomeratic sandstone. Fractures in the sandstone may account for the relatively large (25 gpm) yield of this well.

Hampshire formation.—The Hampshire formation of Late Devonian age flanks the west side of Sideling Hill and the east and west sides of Town Hill in mile-wide bands of relatively uniform width. The Hampshire formation is an interbedded red shale, red mudstone, and red to brown cross-bedded siltstone and sandstone. The thickness of the formation ranges from 1,630 to 2,400 feet. The formation is part of a syncline underlying Sideling Hill and Town Hill.

The area of exposure of the formation is rugged, dissected by small streams, and is sparsely inhabited. Well data are sparse. Water is obtained generally in sufficient quantities for limited domestic and farm use from both dug and drilled wells and from small springs.

Depths of drilled wells range from 58 to 404 feet and casing lengths range from 10 to 45 feet. Yields of 4 wells range from 2 to 8 gpm.

Mississippian System

Pocono formation.—Exposures of the Pocono formation are restricted to the crest of Sideling Hill and Town Hill in belts that average about 0.5 mile wide. The Sideling Hill exposure is continuous for the length of the mountain, but the Town Hill exposure is incised by Fifteen Mile Creek. These exposures are buff shales containing thin coal beds at the base, and crossbedded arkosic sandstone and conglomerate, overlain by thickbedded coarse, white sandstone and conglomerate. The thickness of the formation in this province is about 550 feet. The tops of the mountains are remnants of synclines, as shown in figure 1 on Plate 4.

Ground water from the Pocono formation is obtained from 5 drilled wells that range in depth from 65 to 265 feet. The yields of the wells are not known, but it is estimated that most of them yield less than 5 gpm. The fractured and creviced appearance of the sandstone in exposures suggests that the formation is moderately permeable. Thus locally wells yielding substantially more than 5 gpm may be obtained. The yields of some wells may be improved by deepening.

Aquifer Tests

Oldtown

On August 28, 1957, an aquifer test was made on well All-Cf 44, 74 feet deep, ending in the Romney shale. The well was pumped for 200 minutes at an average rate of 3 gpm, which lowered the water level 14.0 feet. Recovery measurements were made for 200 minutes. The coefficient of transmissibility, computed by means of the Theis recovery formula, was 70 gpd per foot, based on a plot of the early part of the recovery of the water levels, and 45 gpd per foot for the late part of the recovery period. These values of transmissibility are low, indicating the poorly permeable character of the rocks at this locality. The transmissibilities determined from this test are in the same range as those determined for the Wills Creek shale.

Green Ridge Camp

On September 26 and 27, 1957, an aquifer test was made on well All-Ah 1, 8 inches in diameter and 113 feet deep. The well was pumped for 500 minutes at an average rate of 12 gpm, which lowered the water level 14.3 feet. Measurements of recovery of the water levels were made for 640 minutes. The coefficient of transmissibility, based on computations using the Theis formula was 1,000 gpd per foot, a rather high value for shale, indicating moderate permeability of the Jennings formation at the site. The small drawdown of the water level during the pumping period suggests that the well may yield more than 12 gpm with a larger drawdown. The well site is about 500 feet from and 8 to 10 feet above the bed of Fifteen Mile Creek.

Camp Straus

On October 15, 1958, an aquifer test was made on well All-Bi 14, 140 feet deep, ending in the Hampshire formation. The well was pumped for 100 minutes at an average rate of 8 gpm which lowered the water level approximately 7 feet from a static level of 110 feet below the land surface. Measurements of the recovery of the water level were made for 100 minutes. The coefficient of transmissibility, based on the use of the Theis recovery formula, was 210 gpd per foot for the early part of the recovery period, and 530 gpd per foot for the late part. The test showed only moderate permeability of the shales at the well site, although the well yield was a little better than average.

Springs

The springs in all of the geologic units are of the contact or fracture type, and are in many places a combination of both types. The largest spring, All-Cg 24, near the southern end of Town Hill and issuing from the Hampshire formation, discharges an estimated 50 gpm. Other relatively large springs are Wa-Ab 3 and -Ab 14 at the foot of the west side of Sideling Hill. They flowed an estimated 30 and 20 gpm from the Hampshire formation. The water from these springs may be draining from sandstones near the crest of Sideling Hill. The estimated range of flow of several springs in the water province is from 2 to 50 gpm.

Quality of Water

The chemical quality of the ground water is suitable for most domestic and farm purposes. The water from the shales is generally slightly irony, hard, and alkaline. Sulfate commonly occurs in higher than average concentration, probably derived from local deposits of gypsum. The water from well -Bg 13, in the Jennings formation, had a sulfate content of 120 ppm. Sulfate content of ground water from the various sources sampled ranges from 0.2 to 120 gpm. Waters high in sulfate may be associated with hydrogen sulfide gas, which commonly occurs in noticeable concentrations in ground waters from black shales or other shales formed from organic muds. Hydrogen sulfide occurs in the shales of Bedford County, Pennsylvania, just north of the water province (Lohman, 1938, p. 78). "Black Sulfur" Spring, All-Bh 3, is so-called probably because the ground water contains iron and hydrogen sulfide from which a black precipitate of ferrous sulfide forms. "White Sulfur" Spring, All-Bh 8, only about a mile from -Bh 3, is so-called because the ground water apparently contains hydrogen sulfide which forms a white precipitate of sulfate minerals on the rocks near the spring. Water in which sulfate has been reduced may contain hydrogen sulfide (Hem, 1959, p. 224).

The analysis of water from well All-Bi 2, 147 feet deep, suggests that the well may be subject to pollution. The nitrate content of the water is 66 ppm and the chloride content is 45 ppm.

Iron content of the ground water ranges from 0.01 to 20 ppm and hardness ranges from 19 to 227 ppm. Table 23 shows the range of important constituents in the ground water.

Temperature of Water

Temperature logs were run on wells All-Ah 1 near Green Ridge and All-Bg 12 near Bells Hill. Because of the comparatively shallow depths of these wells (113 and 55 feet), the temperatures measured are not indicative of the thermal gradient in the rocks of the area.

The temperature of ground water from wells 38 to 147 feet deep measured

TABLE 23

Range of Important Chemical and Related Data in Aquifers of the Sideling Hill-Town Creek Water Province

Aquifer	Source of water	Number of samples	Chemical data	Range (in ppm, except for pH)
Romney shale	Drilled wells (All-Cf 43, -Cf 44)	2	Hardness as $CaCO_3$	227
			Total iron (Fe)	0.8–1.5
			Sulfate (SO_4)	73
			Nitrate (NO_3)	0.1–0.6
			Chloride (Cl)	2.0–9.3
			pH	7.3–7.7
Jennings formation	Drilled wells (All-Ah1, -Ah 2, -Bg 13, -Bi 2)	4	Hardness as $CaCO_3$	58–174
			Total iron (Fe)	.08–12
			Sulfate (SO_4)	4.0–120
			Nitrate (NO_3)	0.1–66
			Chloride (Cl)	2.6–45
			pH	7.4–7.8
Hampshire formation	Drilled wells (All-Ai 2, -Bi 14, -Cg 31)	3[a]	Hardness as $CaCO_3$	19–77
			Total iron (Fe)	.01–.12
			Sulfate (SO_4)	0.2–5.2
			Nitrate (NO_3)	0.1–2.9
			Chloride (Cl)	5.2–6.0
			pH	6.3–8.7
Pocono formation	Drilled well (All-Ai 22)	1	Total iron (Fe)	20
			Nitrate (NO_3)	0.7
			Chloride (Cl)	2.3
			pH	6.6

[a] Well All-Bi 14 near contact of Hampshire and Jennings formations may yield water from both units.

during various seasons ranged from 53°F to 56°F. The temperature of spring water during the month of June in 1957 and 1958 ranged from 53° to 57° and averaged about 55°F. Mean annual atmospheric temperature is between 52° and 53°F.

Summary of Hydrologic Conditions

Ground water in the Sideling Hill-Town Creek province comes chiefly from the areally extensive shales underlying most of the province. The quantities available are small but in most places they are sufficient for farm and domestic use. The more productive wells are located in draws or in valleys near major streams. Aquifer tests and statistics on well yields indicate little difference in the hydrologic properties of the different shale units.

Because the sandstone units cap the crests of sparsely inhabited ridges, little information is available concerning their water-bearing properties. At favorable sites the sandstone beds may yield more water to wells than is apparent from the available data.

Table 24 summarizes the depth, length of casing, and yield of drilled wells in the province by geologic units.

Small springs are numerous but many of them flow only during wet seasons.

The coefficients of transmissibility, determined from aquifer tests, are among the lowest in the report area, ranging from less than 100 to about 1,000 gpd per foot. The low range in the yield of wells corresponds with the low trans-

TABLE 24

Depth, Length of Casing, and Yield of Drilled Wells in the Sideling Hill-Town Creek Water Province by Geologic Units

Geologic unit	Well diameter (inches)	Depth (feet)		Number of wells	Length of casing (feet)		Number of wells	Yield (gpm)		Number of wells
		Average	Range		Average	Range		Average	Range	
Pocono formation	6	139	65–265	(5)	—	—	—	—	—	—
Hampshire formation	6	125	58–404	(23)	25	10–45	(5)	4	2–8	(4)
Jennings formation	6	88	26–200	(85)	23	8–76	(35)	6	1–36	(33)
	8	109	104–113	(2)	—	14	(1)	19	12–25	(2)
Romney shale	6	80	22–162	(44)	22	6–59	(23)	5	1–15	(28)
Oriskany sandstone[a]										

[a] No data available.

TABLE 25

Summary of Hydrologic Coefficients in the Sideling Hill-Town Creek Water Province

Aquifer	Wells used		Time interval (in minutes)		Formula used	Hydrologic coefficients	
	Pumped	Observation	Pumping	Recovery		Transmissibility (gpd/ft.)	Storage
Hampshire formation	All-Bi 14	-Bi 14	100	100	Recovery (Theis)	210[a]	—
						530[b]	—
Jennings formation	All-Ah 1	-Ah 1	480	640	do	1,000	—
Romney shale	All-Cf 44	-Cf 44	200	200	do	70[a]	—
						45[b]	—

[a] Based on data from early part of test.
[b] Based on data from late part of test.

missibility of the aquifers. The best well in the province yields only 36 gpm and the average yield of 65 wells is only 6 gpm. The low transmissibilities and the low range in the yield of wells precludes the development of large ground-water supplies in the water province. Table 25 summarizes the hydrologic coefficients of the aquifers.

The chemical character of ground water is suitable for most purposes The temperature of ground water from shallow wells (less than 150 feet deep) and springs averages about 54°F.

Warrior-Evitts Mountains Water Province

The Warrior-Evitts Mountains water province (fig. 2) consists of a series of dissected northeast-southwest trending parallel mountains. The province is bordered on the east by Town Creek and on the west by the crest of Evitts Mountain. Drainage is facilitated by the mature topography and the network of streams flowing southward to the Potomac River. Only a few square miles of flat land is present in the province and most of this land is in the flood plain of the Potomac River. Soil cover is variable but rocky outcrops are common on the mountainsides and in the beds of the streams. Runoff is rapid and floods are frequent.

No data are available concerning the quantities of water recharged to the ground-water reservoirs. The recharge is estimated to be about one-fourth to one-third of the annual precipitation. Annual precipitation at Picardy is about 37 inches, based on 33 years of record. Therefore, an estimated minimum of 9 inches of water enters the ground-water reservoirs annually as recharge. On 1 square mile this amounts to about 157 million gallons annually, or about 0.4 mgd per square mile. Because of the relatively low storage capacity of the rocks the water table rises rapidly during periods when ground-water recharge is in excess of discharge. During drought periods the water table, especially in the mountains, frequently declines below the permeable weathered and fractured zone in which most of the ground water is stored. Hence, springs may fail and the yield of wells may decline substantially. Generally, the sandstone and limestone units are the best aquifers and have the greatest capacity for ground-water storage.

Most of the ground water in the province is derived from local precipitation. Ground-water discharge effectively sustains the flow of the streams, most of which are effluent. A few streams are locally influent as, for example, Flintstone Creek near Flintstone (fig. 12). The creek disappears into the Tonoloway limestone south of the high school at Flintstone, and reappears about 4,900 feet farther south as spring All-Ag 14, which becomes tributary to Murley Branch. The difference in elevation of the point of ingress and egress is about 30 feet. Other streams that may be locally influent are Murley Branch, Elk Lick Run, Rocky Gap Run, and Collier Run.

Ground-water discharge to the streams declines near the end of the summer.

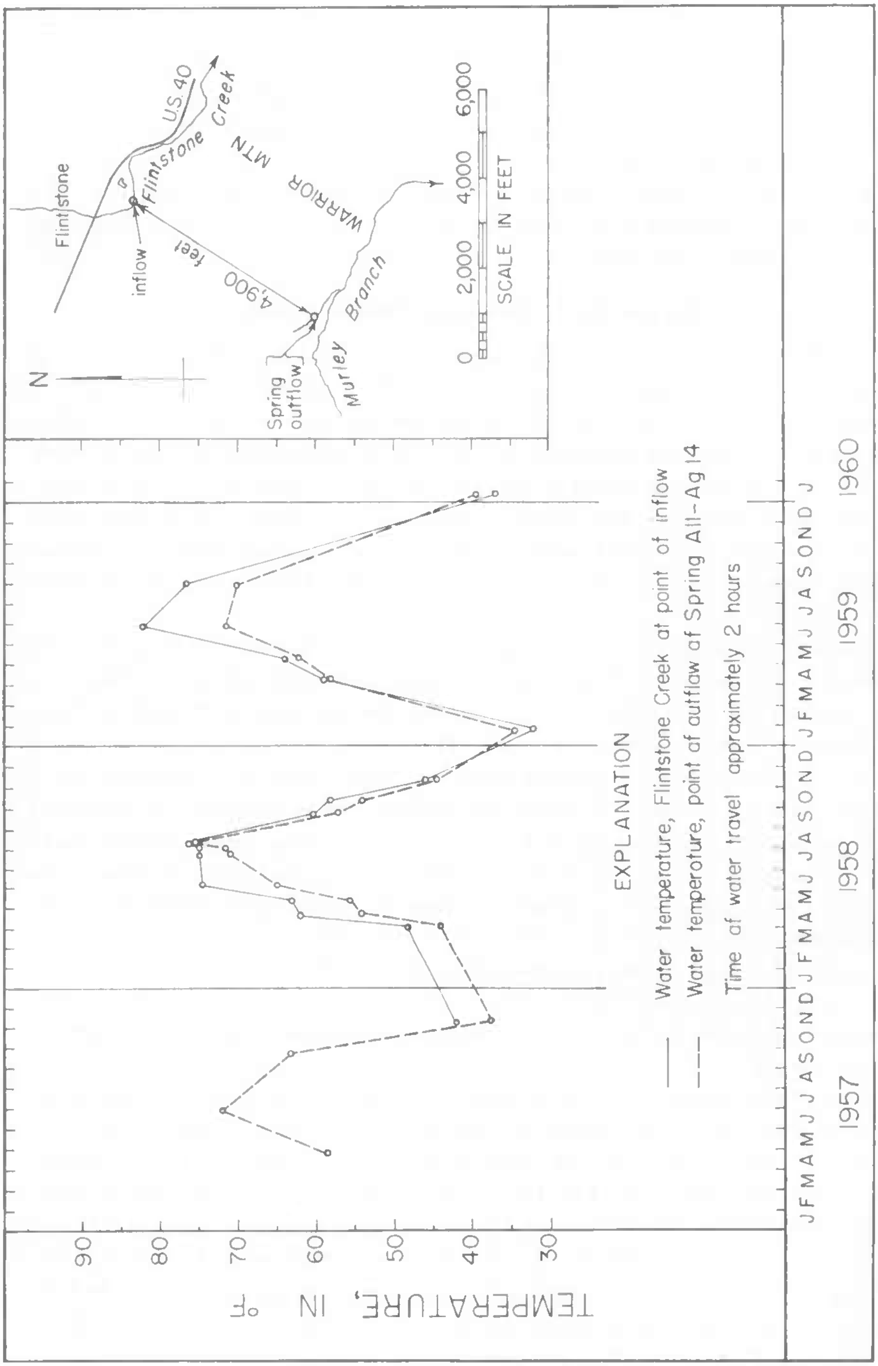

FIGURE 12. Graphs of Water Temperature in Flintstone Creek and Spring All-Ag 14

The southerly flowing streams such as Mill Run, Frog Hollow Run, Brice Hollow Run and Collier Run, draining chiefly the Oriskany and Romney formations, had little or no flow at the end of the summer of 1957. However, Murley Branch, draining chiefly limestones, had a flow of more than 2,000 gpm. This suggests a relatively high storage capacity of the limestone rocks drained by Murley Branch.

A few sinkholes occur in the Tonoloway and the Helderberg limestones. Sinkholes in the Tonoloway limestone are just east of Rush Church at the top of a low ridge, just south of Murley Branch spring (All-Bf 1), and about 0.25 mile east of Yonkers on the north side of U. S. Route 40. A large sinkhole in the Helderberg limestone is at the top of the north end of Toms Hill, near the contact of the limestone and the Oriskany sandstone. Sinkholes are significant because they indicate that the underlying rock is subject to solutional processes and may contain many water-filled voids.

Structural Geology

The major structural feature of the province is referred to in this report as the "Allegany anticlinorium." From east to west the southern half of this major feature is subdivided into four south-plunging anticlinal mountains, Warrior, Martin, Collier, and Nicholas Ridge-Irons (Pl. 4, fig. 1). The first three of these anticlines merge northward to form a larger anticline, known in Pennsylvania as Tussey Mountain. Nicholas Ridge and Irons Mountain form the southern end of the Evitts Mountain anticline, a prominent structural feature which also extends northward into Pennsylvania. The oldest exposed formation, the Tuscarora sandstone, caps Evitts Mountain. The Romney and Jennings formations crop out in the largest syncline, which is between Warrior and Martin Mountains and the Romney shale alone is exposed in the smaller synclines. Figure 1 on Plate 5 shows three geologic sections across the strike of the rocks and one section parallel to the strike.

The sharp-crested anticlines separated by narrow parallel synclines and the high proportion of shale to sandstone and limestone in the water province control the geohydrology of the area. Runoff is rapid and infiltration rates to the aquifers are expected to be low in areas of shaly soil. Probably some ground-water recharge to the aquifers occurs along joint planes. The direction and attitude of these planes range widely within short distances and many of the parting planes parallel one another along the mountain-sides.

Geologic Formations and Their Water-Bearing Properties

Silurian System

Tuscarora sandstone.—The Tuscarora sandstone crops out in two areas. The smaller area is a triangular exposure about 0.5 mile long and 0.3 mile wide at the Maryland-Pennsylvania line about 1.7 miles northwest of Flintstone. The larger outcrop area is on the crest of Evitts Mountain where its outcrop area in Maryland is about 0.7 mile wide and about 2.2 miles long. The Tuscarora is a massive, white sandstone containing a few thin shale layers in its upper part. The maximum thickness of the formation is about 380 feet.

There are no drilled wells in the outcrop area on Evitts Mountain. Wells drilled into the Tuscarora sandstone on the flanks of the structure probably would yield sufficient ground water for domestic and farm purposes.

Rose Hill formation.—The Rose Hill formation is an olive-gray to pink shale containing interbedded thin sandstone. Its thickness is about 500 feet. It is present in two small U-shaped outcrop belts, one northwest of Flintstone and the other on the flanks of Evitts Mountain near Pleasant Grove Church.

Because of the rugged forested terrain it occupies, the formation is sparsely populated and contains few wells. Well All-Af 6, in a draw, is 123 feet deep and is cased to 22 feet; it produced 6 gpm. The formation probably is capable of yielding enough water for average domestic and farm uses.

McKenzie formation.—The McKenzie formation of Middle Silurian age occurs in two narrow separate U-shaped bands in the northern half of the water province. The western outcrop belt of the formation lies along the flanks of Evitts Mountain and extends southward about 0.5 mile south of Hardinger Road. The eastern outcrop belt lies along the flanks of Tussey Mountain in Pennsylvania and extends southward to Hinkle Hollow (Pl. 1). The formation is a calcareous shale, with lenses of argillaceous limestone. Its thickness is about 240 feet.

The outcrop area of the formation is sparsely populated and the only well tapping the formation is All-Ag 8, about 0.5 mile west of Flintstone. This well is 70 feet deep and yielded 5 gpm. It is at the base of a hill. Probably at most localities, the formation will yield adequate supplies of ground water for domestic purposes.

Wills Creek shale.—The Wills Creek shale crops out along two U-shaped belts in the northern half of the water province. The eastern belt lies between Warrior Mountain and Martin Mountain and the western belt flanks Evitts Mountain, extending south nearly to Mount Hermon Church. The formation is an interbedded olive to yellowish-gray shale and limestone. Some thin-bedded olive-gray sandstone is in the upper part, and red and green sandstone and shale of the Bloomsburg red beds in the lower part.

Ground water is obtained from dug wells, drilled wells, and springs. Most of the inventoried wells and springs are in the eastern outcrop belt. The western belt is narrow, somewhat smaller in areal extent, and sparsely populated. The depths of drilled wells range from 21 to 142 feet. Length of casings range from 9 to 28 feet. The most productive wells are All-Ag 24 and -Ag 25 at Flintstone, drilled to depths of 64 and 31 feet, respectively, which reportedly yield 20 gpm. The yields of drilled wells range from 1 to 20 gpm; the mean yield of 12 domestic wells is 7 gpm.

Tonoloway limestone.—The Tonoloway limestone crops out along two U-shaped belts in the northern half of the water province. The eastern outcrop area is the larger and bifurcates into the Warrior and Martin Mountain anticlines. The western area lies low on the flanks of Evitts Mountain. Its maximum width of outcrop is less than 0.5 mile. The Tonoloway limestone consists of platy-weathering, laminated, gray limestone. It has a thickness of about 660 feet.

Ground water is obtained from drilled wells and springs in amounts sufficient for domestic and farm use. The depths of drilled wells range from 45 to 236 feet. Lengths of casings range from 9 to 166 and average 41 feet. Yields of 12 wells range from 1 to 10 and average 6 gpm. The Tonoloway limestone may be expected to provide larger yields in low areas near streams.

Devonian System

Helderberg limestone.—The Helderberg limestone of Early Devonian age crops out in two U-shaped belts in the central and western part of the water province. The eastern area is the more extensive. The maximum width of outcrop (1.5 miles) is at the crest of the southern end of Warrior Mountain near Beltz Road. The formation is a massive, gray, cobbly-weathering limestone in its lower part and a slabby limestone and massive white chert in its upper part. The thickness of the formation is about 350 feet.

The most abundant supplies of ground water in this province, exclusive of springs, are from wells in the Helderberg limestone. Well All-Af 5, 83 feet deep, is reported to have yielded 45 gpm; and All-Ag 3, 287 feet deep and penetrating the Helderberg and ending in the Tonoloway limestone, is reported to have yielded 40 gpm. No "dry holes" were inventoried in the Helderberg limestone.

The Helderberg limestone forms the steeply sloping sides of Warrior and Martin Mountains and favorable well sites are scarce. Favorable sites for wells of moderate capacity are at low altitudes on the flanks of the mountains.

Depths of 5 wells range from 37 to 350 feet and yields of 3 wells range from 10 to 45 gpm.

Oriskany sandstone.—The Oriskany sandstone of Early Devonian age is distributed throughout the water province in a series of northeast-southwest trending bands. It caps Martin Mountain from Pennsylvania to the Potomac River and caps the southern ends of Warrior, Collier, Nicholas, and Irons Mountains. The Oriskany has the most extensive outcrop area of any formation in the water province. It is a highly calcareous, cherty siltstone in the lower part and a calcareous, coarse-grained, locally conglomeratic sandstone in the upper part. Where the lower part of the formation is exposed, it weathers deeply. The thickness of the formation ranges from 300 to 350 feet.

Ground water from the Oriskany sandstone is obtained from drilled wells, dug wells, and springs. Data on drilled wells are few because the sandstone occurs chiefly on sparsely populated mountain tops and ridges. However, the Oriskany sandstone is a poor aquifer even where deeply weathered and apparently moderately permeable.

Well All-Af 8, situated at the crest of Martin Mountain near U. S. Route 40, was drilled to 548 feet, and is reported to be a "dry hole." The outcropping rock at this site consists of steeply dipping weathered chert beds. Well All-Be 16, situated on the crest of Nicholas Ridge, is 268 feet deep and is cased to 100 feet. It yielded only 1 gpm. Nearby dug wells along Nicholas Ridge (All-Be 14, -Be 15, and -Be 18) reportedly yield water in quantities adequate for domestic needs.

The reason for the poor water-bearing properties of the sandstone on or near the mountain crests is not known. At lower altitudes springs are common and some of them have an abundant flow. The springs suggest that wells drilled at low altitudes on the flanks of the mountains through the Romney shale into the uppermost sandstone layers in the Oriskany may yield more adequate supplies of ground water.

Romney shale.—The Romney shale of Middle Devonian age crops out along the axes and flanks of four synclines located principally in the southern half of the water province (Pl. 1). The largest syncline lies between the southern ends of Warrior and Martin Mountains. The Romney is an olive-gray and black shale, containing interbedded argillaceous limestone in the lower part, black shale in the middle part, and silty mudstone and interbedded siltstone in the upper part. The thickness of the formation ranges from 350 to 1,660 feet.

Ground water is obtained from drilled wells, dug wells, and springs in quantities sufficient for domestic and farm use, although a few wells fail to yield even domestic supplies. Yields of wells in the Romney are difficult to predict because wells with small yields, 3 gpm and less, are located in valleys near streams where higher yields usually are expected. One such valley lies along the narrow outcrop band of the shale in Brice Hollow between Martin and Collier Mountains. Brice Hollow has several poor wells and two failures, All-Be 39 and -Be 41. Other inadequate wells are in Frog Hollow and Mill Run. The depths of drilled wells range from 30 to 380 feet. Length of casings range from 8 to 37 feet. Yields of drilled wells range from 0 to 12 and average 6 gpm. The depth to water below the land surface ranges from 1 to 171 feet.

Jennings formation.—The Jennings formation of Late Devonian age crops out in one small triangular area between the southern ends of Warrior and Martin Mountains. The Jennings formation is a dark-gray to black platy shale in the lower part; olive-gray, platy, siliceous shale and interbedded siltstone in the middle part; and shale, siliceous shale, interbedded siltstone and conglomeratic sandstones in the upper part. Its thickness ranges from 3,000 to 4,800 feet.

Wells in the Jennings shale yield sufficient water for average domestic use, although their yields may become inadequate during prolonged dry seasons. Because of the small areal extent of the formation, well data are meager. Depths of wells range from 60 to 353 feet.

Aquifer Tests

Flintstone

On October 9, 1957, an aquifer test was made on well All-Ag 10, 34 feet deep and cased to 21 feet. The well yields water from the Wills Creek shale. It was pumped for 63 minutes at an average rate of 5 gpm, which lowered the water level about 7 feet. Recovery measurements were made for 31 minutes. The coefficient of transmissibility, computed by means of the Theis recovery formula, was 340 gpd per foot for the later part of the recovery period. This value is within the general range of transmissibilities determined from other aquifer tests in shale. However, the shallow depth of the well (34 feet) probably limited the quantity of water available from the aquifer.

Springs

Springs are an important source of water in the Warrior-Evitts Mountains water province. Springs were inventoried in the Wills Creek shale, the Tonoloway limestone, the Helderberg limestone, the Oriskany sandstone, and the Romney shale.

The source areas of many of the springs are the mountains or interstream divides capped by the Helderberg limestone and the Oriskany sandstone. Precipitation infiltrates the weathered zones of the mountain crests and slopes, moves downward as ground water, and emerges as spring discharge at lower altitudes. The ground water moves down hydraulic gradients through and across the beds forming the major geologic structures. The path of movement of ground water is locally complex and is governed chiefly by the relative permeability of the rocks and the slope and direction of the hydraulic gradient. Where the beds dip steeply ground water may collect in and move downward through the Oriskany sandstone and the Helderberg limestone, and emerge as springs or seeps from the Tonoloway limestone. The caprock of Oriskany sandstone along the crests of the mountains serves as a source area for much of the water issuing from the larger springs in the Helderberg and Tonoloway limestones along the slopes of the mountains. The Helderberg and Tonoloway formations are known to be cavernous at sites extending south from Flintstone to Twiggtown (Davies, 1950).

Potomac Blue Spring, All-Ce 1, probably the largest spring in Maryland, had a minimum flow of 3,500 gpm. The flow of this large spring is dependent upon: (1) an intake or source area estimated to be approximately 20 square miles; (2) a vast water-bearing network of channels and solution cavities in the limestone rocks; (3) the dip of the rocks toward the Potomac River; and (4) the presumed existence of a confining layer in the Oriskany sandstone near the southern end of Nicholas Ridge. A southerly constriction of the Nicholas Ridge anticline probably acts as a funnel and channels ground water to the spring mouth from the solution channels in the underlying limestone strata. The existence of a group of springs, All-Cf 11, -Cf 46, -Cf 47, and -Cf 52, at the southern end of Warrior Mountain is probably the result of similar conditions. However, these springs may originate at a greater depth than -Ce 1, because their average annual temperature was 54.7°F, compared to 52.7°F at -Ce 1.

Murley Branch spring, All-Bf 1, which issues from a cavern opening at the base of a small syncline in the Tonoloway limestone (Davies, 1950, p. 25–6) is the only one which flows from an exposed cavern opening. Spring -Bf 1 may be hydraulically connected with spring -Bf 18, located just east of Twiggtown and 2.3 miles to the southwest. The water from -Bf 18 flows into a nearby opening in the Twigg cave system and apparently becomes part of the underground stream in the cave. Davies (1950, p. 27) reports that the stream level in the Twigg cave is 192 feet below the surface of the cave entrance. The gradient is estimated to be about 30 feet per mile from this point to where spring -Bf 1 emerges.

The approximate discharge of springs in the water province ranges from less than 1 to about 3,500 gpm. The range of spring discharge according to the geologic units in which they occur is:

Geologic unit	Approximate discharge (gpm)
Romney shale	5–100
Oriskany sandstone	1–3,500
Helderberg limestone	1–30
Tonoloway limestone	15–370
Wills Creek shale	15–20

The minimum low flow from all springs in the Warrior-Evitts Mountains water province is estimated to be between 10 and 15 mgd, of which probably less than 0.1 mgd is used.

Quality of Water

Chemical analyses were made of ground water from the Wills Creek and Romney shales, Tonoloway and Helderberg limestones, Oriskany sandstone, and the Jennings formation. The analyses are given in Table 38. Hardness of the ground water ranges from 42 to 480 ppm. Iron content ranges from 0.0 to 12 ppm. Water from the limestones commonly has the lowest iron content. The occurrence of ground water high in iron content appears to be somewhat random, and concentrations of iron in adjacent wells penetrating the same aquifer differ greatly. Sulfate content of the ground water ranges from 4.0 to

TABLE 26

Range of Important Chemical and Related Data in Aquifers of the Warrior-Evitts Mountains Water Province

Aquifer	Source of water	Number of samples	Chemical data	Range (in ppm, except for pH)
Wills Creek shale	2 drilled wells (All-Af 7, -Ag 25)	2	Hardness as $CaCO_3$	46
			Total iron (Fe)	0.0
			Sulfate (SO_4)	168
			Nitrate (NO_3)	8.9–12
			Chloride (Cl)	7.4–58
			pH	7.5–8.3
Tonoloway and Helderberg limestones	1 well and 5 springs (All-Ag 3, -Ae 8, -Ae 35, -Ag 15, -Bf 1, -Bf 18)	6	Hardness as $CaCO_3$	54–480
			Total iron (Fe)	.02–0.4
			Sulfate (SO_4)	11–1,311
			Nitrate (NO_3)	1.2–8.3
			Chloride (Cl)	1.0–8.8
			pH	7.3–8.1
Oriskany sandstone	1 well and 3 springs (All-Be 16, -Ce 1, -Ce 4, -Cf 52)	4	Hardness as $CaCO_3$	42–139
			Total iron (Fe)	.00–.96
			Sulfate (SO_4)	4.0–21
			Nitrate (NO_3)	0.1–16
			Chloride (Cl)	0.7–10
			pH	7.3–7.8
Romney shale	3 wells (All-Ag 2, -Cf 43, -Cf 44)	3	Hardness as $CaCO_3$	213–227
			Total iron (Fe)	.79–8.2
			Sulfate (SO_4)	73–78
			Nitrate (NO_3)	0.1–0.6
			Chloride (Cl)	1.6–9.0
			pH	7.1–7.7
Jennings formation	3 wells (All-Ah 1, -Bg 13, -Ce 13)	3	Hardness as $CaCO_3$	58–178
			Total iron (Fe)	0.11–12
			Sulfate (SO_4)	6.0–120
			Nitrate (NO_3)	0.1–1.1
			Chloride (Cl)	4.1–22
			pH	7.4–8.3

1,311 ppm. Ground waters in the vicinity of Flintstone are high in sulfate content, apparently derived from gypsum in the Tonoloway and Helderberg limestones.

Water from spring All-Ag 26, formerly known as the Flintstone Natural Magnesia Spring, was bottled and sold in the early part of the century. Two water analyses from this spring, made about 1920, showed a $CaSO_4$ content of more than 1,500 ppm. The Flintstone High School well, All-Ag 3, ending in the Tonoloway or Helderberg limestone, yields water having a sulfate content of about 1,300 ppm. The water also has a sulfurous odor.

Nitrate content of the ground water ranged from 0.1 to 12 ppm. The maximum nitrate content was in water from well All-Ag 25 in Flintstone, where the water had a chloride content of 58 ppm and a pH of 8.3. This well is only 31 feet deep and may be polluted or contaminated. Chloride content in all the ground water samples is generally low, except locally where the water may be subject to pollution. The pH of the waters sampled ranged from 7.1 to 8.3. Table 26 shows the range of values of chemical and related data for ground water in the province.

Temperature of Water

Temperature of the shallow ground water in the Warrior-Evitts Mountain water province varies seasonally and varies slightly from one locality to another. Springs may be classified on the basis of the temperature of the water. A cold spring is defined as one in which the mean annual water temperature is lower than or equal to the mean annual air temperature; a warm or thermal spring is one in which the mean annual water temperature is higher than the mean annual air temperature. The mean annual air temperature of the water province is between 52° and 53°F. On this basis of classification, most of the springs, including the large ones, are cold springs. Water from cold springs is derived chiefly from shallow sources and, therefore, more subject to annual thermal cycles. The mean annual temperature of the cold springs is 52.6°F.

Spring All-Ag 37, at the east end of Warm Springs Road on the north side of Murley Branch, is the only known thermal spring in Allegany and Washington Counties. It has an average annual temperature of approximately 65°F. Its opening is obscured by stream and marsh debris and vegetation and its flow is generally less than 100 gpm. The spring is near the contact between the Helderberg and Oriskany formations. The source of the water is not known, but a chemical analysis of it suggests a limestone source (Table 38). The temperature of springs -Ag 37 and -Bf 1 are shown in figure 13. The relatively high temperature of spring -Ag 37 suggests that there is an upward movement of ground water from some depth beneath the mountain.

Warm springs in the Appalachian region occur where the Helderberg and the Oriskany formations form the crests of anticlines and are cut by water gaps (Price, 1936, p. 31; Reeves, 1932, p. 36).

Periodic temperature measurements were made of a group of 8 springs (All-Cf 11 and -Cf 46 through -Cf 52) which issue from the Oriskany sandstone along U. S. Route 51 at the southern end of Warrior Mountain. The combined discharge of these springs was about 870 gpm early in October 1957. The correspondence of the temperatures measured in one of the springs, -Cf 52, and in

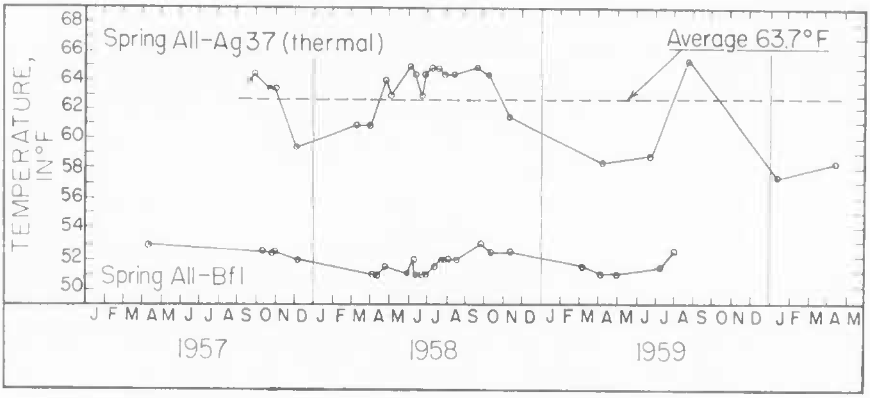

FIGURE 13. Graphs of Temperature of Thermal Spring All-Ag 37 and Cold Spring -Bf 1

spring -Ce 4, located 2.8 miles to the west (Table 27), suggests a possible hydraulic connection between the group of 8 springs and spring -Ce 4. Spring -Ce 4, issuing from the Romney shale near an outcrop of Oriskany sandstone, flows at an estimated rate of 20 to 60 gpm. Because of the narrow seasonal temperature range and the similarity of the chemical characters of the water, all the above springs may yield water from the same deep source.

Temperature measurements were made of Flintstone Creek at the point at which it disappears into the stream bed and at the point of its emergence as spring All-Ag 14, 4,900 feet distant. Except during mid-winter, the temperature at the spring outlet is generally a little lower than the temperature at the stream bed inlet (fig. 12). Dye introduced at the inlet, when the stream had an estimated flow of 400 gpm, reappeared at the point of emergence in 2 hours. The data show that springs hydraulically connected with surface streams may have a wide temperature range (33°F to 82°F). Springs having a smaller temperature range (51°F to 54°F) are fed by water that has been underground for longer periods of time.

Summary of Hydrologic Conditions

Because of the rugged Appalachian terrain, the Warrior-Evitts Mountains water province is sparsely inhabited and its ground-water potential has not been fully explored; there are no large users of ground water. Most of the aquifers supply ground water in quantities sufficient for domestic and farm use. Limestone units are the best aquifers. Shale and sandstone units are poor aquifers. Where the sandstone occurs along mountain crests it is less productive than elsewhere. The yield of wells in the best aquifer, the Helderberg limestone, ranges from 10 to 45 gpm. The average yield of 42 wells in the province, chiefly farm and domestic wells, is 11 gpm. Data concerning well depths and yields are summarized in Table 28.

TABLE 27

Water Temperatures in Two Springs in Allegany County (in °F)

Date of measurement	Spring All-Cf 52	Spring All-Ce 4
9/4/57	56	—
10/10/57	56	—
10/29/57	55.5	55.5
11/14/57	56	—
3/10/58	—	54.5
4/1/58	55.5	55
4/23/58	—	55
5/1/58	—	55
11/11/58	—	55

TABLE 28

Depth, Length of Casing, and Yield of Drilled Wells in the Warrior-Evitts Mountains Water Province by Geologic Units

Geologic unit	Well diameter (inches)	Depth (feet)		Number of wells	Length of casing (feet)		Number of wells	Yield (gpm)		Number of wells
		Average	Range		Average	Range		Average	Range	
Jennings formation	6	129	60–353	(7)	—	—	—	—	5	(1)
Romney shale	6	79	30–380	(29)	20	8–37	(17)	6	0–12	(13)
Oriskany sandstone	6	289	51–548	(3)	—	100	(1)	—	0–1	(2)
Helderberg limestone	6	138	37–350	(4)	29	28–29	(3)	26	10–45	(2)
	8	—	287	(1)	—	20	(1)	—	40	(1)
Tonoloway limestone	6	107	45–236	(14)	41	9–166	(12)	6	1–10	(9)
Wills Creek shale	6	58	21–142	(20)	21	9–28	(13)	7	1–20	(12)
McKenzie formation	6	—	70	(1)	—	24	(1)	—	5	(1)
Rose Hill formation	6	—	123	(1)	—	22	(1)	—	6	(1)
Tuscarora sandstone[a]										

[a] No data available.

An aquifer test on a well at Flintstone, ending in the Wills Creek shale, showed that the coefficient of transmissibility is about 400 gpd per foot. The test suggests that this aquifer is capable of supplying only small quantities of ground water in the area.

An estimated 10 to 15 mgd of ground water flows from the numerous springs throughout the province. Not more than 0.1 mgd of this flow is utilized. The Potomac Blue Spring (All-Ce 1), issuing from the Oriskany sandstone, is the largest known spring in Maryland. The Potomac Blue and other large springs in the area issue from sandstone, although they probably drain chiefly limestone rocks.

The hardness of ground water in the water province, except water from sandstone and shale in some areas, ranges, from 50 to 200 ppm. Iron content is generally low, but ranges from 0.02 to 12 ppm; the maximum content was in a water sample from the Jennings formation. Sulfate content in shale and limestone rocks ranges from 4 to about 1,300 ppm; the highest concentration of sulfate is in water from the Wills Creek shale in the Flintstone area. Nitrate and chloride content are generally below 50 ppm. The pH of the water ranges from 7.1 to 8.3.

The Warrior-Evitts Mountains water province has the only known thermal spring in Allegany and Washington Counties. The mean annual temperature of the water from it is 63.7°F. The mean annual temperature of non-thermal springs was about 53°F, which is about the same as mean annual atmospheric temperature.

Cumberland Water Province

The Cumberland water province (fig. 2) extends westward from Evitts Mountain and the Potomac River nearly to the crest of Piney and Dans Mountains. Much of the province lies within the immediate drainage area of the Potomac River and the lower part of Wills Creek. Shale occupies many of the valleys, and limestone and sandstone commonly are exposed along the crests of the mountains and ridges. Limestone rocks appear to be the most productive aquifers.

Ground-water recharge occurs chiefly through infiltration of precipitation into the soil zone, although locally the precipitation may directly enter solution crevices in limestone and fracture and bedding planes in the sandstone or shale. The average annual precipitation at Cumberland is about 35 inches. If it is assumed that one-fourth to one-third of the precipitation recharges the ground-water reservoirs, the quantity of ground-water recharge is in the range of 0.40 to 0.55 mgd per square mile.

Due to the mountainous terrain, surface runoff is rapid and water table gradients are steep. Springs and seeps are common along the watercourses, but their flow fluctuates seasonally.

During droughts the flow of many of the streams is sustained chiefly by springs on the mountain slopes. Although stream flow is sustained nearly everywhere by ground-water discharge, locally some of the streams may lose water to the ground-water reservoirs, especially in the sinkhole area where the streams cross outcrops of the Tonoloway and Helderberg limestones. For example, Pea Vine Run, which incises Shriver Ridge, flowed an estimated 1,000 to 2,000 gpm on May 2, 1957. By June 18 the flow had decreased to 200 gpm and all of this flow was disappearing underground into the Tonoloway and Helderberg limestones where the stream crosses their outcrop area. Another sinkhole area that receives surface recharge is on the south side of U. S. Route 220 in Pennsylvania, about 0.2 mile north of the Maryland line. This area, which is underlain by the Tonoloway and Helderberg limestones, is about 0.6 mile long and 0.3 mile wide. On April 2, 1958, a small stream, flowing at an estimated rate of 150 gpm, was observed to disappear into a sinkhole. It is likely that some of the underflow from this locality moves southward into Maryland.

Based on the water-level measurements in observation well All-Bd 2 from 1947 through 1959, the ground-water levels in the limestone at Cumberland show no downward trend (Pl. 6, fig. 1). The maximum yearly water-level fluctuation in this well was about 10.4 feet.

The depth to water in wells in the province ranges from 1 to 200 and averages about 34 feet. Generally, the direction of ground-water movement is in accordance with the surface drainage pattern. The major divide of the water table lies along the crest of Haystack and Wills Mountains.

The west slope of Evitts Mountain and the east slope of Wills and Haystack Mountains contribute surface and ground water to the Cumberland valley. The syncline occupied by the valley extends northward into Pennsylvania where one of the streams in it is impounded by the city of Cumberland as a source of municipal water supply.

Structural Geology

The Cumberland water province consists of two major geologic structures (Pl. 5, fig. 2), the Cumberland Valley syncline and the Haystack and Wills Mountains anticline. The west flank of the Haystack and Wills Mountains anticline merges with the east flank of the Georges Creek syncline along the east slope of Dans Mountain. The Cumberland Valley syncline dips toward the south, and the shale beds in it attain their maximum thickness near the Potomac River. The southern end of Haystack Mountain, capped by the Tuscarora sandstone, plunges beneath the surface at Cresaptown. The Fort Hill anticline, 5 miles to the southwest, may be part of this structure. The Fort Hill anticline is capped by the Oriskany sandstone just east of McCoole.

Due to their incompetency, the shale beds are highly folded into complex local structures, which are excellently exposured along the Baltimore and Ohio Railroad from Cumberland to Pinto. One of the most intensely folded exposures is in the McKenzie formation just east of Pinto. Little is known of the effect of this deformation on the occurrence of ground water in the area.

Geologic Formations and Their Water-Bearing Properties

Ordovician System

Juniata formation.—The Juniata formation of Late Ordovician age is exposed in Allegany County only in "The Narrows" of Wills Mountain, where its thickness is 530 feet. The formation is composed of interbedded red shale and sandstone. Test well All-Bd 29 at Amcelle ends in the formation at a depth of 952 feet below the land surface. The well penetrated 72 feet of the formation (Table 44).

Data regarding the water-bearing properties of the Juniata are meager and unreliable. Well All-Bd 48, located in "The Narrows" of Wills Mountain, reportedly yielded 20 gpm of salty water at a depth of 82 feet. The Juniata was reported to have been "dry" at the bottom of well -Bd 29 at a depth of 952 feet. Some time prior to 1924, an oil and gas test well was drilled in "The Narrows" to a depth of 2,240 feet (Tucker, 1936, p. 311, 312) and the well was reported to be dry below the bottom of the casing at 800 feet. Water encountered above 800 feet reportedly was used for the drilling rig boiler and for drinking purposes. The driller also reported that the water was colder than any spring water he ever drank. If this report is reliable, it indicates a shallow origin for the water from the well. From 800 feet downward no gas or oil was encountered, but at a depth of 500 to 600 feet enough gas was found to be lighted. This well was not located during the well inventory and no log of it exists.

Silurian System

Tuscarora sandstone.—The Tuscarora sandstone of Early Silurian age caps Haystack and Wills Mountains. The dip of the beds on the eastern flank of the mountains is much less than the almost vertical dip of the beds on the western flank (Pl. 5, fig. 2). The Tuscarora is a massive, white sandstone containing a few thin layers of shale in its upper part.

Because of its high topographic position, few wells have been drilled in this formation. Homes along Braddock Road near the top of Haystack Mountain use wells in the Tuscarora as their source of water supply. The depths of these wells range from about 40 to 65 feet. Depths to water range from 8 to 48 feet and well yields range from 1 to 10 gpm.

The yield of wells drilled into the sandstone on the mountainsides cannot be reliably predicted, but it is likely that better wells may be obtained along the moderately dipping east flank of the mountain than along the steeply dipping west flank. Where the rocks dip steeply fewer bedding planes are penetrated by the drill.

Test well All-Bd 29 at Amcelle penetrated the Tuscarora sandstone from a depth of 498 to 880 feet. It produced little or no water from the hard, dense sandstone. At this depth even small crevices and fractures in the rock probably are lacking. Prospecting for ground water in the Tuscarora at depths below a few hundred feet is unwarranted.

Small springs issue from the formation along the lower slopes of Haystack and Wills Mountains.

Rose Hill formation.—The Rose Hill formation crops out along a narrow belt on both sides of the base of Wills Mountain. Its maximum thickness is 550 feet. Well All-Bd 29 penetrated 498 feet of the formation, which is chiefly shale containing some interbedded sandstone. The upper 40 feet of the Rose Hill is interbedded with lenticular limestone. Iron-cemented sandstone occurs at the base and top of the formation. The log of -Bd 29 (Table 44) shows the lowermost ironstone beds. These iron ore beds were worked at their outcrop until shortly after the Civil War (Singewald, 1911, p. 299).

The Rose Hill formation yields ground water from drilled wells in amounts sufficient for domestic and farm use. No large-capacity wells produce from the formation. Housing development and the drilling of wells on the outcrops of the formation has been principally in the Cresaptown area and along parts of the east side of Haystack and Wills Mountains.

The depths of 10 drilled wells range from 40 to 150 feet. Casings range from 19 to 43 feet. Yields of 4 domestic wells range from 2 to 19 gpm.

McKenzie formation.—The McKenzie formation of Middle Silurian age, composed of calcareous shale and argillaceous limestone about 240 feet thick, crops out as a narrow band on the east and west flanks of Wills and Haystack Mountains. Locally it is highly compressed into tight folds, broken by small scale faulting. An excellent exposure showing the incompetency of the formation may be seen along the Baltimore and Ohio Railroad at Pinto.

The formation is of small areal extent and only a few small farm and domestic wells are known to produce water from it.

The depths of drilled wells range from 70 to 193 feet. Casings range from 16 to 28 feet and yields of 2 wells are 1 and 6 gpm. On the basis of available information, the water-yielding capacity of the formation appears to be poor.

Wills Creek shale.—The Wills Creek shale is an olive to yellowish-gray shale containing interbedded limestones. It contains at its base the Bloomsburg red beds, which crop out in a thin band along the east and west flanks of Wills and Haystack Mountains. The Wills Creek shale is about 450 feet thick.

The Wills Creek shale yields adequate ground-water supplies for most ordinary purposes. Prior to the development of surface water for the municipal supply of the city of Cumberland, 8-inch diameter wells in the Wills Creek shale were used to obtain ground water for industrial purposes. One of these wells, All-Bd 19, reportedly yielded 133 gpm. The wells of large capacity may end in solution zones in limestone lenses in the shale.

Most of the inventoried wells drilled since 1945 are east of Wills Mountain and north of Cumberland. The depths of 6-inch diameter drilled wells range from 29 to 200 feet. Casings range from 11 to 35 feet. Yields range from 1 to 15 and average 4 gpm. Yields of four 8-inch diameter industrial wells range from 16 to 133 gpm.

Between 1942 and 1946, the West Virginia Pulp and Paper Co. conducted an intensive exploration for briny ground waters suitable for use in their electrolytic plant at Luke, Maryland, under the supervision of J. G. Patrick, Chief Chemist of the Company (Patrick, 1948). A test well was drilled to a depth of 1,100 feet at the engine terminal of the Western Maryland Railroad at Ridgeley, West Virginia. The log of the well is:

Depth (feet)	Formation	Remarks
50–300	Wills Creek shale	Yield 200 gpm; static water level −13 feet; water too hard for boiler use.
325–375	Bloomsburg red beds and Wills Creek shale	No water at 320–360 feet.
375–710	McKenzie formation	At 560 feet soft water encountered; at 622 feet, salt water; at 640 feet, water had 8,300 ppm chloride.
710–1,100	Rose Hill formation	

These data suggest that the water-yielding capacity of the rocks in the Cumberland water province decreases beyond depths of 300 feet and that highly mineralized water may be encountered at depths of several hundred feet.

Tonoloway limestone.—The Tonoloway limestone crops out on the east side of Wills Mountain, along the base of the west side of Shriver Ridge, along the west side of Wills and Haystack Mountains, and between Fort Hill and the Potomac River. The formation consists of about 660 feet of platy, laminated limestone. The widest outcrop belts are between Kriegbaum and LaVale and in the area east of Fort Hill (Pl. 1).

Ground water is obtained from wells and springs in the Tonoloway limestone; the quantity produced is adequate for domestic and farm uses. Some wells drilled through the Tonoloway into the underlying Wills Creek shale have reportedly produced as much as 170 gpm. Where the Tonoloway is overlain by the Helderberg limestone moderately large quantities of ground water may be obtained.

The depths of 17 drilled wells range from 56 to 251 feet. Casing lengths range from 19 to 43 feet. Yields of 10 wells range from 4 to 170 gpm. Some of these wells also yield water from the Wills Creek shale.

One of the largest springs in the area, the Cumberland Blue Spring, All-Bd 34, issues from the Tonoloway limestone in the vicinity of Shriver Ridge in the north part of Cumberland.

Devonian System

Helderberg limestone.—The Helderberg limestone of Early Devonian age crops out in a narrow band north of Cumberland, where it forms the upper part of the west slope of Shriver Ridge. It also forms small hills and knobs along a narrow belt on the west side of Wills and Haystack Mountains and it crops out along the crest of Fort Hill and in small exposures just east of McCoole (Pl. 1). In Allegany County, the Helderberg is a massive, gray, cobbly-weathering limestone in the lower part, and a slabby limestone and massive white chert in the upper part. Its thickness is about 350 feet.

Because the Helderberg crops out chiefly along narrow belts near the mountain crests, comparatively few well data are available. Most of the wells in it are along the west side of Haystack Mountain, where it apparently yields adequate ground-water supplies for domestic and farm use. In the valley near Cumberland, the Helderberg and the underlying Tonoloway limestone together yield about 400 gpm from 10-inch diameter industrial well All-Bd 31.

Springs occur in the formation but have only small flows.

The depths of 6-inch drilled wells range from 56 to 118 feet. Casing lengths range from 29 to 111 feet. Yields of 3 wells in the formation are 10, 20 and approximately 400 gpm.

Although the Helderberg limestone is largely untested in the Cumberland water province, it has yielded large quantities of water in a few places. It is assumed to be a moderately good aquifer because locally it is a cavernous and permeable limestone.

Oriskany sandstone.—The Oriskany sandstone crops out in a narrow band on the west side of Wills and Haystack Mountains, along the west side of Fort Hill, and as the caprock of an anticline just east of McCoole. The sandstone and the underlying Helderberg limestone are ridge-makers and form the eastern slope of Shriver Ridge along a belt ranging from 0.3 to 0.5 mile wide. East of Ellerslie the sandstone is exposed in a belt about 0.5 mile wide and 1.3 miles long. The thickness of the formation ranges from 300 to 350 feet. The Oriskany is a highly calcareous, cherty siltstone in its lower part and a calcareous, coarse-grained, locally conglomeratic sandstone in its upper part.

Ground water is produced from the Oriskany sandstone in quantities sufficient for domestic and farm use. In the Cumberland area where the sandstone is overlain by the Romney shale, wells produce as much as 120 gpm. Few wells are drilled in the Oriskany where it forms topographic highs.

Depths of 13 drilled wells range from 51 to 265 feet. Yields of 13 wells range from 1 to 20 and average 6 gpm. Casings range from 14 to 211 feet. Along the ridge crests the depths to water may be as much as 200 feet. Unless the wells are drilled to substantially greater depths to penetrate a greater saturated zone the limited available drawdown may result in a well of low capacity.

Areas to be considered for future ground-water development are along the contact zone of the Oriskany sandstone and Romney shale at the base of the eastern side of Shriver Ridge and at the base of the western side of Fort Hill. The best wells in the Oriskany sandstone penetrate the overlying Romney shale or the underlying Helderberg limestone.

Romney shale.—The Romney shale occurs along the eastern and western flanks and at the north end of the Evitts Creek basin, along the western side of Wills and Haystack Mountains between Pinto and Rawlings, and along the west side of Fort Hill as far south as McCoole. The formation ranks second to the Jennings formation in areal extent in the province. Its thickness ranges from 350 to 1,660 feet. The Romney is an olive-gray and black shale, containing interbedded argillaceous limestones in its lower part, black shale in its middle, and silty mudstones and interbedded siltstones in its upper part.

Ground water is obtained from wells and small springs in quantities sufficient for domestic and farm use. Depths of 6- and 8-inch diameter wells range from 19 to 300 feet. Casing lengths range from 14 to 101 feet. Yields of 54 wells range from 2 to 120 gpm. The average yield of 50 domestic or farm wells is 7 gpm. The average yield of four 8-inch diameter wells, chiefly in the Cumberland area, is about 70 gpm.

Jennings formation.—The Jennings formation of Late Devonian age crops out in two belts in the Cumberland water province. The eastern belt extends southward from Dickens to the Potomac River west of Irons Mountain. Its maximum width is 2 miles. The western belt extends southward from the Pennsylvania line and forms the base of Dans, Piney, and Little Allegheny Mountains (Pl. 1). The thickness of the formation ranges from 3,000 to 4,800 feet. The lower part of the Jennings formation is a dark-gray to black platy shale; the middle part is an olive-gray, platy, siliceous shale with interbedded siltstone; and the upper part is shale, siliceous shale, interbedded siltstone and conglomeratic sandstone.

Most of the wells in the Jennings formation are in the Evitts Creek basin and in the valley of the Potomac River west of Irons Mountain. Ground water is obtained from wells and small springs. The quantity of water produced by drilled wells is generally sufficient for domestic and farm use. A few wells for industrial use have been drilled in the Jennings formation, but none are known to be in use at present.

There seems to be little relationship between the yield of water from drilled wells in the Jennings formation and the topographic location of the wells. Although low-lying sites are productive in most formations in the water province, this is not always so in the Jennings. The incompetent strata of the Jennings locally are folded tightly and complexly fractured. An exposure showing this condition may be seen on U. S. Route 220 at McCoole near the contact of the Jennings and Romney formations. Because of the complex structure of the rocks, the yield of nearby wells may range considerably. For example, well All-Db 1 produces 0.2 gpm, while nearby well -Db 10 produces 10 gpm. The depths of drilled wells range from 43 to 314 feet. Casing lengths range from 17 to 49 feet. Yields of 28 wells range from 1 to 50 gpm. The mean yield of these wells, largely domestic and farm, is about 9 gpm.

Six- and eight-inch diameter wells bored or augered into the Jennings are a source of ground water along the Potomac River west of Irons Mountain. The capacity of the wells is not known, but apparently their yield is adequate for domestic purposes. Depths of the bored wells range from 11 to 46 feet and some of them are equipped with a gauze screen. Depths to water commonly are less than 5 feet.

Hampshire formation.—The Hampshire formation of Late Devonian age crops out below the rocks of the Mississippian system that form the top of the eastern slope of Dans, Piney, and Little Allegheny Mountains. The thickness of the formation along this half-mile wide outcrop belt is about 2,000 feet. The Hampshire is principally interbedded red shale, mudstone, siltstone, and sandstone. Near Jennings Run the bedding dips to the west at an angle of nearly 70°, at Braddock Run about 60°, and along the Potomac River just west of the contact with the Jennings formation, about 25°.

The only places where drilled wells penetrating the formation are in use are along Jennings Run, Braddock Run, and along the Potomac River. Where the Hampshire formation underlies valleys, it should yield adequate ground-water supplies for domestic and farm use. Because of the lack of well and spring data, no reliable estimate can be made of its ground-water potential.

Two drilled wells, All-Bc 13 and -Bc 54, at Braddock Run reportedly yield 18 and 7 gpm, respectively. Well All-Da 11 near the Potomac River yields 6 gpm. The depths of the drilled wells range from 62 to 82 feet. Casing lengths range from 30 to 38 feet.

Quaternary System

Potomac River alluvium.—River terrace deposits of Recent and Pleistocene age occur chiefly in the flood plain of the Potomac River. The largest areas underlain by the deposits extend from Pinto to the Mexico Farms locality south of South Cumberland, a distance of about 12 miles.

Sixteen auger holes were bored through the alluvium to bedrock in the Pinto-Mexico Farms area. The holes ranged in depth from 5.5 to 42 feet and penetrated brown, reddish-brown, tan, and gray poorly sorted silt, sand, and gravel, and some shale granules. Although the river alluvium does not appear to be a productive aquifer, small supplies of ground water are probably available for domestic wells. If the impervious character of the deposits persists beneath the river channel, their main hydrologic significance may be that they would serve to retard downward movement of river water to underlying aquifers.

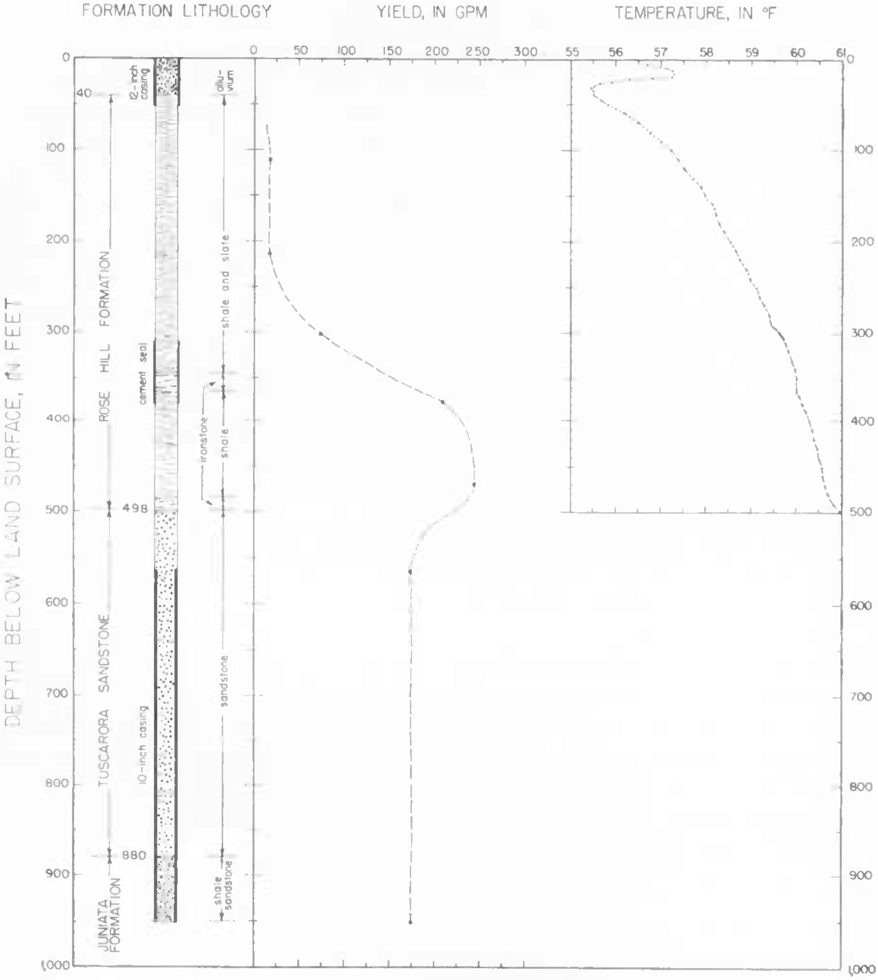

FIGURE 14. Log, Yield, and Temperature of Well All-Bd 29 at Amcelle

Aquifer Tests

Amcelle

During 1930 and 1931 test well All-Bd 29 was drilled by the Celanese Corp. at Amcelle. The diameter of the hole was 12 inches to 563 feet and 10 inches from 563 to 952 feet. The well was cased at the surface with 54 feet of 12-inch pipe. The driller made pumping tests at various depths during the drilling operations. Figure 14 shows the quantity of water produced at various depths, the log of the well, and a temperature log. The pumping tests show that at a depth of 213 feet the well produced only 18 gpm, at 302 feet 75 to 80 gpm, and at 377 feet 210 gpm.

On the test at 377 feet, the water was red in color and had an iron content of over 3 ppm. The water was presumed to come from the ironstone beds at 345 to 366 feet, and a cement seal was installed from 307 to 377 feet to cut off the zone yielding the undesirable water. Another pumping test made after the cement seal was emplaced showed the seal to be ineffective. The maximum rate of discharge during the second test was also 210 gpm. Because the production rate at 302 feet had been only 75 to 80 gpm and because the well was sealed from 307 to 377 feet, the continued presence of iron in the water suggests that the main water-bearing crevice system was between 302 and 307 feet and that the cement seal was placed about 5 feet below the main water-yielding zone.

At 470 feet a yield of 245 gpm was reportedly obtained by pumping with compressed air, but this measurement may not be reliable as the measurement period lasted only 30 seconds. At depths of 563 and 952 feet the yield was only 175 gpm, or less than that reported at a depth of 377 feet. These tests indicate the poor water-yielding character of the Tuscarora sandstone and the Juniata formation which were encountered at depth.

Using the water levels recorded by the driller during his first pumping test at the depth of 377 feet, a semi-log plot of water levels against pumping time was made to obtain an approximate value of the coefficient of transmissibility of the shales in the Rose Hill formation. After pumping 240 minutes at an average rate of 120 gpm, the water level lowered 53 feet from an initial static level of about 9 feet below the land surface. Using the data from the first 240 minutes of the test and plotting drawdown as recovery, an approximate coefficient of transmissibility of 1,200 gpd per foot was obtained. Later during the same test the rate of pumping was increased to about 200 gpm for 120 minutes. On the basis of water level measurements made at this time a coefficient of transmissibility of about 125 gpd per foot was obtained. Subsequent tests at a depth of 563 feet pumping at 220 gpm, and at 952 feet pumping at 210 gpm, indicate a coefficient of transmissibility in the order of that obtained at a depth of 377 feet.

The pumping tests on well All-Bd 29 indicate that at this site the most productive aquifer is the Rose Hill formation. Apparently the underlying Tuscarora sandstone and the Juniata formation are not water bearing in this locality.

An electric log of the well shows that from 480 to 952 feet the rocks are more resistant to the flow of current than at shallower depths. This suggests that the rocks are tighter and denser below 480 feet and corroborates the pumping test results.

Cumberland (Kelly-Springfield Tire Co.)

From August 6 to 21, 1957, an aquifer test was made using wells at the tire company's plant to determine the hydrologic coefficients of the Wills Creek shale. The two wells used in the test are 419 feet apart, are at the same altitude and both are 8-inches in diameter. The pumped well, All-Bd 19, is 202 feet deep; the observation well, -Bd 20, is 194 feet deep. Both wells are cased, but the lengths of casing are not known. Well -Bd 20 is within a few feet of the contact zone of the Tonoloway limestone and the Wills Creek shale. The dip of the rocks is to the east at about 35 degrees. Although well -Bd 20 is in the Tonoloway limestone at the surface, the greater part of it may be in the Wills Creek shale. The land surface at -Bd 20 is about 20 feet above the level of the Potomac River, and the static water in the well was about 5 feet above the river level.

Well All-Bd 19 was pumped for 8.9 days at an average rate of 83 gpm. At the end of the pumping period, the water level in observation well -Bd 20 had lowered 2.59 feet. By the end of 6 days of recovery, the water level in well -Bd 20 had risen 1.58 feet and in well -Bd 19 about 8 feet. Based on computations using the Theis non-equilibrium formula, the coefficient of transmissibility is in the range of 10,000 to 15,000 gpd per foot. This is a fairly high value for shales and may indicate the water is coming from limestone beds within the

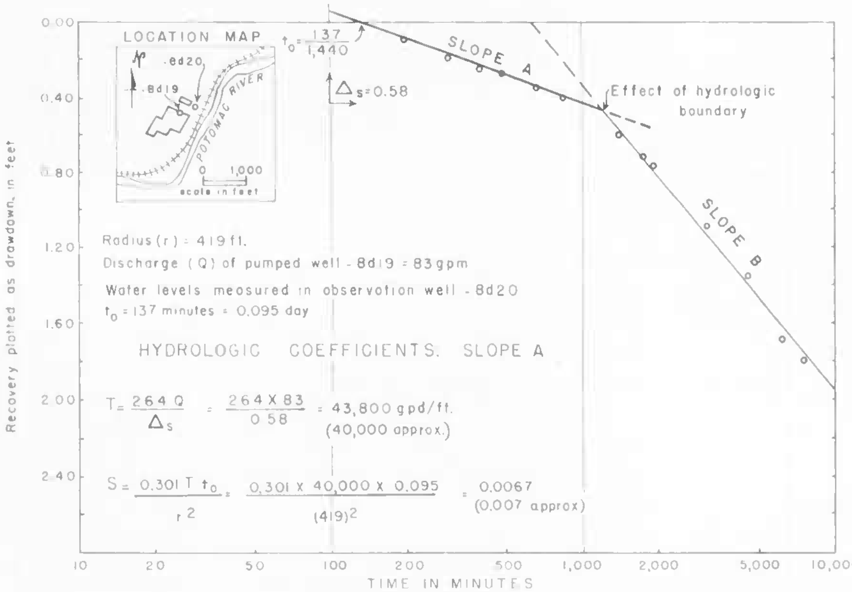

FIGURE 15. Graph of Data from Aquifer Test on Well All-Bd 19 at Cumberland

Wills Creek. The storage coefficient of 0.008 indicates semiartesian, or modified water-table, conditions in the vicinity of the wells.

Figure 15 shows the recovery of the water level in well All-Bd 20. The plot of water-level recovery did not produce one straight line, but two. The coefficient of transmissibility computed for the line 100 to 1,000 minutes (slope A) was 43,800 gpd per foot and the coefficient of storage was 0.007. The hydrologic coefficients computed for the next 7,690 minutes (slope B) were 13,200 gpd per foot and 0.010, respectively. The graph of water level recovery indicates that the aquifer is moderately permeable within a limited area in the vicinity of the test, but after a period of 1,000 minutes of pumping the cone of depression encountered a hydrologic barrier or a change in permeability of the rocks, which influenced the expanding cone of depression. The hydrologic coefficients computed from slope B are believed to be more representative of the rocks in the general locality of the test. The aquifer test shows that the Wills Creek shale, where it contains interbedded shales and limestones, may be a good aquifer. The test also emphasizes that hydrologic coefllcients determined on the basis of brief tests (slope A—100 to 1,000 minutes) may not be representative of the rocks over large areas.

The interpretation and application of the test data are dependent upon the assumption that the aquifer is homogeneous, physically and hydraulically isotropic, and that the thickness and areal extent of the aquifer is known. The

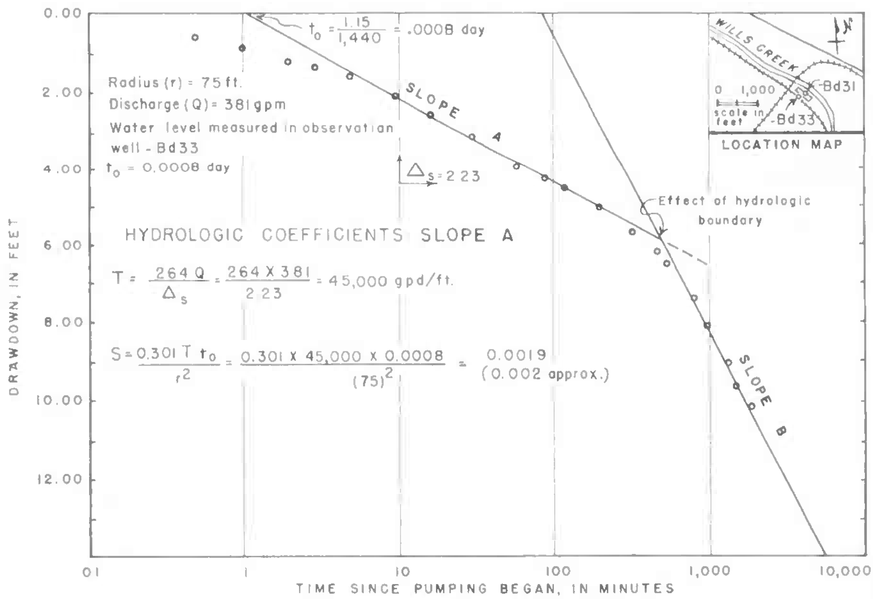

FIGURE 16. Graph of Data from Aquifer Test on Well All-Bd 31 at Cumberland

thickness and areal extent of the Wills Creek shale is known, but the physical and hydrologic properties are likely to be non-isotropic, changing in both the vertical and horizontal directions. It is postulated that 180 days of pumping at the rate of 100 gpm would extend the cone of depression of well All-Bd 19 to the Potomac River, about 700 feet distant. The extent to which the Potomac River would be a source of recharge to the rocks in the well field area is not known.

Cumberland (Queen City Brewing Co.)

On April 19–20, 1958, an aquifer test was made on well All-Bd 31, which penetrates both the Helderberg and Tonoloway limestones. At the test site both formations dip about 30° to 40° to the east. The pumped well, All-Bd 31 is about 550 feet deep and observation well -Bd 33 is 493 feet deep. The test pumping covered a period of 1,830 minutes at an average rate of about 380 gpm. During the pumping the water level in observation well -Bd 33, 75 feet distant, lowered 9.27 feet. Measurements of recovery of the water level were made for 480 minutes, during which the water level rose 9.17 feet.

Figure 16, a semi-log plot of the drawdown of water level in well All-Bd 33 during the period of pumping, shows two lines of different slope. An increased drawdown rate began after 200 minutes of pumping, and a continuous rate was not established until after 800 minutes of pumping. The computed coefficients of transmissibility and storage were about 45,000 gpd per foot and 0.002, respectively, for the first 200 minutes of drawdown (slope A), and about 13,000 gpd per foot and 0.04 for the next 1,600 minutes of drawdown (slope B). The apparent decrease of transmissibility indicates that the spreading cone of depression encountered a hydrologic boundary in the aquifer. The coefficient of storage determined from slope B indicates water table conditions.

It is not possible to ascertain from the test data what proportion of the water produced is coming from either formation. However, current-meter and temperature logs of well All-Bd 33 indicate that most of the water is coming from the Helderberg limestone (fig. 17). The logs also show that below 325 feet there is little or no movement of water, indicating that the rocks below this depth are nearly impervious. The resistivity of the strata increases below a depth of about 200 feet (fig. 17).

Cumberland (Cumberland Times)

On February 25 to 26, 1959, a pumping test was conducted on well All-Bd 70, 8 inches in diameter and 217 feet deep. The well was pumped 450 minutes at an average rate of 50 gpm, which lowered the water level 2.41 feet. Measurements were made of the recovery of the water level for 878 minutes, during which time the water level rose 2.28 feet. Based on early measurements, the coefficient of transmissibility, computed by means of the Theis recovery for-

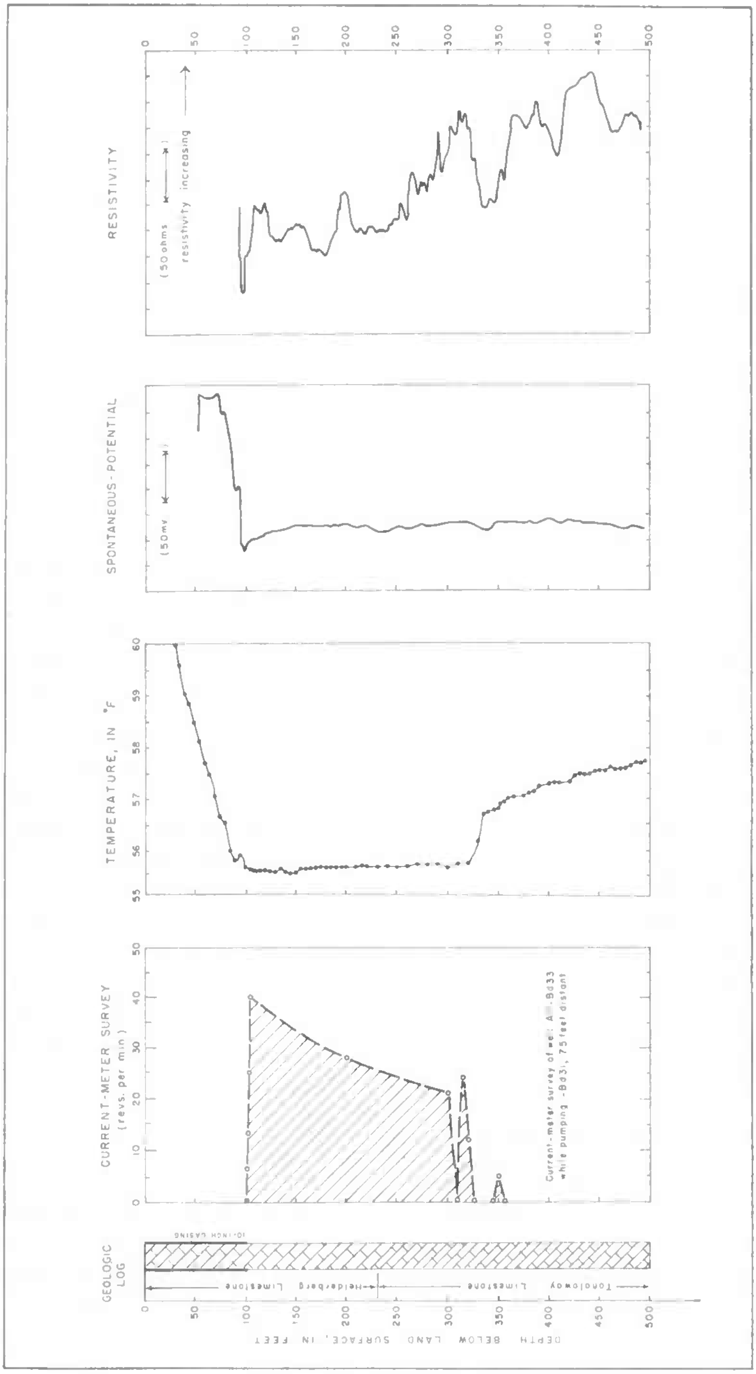

FIGURE 17. Current Meter, Temperature and Geophysical Logs of Well All-Bd 33 at Cumberland

mula, is about 14,000 gpd per foot. Because of the small drawdown caused by the pumping rate of 50 gpm and the relatively short length of the test, the coefficient of transmissibility may be somewhat less than 14,000 gpd per foot. The well, when tested by the driller, reportedly produced 120 gpm with a drawdown of 12 feet. Apparently this well was pumped at less than its maximum capacity during the test. The driller's log shows that the well penetrates the Romney shale from the surface to 164 feet, and the Oriskany sandstone from 164 to 217 feet. A current-meter survey showed that most of the water produced is coming from the lower part of the Oriskany sandstone.

Favorable ground-water conditions appear to be present in downtown Cumberland where three nearby wells yield from 60 to 120 gpm from the Oriskany sandstone and the overlying Romney shale.

St. Peter and St. Paul's Camp

On October 2, 1957, an aquifer test was conducted on well All-Ae 20 about 3 miles northeast of Cumberland. The well is 81 feet deep and contains 41 feet of 6-inch diameter casing. It was pumped 128 minutes at an average rate of 2.4 gpm, which lowered the water level 37.7 feet. Measurements were made of the recovery of the water level for 140 minutes, during which time the water level rose 35.6 feet. The coefficient of transmissibility, computed by means of the Theis recovery formula, was 23 gpd per foot for the early part of the recovery curve and 108 gpd per foot for the late part of the curve. Possibly, the change in slope of the recovery curve is due to recharge from Evitts Creek. This well, located in a valley 1.5 miles northeast of Wolfe Mill and about 400 feet west of Evitts Creek, does not produce the quantity of water normally expected from a well in an apparently favorable topographic location. The pumping test indicates that the Romney shale at this location is very tight, having a minimum of water-bearing fractures and crevices.

Pittsburgh Plate Glass Co.

On July 2, 1957, a pumping test was conducted on well All-Be 8, 8-inches in diameter, ending in the Jennings formation. The well is 200 feet deep and cased to 42 feet. It was pumped for 360 minutes at an average rate of 37 gpm, which lowered the water level 104.1 feet. A plot of the drawdown of water levels against time since pumping started showed that after 50 minutes the rate of water level decline decreased from 1.7 feet per minute to 0.07 feet per minute. Water level recovery measurements were made for 360 minutes, during which time the water level rose 102.2 feet. The coefficient of transmissibility based on the late measurements, computed by means of the Theis recovery formula, is about 1,300 gpd per foot. This value of transmissibility is in the range to be expected for shales in the Jennings formation.

Springs

Springs were formerly a common source of water supply in the Cumberland water province. In recent years they have been replaced by drilled wells, largely for sanitary considerations. Springs were inventoried in the Tuscarora sandstone, the Tonoloway limestone, the Helderberg limestone, the Oriskany sandstone, the Romney shale, and the Jennings formation. Although there probably are springs in the Rose Hill formation, the McKenzie and the Hampshire formations, none was inventoried.

Cumberland Blue Spring, All-Bd 34, in Cumberland has the largest flow in the water province. The spring emerges from solution tubes in the outcropping Tonoloway limestone and discharges into Wills Creek. Six flow measurements during the period from October 1957 to May 1959 ranged from 330 to 1,740 gpm and the mean was about 960 gpm. The flow was observed to increase and become turbid after periods of moderate to heavy precipitation. The spring reportedly drains a sinkhole area just north of the Maryland line. Another possible source of its water is Pea Vine Run which flows across outcrops of the Tonoloway and the Helderberg limestones north of Cumberland.

A small, fracture-type spring, All-Bd 35, issuing from the Tuscarora sandstone, was measured periodically from April 1957 to January 1960. It is located at the east end of the Cumberland "Narrows" on the north side of Wills Creek, just above the railroad track. A stone wall retains and collects the water, which discharges from a 2-inch diameter metal pipe. The maximum measured discharge was 40 gpm and the minimum was 0.3 gpm. The discharge increased almost immediately during a steady rain, although the water was never observed to be cloudy. The source area for -Bd 35 is probably the overlying Tuscarora sandstone on Wills Mountain. It was reported that water from this spring was bottled and sold commercially many years ago.

The average discharge of most springs in the water province is in the sixth magnitude, 1 to 10 gpm.

Quality of Water

Many industrial wells in the Cumberland area have been abandoned because of the poor quality of the water. The ground water in some places is too highly mineralized for boiler use.

Hardness of the ground water ranges from 25 to 518 ppm. Ground water from the Tonoloway and Helderberg limestones commonly has the greatest hardness. Extremely hard water, as high as 1,990 ppm of hardness, has been reported by Lohman (1938, p. 95–96) from wells in the Tonoloway and Helderberg limestones in Pennsylvania just north of Allegany County. Hardness of these waters is believed to be due to solution of gypsum from the rocks. The water also has a sulfurous odor due to hydrogen sulfide gas.

Chloride concentrations of several thousand parts per million occur in ground water from the Wills Creek and McKenzie formations where these units occur at depths of more than 300 feet. Probably the connate water in the aquifers has not been completely flushed by circulating fresh water below the depth indicated. A chloride content of 8,300 ppm was reported from the McKenzie formation at a depth of 640 feet from a well 1,100 feet deep at the Western Maryland Railroad terminal at Ridgeley, West Virginia. The existence of a salt marsh about 1 mile east of Keyser, West Virginia, prompted the West Virginia Pulp and Paper Co. to explore for salt deposits in the area by drilling two test holes. One test hole was drilled through the McKenzie formation and into the Rose Hill formation to a depth of 888 feet. It produced water containing 190 ppm of chloride. The other test hole was drilled through the Tonoloway limestone into the McKenzie formation to a depth of 1,689 feet. It produced water containing 576 ppm of chloride.

The high iron content in the waters from the Rose Hill formation apparently is associated with the existence of the ironstone beds in the formation. The Cresaptown iron sandstone (Swartz, 1923) is about 175 feet above the base of the formation, and the Keefer sandstone of the Clinton group or Roberts iron sandstone beds (of local usage) are 25 to 40 feet below the top of the formation. Above a depth of 345 feet, test well All-Bd 29 yielded water low in iron content (0.1 ppm), but at a depth of 345 to 366 feet, in the Cresaptown iron sandstone beds, the iron content was 3.2 ppm.

The sulfate content of the ground water ranges from 3 to 335 ppm. Ground water having the highest sulfate content is from well -Bd 31 in Cumberland. This water has a hardness of 518 ppm, but as it is used for industrial cooling its poor quality is relatively unimportant.

Nitrate content of the ground water in the province is generally low, ranging from 0.0 to 29 ppm. The highest nitrate content was in water from dug well All-Db 5 near McCoole. This well is 25 feet deep in the Romney shale and may be subject to surface pollution.

The pH of the ground water in the province ranges from 5.1 to 8.1 but in most aquifers it is greater than 7.0. Most of the samples of ground water having a pH of less than 7.0 are from the Tuscarora sandstone.

Table 29 shows the range of important constituents in the ground waters of the province.

Temperature of Water

The principal use of ground water from industrial wells in Cumberland is for cooling purposes.

Table 30 shows a wide range in the temperature of ground-water at any given depth. The temperature range is due to many factors, such as the length of casing in the well, the heat conductance of the rock penetrated, the permeability of the rock, and the seasonal thermal cycle in the case of shallow ground

TABLE 29

Range of Important Chemical and Related Data in Aquifers of the Cumberland Water Province

Aquifer	Source of water	Number of samples	Chemical data	Range (in ppm, except for pH)
Tuscarora sandstone	1 spring and 1 well (All-Bd 35, -Bd 59)	2	Hardness as $CaCO_3$	25–41
			Total iron (Fe)	3.0
			Sulfate (SO_4)	6.0–52
			Nitrate (NO_3)	0.0–10
			Chloride (Cl)	3.8–10
			pH	5.1–6.8
Rose Hill and McKenzie formations	3 wells (All-Ad 3, -Bc 68, -Cc 18)	3	Hardness as $CaCO_3$	92
			Total iron (Fe)	.75–3.6
			Sulfate (SO_4)	10
			Nitrate (NO_3)	0.0–2.5
			Chloride (Cl)	0–3.1
			pH	7.3–7.8
Wills Creek shale	2 wells (All-Ad 42, -Bd 19)	2	Hardness as $CaCO_3$	444
			Total iron (Fe)	.05–.08
			Sulfate (SO_4)	215
			Nitrate (NO_3)	12
			Chloride (Cl)	16–215
			pH	7.0–7.9
Tonoloway limestone	2 wells and 1 spring (All-Bd 1, -Bd 31, -Bd 34)	3[a]	Hardness as $CaCO_3$	184–518
			Total iron (Fe)	.11–1.4
			Sulfate (SO_4)	16–335
			Nitrate (NO_3)	4.6–13
			Chloride (Cl)	7.5–13
			pH	7.4–8.1
Romney and Jennings formations	4 wells (All-Bd 70, -Bc 31, -Cc 4, -Db 5)	4[b]	Hardness as $CaCO_3$	137–238
			Total iron (Fe)	.00–6.5
			Sulfate (SO_4)	48–67
			Nitrate (NO_3)	1.0–29
			Chloride (Cl)	14–60
			pH	7.1–79

[a] Well -Bd 31 yields water from both Tonoloway and Helderberg limestones.
[b] Well -Bd 70 yields water from both the Oriskany sandstone and the Romney shale.

water. Figure 3 includes data on ground-water temperature in the Cumberland water province.

The temperature log of test hole All-Bd 29 is shown in figure 14. Prior to temperature logging the well had not been pumped for many years. The lowest temperature measured was 55.4°F at depth of 30 to 32 feet. Its temperature at a depth of 500 feet was 60.9°F, the highest recorded temperature in any well in Allegany and Washington Counties. The well is located near the southern end of the plunging Haystack Mountain anticline. The proximity of the mountain may result in the relatively high temperature of the water in the well. The reciprocal geothermal gradient for the well is 106 feet per °F, which is not an anomalous value. In November 1958 a test of the well pumping at a rate of 40 gpm produced ground water with a temperature of 57°F.

Well All-Bd 33, in Cumberland, was temperature logged to 493 feet (fig. 17). This well is about 75 feet from pumping well -Bd 31 and its log shows definite temperature changes at 100 and 330 feet, which correlate with changes in velocity from the current-meter survey. Apparently, water at 55.5°F is moving through permeable zones toward the pumping well while the temperatures above and below the permeable zone are higher. The temperature at the well bottom was 57.7°F. The reciprocal geothermal gradient in -Bd 33, based on measurements from a depth of 350 to 493 feet was 183 feet per °F, an above-

TABLE 30

Temperature Range of Ground Water in Wells in Allegany County
(in °F.)

Well nn. (All-)	Date of measurement	Altitude above mean sea level (feet)	Temperature at depth indicated						Well status	Water-bearing formation
			50 feet	100 feet	200 feet	300 feet	400 feet	500 feet		
Af 3	11/13/57	1,255			51.9				non-pumping	Tonoloway limestone
Ah 1	11/8/57	720	52.7	52.9					pumping	Jennings formation
Bc 24	11/7/57	1,640	53.0						do	Conemaugh formation
Bc 40	11/13/57	1,060	53.8						do	Romney shale
Bc 41	11/13/57	1,060	52.5						do	Do.
Bd 2	11/6/57	660	53.7						non-pumping	Tonoloway limestone
Bd 20	11/7/57	630	57.7						do	Do.
Bd 28	11/7/57	644	63.4	60.5					do	McKenzie formation
Bd 29	11/20/57	655	55.8	57.2	58.5	59.6	60.3	61.0	do	McKenzie-Rose Hill formations
Bd 33	11/5/57	630	58.4	55.6	55.6	55.6	57.2	57.7	do	Helderberg-Tonoloway limestones
Bd 36	11/13/57	660	54.6						do	Wills Creek shale
Bd 70	2/24/59	620	57.5	57.4	57.4				non-pumping[a]	Romney shale-Oriskany sandstone
Be 8	11/19/57	630	54.5	54.6	55.1				pumping	Jennings formation
Bg 12	11/13/57	690	53.8						do	Do.
Cb 4	9/28/54	2,180		52.2				at 960 ft. 63.1	flows	Conemaugh formation
Da 1	11/6/57	970	55.0						non-pumping	Pottsville-Allegheny formations
Da 7	12/4/57	940	59.4	57.5	55.3	55.8	56.6	56.6	do	Pottsville-Allegheny formations and Mauch Chunk shale

[a] Well drilled a short period before temperature logged; temperature may not be stabilized.

average gradient. During the pumping test on this well, the temperature of the water pumped remained at 56.5°F, or about 1°F higher than the temperature of the producing zone. The rise of 1°F may be due to friction and heat from the well pumping equipment or to the water from the producing zone mixing with warmer water as a result of pumping the well.

Well All-Bd 28, 193 feet deep and cased to 28 feet, is located inside a plant building which is heated during the winter. This well had been idle for many years. Its static water level on November 7, 1957, was 4.3 feet below land surface. The temperature log of this well showed that the heating of the ground water under the building resulted in gradually diminishing temperature from a high of 80.1°F at a depth of about 5 feet to 58.5°F at a depth of 143 feet. The bottom temperature of this well approximates that of well -Bd 29, a few hundred feet away.

The effect of recharging warm water to the ground-water reservoirs by input wells was measured periodically from February 1959 to April 1960. Ground water for industrial cooling is produced from well -Bd 70, 217 feet deep. The amount of water pumped for cooling and then recharged is estimated to be between 5,000 and 10,000 gpd. The used water is returned to the Romney and the Oriskany formations by recharge wells -Bd 71 and -Bd 72, the greater portion being recharged by -Bd 72. Recharge wells -Bd 71 and -Bd 72 are 10 and 45 feet distant from pumping well -Bd 70. The input, or recharge, water temperature ranged from 76°F to 97°F. The temperature of the ground water in pumping well -Bd 70, showing the effect of warm water recharge, is illustrated in figure 18, which shows that the water temperature in the vicinity of the wells rises during the warm months and declines during the cold months of the year. A longer record will show if ground-water temperatures will continue to rise in the vicinity of the wells.

The ground-water temperature in all geologic units, measured in drilled wells at depths of 50 feet below land surface, averages 55.4°F. The range of ground-water temperature at depths of 100 to 300 feet is from 56.2°F to 57.6°F.

Temperature measurements of spring All-Bd 34, which issues from the Tonoloway limestone in Cumberland, ranged from 53.5°F to 48.5°F during the period April 1957 to April 1960. During the period April 1957 to January 1960 the temperature of spring All-Bd 5, issuing from the Tuscarora sandstone in "The Narrows," ranged from 49°F to 59°F and averaged 54.4°F.

The mean annual air temperature in the Cumberland water province is between 51°F and 53°F. In general, the mean annual temperature of ground water at shallow depths approximates the mean annual air temperature. However, in the Cumberland water province, the temperature of ground water from the land surface down to a depth of 100 feet is 2°F to 4°F above the mean air temperature. This, plus the higher water temperatures at depths of 500 feet

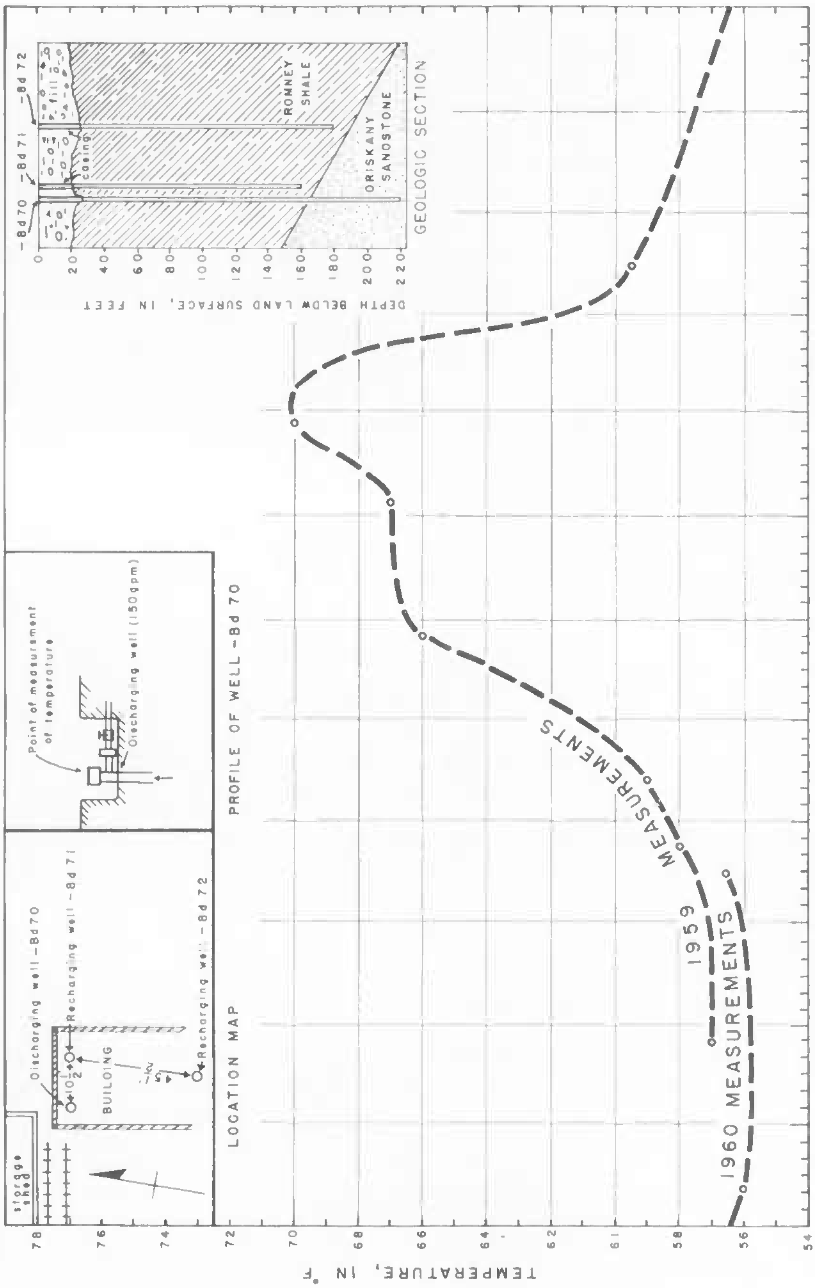

FIGURE 18. Graph Showing Temperature of Water, Geology, and Construction Details of Well All-Bd 70 at Cumberland

suggests a deviation from normal geothermal conditions in the Cumberland area. The position of the 55°F and 56°F isotherms shows this anomaly (fig. 3).

Summary of Hydrologic Conditions

Substantial additional ground-water supplies can be developed in the Cumberland water province. The valley lying east of Haystack and Wills Mountains

TABLE 31

Depth, Length of Casing, and Yield of Drilled Wells in the Cumberland Water Province by Geologic Units

Geologic unit	Well diameter (inches)	Depth (feet)		Number of wells	Length of casing (feet)		Number of wells	Yield (gpm)		Number of wells
		Average	Range		Average	Range		Average	Range	
Hampshire formation	6	69	62–82	(3)	35	30–38	(3)	12	7–18	(2)
Jennings formation	6	103	43–314	(40)	31	17–49	(27)	9	1–50	(28)
Romney shale	6	67	19–256	(72)	34	14–101	(49)	7	2–20	(50)
	8	194	114–300	(5)	31	22–48	(4)	68[a]	7–120	(4)
Oriskany sandstone	6	159	51–265	(13)	58	14–211	(12)	6	1–20	(13)
Helderberg limestone	6	84	56–118	(4)	54	29–111	(4)	15	10–20	(2)
	10	558	550–630	(3)	—	100	(1)	—	400[b]	(1)
Tonoloway limestone	6	110	56–200	(8)	31	19–43	(2)	7	4–12	(3)
	8	185	86–251	(9)	76	72–79	(2)	67[c]	5–170	(7)
Wills Creek shale	6	93	29–200	(16)	25	11–35	(10)	4	1–15	(9)
	8	241	202–296	(5)	—	—	—	68	16–133	(4)
McKenzie formation	6	106	70–193	(7)	22	16–28	(3)	4	1–6	(2)
Rose Hill formation	6	76	40–150	(10)	31	19–43	(4)	11	2–19	(5)
	12	—	952	(1)	—	54	(1)	—	200[d]	(1)
Tuscarora sandstone	6	54	39–65	(3)	54	39–65	(3)	5	1–10	(3)
Juniata formation	6	—	82	(1)	—	20	(1)	—	20	(1)

[a] Includes 3 wells completed in the Oriskany sandstone.
[b] Well completed in the Tonoloway limestone.
[c] Includes 7 wells completed in the Wills Creek shale.
[d] Well completed in the Juniata formation.

appears to have the greatest potential. On the basis of well yields, the best aquifers are the Tonoloway and Helderberg limestones. The best well in the province yields 400 gpm from these aquifers. However, because solution channels and crevices in the limestones provide ready access for polluted or contaminated surface water, some wells in these aquifers may yield water with undesirable chemical, physical or bacteriological characteristics. Other good wells in the province yield water from the Oriskany sandstone where it is overlain by the Romney shale. Where surface streams are not near the wells to recharge the aquifers, the yield of even the best wells may be expected to decline after sustained pumping. Pumping tests and geophysical logging suggests that below depths of 300 to 500 feet the rocks become less permeable and would yield less water to wells. Table 31 summarizes the depths, lengths of casing, and yields of drilled wells in the province.

Aquifer tests indicate a wide range in the coefficients of transmissibility and storage for the aquifers. The highest coefficient of transmissibility (45,000 gpd per foot) was determined for the Helderberg and Tonoloway limestones in the valley of Wills Creek in Cumberland. Values of the coefficient of transmissibility in the range of about 100 gpd per foot were determined for the Romney

TABLE 32

Summary of Hydrologic Coefficients in Cumberland Water Province

Aquifer	Wells used		Time interval (in minutes)		Formula used	Hydrologic coefficients	
	Pumped	Observation	Pumping	Recovery		Transmissibility (gpd/ft.)	Storage
Jennings formation	All-Be 8	—	360	1,065	Recovery (Theis)	150[a] 1,300[b]	— —
Romney shale	All-Ae 20	—	125	140	do	25[a] 110[b]	— —
Oriskany and Romney formations	All-Bd 70	—	450	878	do	14,000[a] 40,000[b]	— —
Helderberg and Tonoloway limestones	All-Bd 31	All-Bd 33	1,830	480	Theis	43,000[a] 12,000[b]	0.002 .043
Do	—	do	1,830	—	Jacob	45,000[a] 13,000[b]	.002 .004
Wills Creek shale	All-Bd 19	—	12,914	8,840	Recovery (Theis)	15,000	—
Tonoloway and Wills Creek formations	All-Bd 19	All-Bd 20	12,914	—	Theis	10,000	.008
Do	—	—	—	8,690	do	10,000	.013
Do	All-Bd 19	All-Bd 20	12,914	—	Jacob	13,000	.005
Do	—	—	—	8,690	do	13,000	.001
Rose Hill and Juniata formations	All-Bd 29	—	960	—	Recovery (Theis)	125[a] 1,200[b]	— —

[a] Based on measurements from early part of test.
[b] Based on measurements from late part of test.

shale at a locality north of Wolfe Mill. Coefficients of storage, based on aquifer tests, range from about 0.002 to 0.04, indicating that the ground water occurs under both artesian and water table conditions at the test sites. Most of the ground water from the deeper aquifers is under artesian head. Hydrologic coefficients of the aquifers in the province are summarized in Table 32.

Small springs are common and occur in all of the formations. Large springs are uncommon; the largest of these, the Cumberland Blue Spring (All-Bd 34), issues from the Tonoloway limestone. Its lowest measured flow was about 330 gpm.

The chemical character of the ground water is variable. Ground water from some of the deeper aquifers may be high in chloride content and other undesirable constituents. The iron content of the water ranges widely. In some places it is above 0.3 ppm and may require treatment for most uses. Hardness of water from many of the aquifers exceeds 200 ppm, and most of the ground water has a pH above 7.0. The range of important chemical data from the aquifers of the Cumberland water province is:

Chemical and related data	Number of samples	Range (ppm, except for pH)
Hardness as $CaCO_3$	9	25–518
Total iron (Fe)	11	0.0–6.5
Sulfate (SO_4)	9	3–335
Nitrate (NO_3)	13	0.0–29
Chloride (Cl)	14	0.0–60
pH	14	5.1–8.1

The temperature of the ground water at many places in the province is somewhat above the mean annual air temperature of 51° to 53°F. One of the important uses of ground water at a few places is for industrial cooling.

Georges Creek Basin Water Province

The Georges Creek basin water province (fig. 2) consists of the eastern two-thirds of the Georges Creek syncline or basin. The province extends westward from Dans and Piney Mountains to the boundary of Garrett County. Drainage is chiefly by Georges Creek, a major south-flowing tributary of the Potomac River. The northern segment of the province is drained by Jennings Run, a tributary of Wills Creek.

Shale, siltstone, sandstone and limestone are the major rocks underlying the basin. Erosion-resistant sandstone commonly forms the crests of the mountains. The province is heavily forested and most of the population is in small towns along Georges Creek.

Precipitation ranges from 40 to 42 inches per year. It is estimated that 14 to 15 inches, or 35 percent, of the annual precipitation becomes streamflow, which includes ground-water runoff or discharge. If it is assumed that one-fourth of the precipitation recharges the ground-water reservoirs, then ground-water recharge is about 10 inches per year, or about 0.5 mgd per square mile.

During most of the year, and especially during droughts, the flow of the streams is sustained by ground-water discharge. However, when water tables are low the surface streams locally may recharge the ground-water reservoirs. The summer of 1957 was extremely dry; precipitation at Westernport for May through September was 9.2 inches below the average for the period. On October 1, 1957, Georges Creek was flowing an estimated 600 to 700 gpm at Borden Shaft, while at Ocean, 1.7 miles south, the creek bed was dry. The flow gradually diminished to a mere trickle in the creek bed and went underground halfway between Borden Shaft and Ocean. Other streams, particularly Braddock Run and Jennings Run, may also be a source of recharge locally to the underlying rocks.

Changes in the quantity of ground water stored in the aquifers are revealed by measurements of the water levels in observation wells. Water-level measurements in shallow wells also provide information concerning the relative rates of recharge of an aquifer from local precipitation. During the season of the year when evapo-transpiration is great, less water will enter the ground-water reservoirs and the rise in water level will be less for given amounts of precipitation.

Figure 1, Plate 6 shows water-levels in well All-Da 1 at Westernport during the period from January 1947 through December 1959. Well -Da 1 is 88 feet deep and penetrates parts of the Allegheny and Pottsville formations. During the 13 years of record the water level fluctuated 4.3 feet. The hydrograph shows seasonal fluctuations but does not indicate a general declining or rising trend. The hydrograph of well -Da 1 during the 5-year period 1947–51 shows that the cumulative net rise of the water level was 20.71 feet. During this period the cumulative precipitation at Westernport was 200.0 inches. Thus, the unit rise in water level in the well was 0.1 foot per 0.08 foot of precipitation. If the specific yield of the aquifer is assumed to be 10 percent, then about 12 percent of the precipitation effectively recharges the aquifer at the site of well -Da 1. The method of computation is:

$$\frac{\text{unit rise in water level (ft.)} \times \text{specific yield (per cent)}}{\text{unit precipitation (ft.)}}$$

$$= \frac{0.1 \times 0.10}{0.08} = 0.12 \text{ (proportion effective recharge)}$$

Ground water in the deeper aquifers is under artesian head, but few flowing wells are present in the province. Ground water confined under artesian head in the deep-lying sandstones may be expected to move toward the center of the physiographic and structural basin. Some of the confined ground water may move upward in the center of the basin by means of vertical leakage through the overlying shale or other nearly impervious beds. No information is available concerning the rate at which such leakage may be occurring.

At the turn of the century, ditches and drainage tunnels were constructed in the Georges Creek basin in order to carry on coal mining operations. One of the most extensive drainage systems was constructed to drain the Pittsburgh coal (Big Vein) at the base of the Monongahela formation. The area drained extends north from Midland to Zihlman, and covers about 14 square miles. In 1903, construction was begun on the Hoffman drainage tunnel to connect mines at Borden Shaft with a point near Clarysville on Braddock Run about 2.2 miles northeast. The tunnel had a total length of 10,646 feet and a 0.35 percent grade toward Clarysville. The tunnel begins in the upper part of the Monongahela formation and ends in the middle of the Conemaugh formation. Approximately 2,600 feet of auxiliary tunnels and 26,700 feet of ditches draining the Big Vein coal area were connected to the Hoffman tunnel. Baker (1920, p. 170) stated that the drainage through the rocks over the Big Vein averaged 3,840 gpm per square mile. For the entire area drained, this is equivalent to 53,800 gpm, or about 5.5 mgd per square mile. The Maryland Bureau of Mines reported that in 1923 the discharge from the tunnel ranged from 14,000 to 30,000 gpm. In 1947 parts of the tunnel caved, reducing its outflow. Measurements of the outflow from the tunnel from April 1958 to August 1959 are:

Date of Measurement	Discharge (gpm)
April 17, 1958	17,500
August 29, 1958	6,700
January 29, 1959	3,930
May 12, 1959	12,400
June 25, 1959	10,100
August 27, 1959	4,400
Mean	9,170

Based on the above measurements, the mean flow from the drainage tunnel is about 0.94 mgd per square mile. This is about twice the assumed average rate of ground-water recharge to the aquifers (0.5 mgd per square mile) and the effective drainage area of the tunnel may be substantially greater than the 14 square miles reported. The map of the tunnel area indicates that probably the tunnel is intercepting the flow of Georges Creek south of Borden Shaft. This could be verified by the introduction of a suitable tracer substance into Georges Creek upstream from the tunnel workings.

Apparently, during low-flow periods, the Hoffman tunnel is capable of diverting nearly all the flow of the upper one-third of Georges Creek. During the period 1929–59 the mean annual discharge of Georges Creek, based on gaging station records near its mouth, was 0.68 mgd per square mile. This amount is well below the mean flow per square mile for streams draining areas of similar geology in Garrett County (Martin, p. 267) and the diversion of flow of Georges Creek caused by the Hoffman tunnel may explain this apparent anomaly.

During March, April, and August 1957, 43 wells were measured to determine flucutations in static water levels. The wells are rather evenly distributed throughout the basin. In 15 wells in the Mount Savage-Jennings Run area during the period from April to August, the average water-level decline was 5.4 feet; in 7 wells in the Eckhart Mines-Vale Summit-Braddock Run area the average water level decline was 2.3 feet; and in 21 wells in the lower part of the Georges Creek basin the average decline was 3.6 feet. This larger decline of water levels in the Mount Savage-Jennings Run area is probably due to steeper hydraulic gradients or more permeable aquifers, or both, in that area than in the other two areas.

Drilled wells were inventoried in all geologic units except the Greenbrier limestone and rocks of the Permian system. Dug wells are a common source of ground water in the province. Numerous springs occur in all of the formations and are a major source of ground water.

Structural Geology

Two geologic sections across the Georges Creek basin along lines C-C′ and G-G′ (fig. 2, Pl. 4) serve as a basis for an understanding of the ground-water conditions. The east and west flanks of the basin are rimmed by mountains. The strata dip steeply near the flanks of the basin but decrease toward its center. The axis of the basin dips about 7 feet per mile toward the north. Rocks of the Mississippian system are exposed on the flanks of the basin, but toward the center near the town of Midland these rocks lie at a depth of about 1,200 feet. In the central part of the basin, the top of the Pocono formation is estimated to lie about 2,000 feet below the land surface. Overlying the formations of Mississippian age are about 1,570 to 1,875 feet of strata of Pennsylvanian age. The uppermost Pennsylvanian units, the Monongahela and Conemaugh formations, occupy the central part of the basin. A few hills in the central part of the basin are capped with about 250 to 370 feet of strata of Permian age.

No major faults are known in the Georges Creek basin water province. Small faults are probably present, because local faulting exists in Garrett County (Amsden, 1954, p. 94).

Geologic Formations and their Water-bearing Properties

Mississippian System

Pocono formation.—The Pocono formation, at the base of the Mississippian system, crops out along a narrow belt dipping to the west along the lower east slope of Dans, Piney, and Little Allegheny Mountains. The formation is a gray, white, tan, and brown, crossbedded, platy to massive sandstone, locally conglomeratic. It is interbedded with gray and reddish-brown shale, mudstone, and siltstone. It is from 250 to 1,700 feet thick.

The Pocono formation yields ground water in quantities sufficient for domestic and farm use and for small public supplies. Wells All-Bc 4, -Bc 5, and -Bc 6 furnish water as part of the LaVale supply. The depths of the 8-inch diameter supply wells range from 128 to 250 feet. In October 1951 the two best wells yielded 41 and 65 gpm.

Well All-Da 7, at Luke, penetrated the top of the Pocono formation at about 1,293 feet below land surface, and continued in the formation to 2,379 feet at the bottom of the well. No test was conducted to determine its yield; but after casing the uppermost 800 feet, the water level in the well dropped from 5 to 70 feet below the land surface. The change in water level indicates the existence of at least two water-bearing zones of different hydraulic heads. The well log is in Table 44.

Greenbrier limestone.—The Greenbrier limestone of Late Mississippian age occurs along the eastern slope of Dans, Piney and Little Alleghany Mountains. Its maximum width of outcrop is about 0.3 mile. In its lower part the Greenbrier is a gray to purplish-red, crossbedded, sandy limestone. Its upper part is a reddish shale, mudstone, and sandstone and some interbedded grayish limestone. The formation is about 240 to 250 feet thick.

No wells are known to end in the formation. The Greenbrier formation, however, is the source of springs All-Bc 7 and -Bc 8 which are part of the public supply of LaVale. The flows of the springs on October 18, 1951, were measured to be 65 and 5 gpm. When their flow declines, wells -Bc 4, -Bc 5 and -Bc 6 supplement the water supply of the town.

Only one well taps the Greenbrier limestone in the Georges Creek water province. Well All-Da 7, near Luke, penetrates the formation between depths of 927 and 1,293 feet, but the water-yielding capacity of the formation in this locality is not known. In Garrett County the yield of 6 drilled wells in the formation ranges from 1 to 20 gpm (Overbeck, 1954, p. 138), and the Greenbrier probably would furnish enough water for farm and domestic use in Allegany County.

Mauch Chunk shale.—The Mauch Chunk shale of Late Mississippian age crops out along a narrow band just east of the crest of Dans, Piney, and Little Allegheny Mountains. The formation consists of red shale, reddish-purple mudstone, and red, brown, and gray crossbedded, slabby-weathering sandstone. The shale and mudstone include some thin light-green beds. The formation is about 650 to 700 feet thick.

Only three drilled wells were inventoried in the formation. These are well All-Ad 16 along Jennings Run and wells -Da 8 and -Da 9 along the Potomac

River east of Westernport. Their depths range from 41 to 90 feet. The wells at Westernport reportedly produce 12 and 10 gpm, respectively.

Well All-Da 7 penetrated the Mauch Chunk shale from 271 to 927 feet. The well yielded 180 gpm in the Mauch Chunk at a depth of 797 feet (see log, Table 44). In Garrett County, the yields of 17 drilled wells in the formation range from 5 to 24 gpm, (Overbeck, 1954, p. 139).

Pennsylvanian System

Pottsville and Allegheny formations (undifferentiated).—The Pottsville and Allegheny formations crop out along the crest of the east and west rims of the Georges Creek basin. The maximum width of the eastern outcrop belt is about 0.7 mile at the southern end of Dans Mountain. Only a small segment of the western outcrop is in Allegany County. Most of the outcrop area is along the basinward slope of the mountain crests. The formations consist chiefly of shale, siltstone, and sandstone, but also contain claystone, clay, and coal. Conglomeratic sandstone is present in the middle and lower parts of the unit. The thickness of the formations ranges from 300 to 600 feet, the thickest part being in the southern end of the basin (Waagé, 1949, p. 20). Extensive coal beds occur in the upper half of the unit.

Due to their mountainous position, only a small part of the outcrop area of the formations is inhabited and only a few wells tap the Pottsville and Allegheny formations. Wells in the two formations are along Jennings Run, Braddock Run, and near Luke and Westernport. Few wells are drilled into the formations at Luke and Westernport because these towns use surface-water supplies. The formations can be penetrated only at depths of more than 600 feet toward the center of the basin. Toward the elevated flanks of the basin, the overlying Conemaugh formation thins and the Pottsville and Allegheny formations lie closer to the surface.

The small amount of data available suggests that ground water is obtainable in the outcrop area of the formations in quantities sufficient for domestic, farm, and limited industrial purposes. Well All-Ac 45 near Barrelville is 32 feet deep and produces 4 gpm. Well -Da 2 near Franklin is 165 feet deep and produces 100 gpm.

Where standstone in the Pottsville and Allegheny formations is overlain by the younger Conemaugh formation, it may yield large quantities of ground water. Well Gar-Bg 1, located just across the Garrett County line on Koontz Run, reportedly yielded 300 gpm. The well is 8 inches in diameter and is 1,276 feet deep. On the basis of tests made before and after penetrating the Pottsville and Allegheny formations, their yield is estimated to be 180 gpm. The driller reported water flows from a sandstone at depth of 604 to 632 feet, from a slate at 674 to 692 feet, and from a slate with interbedded coal at 733 to 752 feet.

During an investigation of the coal beds in the Georges Creek basin (Toenges and others, 1949), twenty test holes were drilled, fifteen of which were in Allegany County. Ground water was reported in quantity in the Pottsville and Allegheny formations in only two of the holes. One of these, near Laurel Run in Garrett County, flowed 150 gpm, and the other, near Elklick Run east of Gilmore, flowed 300 gpm. The ground water in both holes was from sandstone beds in the Allegheny formation.

The test holes for coal exploration revealed many sandstone beds within the formations, some nearly 70 feet thick. The sandstone is in lenses that rarely continue for more than several miles.

Ample ground-water supplies are not necessarily available from all of them. In some of the test holes where excellent sandstone aquifers are reported, part of the water may be coming from the coals.

Conemaugh formation.—The Conemaugh formation crops out along irregular belts, 1 to more than 2 miles wide, which extend across the basin. The most extensive outcrop area is at the north end of the basin near Mount Savage. Other extensive areas are at the south end from Dogwood Flats to Westernport. Georges Creek is incised in the formation in a narrow valley southward from Midland. The formation is composed of interbedded argillaceous limestone, clay, claystone, shale, siltstone, sandstone and coal. The formation is about 900 feet thick in the central part of the basin but thins toward the flanks.

Ground water from wells or springs in the Conemaugh formation is used for public supplies in Barton, Lonaconing, and Mount Savage, where many of the deep wells are 8 inches in diameter. Most of the wells in the water province are in the Conemaugh formation. The depths of wells range from 22 to 1,354 feet. Casing lengths range from 6 to 120 feet. Yields range from 1 to 170 gpm. The yields of the 8-inch diameter wells are generally higher than the 6-inch diameter wells.

The water supply of the town of Barton consists of surface water from Butcher Run and four wells in Garrett County near the Allegany County line. In one well, Gar-Cf 6, 512 feet deep, the producing zones are reported to be sandstones at depths of 120–203 feet and 394–436 feet.

Ground water from the Conemaugh formation furnishes part of the supply of the towns of Midland and Lonaconing. Well All-Cb 1, east of Gilmore, yielded 170 gpm, at a depth of 500 feet. Well All-Cb 3, located about 0.5 mile from -Cb 1, yielded 433 gpm with a pumping level of 110 feet. Well -Cb 4, located about 0.7 mile southeast of -Cb 1, yielded 60 gpm at a depth of 208 feet. Well -Cb 4 was subsequently deepened to 1,354 feet and some water was obtained from formations underlying the Conemaugh.

The town of Mount Savage is supplied by ground water from nearby springs, supplemented by wells ending in the Conemaugh formation. The depth, diameter, and yields of these wells is:

Well No.	Depth (feet)	Yield (gpm)	Diameter (inches)
A11-Ac 6	93	30	8
-Ac 20	240	—	6
-Ac 33	210	8.5	8
-Ac 42	210	5	8
-Ac 53	154	27	6

Part of the supply of the community of Barrelville, just east of Mount Savage, is furnished by well All-Ac 44. This well is 97 feet deep and reportedly produces 30 gpm from the Conemaugh formation.

The logs of coal exploration test holes show that the Conemaugh formation has a lower proportion of sandy sediments than the Pottsville and Allegheny. Waagé (1949, p. 25) states that though the sandstone beds in the Conemaugh are more persistent than those in the Pottsville and Allegheny formations, they are discontinuous and vary in thickness and lithology from hole to hole.

Monongahela formation.—The Monongahela formation crops out along the hilltops in the central part of the basin. The average width of outcrop is about 2 miles, but the maximum width, between Vale Summit and Midlothian, is about 3.7 miles. The formation is composed of argillaceous limestone, claystone, shale, siltstone, sandstone, and coal. The Pittsburgh coal (Big Vein) forms the base of the formation. The thickness of the formation ranges from 75 to 370 feet. Six horizon-marking sandstone beds have been described within the formation (Swartz, 1920, p. 71–76). Most of them are of local occurrence and range in thickness from a few feet to about 40 feet. Thin sandstone stringers are common throughout the unit. Lenticular limestone beds less than 10 feet in thickness are fairly common in parts of the formation (O'Harra, 1900, p. 125–128).

The Monongahela formation yields ground water to wells and springs in quantities generally sufficient for domestic and farm use. Because of its thinness and its isolated topographic position in some places, the formation is not as good an aquifer as the Conemaugh formation. Depths of drilled wells range from 60 to 85 feet. Casing lengths range from 35 to 39 feet and the yields of two wells are 2 and 20 gpm.

Because of the extensive tunneling in the Pittsburgh coal in the area between Midland and Frostburg, the sands in the Monongahela formation may be partially or completely drained and may therefore be poor aquifers. In the vicinity of the Hoffman tunnel, places where the rocks are drained might be indicated by the preparation of a piezometric map prior to an attempt to develop ground-water supplies.

Permian System

Rocks of probable Permian age cap five isolated hills between Lonaconing and Frostburg. The largest area of outcrop, north of Lonaconing between Koontz Run and Squirrel Neck Run, is a roughly circular area approximately 1.5 miles in diameter. The rocks consist mainly of shale, siltstone, and sandstone; argillaceous lenticular limestone and several thin beds of impure coal also are present. Thickness of the Permian strata ranges from about 250 to 400 feet.

Because the outcrop area of the Permian strata is uninhabitated, no ground-water data are available. These rocks probably would yield only small supplies of water to wells because they chiefly cap isolated hills and are probably well drained.

Aquifer Tests

LaVale (Red Hill)

On October 18, 1951, an aquifer test was conducted on the public-supply wells of LaVale at Red Hill. The wells end in the Pocono formation of Mississippian age. The pumping well, All-Bc 5, is 143 feet from observation well -Bc 4 and 100 feet from observation well -Bc 6. Well -Bc 5 was pumped for 178 minutes at an average rate of 65 gpm. After the cessation of pumping, the water level recovered 17.6 feet. Coefficients of transmissibility, computed from the drawdown and recovery measurements on wells -Bc 5 and -Bc 6, range from 1,300 to about 1,600 gpd per foot. Because of the likelihood of recharge to the aquifer from nearby Braddock Run and as the effect of hydrologic boundaries may have complicated the analysis of the data, the coefficients are probably only correct in their general order of magnitude. Computed coefficients of storage range from 0.0004 to 0.004, but these are unreliable. Probably the higher value, indicating modified artesian conditions for the short period of the test, is the more nearly correct.

Midland

On October 17, 1951, aquifer tests were made on wells All-Cb 1 and -Cb 4, situated about 4,000 feet apart on Elklick Run, southeast of Gilmore. These wells apparently yield water from one or more sandstones in the Conemaugh formation. Because well -Cb 1 had been pumped steadily for 90 days at 170 gpm and -Cb 4 had been pumped steadily for about 24 days at 60 gpm, measurements were made only of recovery of the water levels in the wells. Recovery measurements were made for 65 minutes in well -Cb 1 and for 140 minutes in -Cb 4. Based on the Theis recovery formula, the computed transmissibility for the aquifer at the site of well -Cb 1 is 10,300 gpd per foot and at well -Cb 4 about 6,100 gpd per foot. Because of likely hydraulic interference between the discharging wells during the long period of pumping and as recharge to the aquifer probably occurred during the test, the reliability of the computed values of transmissibility is questionable.

Springs

Springs in the Georges Creek basin water province are numerous but generally small. They probably occur in all of the formations, but were inventoried only in the Greenbrier limestone, the Pottsville, Allegheny, Conemaugh, and Monongahela formations. The springs are principally of the contact type. The known range of discharge of the springs is from 1 to 300 gpm. The largest spring inventoried, All-Cb 15 at Lonaconing, attained its highest flow in April 1957; it issues from the Monongahela formation. The range of spring discharge according to the geologic units in which the springs occur is:

Geologic unit	Discharge (gpm)
Monongahela formation	3–300
Conemaugh formation	1–150
Pottsville and Allegheny formations	8–10
Greenbrier limestone	5–65

The flow of springs in the province may vary widely from wet to dry seasons. For example, in 1957, spring All-Cb 9 in the Dans Mountain recreation area east of Lonaconing flowed 43 gpm on March 21 and 0.4 gpm on August 27. The flow of most of the small streams draining into Georges Creek is sustained during dry weather by small springs and seeps. Locally, these streams are impounded and furnish water to individual homes or to groups of homes.

The use of spring water in the province during 1960 was estimated to be about 0.6 mgd, distributed as follows:

Town or Community	Average daily use (in mgd)
Mount Savage	0.10
Frostburg[a]	0.20
LaVale	0.07
Lonaconing	0.20
Barton	0.01
Midlothian, Woodland, Klondike, and Moscow	0.01
	0.59

[a] Source in Garrett County adjacent to Allegany County.

During droughts the flow of the springs is frequently inadequate for the water requirements of the towns and must be supplemented from other sources, commonly stand-by wells. During wet periods the flow of the springs may be far greater than the water requirements and most of the water flows to waste.

TABLE 33

Chemical Analyses of Ground Water from Deep Test Well All-Da 7 at Luke[a]

Aquifer	Depth of sampling (in feet)	Results in ppm, except for pH					
		Total solids	Hardness as $CaCO_3$	Iron (Fe)	Sulfate (SO_4)	Chloride (Cl)	pH
Allegheny (?) formation	near surface	165	85	18.5	57	5.8	7.0
Pottsville (?) formation	400	202	75	88	57	5.3	6.7
Mauch Chunk shale	800	268	95	66	57	6.9	6.3
Pocono formation	1,521-2,379	16,100	2,460	2.9	70	9,550	7.0

[a] Analyses by West Virginia Pulp and Paper Co. Hardness determined by soap method; results only approximate.

Quality of Water

The chemical quality of ground water in the province is satisfactory for most domestic and farm purposes, although the hardness of the water is commonly from 50 to 200 ppm. Locally the iron content may be sufficiently high to require treatment for iron removal. Water from the springs commonly has less hardness than well water, is lower in iron content, and locally is acidic in character. The acidity of many of the spring waters may be due to oxidation and solution of the sulfide minerals in the coal-bearing rocks (Hem, 1959, p. 62). The ground water percolating through such rocks may contain dilute free sulfuric acid, sulfate ions, or both. Water issuing from springs All-Bd 21 and -Bd 22 at two abandoned coal mines had a pH of 3.5.

An analysis of water issuing from the Hoffman tunnel (All-Bc 69) near Clarysville showed that its pH was 6.7, its hardness was 457 ppm, and its sulfate content was 455 ppm. The rocks in the bed of the tunnel are covered with a red deposit of iron oxides precipitated from the water.

Ground water from the deeper aquifers in the central part of the basin is highly mineralized. Samples of water were collected and analyzed at various depths in well All-Da 7. This well was drilled to a total depth of 2,379 feet and cased to a depth of 1,521 feet. After sampling the water between 1,521 and 2,379 feet the well was plugged just below 800 feet and the casing was slit to permit water to enter the well. Water samples were then collected at 800 feet, 400 feet, and near the top of the well. The analyses of these samples are given in Table 33. The chemical analyses and the drilling of the well are described in a report by J. G. Patrick (1948). The analyses indicate that the water above a depth of about 800 feet is fresh but unusually high in iron content. The water below a depth of 1,521 feet would be classified as saline water and is unusable as a source of water supply.

When well -Da 7 was 797 feet deep, it was pumped for 20 hours and samples of water were collected at the start and end of pumping. During this period, the dissolved solids content increased from 282 to 753 ppm; chlorides from 26 to 291 ppm; and hardness from 60 to 86 ppm. The pH of both samples was 7.0. The increase in mineralization of the water during the pumping period probably is the result of an increased contribution of water to the well from the deeper, more mineralized aquifers.

Well All-Ab 1, near Frostburg on the west rim of the basin, yielded fresh water at a depth of 1,030 feet. Patrick (1948) reports that in 1917 an oil and gas test well was drilled to a depth of 2,900 feet at Knapps Meadow just north of Lonaconing. Saline water was reported at depths ranging from 500 to 1,000 feet in the Pottsville or Allegheny formation. Inflammable gas was reported to have bubbled out of this well from water that rose to within 1 foot of the surface.

Table 34 shows the range of important chemical constituents in aquifers in the province. Most of the analyses are from wells tapping the Conemaugh formation. These wells range in depth from 40 to 500 feet. Iron content ranges widely from 0.02 to 6.0 ppm. The hardness of the water ranges from 17 to 303 ppm, but the average hardness in 8 analyses is about 167 ppm. The chloride content in 10 water samples ranges from 1.1 to 33 ppm. The pH of the waters ranges from 6.5 to 8.3 ppm.

TABLE 34

Range of Important Chemical and Related Data in Aquifers of the Georges Creek Basin Water Province

Aquifer	Source of water	Number of Samples	Chemical and related data	Range (in ppm, except for pH)
Pottsville, Allegheny, and Mauch Chunk formations	Well All-Da 7[a]	2	Hardness as $CaCO_3$	60-86
			Iron (Fe)	0.0-0.2
			Sulfate (SO_4)	13-14
			Nitrate (NO_3)	—
			Chloride (Cl)	26-291
			pH	7.0
Conemaugh formation	10 wells (All-Ab 1, -Ac 7, -Ac 21, -Ac 25, -Ac 43, -Ac 50, -Ac 52, -Bc 24, -Ca 8, -Cb 1)	12[b]	Hardness as $CaCO_3$	17-303
			Iron (Fe)	0.02-6.0
			Sulfate (SO_4)	8.8-52
			Nitrate (NO_3)	0.2-8.8
			Chloride (Cl)	1.1-33
			pH	6.5-8.3

[a] Range based on two analyses from one well uncased from 24 to 797 feet; one sample collected at beginning of pumping and other sample after 20 hours of pumping.

[b] Three analyses from well All-Ab 1.

Temperature of Water

Wells All-Cb 4, -Da 1, and -Da 7 were temperature logged. The temperatures measured at specified depth intervals are in Table 30. Well -Cb 4 ends at a depth of 960 feet in the top of the Greenbrier limestone. The temperature of 63.1°F at a depth of 960 feet is the highest measured water temperature in the province. It is estimated that the reciprocal geothermal gradient in the well is 77 feet per °F. In August 1956 the well flowed 20 gpm and the temperature of the flowing water was 52°F, suggesting that much of the water coming from the well is derived from a shallow source. The water temperature in well -Da 7 at Luke was 55.3°F at depths of 142 to 264 feet, and 56.5°F at 500 feet. This well, originally drilled to 2,379 feet, is plugged at 800 feet. Water temperature was measured to a depth of 500 feet. Some circulation of water may take place through slits in the casing above 800 feet, and, therefore, determination of the reciprocal geothermal gradient may be unreliable. Projecting an estimated gradient of 117 feet per °F, the temperature at the well bottom would be about 61.5°F, or slightly below the temperature at the same depth in well -Cb 4.

The temperature log of well All-Da 1 shows an increase of temperature from 10 to 30 feet below land surface, and then a gradual decrease toward the bottom of the well at 88 feet. The water level in the well was about 5 feet below land surface at the time of measurement. Measured temperatures in this well are:

Depth (feet)	Temp. °F)	Depth (feet)	Temp. (°F)
10	56.5	34	56.9
14	56.7	40	56.0
18	56.9	50	55.0
22	57.0	60	54.3
26	57.0	70	54.1
30	57.0	80	54.0

The average temperature in 12 dug wells (average depth 17 feet) during July and August 1956 was 57.5°F.

Water temperatures were measured in a number of springs in the province during April and October 1957. The average April temperature of 21 of the springs was 50°F; the average October temperature of about the same number of springs was 53°F. The mean temperature of the springs for the two periods of measurement is slightly greater than 51°F, which is about equal to the average annual air temperature of the area.

Summary of Hydrologic Conditions

The Georges Creek basin water province is underlain by a thick series of sedimentary strata, consisting chiefly of shale, siltstone, sandstone and coal.

The surface rocks throughout most of the basin are of the Pennsylvanian system. Rocks of the Mississippian system crop out along narrow belts on the mountainous rims of the basin.

The most productive aquifers are irregularly distributed sandstone units in the Pottsville, Allegheny, and Conemaugh formations. Wells range in depth from 22 to 2,379 feet. Most domestic and farm wells are 6 inches in diameter; their yields range from 1 to 33 gpm.

The best well, a deep test hole near Luke (All-Da 7), yielded about 180 gpm from several aquifers. This well was drilled in exploration for brine deposits, and the water from the deeper aquifers is unusable as a source of fresh water. Another large-capacity well (All-Cb 1) was drilled to a depth of 500 feet for the Lonaconing Water Co. The well yielded 170 gpm from sandstones in the Pottsville and Allegheny formations. Table 35 summarizes the depths, lengths of casing, and yields of drilled wells in the water province by geologic units.

Springs issue from nearly all the geologic units. Their flows are generally small, in the range of 1 to 100 gpm, and the flow varies widely from wet to dry seasons of the year. The largest spring had an estimated flow of 300 gpm at the time of observation. The quantity of spring water used in the province during 1960 is estimated to have been 0.6 mgd. During wet seasons most of the flow of springs goes to waste.

TABLE 35

Depth, Length of Casing and Yield of Drilled Wells in the Georges Creek Basin Water Province by Geologic Units

Geologic unit	Well diameter (inches)	Depth (feet)		Number of wells	Length of casing (feet)		Number of wells	Yield (gpm)		Number of wells
		Average	Range		Average	Range		Average	Range	
Monongahela formation	6	69	60–85	(3)	37	35–39	(2)	11	2–20	(2)
Conemaugh formation	6	70	22–369	(62)	27	6–58	(42)	9	1–33	(35)
	8	387	98–1,354[a]	(10)	49	38–120	(6)	44	5–170	(10)
Pottsville and Allegheny formations (undifferentiated)	3	238	189–257	(4)	—	—	—	—	—	—
	6	—	32	(1)	—	16	(1)	—	4	(1)
	12	—	88–2,379[b]	(3)	—	35–1,521	(2)	—	100–180	(2)
Mauch Chunk shale	6	66	41–90	(3)	33	31–35	(2)	11	10–12	(2)
Pocono formation	6	—	45	(1)	—	31	(1)	—	6	(1)
	8	193	128–250	(3)	32	32	(3)	39	12–65	(3)

[a] Well drilled into the Mauch Chunk shale, but yields water from Conemaugh formation.
[b] Well drilled into the Pocono formation, but yields water from several formations.

TABLE 36

Summary of Hydrologic Coefficients in the Georges Creek Basin Water Province

Aquifer	Wells used		Time interval (in minutes)		Formula used	Hydrologic coefficients	
	Pumped	Observation	Pumping	Recovery		Transmissibility (gpd/ft.)	Storage
Conemaugh formation	All-Cb 1	-Cb 1			Recovery (Theis)	10,300[b]	—
Do	All-Cb 4	-Cb 4	—	140	do	6,100	—
Pottsville-Allegheny-Mauch Chunk formations	All-Da 7	-Da 7	1,440	40	do	470	—
Pocono sandstone	All-Bc 5	-Bc 5	178	83	do	960	—
Do	do	All-Bc 6	—	83	Jacob	1,570	.0042
Do	do	All-Bc 6	178	—	Theis	1,300[a]	.0004
						1,300[b]	.0006

[a] Based on measurements from early part of test.
[b] Based on measurements from later part of test.

Several aquifer tests in the province give coefficients of transmissibility from less than 500 to more than 23,000 gpd per foot. The highest value was from a test on a well tapping the Pocono formation west of LaVale. Coefficients of storage at this site range from 0.0006 to 0.004. These values indicate the existence of artesian and modified artesian conditions. However, water-table conditions normally prevail at shallow depths in nearly all aquifers in the province. Table 36 summarizes the hydrologic coefficients determined from aquifer tests.

Most of the ground water has a hardness in excess of 60 ppm and it may, in places, be objectionably high in iron content or have a pH of less than 6.0. Water from the deeper aquifers in the center of the basin (below a depth of 800 to 1,000 feet) may be too saline for use as a source of water supply.

The average annual temperature of ground water from drilled wells is about 55°F. The temperature of spring water averages about 51°F.

Future Development of Ground Water in Allegany and Washington Counties

The water-bearing character of the rocks that underlie Allegany and Washington Counties ranges widely from poor to good or excellent. All of the rock units are aquifers at one place or another, but in certain localities some rocks will yield no water to wells. The yields of several hundred wells in the area range from less than 1 to more than 400 gpm.

The best aquifers in the area are the limestones of the Hagerstown Valley. The range in yield of the best industrial wells in the valley is from 200 to 400

TABLE 37

Estimated Ground-Water Discharge in Alleghany and Washington Counties

Water province	Approximate area (sq. mi.)	Ground-water discharge (mgd. sq. mi.)	Approximate total for area (mgd)
South Mountain-Elk Ridge	85	0.3	25
Hagerstown Valley	275	0.5–0.6	140–170
All others	520	0.4–0.5	200–260
Total	880	—	365–455

gpm. The flow of the largest springs ranged from 0.9 to 2.7 mgd during nearly 2 years of measurement. However, in a limestone region hazards are attendant upon the use of ground water as a source of supply. Many wells and springs yield water that is bacterially contaminated and during certain times of the year water in some of the limestone springs is turbid or muddy due to the ready access of surface drainage into the limestones. The hardness of water from most limestone sources exceeds 60 ppm. Nevertheless, the Hagerstown Valley is considered to be the only area in Allegany and Washington Counties where ground-water supplies of several hundred thousand gallons a day may be readily available.

Although ordinarily shales are not regarded as good aquifers, moderately large water supplies, locally as much as 130 gpm, have been obtained from them, especially in the Cumberland area. There the yield of wells in the Wills Creek shale ranges from 1 to 133 gpm. The average yield of four of the wells of largest capacity is 68 gpm. Because the shales are relatively impervious, sustained yields of more than a few tens of gallons per minute are unlikely, except locally where the supply is near a surface stream that may provide recharge to the aquifer.

The mean yield of 6-inch diameter wells in limestone is 14 gpm, in shale is 9 gpm, and in sandstone is 6 gpm.

Based on an analysis of streamflow records, the total quantity of ground water theoretically available in the two counties for perennial use is estimated to be about 400 mgd (Table 37). To obtain this quantity of ground water would require a very large number of closely spaced wells, and would involve an uneconomic expenditure of money for well drilling, pumps, and related equipment.

The estimated present use of ground water in the area is about 7.2 mgd (5.3 mgd from wells and 1.9 mgd from springs). Thus, the current use of the water resources is less than 2 percent of the total quantity theoretically available. For the area as a whole, large supplies of ground water are available for prudent use and development, but most of these uses will of necessity be either domestic

TABLE 38

Chemical Analyses of Water from Wells and Springs in Allegany County

(Results in parts per million except specific conductance and pH)

[Analysis: A, U. S. Geological Survey; B, Maryland State Health Department; C, Hall Laboratories; D, Celanese Corporation of America; E, West Virginia Pulp and Paper Company.]

Spring or Well	Date of collection	Water-bearing formation	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Copper (Cu)	Zinc (Zn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Lithium (Li)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Phosphate (PO_4)	Dissolved Solids	Hardness as $CaCO_3$		Carbon dioxide (CO_2)	Specific conductance (micromhos at 25°C)	pH	Analyst
																					Total	Noncarbonate				
Ab 1	June 26, 1946	Conemaugh	13	0.0	4.0	0.2	—	—	41	6.2	—	—	—	—	18	5	—	—	—	118	80	—	—	—	6.5	B
Ab 1	Apr. —, 1950	do	5.4	3.2	4.0	.2	—	—	35	.07	—	—	—	—	50	—	—	—	—	152	127	—	—	—	6.5	B
Ac 7	May 11, 1950	do	4.4	.5	.02	.07	—	—	6	19	—	—	—	211	83	6	—	—	—	370	251	—	—	—	6.9	B
Ac 21	Apr. 23, 1959	do	—	—	1.2	—	0.00	1.5	33	12	—	—	—	74	—	9.7	0.3	3.2	—	—	—	—	—	7.1	6.6	A
Ac 25	Apr. 23, 1959	do	—	—	.13	—	.00	.06	23	6.2	—	—	—	55	—	3.1	.2	4.9	—	—	—	—	—	163	6.7	A
Ac 43	May 9, 1950	do	7.0	.0	.2	.0	—	—	58	12	—	—	—	201	52	12	—	—	—	260	195	—	—	—	7.5	B
Ac 50	May 1, 1950	do	—	—	—	—	—	—	42	7.9	63		—	292	16	7.5	0.1	9.8	—	—	138	0	—	428	8.3	A
Ac 52	July 12, 1950	do	—	—	6.0	—	—	—	—	—	—	—	—	146	—	20	—	—	—	520	303	—	—	—	6.8	B
Ad 3	May 10, 1957	Rose Hill	9.4	.1	3.6	.31	.00	3.4	17	12	2.7	1.4	0.2	111	10	2.9	.2	.0	0.0	126	92	1	18	201	7.8	A
Ad 42	Apr. 23, 1959	Wills Creek shale	—	—	.08	—	.00	.88	42	53	—	—	—	305	—	16	.3	12	—	—	—	—	—	593	7.9	A
Ae 8	Apr. 23, 1959	Tonoloway limestone	—	—	.14	—	.00	.00	44	52	—	—	—	326	—	4.1	.1	8.3	—	—	—	—	—	461	7.4	A
Ae 35	May 1, 1958	do	6.3	.0	.05	.02	.00	.00	17	2.7	.5	1.2	.4	46	14	2.5	.0	1.2	.2	74	54	16	2.9	114	7.4	A
Af 7	Apr. 23, 1959	Wills Creek shale	—	—	.00	—	.00	.85	42	37	—	—	—	268	—	7.4	.3	8.9	—	—	—	—	—	479	7.5	A
Ag 2	Mar. 7, 1951	Romney shale	11	2.0	8.2	.17	—	—	69	10	1.8	1.3	—	177	78	1.6	.1	.3	—	264	213	68	—	420	7.1	A
Ag 3	Sept. 30, 1953	Tonoloway limestone	55	1.0	.40	.0	—	—	234	50	—	—	—	212	1310	.8	1.2	—	—	2324	480	—	—	—	7.3	B
Ag 15	May 1, 1958	do	6.0	.0	.03	.02	.00	.00	61	8.2	.5	1.0	.4	204	20	2	.0	4.4	.1	232	168	19	4.1	374	7.9	A
Ag 25	May 2, 1958	Wills Creek shale	—	—	—	—	—	—	120	39	63		—	402	168	58	.3	12	—	—	460	130	—	953	8.3	A
Ag 37	May 2, 1958	Oriskany sandstone	—	—	—	—	—	—	69	12	23		—	188	96	12	.0	1.1	—	—	222	68	—	456	8.1	A
Ah 1	Nov. 15, 1957	Jennings	12	.0	.11	.22	.00	1.1	17	3.7	21	1.6	.0	110	6	4.1	.1	.1	.1	119	58	0	—	193	7.4	A
Ah 2	Mar. 7, 1951	do	20	.1	.08	.08	—	—	16	12	12	1.4	—	139	4	2.6	.2	.9	—	135	93	0	—	227	7.8	A
Ai 2	Nov. 15, 1957	Hampshire	20	.0	.02	.00	.00	.75	17	8.4	7.0	3.0	.0	111	5.2	5.2	.1	.1	.3	118	77	0	—	185	7.2	A
Ai 22	Apr. 22, 1959	Pocono	—	—	20	—	.02	3.8	4.8	12	—	—	—	87	—	2.3	.3	.7	—	—	—	—	—	153	6.6	A

Bc 24	Nov. 14, 1957	Conemaugh	6.1	.0	.59	.05	.00	.58	60	15	3.3	3.9	.0	237	22	2	.2	.7	.0	237	211	17	—	408	7.6	A
Bc 68	Apr. 23, 1959	McKenzie	—	—	.75	—	.00	2.8	56	18	—	—	—	232	—	3.1	.2	2.5	—	—	—	—	—	398	7.5	A
Bc 69	May 1, 1958	Conemaugh	—	—	—	—	—	—	104	48	21		—	20	455	7.5	.0	1.8	—	—	457	440	—	—	6.7	A
Bd 1	—— —, 1946	Tonoloway limestone	8.0	—	1.4	—	—	—	82	20	8.3	2.9	—	259	58	12	.3	13	—	340	287	—	—	568	7.4	A
Bd 19	Aug. 13, 1957	Wills Creek shale	10.0	—	.05	.01	—	—	126	32	—	—	—	337	215	14	—	—	—	—	444	—	—	—	7.0	C
Bd 29	July 21, 1930	Rose Hill	—	—	3.2	—	—	—	—	—	—	—	—	—	105	35	—	—	—	—	154	—	—	—	7.9	D
Bd 29	Sept. 26, 1930	Tuscarora sandstone	—	—	1.4	—	—	—	—	—	—	—	—	—	115	23	—	—	—	—	182	—	—	—	7.6	D
Bd 29	Mar. 4, 1931	Juniata sandstone	—	—	4.0	.10	—	—	40	10	—	—	—	—	41	15	—	—	—	—	75	—	—	—	7.3	D
Bd 31	Nov. 14, 1957	Helderberg limestone	9.4	.1	.11	.00	.00	.00	143	41	13	4.6	.0	216	335	13	.6	6.2	.0	693	518	340	—	936	7.6	A
Bd 34	May 1, 1958	Tonoloway limestone	—	—	—	—	—	—	54	12	—	—	—	182	16	7.5	.3	4.6	—	—	184	35	—	365	8.1	A
Bd 35	May 1, 1958	Tuscarora sandstone	—	—	—	—	—	—	12	2.6	—	—	—	8	6	10	.0	.4	—	—	41	—	—	—	5.1	A
Bd 59	Nov. 14, 1957	do	6.6	.3	3.0	.02	.00	1.7	6.5	2.2	11	2.0	.0	52	3	3.8	.0	2.2	.0	74	25	0	—	150	6.8	A
Bd 70	Apr. 23, 1959	Romney shale	—	—	.00	—	.00	.07	60	5.4	—	—	—	174	—	2.9	.2	6.2	—	—	—	—	—	338	7.6	A
Be 16	May 2, 1958	Oriskany sandstone	—	—	—	—	—	—	15	1.1	8.4		—	44	4	10	.2	6.6	—	—	42	6	—	—	7.4	A
Be 31	Apr. 23, 1959	Jennings	—	—	.33	—	.00	.94	52	51	—	—	—	185	—	60	.5	11	—	—	—	—	—	934	7.1	A
Bf 1	May 9, 1957	Tonoloway limestone	7.4	.0	.02	.02	.00	.00	66	6.4	1.2	.4	.1	209	17	2.2	.2	7.5	.0	260	191	20	2.6	364	8.1	A
Bf 18	May 2, 1958	Helderberg limestone	5.8	.0	.12	.00	.00	.00	56	8.6	9.9		—	216	11	1	.1	4.9	.1	221	173	0	3.4	367	8.0	A
Bg 13	May 1, 1958	Jennings	10	.0	12	.25	.00	.00	28	20	10	2.1	.4	50	120	9	.0	.1	.1	243	152	111	2.5	377	7.5	A
Bi 2	May 2, 1958	do	—	—	—	—	—	—	48	13	16		—	102	8	45	.0	66	—	—	174	90	—	365	7.6	A
Bi 14	Oct. 15, 1958	Hampshire	—	—	.12	—	.08	.02	20	11	49		—	172	6	6	.2	2.9	—	—	50	0	—	261	8.7	A
Ca 8	May 10, 1957	Conemaugh	7.8	.0	.18	.12	.00	.00	75	7.4	9.3	2.0	.1	182	45	33	.1	.3	.0	305	218	68	7.3	463	7.6	A
Cb 1	Mar. 6, 1951	do	7.8	.0	.64	.03	—	—	34	7.4	3.4	2.8	—	141	8.8	1.1	.1	4.2	—	141	115	0	—	246	7.4	A
Cc 4	May 2, 1958	Romney shale	—	—	—	—	—	—	35	12	40		—	172	48	22	.0	1	—	—	137	0	—	348	7.9	A
Cc 18	Apr. 23, 1959	Rose Hill	—	—	2.1	—	.00	3.1	35	11	—	—	—	173	—	0	.3	1.6	—	—	—	—	—	271	7.3	A
Ce 1	May 1, 1958	Oriskany sandstone	6.5	.1	.96	.02	.00	.00	46	6.0	2.1	2.2	.4	129	21	5.5	.0	16	.4	186	139	34	10	304	7.3	A
Ce 4	May 1, 1958	do	9.6	.0	.02	.00	.00	.00	34	2.2	1.8		—	107	8.7	.7	.0	.1	.5	115	74	6	2.7	190	7.8	A
Ce 13	May 1, 1958	Jennings	—	—	—	—	—	—	40	19	18		—	210	12	22	.3	1.1	—	—	178	6	—	389	8.3	A
Cf 43	Apr. 23, 1950	Romney shale	—	—	.79	—	.00	.82	34	32	—	—	—	252	—	9.3	.3	.6	—	—	—	—	—	541	7.3	A
Cf 44	Nov. 14, 1957	do	17	.1	1.5	.05	.00	1.0	48	26	17	2.2	.0	231	73	2	.2	.1	.0	295	227	38	—	489	7.7	A
Cf 52	Nov. 14, 1957	Oriskany sandstone	10	.0	.00	.03	.00	.04	36	2.0	3.9	1.4	.0	108	16	1.7	.0	.3	.3	128	98	10	—	213	7.5	A
Cg 31	July 29, 1959	Hampshire	18	.0	.01	.01	.00	.32	3	2.8	3.3		—	22	.2	5.7	.1	.1	.1	48	19	0	18	564	6.3	A
Da 7	Oct. 26, 1945	Pocono	68	12.4	2.9	—	1.7	—	697	176	—	—	—	—	70	9,550	—	—	—	—	2,460	—	—	—	7.0	E
Db 5	May 1, 1958	Romney shale	13	.0	6.5	.00	.00	.00	30	11	7.0	8.0	—	39	67	14	.2	29	0	238	120	88	4.9	345	7.1	A

TABLE 39

Chemical Analyses of Water from Wells and Springs in Washington County

(Results in parts per million except specific conductance and pH)

[Analyst: A, U. S. Geological Survey; B, Penniman and Browne, Inc.]

Spring or Well Wa-	Date of collection	Water-bearing formation	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Copper (Cu)	Zinc (Zn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Lithium (Li)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Phosphate (PO_4)	Dissolved solids	Hardness as $CaCO_3$		Carbon dioxide (CO_2)	Specific conductance (micromhos at 25°C)	pH	Analyst
																					Total	Noncarbonate				
Ab 5	Oct. 16, 1958	Hampshire	—	—	0.00	—	0.00	4.4	18	11	13		—	133	7.4	0.6	0.1	7.8	—	—	90	0	—	225	7.0	A
Ab 32	Oct. 16, 1958	do	—	—	.00	—	.01	.30	1.7	2.2	11		—	20	5.4	1.4	.1	18	—	—	13	0	—	40	7.0	A
Ac 2	Oct. 16, 1958	Oriskany sandstone	—	—	.02	—	.01	.29	77	29	51		—	393	28	7	.1	78	—	—	312	0	—	733	7.4	A
Ad 3	Nov. 28, 1955	Jennings	19.0	0.20	4.30	0.41	.00	1.8	13	9.4	7.2	.04	0.2	106	.4	4.2	.1	.0	0.0	113	76	0	—	177	6.8	A
Ae 15	Oct. 16, 1958	do	—	—	.72	—	.00	.07	22	11	17		—	158	4.6	2	.3	.3	—	—	101	0	—	261	8.0	A
Af 12	Apr. 24, 1959	Martinsburg shale	17	.1	1.8	.06	.03	.10	38	15	9.0	1.5	.0	101	46	22	.4	9.4	3.4	186	156	105	10	360	7.2	A
Ag 2	Apr. 24, 1959	Stonehenge limestone	8.0	.1	.00	.00	.00	.00	46	7.6	1.6	1.2	.0	149	10	3.1	.4	10	3.1	257	146	24	5.9	278	7.6	A
Ah 8	Mar. 19, 1958	Martinsburg shale	—	—	.00	—	—	—	4	2.7	12		—	14	12	7.5	—	17	—	—	21	0	22	117	6.0	A
Ai 1	Mar. 7, 1951	Rockdale Run	9.2	.1	.04	.01	—	—	91	5.1	3.4	3.7	—	241	36	5.9	.1	22	—	304	248	50	—	501	7.7	A
Ai 4	Mar. 19, 1958	Conococheague limestone	9.6	.0	.03	.02	.00	.45	114	11	2		—	332	28	8.3	.2	2	.1	336	310	38	5.3	473	8.0	A
Ai 19	Sept. 17, 1958	Rockdale Run	—	—	.07	—	.00	10	103	6.5	51		—	410	13	17	.2	44	—	—	283	0	—	815	7.0	A
Ai 20	Oct. 15, 1958	Conococheague limestone	—	—	.00	—	.00	.53	51	34	30		—	311	18	9.4	.2	56	—	—	266	11	—	598	7.9	A
Aj 2	Mar. 12, 1958	do	—	—	.00	—	—	—	95	25	5		—	312	60	8.2	—	26	—	—	340	—	16	620	7.5	A
Ak 6	Jan. 5, 1960	Catoctin metabasalt	4.8	.0	.19	.00	.00	.19	49	.7	1		—	5	5	2.4	.1	6.8	.2	33	15	11	20	37	5.2	A
Ak 7	Jan. 5, 1960	do	5.1	.1	.07	.00	.00	.06	33	.9	—	—	—	2	7	2.4	.1	.5	.2	30	12	10	23	35	6.6	A
Ak 8	Jan. 5, 1960	do	22	.0	.89	.00	.00	.14	66	1.2	11		—	47	1	3.4	.1	.2	.2	72	21	0	19	86	6.6	A
Al 1	June 11, 1958	Wererton quartzite	—	—	.09	—	.20	3.7	4.3	1.3	4		—	14	8.2	7	.2	.7	—	—	16	1	—	71	6.8	A
Al 7	Jan. 5, 1960	Catoctin metabasalt	25	.0	.89	.00	.00	.00	21	7.9	30		—	167	5	4.9	.1	1.4	.8	181	85	0	67	284	6.6	A
Al 8	Jan. 5, 1960	do	22	.0	.60	.00	.00	.00	12	1.8	18		—	78	4.2	4.9	.1	.7	.3	108	37	0	39	151	6.5	A
Al 9	Jan. 5, 1960	do	37	.0	.37	.00	.00	.00	12	2.3	5		—	58	.6	1	.1	.0	.0	94	39	0	12	98	6.9	A
Al 10	Jan. 5, 1960	do	34	.0	.11	.00	.00	.00	9.9	7.2	1		—	58	2.8	4.9	.1	.2	1.6	96	54	7	12	100	6.9	A

Al 11	Jan. 5, 1960	do	25	.0	.30	.00	.00	.00	8.7	3.6	16		—	55	11	7.4	.2	3.7	3.0	112	37	0	17	141	6.7	A
Al 12	Jan. 5, 1960	do	.22	.0	.60	.00	.00	.00	12	2.2	21		—	57	10	14	.1	9.7	.5	124	39	0	18	183	6.7	A
Bb 2	Mar. 18, 1958	Jennings	—	—	.00	—	—	—	4.3	7	21		—	210	4	2.8	—	1.5	—	—	136	—	6.7	334	7.7	A
Be 3	Mar. 7, 1951	Romney shale	19.0	2.4	.03	.10	—	—	6.4	5.1	7.3	1.0	—	77	4	1.2	.2	.2	—	—	—	—	—	126	7.0	A
Be 5	Mar. 19, 1958	do	—	—	.13	—	—	—	40	3.7	13		—	141	21	3.5	—	.5	—	—	115	—	1.8	271	8.1	A
Be 24	Oct. 15, 1958	do	—	—	.79	—	.00	.21	11	1.4	7		—	16	30	2	.1	.1	—	—	32	19	—	110	6.1	A
Be 29	Oct. 16, 1958	Oriskany sandstone	—	—	.68	—	.00	.28	18	6.1	16		—	110	1	6	.1	4.8	—	—	69	0	—	198	7.6	A
Bf 2	Feb. 21, 1957	do	5.2	.0	.10	.00	.00	.00	36	2.4	1.7	1.1	.0	120	1	1.3	.1	.8	.0	110	100	—	—	208	7.8	A
Bf 3	Oct. 15, 1958	Conococheague limestone	—	—	.00	—	.00	.00	42	14.0	14		—	188	8.6	3	.2	30	—	—	161	7	—	347	8.1	A
Bf 5	Mar. 18, 1958	Wills Creek shale	—	—	.07	—	—	—	64	2.8	9		—	180	15	8.1	—	19	—	—	171	—	11	366	7.4	A
Bg 1	Mar. 19, 1958	Martinsburg shale	—	—	.00	—	—	—	46	16	21		—	155	51	23	—	16	—	—	180	—	2.0	442	8.1	A
Bg 2	Mar. 19, 1958	do	—	—	.00	—	—	—	37	6.4	9		—	90	40	4.3	—	21	—	—	119	—	9.0	271	7.2	A
Bg 14	Apr. 24, 1959	Conococheague limestone	10	.1	.03	.00	.03	1.2	62	6.0	3.2	2.0	.0	166	22	5.5	.6	16	4.4	231	179	33	2.6	357	8.0	A
Bh 17	Oct. 15, 1958	Rockdale Run	—	—	.00	—	.00	.24	94	7.7	26		—	304	35	11	.0	29	—	—	267	18	—	596	7.9	A
Bh 19	Oct. 15, 1958	do	—	—	.01	—	.00	.45	218	45	19		—	76	679	.0	.1	2.6	—	—	730	667	—	1380	7.5	A
Bi 16	Mar. 7, 1957	Stonehenge limestone	16	3.6	.04	.07	—	—	145	3.2	4.4	1.4	—	436	29	5.6	.0	14	—	447	375	18	—	724	7.2	A
Bi 19	Mar. 19, 1958	Conococheague limestone	—	—	35	—	—	—	547	45	—	—	—	0	2560	42	—	.8	—	—	—	—	.0	3680	3.0	A
Bi 21	Mar 19, 1958	Stonehenge limestone	4.3	.1	.02	.03	.00	.05	.3	.3	34	.4	.3	41	33	6.8	.7	.7	.0	108	2	0	2.1	179	7.5	A
Bi 27	Oct. 14, 1958	do	—	—	.00	—	.00	.00	41	50	49		—	324	83	12	.2	57	—	—	308	42	—	659	7.4	A
Bj 1	Mar. 12, 1958	Waynesboro	—	—	.00	—	—	—	52	22	7		—	247	14	4.5	—	14	—	—	220	—	7.8	440	7.7	A
Bj 2	Mar. 19, 1958	Tomstown dolomite	—	—	.00	—	—	—	66	13	11		—	231	24	6.1	—	24	—	—	218	—	4.6	444	7.9	A
Bj 4	Oct. 8, 1958	Elbrook limestone	—	—	.01	—	.00	.85	37	22	12		—	233	4.8	3.6	.3	8.5	—	—	183	0	—	411	7.8	A
Bj 7	June 12, 1958	Tomstown dolomite	—	—	.00	—	.00	.08	35	15	17		—	213	.6	2	.1	9.8	—	—	149	0	—	332	7.6	A
Bk 3	Mar. 12, 1958	Harpers	7.8	.0	.12	.00	.00	.06	1.1	.5	2.0	.6	.0	7.8	.2	2.4	.0	.1	.0	18	5	.0	2.0	185	6.8	A
Bk 4	Mar. 12, 1958	do	—	—	.00	—	—	—	1.8	.1	10		—	20	7.8	1.5	—	.8	—	—	5	—	4.0	56	6.9	A
Bk 9	Aug. —, 1958	Tomstown dolomite	13	—	.04	—	—		—	—	16	2.7	—	—	10	5	—	.66	—	200	159	11	1.8	—	7.9	B
Bk 11	Oct. 8, 1958	Harpers	—	—	.02	—	.00	5.4	17	.9	6		—	53	15	.6	.3	.2	—	—	46	3	—	130	7.7	A
Cg 3	Apr. 24, 1959	Martinsburg shale	13	.2	.00	.00	.03	3.7	81	7.8	4.4	.5	.0	261	14	4.4	.8	11	3.7	239	234	20	13	444	7.5	A
Ch 2	Oct. 15, 1958	Conococheague limestone	—	—	.00	—	.00	.30	23	59	3		—	291	23	14	.2	31	—	—	299	61	—	575	7.5	A
Ch 7	Apr. 24, 1959	Rockdale Run	11	.1	.00	.00	.00	.00	98	8.6	3.8	2.0	.0	285	25	11	.5	19	4.1	319	280	50	7.2	542	7.8	A
Ch 9	Oct. 15, 1958	do	—	—	.00	—	.00	.25	22	53	21		—	272	19	4.6	.2	87	—	—	102	0	—	499	8.2	A
Ci 12	Sept. 9, 1958	Tomstown dolomite	—	—	.01	—	.00	5.0	56	40	78		—	540	17	4	.2	17	—	—	303	0	—	582	7.7	A
Ci 16	Sept. 9, 1958	Conococheague limestone	—	—	.02	—	.00	.53	44	28	16		—	268	8.4	2.8	.2	34	—	—	224	4.6	—	452	7.5	A
Ci 21	Jan. 4, 1960	do	12	.0	.02	.00	.00	.14	61	2.8	28		—	230	9	7.8	.2	18	.0	264	164	0	9.2	433	7.6	A
Ci 33	Sept. 30, 1954	do	7.5	—	1.8	—	—	—	48	6.8	7		—	137	20	11	.2	19	—	201	148	36	—	310	7.4	A

TABLE 39 (*Continued*)

Spring or Well Wa-	Date of collection	Water-bearing formation	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Copper (Cu)	Zinc (Zn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Lithium (Li)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Phosphate (PO_4)	Dissolved solids	Hardness as $CaCO_3$		Carbon dioxide (CO_2)	Specific conductance (micromhos at 25°C)	pH	Analyst
																					Total	Noncarbonate				
Cj 8	Oct. 8, 1958	Tomstown dolomite	—	—	.00	—	.00	.47	67	24	13		—	289	7.4	14	.5	35	—	—	265	28	—	490	7.4	A
Cj 15	July 11, 1958	Antietam quartzite	—	—	.02	—	.00	.05	41	12	11		—	180	3.4	4	.1	24	—	—	152	4	—	311	7.9	A
Cj 16	July 11, 1958	Quaternary	—	—	.01	—	.00	.02	25	9.9	10		—	147	1	1.2	.1	2.0	—	—	103	0	—	233	8.2	A
Cj 17	Oct. 8, 1958	Antietam quartzite	14	.10	.18	.00	.00	.26	53	34	3.3	1.7	.0	291	27	7.5	.4	7.5	.0	282	268	30	7.3	501	7.8	A
Cj 18	June 12, 1958	Quaternary	—	—	.11	—	.08	.66	9.4	.7	2		—	37	.6	.0	.1	.6	—	—	26	0	—	69	6.6	A
Cj 21	Sept. 9, 1958	Tomstown dolomite	—	—	.01	—	.07	.60	36	28	16		—	215	5.6	2.2	.4	67	—	—	204	28	—	389	8.0	A
Dh 11	Oct. 1, 1958	Conococheague limestone	—	—	.01	—	.00	.31	.9	2.4	189		—	366	114	2.4	1.0	.1	—	—	13	0	—	929	7.3	A
Di 5	Oct. 8, 1958	Catoctin metabasalt	—	—	.00	—	.01	3.8	51	7.9	6		—	172	25	3	.1	8.5	—	—	159	18	—	352	7.3	A
Di 10	Sept. 9, 1958	Tomstown dolomite	—	—	.02	—	.00	13	22	7.6	45		—	53	8.2	28	.1	14	—	—	87	43	—	407	6.8	A
Di 11	Oct. 18, 1958	Waynesboro	—	—	.00	—	.00	.22	4.7	1.6	5		—	11	4.4	5	.0	12	—	—	18	9	—	63	5.9	A
Ei 1	Nov. 28, 1955	do	20	.5	1.3	.00	.00	.83	91	34	3.9	1.4	2.9	389	72	3.3	.2	.8	.0	464	372	52	—	704	7.3	A
Ei 2	Oct. 1, 1958	Harpers	—	—	.02	—	.00	1.2	28	7.2	4		—	123	3.4	2.6	.3	.8	—	—	99	0	—	233	7.0	A
Ei 5	Oct. 1, 1958	do	—	—	.19	—	.00	.74	35	8.7	6		—	145	14	3.0	.1	.1	—	—	123	.5	—	274	7.4	A

supplies requiring only a few hundred gallons a day or small industrial or public supplies requiring only a few hundred thousand gallons a day. In some localities only small ground-water supplies, sufficient for domestic or farm use, are available.

The chemical quality of the water is variable but is generally suitable for most purposes. Ground water from the limestone commonly has a hardness in excess of 60 ppm. Some of the aquifers in the Georges Creek basin yield water that is excessively high in iron content or has a pH of less than 6.0. Water with these deficiencies may require treatment.

TABLE

Records of Wells

Water level: Measured water levels designated by "m".
Pumping equipment: A, airlift; B, bucket; C, cylinder (piston and pitcher types); I, impeller (centrifugal); J, jet; N, none; S,
Use of water: C, commercial; D, domestic; F, farm; I, industrial; Ir, irrigation; N, not used; O, observation; P, public supply,

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Ab 1	—	U. S. Bureau of Mines	Pennsylvania Drilling Co.	1946	2,415	Drilled	1,030	2 1/8	Conemaugh
Ab 2	3432	Harry Carey	Irwin	1948	2,300	do	60	6	do
Ac 1	—	Joseph M. Brailer	—	1854	1,430	Dug	41.5	36	do
Ac 2	—	H. Turley	Ford	1932	1,440	Drilled	108	8	do
Ac 3	—	Do	—	—	1,440	Dug	40	—	do
Ac 4	—	F. Snyder	Carpenter	1944	1,430	Drilled	57	6	do
Ac 5	—	Truile	Irwin	1928	1,420	do	47	6	do
Ac 6	1660	Mt. Savage Water Works	Carpenter	1946	1,370	do	98	8	do
Ac 7	4974	Board of Education	do	1949	1,450	do	200	8	do
Ac 8	—	I. Snyder	—	—	1,435	Dug	20	36 1/2	do
Ac 9	—	Elwood Harden	Carpenter	1956	1,480	do	30	5 5/8	do
Ac 10	—	U. S. Bureau of Mines	Pennsylvania Drilling Co.	1946	1,390	Drilled	878	2 1/8	do
Ac 11	—	Do	do	1946	1,700	do	885	2 1/8	do
Ac 12	6579	Robert C. Harden	Carpenter	1950	1,490	do	38	5 5/8	do
Ac 13	3019	John Harden	Ford	1948	1,670	do	107	5 5/8	do
Ac 14	—	Herbert Lennox	Carpenter	1956	1,585	do	30	6	do
Ac 15	11048	Board of Education	do	1952	1,450	do	369	8 1/4	do
Ac 16	21262	Do	do	1955	1,450	do	500	8	do
Ac 20	—	Mt. Savage Water Works	Ford	1956	1,530	do	240	6	do
Ac 21	—	Arthur Blank	Carpenter	1948	1,600	do	50.4	6	do
Ac 22	—	U. S. Bureau of Mines	Pennsylvania Drilling Co.	1945	1,405	do	980	2 1/8	do
Ac 23	8369	Nick Via	Carpenter	1951	1,490	do	39	5 5/8	do
Ac 24	1954	Frank D'Amico	Krey	1947	1,450	do	40	4	do
Ac 25	20474	Mary Lemmert	Ford	1956	1,380	do	74	6	do
Ac 26	16554	Mt. Savage Refractories	do	1955	1,240	do	100	5 5/8	do
Ac 27	16553	Do	do	1955	1,230	do	99	5 5/8	do
Ac 28		Ribbon Copies Corp. of America	—	old	1,200	do	213	8	do
Ac 29	14077	John Geary	Ford	1954	1,440	do	54	5 5/8	do
Ac 30	—	Edward Weimar	—	old	1,640	Dug	12.9	36	do
Ac 33	—	Mt. Savage Water Works	—	old	1,580	Drilled	210	8	do
Ac 35	—	Martha Brailer	—	old	1,990	Dug	25.1	36	do

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in Allegany County

submersible; T, turbine; W, windmill

camp. and institutions; S, school; T, test well

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
—	—	—	—	—	2.6	5/15/47	—	T,N		Georges Creek hole 21. Drilled to Mauch Chunk Shale. Flowed at depths of 92–94 ft. and 490–512 ft. Flowed until May 1950. See chemical analysis.
4.12^{m}		3/22/57	J	22	3	1/20/48	—	D		Field test: iron 0.1 ppm, hardness 68 ppm, pH 6.5.
	25	1/20/48								
26.34^{m}	—	4/18/57	B	—	—	—	—	D		Reported never dry
35.88^{m}		1/5/50								
—	—	—	C	—	—	—	—	D		Water reported "irony". Field test: iron 0.6 ppm, hardness 85 ppm, pH 7.
12.30^{m}	—	1/5/50	C	—	—	—	—	D		Field test: iron 0.6 ppm, hardness 85 ppm, pH 7.
39.60^{m}	—	1/5/50	J	—	—	—	—	D		Well destroyed since 1950.
28.46^{m}	—	1/5/50	N	26	—	—	—	N		
19.13^{m}	—	4/17/57								
30	—	4/18/57	C	38	30+	11/47	—	P		
44	64	12/15/49	N	86	52	12/15/49	2.6	S		Yield reported 52 gpm for 24 hours with 20 ft. draw down. See chemical analysis. Well abandoned.
13.97^{m}	—	4/17/57	N	—	—	—	—	N		Reported dry May, 1950.
7	—	6/56	N	22	7	6/56	—	C		
—	—	—	N	—	—	—	—	C		Georges Creek hole 19. Drilled into Allegheny and Pottsville formations.
—	—	—	N	—	—	—	—	T		Georges Creek hole 25. Drilled into Allegheny and Pottsville formations.
23.19^{m}	—	3/18/57	J	32	10	8/8/50	—	D,C		
32	—	11/16/48	—	23.5	1.5	11/16/48	—	D		
5.67^{m}	—	3/22/57	J	—	—	—	—	D		Field test: iron 5 ppm, hardness 222 ppm, pH 6.8–7.0.
18	—	10/52	S	45	18	5/52	—	S		Field test of AC 15 and 16: iron 3 ppm, hardness 425 ppm, pH 7.0.
160	290	12/1/55	S	45	12	12/1/55	.09	S		Water reported to have sulfurous odor. See well log.
—	—	—	S	—	—	—	—	P		
19.12^{m}	—	4/17/57	J	—	—	—	—	D		See chemical analysis
—	—	—	N	—	—	—	—	N		Georges Creek hole 20. Drilled to Mauch Chunk shale.
8	16	7/31/51	J	11	—	—	—	D		
10	30	10/11/47	J	15	0.85	10/11/47	—	D		
29.76^{m}	—	4/18/57	J	36	—	—	—	D		See chemical analysis
40	48	7/11/55	C	21	25	7/11/55	3	C		Field test: iron 0 ppm, hardness 257 ppm, pH 7.
23	—	7/5/55	C	43.5	25	7/5/55	—	C		
16.20^{m}	—	4/18/57	S	—	—	—	—	C,I		Also supplies nearby glass factory
19.50^{m}	—	4/18/57	C	18.5	20	1/14/54	—	D		
7.80^{m}	—	4/18/57	C	—	—	—	—	F		Reported to be contaminated by nearby silo.
30	—	4/17/57	C	80	8.5	4/17/57	—	P		Used only in summer.
8.58^{m}	—	4/18/57	C	—	—	—	—	N		

TABLE 40

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Ac 37	—	John Loar	—	old	1,620	Dug	19.2	36	Conemaugh
Ac 39	—	John Burkett	—	old	1,470	do	11.4	36	do
Ac 40	—	George Adams	Ford	1940	1,410	Drilled	42	6	do
Ac 41	—	Wallace Borr	—	old	1,390	Dug	13.3	36	do
Ac 42	—	Mt. Savage Water Works	—	—	1,460	Drilled	210	8	do
Ac 43	—	Duffy Walomac	—	old	1,210	do	125	—	do
Ac 44	16501	Barrellville Water Co.	Ford	1954	1,130	do	130	6	do
Ac 45	13940	E. H. Holt	Johnson	1953	1,010	do	32	5⅝	Allegheny-Pottsville
Ac 46	10400	Harry Simpson	Irwin	1952	1,500	do	62	5⅝	Conemaugh
Ac 47	16554	Mt. Savage Refractories	Ford	1955	1,220	do	100	5⅝	do
Ac 48	—	C. E. Winebrenner	—	—	1,110	Dug	15.3	36	do
Ac 49	—	Earle Boor	Ford	1949	1,025	Drilled	75	6	do
Ac 50	—	James Thompson	do	1956	1,125	do	107	6	do
Ac 51	—	Percy Samson	—	—	1,150	do	22.4	6	do
Ac 52	—	Hazel Shine	—	1946	1,200	do	40	6	do
Ac 53	27485	Mt. Savage Water Co.	Ford	1956	1,420	do	154	6	do
Ad 1	13088	Victor C. Berg	Johnson	1953	970	do	107	5⅝	McKenzie
Ad 2	—	Mullanax	Carpenter	1956	980	do	70	5⅝	do
Ad 3	13241	Dewey Wilfong	Johnson	1953	950	do	49	5⅝	Rose Hill
Ad 4	4087	Wm. J. Jewell	Carpenter	1949	650	do	118	6	Tonoloway limestone
Ad 5	—	Paul C. Jewell	do	1957	660	do	116.5	5⅝	do
Ad 6	13422	Donald R. Davis	Johnson	1953	940	do	60	5⅝	Rose Hill
Ad 7	23599	Wendell Hott	do	1956	880	do	40	5⅝	do
Ad 8	—	Robert Timbrook	—	—	895	do	44.3	5⅝	do
Ad 9	—	Walter Johnson	—	—	890	do	42	5⅝	do
Ad 10	6553	John Datri	Johnson	1950	820	do	66	5⅝	Wills Creek shale
Ad 11	—	Dale Landis	Carpenter	1956	760	do	43	5⅝	Romney shale
Ad 12	12235	Board of Education	do	1953	790	do	114	8	do
Ad 13	24344	Earl Betts	Ford	1956	740	do	99	5⅝	do
Ad 14	21830	James M. Bridger	Irwin	1956	1,020	do	55	5⅝	do
Ad 15	—	Do	—	—	1,020	Dug	10.5	36	do
Ad 16	—	Paul F. Sell	Ford	1951	880	Drilled	40.6	6	Mauch Chunk shale
Ad 17	—	Earl Waggoner	—	—	980	Dug	13.4	36	Hampshire
Ad 18	11430	Howard Carpenter	Carpenter	1953	810	Drilled	65	5⅝	Romney shale
Ad 19	14305	John Helmstetter	Johnson	1954	1,010	do	78	5⅝	do
Ad 20	—	Paul Sanders	Carpenter	1952	980	do	63	5⅝	do
Ad 21	22173	George L. Keidel	Irwin	1956	1,010	do	57	5⅝	do
Ad 22	25660	Kenneth W. Wisenburg	do	1956	980	do	60	6	do
Ad 23	13016	Wm. A. Cook	Johnson	1953	1,000	do	60	5⅝	do
Ad 24	—	John Poorbaugh	—	1910	810	do	68	6	do
Ad 25	7530	William Barrs	Ford	1951	810	do	78	6	do
Ad 26	7474	Robert A. Conners	do	1951	880	do	45	5⅝	Pocono

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
11.97[m]	—	4/18/57	C	—	—	—	—	D		
7.66[m]	—	4/18/57	B	—	—	—	—	D		
—	—	—	J	37	—	—	—	D		Field test: iron 0.2 ppm, hardness 171 ppm, pH 7.5.
7.17[m]	—	4/18/57	N	—	—	—	—	N		
—	—	—	S	—	5	4/18/57	—	P		
—	—	—	T	—	6.5	—	—	P		Supplies about 25 families. See chemical analysis.
32	—	11/26/54	S	—	30	11/26/54	—	P		Supplies 35 families.
15	—	12/9/53	J	16	4	12/9/53	—	N		Field test: iron 5 ppm, hardness 428 ppm, pH 7.5.
11.62[m]	—	5/15/57	J	41	2	1952	—	D		Field test: iron 0.1 ppm, hardness 68 ppm, pH 7.
40	—	7/55	J	21	—	—	—	I		Field test: iron <0.1 ppm, hardness 102 ppm, pH 6.5.
10.36[m]	—	4/26/57	C	—	—	—	—	D		
—	—	—	J	—	—	—	—	D		Field test: iron <0.1 ppm, hardness 188 ppm, pH 7.5.
48.23[m]	—	4/26/57	J	—	—	—	—	D		See chemical analysis.
3.27[m]	—	4/26/57	C	—	—	—	—	D		
—	—	—	C	—	—	—	—	D,C		See chemical analysis.
52	—	7/57	—	132	27	7/57	—	P		
58.5	—	8/53	C	16	1	8/53	—	D	56	
—	—	—	C	—	—	—	—	D		
4	—	9/53	J	18.5	15	9/53	—	D	56	See chemical analysis.
60	—	6/49	J	43	6	6/49	—	D		
77	—	2/57	J	—	12	2/57	—	D		
20	—	9/53	—	15	8	9/53	—	D		
3	—	6/56	C	11	10	6/56	—	D		
15.85[m]	—	4/25/57	C	—	—	—	—	D		
2.95[m]	—	4/25/57	J	—	—	—	—	D		
26	61	10/50	J	29.5	2	10/50	.06	D		
14	30	11/56	J	—	7	11/56	.4	D		
36	80	5/53	C	48	7	5/53	.1	S		
35.16[m]	—	4/25/57	J	22	20	9/56	—	D		Field test: iron 0.1 ppm, hardness 68 ppm, pH 7.
24	31	1/56	J	28	5	1/56	.7	D		
3.98[m]	—	4/25/57	N	—	—	—	—	N		
5.89[m]	—	4/26/57	C	—	—	—	—	D		Field test: iron < 0.1 ppm, hardness 34 ppm, pH 8.5.
11.03[m]	—	4/26/57	C	—	—	—	—	D		
41	59	1/53	J	19	4	1/53	.2	D		
19	—	2/54	S	25.5	5	2/54	—	D		
12	45	11/52	—	—	4.5	11/52	.1	D		
17	32	3/56	S	31	10	3/56	.7	D		
22	37	1/56	J	34	3	1/56	.2	D		
29	—	8/53	—	29	5	8/53	—	D		
44.07[m]	—	5/16/57	N	—	—	—	—	D		
28	40	4/51	J	32	3.3	4/51	.3	N		Field test: iron 8 ppm, hardness 255 ppm, pH 6.
28	30	3/51	J	31	6	3/51	3	D		

TABLE 40

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Ad 27	—	Robert Price	Ford	1952	780	Drilled	230	5⅝	Jennings
Ad 28	—	Mrs. Miller	do	1947	810	do	62	6	Romney shale
Ad 29	—	Do	—	—	830	Dug	22.6	48	do
Ad 30	—	John Gilson	—	—	830	do	17.3	36	do
Ad 31	—	J. J. Helmstetter	Helmstetter	1910	940	do	24	48	do
Ad 32	—	Do	do	1925	925	do	23.8	72	do
Ad 34	—	Frank Wilgood	—	1925	780	Drilled	40	6	do
Ad 35	16381	Ralph C. Gardner	Carpenter	1954	740	do	51	6	do
Ad 36	13794	Carson Shaffer	Martin	1953	730	do	50	5⅝	do
Ad 37	22653	Henry L. Griffey	Ford	1956	810	do	85	5⅝	do
Ad 38	2470	Richard D. Nixon	do	1948	790	do	49	6	do
Ad 39	1036	Roy C. Clites	do	1946	740	do	78.5	5⅝	do
Ad 40	213	Josephine LaRue	do	1946	760	do	43	5⅝	do
Ad 41	—	Eugene Johnson	Carpenter	1951	735	do	66	5⅝	Wills Creek shale
Ad 42	25871	Benjamin Dorsey	Irwin	1957	740	do	73	6	do
Ad 43	—	H. E. DeVore	Ford	1955	725	do	68.35	5⅝	do
Ad 44	—	C. T. Albright	—	—	720	do	—	5⅝	do
Ad 45	—	Joseph Riley	—	—	—	do	110	6	do
Ae 1	15626	Harold Crawford	Johnson	1954	1,080	do	152	5⅝	Oriskany sandstone
Ae 2	15933	Randie Nee	do	1954	850	do	71	5⅝	Wills Creek shale
Ae 3	13148	Vernon C. Mummert	do	1953	1,000	do	96	5⅝	do
Ae 4	23366	Robert J. Hartman	do	1956	950	do	28.5	5⅝	do
Ae 5	9462	E. L. Warner	Carpenter	1952	685	do	36	5⅝	Romney shale
Ae 6	—	Do	Light	1940	685	do	35	6	do
Ae 7	9724	Raymond Minke	Carpenter	1952	760	do	56	5⅝	Tonoloway limestone
Ae 9	13371	J. W. Rankins	do	1953	830	do	90	5⅝	Romney shale
Ae 10	18524	J. B. Wentling	Johnson	1955	800	do	64.5	5⅝	do
Ae 11	—	Do	do	1957	800	do	38.6	5⅝	do
Ae 12	—	Do	do	1943	790	do	48.8	5⅝	do
Ae 13	—	Do	—	—	790	do	37.6	5⅝	do
Ae 14	—	Do	Johnson	1948	780	do	50	5⅝	do
Ae 15	14434	Arthur Bopp	Carpenter	1954	830	do	146	8	Oriskany sandstone
Ae 16	21602	Ernest B. Barnes	do	1956	860	do	234	5⅝	do
Ae 17	6264	W. J. Winfield	do	1950	1,030	do	260	5⅝	do
Ae 18	4298	F. N. Donahue	do	1949	1,065	do	219	5⅝	do
Ae 19	4368	F. Simon	do	1949	1,030	do	147	5⅝	do
Ae 20	19368	St. Peter & Pauls Church	do	1955	700	do	81	5⅝	Romney shale
Ae 21	9463	Ernest B. Barnes	do	1952	840	do	51	5⅝	Oriskany sandstone
Ae 22	25324	Robert Winfield	do	1956	1,070	do	104	5⅝	do
Ae 23	11915	Mt. Pleasant Church	Johnson	1953	910	do	115	5⅝	Romney shale
Ae 24	6525	Richard Grouden	do	1950	870	do	76	5⅝	do
Ae 25	5664	G. Broadwater	do	1950	760	do	61.2	5⅝	Tonoloway limestone
Ae 26	5698	Howard Perrin	do	1950	770	do	45.5	5⅝	do
Ae 27	6324	Floyd Wigfield	do	1950	780	do	50	5⅝	Wills Creek shale

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
—	—	—	J	—	—	—	—	D		
20	—	—	J	—	—	—	—	D		
16.35^{m}	—	5/16/57	N	—	—	—	—	N		Reported to go dry.
										Field test: iron 0.1 ppm, hardness 170 ppm, pH 6.5.
7.94^{m}	—	5/16/57	N	—	—	—	—	N		
9.32^{m}	—	5/16/57	N	—	—	—	—	N		
6.32^{m}	—	5/16/57	C	—	—	—	—	F		Field test: iron <0.1 ppm, hardness 137 ppm, pH 7.
12.14^{m}	—	5/16/57	C	—	—	—	—	D		Field test: iron 2.5 ppm, hardness 85 ppm, pH 6.
12	29	9/54	J	39	8	9/54	.4	D		Water reported hard.
15	—	11/53	—	33	1.5	11/53	—	D		
41	45	3/56	J	22	18	3/56	3.5	D		
22	—	10/48	J	43	6	10/48	—	D		
20	22	12/46	S	24	11	12/46	5.5	D		
5.55^{m}	—	6/5/57	J	25	5	2/46	.7	D		
15	22	2/46								
—	—	8/1/57	J	31	—	—	—	D		No water at 56 ft.
60	—	3/57	J	35	2	3/57	—	D		See chemical analysis.
47.60^{m}	—	8/1/57	J	—	—	—	—	D		
—	—	—	C	—	—	—	—	D		
40	—	5/58	C	—	—	—	—	N		Well reported contaminated.
—	—	4/24/57	J	65	4	7/54	—	D		No water at 68 ft.
45	—	7/54	J	11	3	7/54	—	D		
60	—	8/53	J	31	4	8/53	—	D		
.5	—	5/56	J	28.5	15	5/56	—	D		
6	10	2/52	S	16	8	2/52	2	C		
—	—	—	S	—	—	—	—	C		
30	36	4/52	J	9	10	4/52	1.7	D		Supplies 6 homes.
48	—	10/53	J	26	3	10/53	—	D		
23.37^{m}	—	6/12/57	J	22	5	4/55	—	D		
17.07^{m}	—	6/12/57	J	20	—	—	—	D		
12.78^{m}	—	6/12/57	C	—	—	—	—	F		
13.31^{m}	—	6/12/57	N	—	—	—	—	N		
—	—	—	J	22	—	—	—	D		
40	65	5/54	J	14	12	5/54	.5	C		
190	—	1/56	S	31	1	1/56	—	D		
57	—	8/50	C	42	1	8/50	—	D		
141	—	7/49	C	32	1.5	7/49	—	D		
60	—	8/49	C	38	6	8/49	—	D		Have cistern.
3	65	6/55	S	41	5	6/55	.1	P		See aquifer test.
30	—	2/52	N	14	2	2/52	—	N		
55	80	11/56	J	69	6	11/56	.2	D		Have spring and cistern.
60	—	5/53	C	40	1.5	5/53	—	P		
36	64	10/50	J	23	5	10/50	.2	D		
5.0^{m}		6/13/57	C	11.5	4	4/50	.8	C		
	55	4/50								
10	25	4/50	C	28.5	10	4/50	.6	D		Have cistern.
20	—	9/50	J	23.5	4	9/50	—	D		Water reported very hard.

TABLE 40

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Ae 28	5527	T. Luttrell	Johnson	1950	820	Drilled	104	5⅝	Wills Creek shale
Ae 29	—	Do	do	—	780	do	43.85	5⅝	do
Ae 30	5429	Leslie Wilson	do	1950	770	do	46	5⅝	do
Ae 31	15458	Walter W. Nazelrod	do	1954	940	do	86	5⅝	Tonoloway limestone
Ae 32	5697	Taylor Dicken	do	1950	940	do	96	5⅝	Wills Creek shale
Ae 33	—	Arthur J. Fitch	do	1931	700	do	45	5⅝	Romney shale
Af 1	11862	Robert Wills	Carpenter	1953	1,270	do	236	5⅝	Tonoloway limestone
Af 2	—	Do	Johnson	1950	1,270	do	80	6	do
Af 3	—	W. T. Mcluckie	Ford	1952	1,255	do	211	5⅝	do
Af 4	7904	Raymond May	Johnson	1951	1,460	do	82	5⅝	Helderberg limestone
Af 5	8248	Do	Ford	1951	1,460	do	83	5⅝	do
Af 6	26120	Hazel Bottomfield	Tressler	1957	1,070	do	123	5⅝	Rose Hill
Af 7	25949	William Mauzy	do	1957	1,220	do	142	5⅝	Wills Creek shale
Af. 8	25362	Hattie V. Wolford	do	1956	1,700	do	548	5⅝	Oriskany sandstone
Af 11	—	S. C. Twigg	—	—	1,290	do	—	5⅝	Tonoloway limestone
Af 12	—	M. I. Deremer	Johnson	1947	1,290	do	60	6	Wills Creek shale
Af 13	—	Robert J. Martin	Ford	1955	1,215	do	35	6	do
Af 14	—	C. L. Smith	Johnson	1946	1,220	do	48	6	Tonoloway limestone
Af 16	—	Rev. H. B. Kelchner	—	—	1,575	Dug	13.4	36	Oriskany sandstone
Af 17	—	B. D. Wallace	—	1954	1,720	Drilled	350	6	Helderberg limesstone
Af 19	—	Earl Stonestreet	—	—	1,210	do	110	6	Wills Creek shale
Af 20	—	Do	—	—	1,260	do	119.5	6	Tonoloway limestone
Af 22	—	E. H. Browning	—	—	850	do	35	6	Wills Creek shale
Ag 1	—	Methodist Church	—	—	800	Dug	11.1	36	Helderberg limestone
Ag 2	6039	Alfred Brown	Johnson	1950	760	Drilled	30	5⅝	Romney shale
Ag 3	2269	Board of Education	Carpenter	1948	800	do	287	8	Tonoloway limestone
Ag 4	27413	Ernest Mullenax	Tressler	1957	770	do	63.5	5⅝	Romney shale
Ag 5	27415	Josiah Mullenax	do	1957	830	do	—	5⅝	do
Ag 6	24882	J. E. Wagoner	do	1956	880	do	380	5⅝	do
Ag 7	8068	Mrs. H. H. Hebner	Johnson	1951	820	do	44.5	5⅝	Tonoloway limestone
Ag 8	15259	Lester Kolb	do	1954	860	do	70	5⅝	McKenzie
Ag 9	10041	H. K. Chaney	Carpenter	1952	840	do	35.8	5⅝	Wills Creek shale
Ag 10	10040	Russell Dolly	do	1952	820	do	34.1	5⅝	do
Ag 11	7004	Howard Willison	Johnson	1950	820	do	35	5⅝	do
Ag 12	3225	Blaine Burgess	Carpenter	1948	990	do	148	6	Tonoloway limestone

—Continued

Water level (feet below land surface) Static	Pumping	Date	Pumping equipment	Length of casing below land surface (feet)	Yield Gallons a minute	Yield Date	Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
43.35[m]		6/13/57	J	26	.3	3/50	—	D		Water reported hard. Have cistern.
	103	3/50								
19.65[m]	—	6/13/57	C	—	—	—	—	N		
17	—	3/50	—	19.5	3	3/50	—	D		
50	—	6/54	J	18.5	4	6/54	—	D		
85.6[m]	—	6/18/57	J	12	3	4/50	—	D		
48	—	4/19/50								
16.45[m]	—	6/19/57	—	—	—	—	—	D		Have dug well 18 ft. deep.
190	222	3/53	S	46	7	3/53	.2	C		
—	—	—	J	—	—	—	—	C		
161.8[m]	—	6/12/57	N	166	—	—	—	N		See table 30 for temperature.
—	—	—	N	—	—	—	—	N		Abandoned.
34	—	11/51	C	28	45	11/51	—	D		
45	—	3/57	J	22	6	3/57	—	D		
62	—	2/57	J	26	3	2/57	—	D		See chemical analysis.
—	—	—	—	—	—	—	—	D		Abandoned, "dry hole."
—	—	—	J	30	—	—	—	D		
—	—	—	J	—	—	—	—	D		
—	—	—	J	20	—	—	—	D		
—	—	—	C	48	—	—	—	D		
5.36[m]	—	8/21/57	J	—	—	—	—	D		Have dug well and cistern.
—	—	8/21/57	C	—	—	—	—	D		Have cistern. No water at 102.6 ft.
—	—	—	C	—	—	—	—	D		
31.87[m]	—	8/22/57	N	—	—	—	—	F		
—	—	—	C	—	—	—	—	D		
4.76[m]	—	10/2/46	C	—	—	—	—	P		
6	16	7/10/50	C	13	6	7/10/50	.6	D		See chemical analysis.
3	24	1/1/48	C	20	40	1/1/48	2	S		Do
10	—	6/57	J	10	4	6/57	—	D		
30	—	7/57	—	25	3.5	7/57	—	D		
Flowing	—	6/20/57								
12	—	10/56	J	26	12	10/56	—	D		
15	—	6/51	—	30	4	6/51	—	D		
36	—	5/54	J	23.5	5	5/54	—	C,D		Field test: iron 0.3 ppm, hardness 164 ppm, pH 7.
7.78[m]		6/26/57	J	22	8	5/52	.6	D		
	18	5/52								
3.81[m]		6/26/57	C	21	5	10/9/57				
	30	1952			10	1952	.6	C,D		See aquifer test.
8	—	11/50	C	9	3	11/50	—	D		
116.7[m]	—	6/28/57	J	18	10	11/48	—	D		

TABLE 40

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Ag 13	15312	Homer Teeter	Carpenter	1954	1,010	Drilled	180	$5\frac{5}{8}$	Tonoloway limestone
Ag 17	25712	James Barnes	do	1957	810	do	37	$5\frac{5}{8}$	Helderberg limestone
Ag 18	4473	Catherine Moore	Johnson	1949	810	do	43.5	6	do
Ag 19	21854	Grant Bible	do	1956	805	do	87	$5\frac{5}{8}$	Romney shale
Ag 20	24843	Russell Clites	Carpenter	1956	795	do	66	$5\frac{5}{8}$	do
Ag 21	3224	L. Hartsock	do	1948	910	do	109	6	Tonoloway limestone
Ag 22	3212	B. Shreve	do	1948	995	do	79	6	do
Ag 23	27435	Shafer	do	1957	855	do	98	$5\frac{5}{8}$	Wills Creek shale
Ag 24	27434	Do	do	1957	855	do	64	$5\frac{5}{8}$	do
Ag 25	27702	N. Wigfield	do	1957	820	do	31	$5\frac{5}{8}$	do
Ag 27	4037	Dwight R. Spencer	do	1949	1,240	do	110	6	Jennings
Ag 28	604	Ernest Poole	Johnson	1946	1,095	do	92	$5\frac{5}{8}$	do
Ag 29	13312	Do	do	1953	1,100	do	114	$5\frac{5}{8}$	do
Ag 30	4147	Dwight R. Spencer	do	1949	1,040	do	62	$5\frac{5}{8}$	do
Ag 31	24172	Joseph Weddle	do	1956	1,030	do	46	$5\frac{5}{8}$	do
Ag 33	3214	C. Borror	Carpenter	1948	1,035	do	102	6	Wills Creek shale
Ag 34	—	Julia Cole	—	1941	1,035	do	35	6	do
Ag 38	—	Russell Dolly	—	—	760	Dug	21	—	do
Ah 1	—	Dept. of Forest and Parks	Carpenter	1933	720	Drilled	113.4	8	Jennings
Ah 2	4702	J. Stokes	do	1949	1,080	do	114	$5\frac{5}{8}$	do
Ah 3	—	Dept. of Forest and Parks	—	1930	760	do	145	6	do
Ah 4	—	Game and Inland Fish Comm.	Carpenter	1950	1,080	do	185	6	Hampshire
Ah 5	—	Edward Walizer	—	1956	1,010	do	137	6	Jennings
Ah 6	8586	Paul H. Bennett	Johnson	1951	1,200	do	61	$5\frac{5}{8}$	do
Ah 7	2654	J. M. Shipways	Carpenter	1948	1,220	do	104	8	do
Ah 8	—	Do	—	—	1,210	do	116	6	do
Ah 9	—	Do	Johnson and Carpenter	—	1,200	do	96	6	do
Ah 10	24258	J. Stokes	Johnson	1956	1,080	do	101	$5\frac{5}{8}$	do
Ah 11	—	Lafayette Smith	Carpenter	1948	1,125	do	77	6	do
Ah 12	—	John Burnette	—	1940	1,205	do	107	6	do
Ah 13	17597	Thad Smith	Carpenter	1955	1,240	do	91	$5\frac{5}{8}$	do
Ah 14	—	H. M. Piper	—	—	960	do	38	6	do
Ah 15	—	L. T. Smith	—	—	1,190	do	64	6	do
Ah 17	—	George R. Eichelberger	—	—	1,110	do	68	6	do
Ah 18	10941	L. H. McCoy	Carpenter	1952	1,320	do	97	$5\frac{5}{8}$	do
Ah 19	28560	Herman Barnes	do	1957	1,290	do	29.7	$5\frac{5}{8}$	do
Ah 20	—	Paul Drummer	—	1952	780	do	110	6	do
Ah 21	—	Charles Fry	—	—	860	do	45	6	do
Ah 22	—	Oliver Davis	—	—	830	do	45	6	do
Ah 23	—	Harry Davis	—	—	745	do	30	6	do
Ah 24	—	Edward Blubaugh	—	1930	1,210	do	107	6	do
Ah 25	—	W. Price	—	—	1,025	do	65	6	do

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
120	—	6/54	J	59	1.3	6/54	—	D		
16	20	1/57	J	29	10	1/57	2.5	D		
5.63m		6/27/57	C	13	7	8/49	.4	D	58	
	25	8/49								
30	—	1/56	J	19	.2	1/56	—	D		Have dug well 21 ft. deep.
18	46	10/56	J	22	8	10/56	.3	D		
70	—	10/48	—	14	5	10/48	—	D		
—	—	6/27/57	J	32	2	10/48	—	D		No water at 53 ft.
17.80m	—	7/57	N	22	10	7/57	—	D		
18	—	7/57	N	26	20	7/57	—	D		
4.26m	—	7/57	N	15	20	7/57	—	D		See chemical analysis.
50	—	5/49	S	38	2	5/49	—	D		
60	—	7/46	S	—	1	7/46	—	D, C		
79.6m	—	9/12/57	J	9	2	9/53	—	D		
15	—	7/49	J	15	6	7/49	—	D		
3	—	8/56	J	10	15	8/56	—	D		
87.3m	—	9/19/57	C	28	6	10/48	—	N		
30.88m	—	9/19/57	C	—	—	—	—	D		Water reported irony.
—	—	—	I	—	—	—	—	D		
4.68m	—	12/1/49	C	—	12	9/26/57	—	P, O		See aquifer test. See table 30 for temperature. See chemical analysis.
56.10m	—	3/7/51								Well filled in to 85 ft. when drilled.
—	92	9/20/49	B	36	12	9/20/49	—	N		See chemical analysis.
—	—	—	C	—	—	—	—	D		
40	—	7/57	J	—	—	—	—	D		Reported never dry.
										Field test: iron 2 ppm, hardness 51 ppm, pH 6.5.
56.14m	—	7/57	N	—	—	—	—	D		
15	20	9/51	J	17.5	8	9/51	1.6	D		
30	64	5/48	S	14	25	5/48	.8	C		
40	—	7/57	J	—	—	—	—	C		
35.62m	—	7/57	C	—	—	—	—	C		
76	—	8/56	C	23	4	8/56	—	D		
41.43m	—	7/57								
52.04m	—	10/15/57	B	—	—	—	—	D		
35.62m	—	7/57	C	—	—	—	—	D		
30	70	2/55	J	14	6	2/56	—	D		
20	—	7/57	C	—	—	—	—	D		
35.17m	—	7/57	C	—	—	—	—	D		
20	—	9/57	J	—	—	—	—	D		
30	—	9/52	C	16	2	9/52	—	D		Water reported irony.
6	70	9/19/57	N	16	2.5	9/19/57	—	D		
5.36m	—	8/57	I	—	—	—	—	D, C		Reported never dry.
30	—	8/57	C	—	—	—	—	D		Supplies 2 homes. Water reported irony.
8.97m	—	9/57	J	—	—	—	—	D		
5	—	9/57	C	—	—	—	—	D		
40	—	9/57	C	—	—	—	—	D		
30	—	9/57	C	—	—	—	—	D		

TABLE 40

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Ab 26	—	John Rhodes	—	—	1,110	Drilled	32.4	6	Jennings
Ai 1	8214	County Roads Commission	Carpenter	1951	1,065	do	81	5⅝	do
Ai 2	—	Board of Education	—	1939	1,105	do	184	6	Hampshire
Ai 3	—	Elmer Joy	Johnson	1953	1,200	do	97	6	do
Ai 4	23268	Lewis Joy	Carpenter	1956	1,210	do	88	5⅝	do
Ai 5	—	Mrs. Robert Opdycke	—	—	1,075	do	86	6	do
Ai 6	—	Edward Mann	Dineen	1956	1,000	do	79	6	do
Ai 7	—	Stanley Creek	Johnson	1952	960	do	45	6	Jennings
Ai 10	6619	Game and Inland Fish Comm.	—	1950	950	do	180	5⅝	do
Ai 11	—	Howard Riscamore	—	—	1,190	do	57	6	do
Ai 12	—	John T. Smith	—	—	690	do	29	6	do
Ai 13	—	Do	—	—	690	do	32	6	do
Ai 14	23269	Archie Smith	Carpenter	1956	690	do	56	5⅝	do
Ai 15	10942	Mrs. Jane Fletcher	do	1952	705	do	32	5⅝	do
Ai 16	25189	Frank Price	Johnson	1956	750	do	40	5⅝	do
Ai 17	15439	James Price	do	1954	930	do	80	5⅝	do
Ai 18	16054	Erwin Price	do	1954	1,140	do	99	5⅝	Hampshire
Ai 19	—	William Rohrer	do	1953	1,035	do	73	6	Jennings
Ai 20	—	C. W. Coldren	—	1905	695	do	45.2	6	do
Ai 21	—	Walter White	—	1923	1,670	do	265	6	Pocono
Ai 22	—	Do	Ford	1954	1,630	do	119	6	do
Ai 23	—	Do	do	1954	1,630	do	117	6	do
Ai 24	—	Do	Dillon	1923	1,630	do	65	6	do
Ai 25	2019	Marvin Golden	Barnbart	1947	940	do	118	5⅝	Jennings
Aj 1	—	James Swain	—	1905	840	do	72	6	do
Aj 2	—	John Roby	—	—	690	do	36	6	do
Aj 3	—	C. T. Norris	—	—	675	do	44	6	do
Bb 1	—	National Refractories Co.	—	—	1,610	do	157	8	Conemaugh
Bb 2	—	U. S. Bureau of Mines	Pennsylvania Drilling Co.	1946	2,000	do	1,127	2½	do
Bb 3	—	Do	do	1946	2,165	do	1,081	2½	do
Bb 4	18665	Philip Krauss	Irwin	1950	1,950	do	50	5⅝	do
Bb 5	9492	Webster C. Ball	do	1952	1,970	do	73	5⅝	do
Bb 6	15804	Irvin Wampler	do	1952	1,975	do	52	5⅝	do
Bb 7	7051	Eugene Busb	do	1950	2,055	do	55	5⅝	do
Bb 8	6392	Clarence Gamer	Carpenter	1950	1,640	do	52	5⅝	do
Bb 9	2507	Forrest G. Webster	Ford	1948	1,890	do	40	5⅝	do
Bb 10	—	Gilbert Barnes	—	old	1,976	Dug	7.1	36	do
Bb 11	—	James Speer	—	old	2,000	do	7.0	36	do
Bb 13	—	R. N. Wilson	—	1905	1,980	Drilled	85	6	Monongahela
Bb 14	—	George Sagle	—	old	1,900	Dug	10	—	do
Bb 15	—	Calvin Miller	—	old	1,770	do	17	—	do
Bb 16	—	Robert Jenkins	Jenkins	1931	1,735	do	20	—	do

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
11.12^{m}	—	9/57	C	—	—	—	—	D		
8	68	8/51	J	24	3	8/51	.05	D		
32±	—	7/57	C	—	—	—	—	S		See chemical analysis.
—	—	—	C	—	—	—	—	D		
55	84	6/56	J	44	2.5	6/56	.1	D		
30.52^{m}	—	7/57	C	12	—	—	—	D		
30	—	7/57	J	—	—	—	—	D, F		
30.79^{m}	—	7/57	J	—	—	—	—	D		
60	85	9/50	J	30	10	9/50	.4	D, F		
26.45^{m}	—	7/57	B	—	—	—	—	D		
$.34^{m}$	—	9/57	C	—	—	—	—	N		
$.83^{m}$	—	9/57	C	—	—	—	—	D		
25	36	6/56	J	31	8	6/56	.7	D		
6	18	9/52	C	14	6	9/52	.5	D		
33	—	11/56	J	17	8	11/56	—	D		
50	—	6/54	C	17	6	6/54	—	D		
49	—	10/54	C	10	4	10/54	—	D, F		
9.17^{m}	—	9/57	J	—	—	—	—	D		
8.70^{m}	—	9/57	J	—	—	—	—	D, C		
—	—	—	C	—	—	—	—	D, C		Water reported irony.
—	—	—	J	—	—	—	—	C		See chemical analysis.
—	—	—	J	—	—	—	—	C		Water reported irony.
—	—	—	C	—	—	—	—	C		Do
40	—	12/47	—	—	—	—	—	D		
17.46^{m}	—	7/18/57	C	—	—	—	—	D		
4.62^{m}	—	9/16/57	J	—	—	—	—	D, C		
10	—	9/16/57	C	—	—	—	—	D		
—	—	—	T	—	60	—	—	I		Water reported very irony.
—	—	—	—	—	See Remarks	—	—	T		Georges Creek hole 5. Flowed 25 gpm at 220 ft. and 150 gpm at 305 ft. Drilled to Mauch Chunk shale.
—	—	—	—	—	See Remarks	—	—	T		Georges Creek hole 10. Water at 513 ft. Drilled into Allegheny and Pottsville formations.
25	30	4/19/55	J	—	10	4/19/55	2	D		Field test: iron 0.3 ppm, hardness 154 ppm, pH 7.5.
Flowed	—	3/15/52	J	—	1.5	3/15/52	—	D		
Flowed	—	3/21/52	J	21	33	3/7/54	—	D		
27	35	11/25/50	J	10	10	11/25/50	1.2	D		
27.16^{m}	—	3/22/57	J	31	3	8/8/50	—	D		
21	28	4/27/48	J	11.5	7	4/27/48	1	D		Field test: iron 0.2 ppm, hardness 171 ppm, pH 7.5.
1.97^{m}	—	3/27/57	N	—	—	—	—	D		Field test: iron 0 ppm, hardness 68 ppm, pH 4.
2.21^{m}	—	3/27/57	N	—	—	—	—	N		
15	—	1940	N	—	—	—	—	N		
1	—	1950	N	—	—	—	—	N		
4	—	3/27/57	I	—	—	—	—	D		Field test: iron 0.1 ppm, hardness 171 ppm, pH 6.
5	—	1937	N	—	—	—	—	N		

TABLE 40

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Bb 18	—	Earl Ritchey	—	1908	2,090	Dug	27.3	36	Conemaugh
Bb 19	—	Harry Stevenson	Ritchey	old	1,775	do	25.6	36	do
Bb 20	—	Mr. Blubaugh	—	old	1,750	do	21.5	36	do
Bb 23	—	Emory Perkins	—	old	1,870	do	13.9	36	do
Bc 3	—	Garden Homes Inc.	Carpenter	1945	870	Drilled	82.2	8	Tonoloway limestone
Bc 4	—	LaVale Sanitary Commission	do	—	1,180	do	148	8	Pocono
Bc 5	—	Do	do	—	1,180	do	250	8	do
Bc 6	—	Do	do	—	1,180	do	200	8	do
Bc 9	23648	A. H. Ge llauf	Tressler	1956	1,070	do	73.2	5⅝	Jennings
Bc 10	—	U. S. Bureau of Mines	Pennsylvania Drilling Co.	1946	2,420	do	1,011	2⅛	Conemaugh
Bc 11	—	Do	do	1946	2,000	do	897	2⅛	do
Bc 12	—	Do	do	1946	2,065	do	921	2⅛	do
Bc 13	24242	Hugh Kiffer	Carpenter	1956	1,085	do	82	5⅝	Hampshire
Bc 14	24388	Charles Plummer	Irwin	1956	1,705	do	33	6	Conemaugh
Bc 15	24519	Ervin Skidmore	do	1956	1,875	do	60	6	Monongahela
Bc 16	10863	Chester A. Blubaugh	do	1952	1,860	do	62	5⅝	do
Bc 17	8073	Consolidated Mines Co.	Carpenter	1951	1,640	do	81	5⅝	Conemaugh
Bc 18	11026	P. W. Sandovik	Irwin	1952	1,740	do	60	5⅝	do
Bc 19	8074	Wilson C. Pape	Carpenter	1951	1,760	do	68	5⅝	do
Bc 20	5105	Joseph Evans	Miller	1949	1,650	do	60	5⅝	do
Bc 21	5104	E. L. Kroll	do	1949	1,670	do	45	5⅝	do
Bc 22	20811	Harold E. Carter	Northcroft	1955	1,500	do	58	5⅝	do
Bc 23	21404	Donald Filsinger	Irwin	1955	1,505	do	47	5⅝	do
Bc 24	8488	Joseph Huber	Carpenter	1951	1,640	do	88	5⅝	do
Bc 25	13469	Leslie Duckworth	Irwin	1953	1,800	do	58	5⅝	do
Bc 26	20436	Francis B. Eberly	do	1955	1,800	do	110	5⅝	do
Bc 27	—	Charles Lewis	Carpenter	1953	1,720	do	55	5⅝	do
Bc 28	—	William Lewis	—	1915	1,735	Dug	45	36	do
Bc 29	24622	Thomas Eckhart	Irwin	1956	1,730	Drilled	35	6	do
Bc 30	—	Joseph Huber	—	1925	1,650	Dug	19	24	do
Bc 32	3036	Kerbert L. Kneppe	Irwin	1948	1,535	Drilled	74	6	do
Bc 33	—	Mrs. Mildred Higgins	—	old	2,060	Dug	45	36	Monongahela
Bc 34	—	Edgar Albright	—	old	2,030	do	39.6	36	Conemaugh
Bc 38	—	Henry Loar	—	1929	2,050	Drilled	62	6	do
Bc 39	—	Oliver Gilkey	—	old	2,090	Dug	39	36	do
Bc 40	—	Marshal Porter	Ford	1948	1,060	Drilled	46.2	—	Jennings
Bc 41	16987	Delbert Stewart	Carpenter	1954	1,060	do	43.2	5⅝	do
Bc 42	19966	Wade Morrell	do	1955	1,070	do	51	5⅝	do
Bc 43	—	Robert Yonker	Ford	1957	1,090	do	55.25	5⅝	do

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
13.12[m]	—	3/27/57	B	—	—	—	—	D		Field test: iron 0 ppm, hardness 85 ppm, pH 6.
9.54[m]	—	3/27/57	C, B	—	—	—	—	D		Field test: iron 0 ppm, hardness 85 ppm, pH 7.5.
9.40[m]	—	3/27/57	N	—	—	—	—	N		
9.10[m]	—	4/24/57	N	—	—	—	—	N		
6.38[m]	—	5/22/57	N	—	6	11/47	—	N		Used as a source of water for Cresaptown until Jan. 1950. Abandoned. See table 30 for temperature.
11.55[m]	—	10/18/51	C	32	12	10/18/51	—	P		See aquifer test
24.29[m]	—	10/18/51	T	32	65	10/18/51	—	P		Do
24.90[m]	—	10/18/51	T	32	41	10/18/51	—	P		Do
12.59[m]	—	6/14/56								
	60	6/20/56	—	—	11	6/20/56	.2	C		
—	—	—	—	—	—	—	—	T		Georges Creek hole 11. Drilled into Allegheny and Pottsville formations.
—	—	—	—	—	—	—	—	T		Georges Creek hole 15. Drilled into Allegheny and Pottsville formations.
—	—	—	—	—	—	—	—	T		Georges Creek hole 16. Drilled into Allegheny and Pottsville formations.
30	62	9/56	—	30	18	9/56	.6	C		
2	8	8/17/56	J	12	7	8/17/56	1.1	D		
23	44	8/26/56	J	35	20	8/26/56	.9	D		
17	26	9/10/52	J	39	2	9/10/52	.2	D		
18	63	6/9/51	J	57.5	12	6/9/51	.3	D		
28	42	9/29/52	J	22	.5	9/29/52	.03	D		
30	58	6/12/51	—	35.5	4	6/12/51	.1	D		
30.67[m]	—	3/18/57	J	6	8	12/17/49	—	D		
29.96[m]	—	3/18/57	J, C	40	7	12/3/49	—	D		Field test: iron 0.6 ppm, hardness 198 ppm, pH 7.2-7.5.
Flowing	—	3/18/57	J	50	10	8/25/55	—	D		
22	77	11/28/55	J	30	2.5	11/28/55	.03	D		
13.80[m]	—	3/19/57	J	58	—	—	—	D		See table 30 for temperature. See chemical analysis.
28	40	10/9/53	J	40	2	10/9/53	.1	D		
79	82	8/31/55	J	10	5	8/31/55	1.7	D		
10	—	10/53	J	—	—	—	—	D		
15.67[m]	—	3/19/57	C	—	—	—	—	D		
12	27	9/8/56	J	7	10	9/8/56	.7	D		
3.14[m]	—	3/19/57	N	—	—	—	—	O, N		
37.17[m]	60	3/19/57	J	46	2	8/28/48	.06	D		
23.98[m]	—	4/10/57	J	—	—	—	—	D		Water reported to turn yellow after rains. Field test: iron 0.1 ppm, hardness 68 ppm pH 8.
16.27[m]	—	4/10/57	N	—	—	—	—	N		
—	—	—	C	—	—	—	—	D		
18.12[m]	—	4/10/57	C	—	—	—	—	D		
9.99[m]	—	5/1/57	S	—	—	—	—	D		See table 30 for temperature
8.49[m]	—	5/1/57	J	37	—	—	—	D		Do
18	40	7/55	—	37	6	7/55	.3	D		
11.95[m]	—	5/1/57	—	—	—	—	—	N		

TABLE 40

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Bc 44	15888	Samuel Glenn	Carpenter	1954	1,100	Drilled	59	5⅝	Jennings
Bc 45	—	Baxter Day	Ford	1947	1,040	do	30.1	5⅝	Romney shale
Bc 46	14748	Edward M. McKenzie	Johnson	1954	1,040	do	6	5⅝	do
Bc 47	22670	Marshal Porter	Carpenter	1956	1,200	do	71.6	5⅝	Jennings
Bc 48	13571	Francis Martz	Johnson	1953	1,110	do	83.5	5⅝	do
Bc 49	7531	Do	do	1951	1,110	do	52	5⅝	Romney shale
Bc 50	13856	Adrian M. Holt	do	1953	1,130	do	86.5	5⅝	Jennings
Bc 51	—	Robert Hendershot	Ford	1957	970	do	101	5⅝	Helderberg limestone
Bc 52	24740	George Skidmore	Irwin	1956	1,750	do	35	6	Conemaugh
Bc 53	2168	Paul Hager	Carpenter	1947	1,670	do	112.5	5⅝	do
Bc 54	1661	Stanley R. Donahue	do	1947	1,175	do	63.5	5⅝	Hampshire
Bc 55	1654	Ellsworth Lewis	Miller	1947	1,060	do	75	6	Romney shale
Bc 56	—	Joseph Snyder	—	1955	1,070	Dug	27	36	do
Bc 57	21898	William Judy	Carpenter	1956	870	Drilled	56	5⅝	Helderberg limestone
Bc 58	—	James Winters	do	1953	855	do	60	6	do
Bc 59	—	James Judy	do	1953	1,075	do	109	6	Jennings
Bc 60	20337	Charles Freeland	do	1955	1,030	do	122	5⅝	do
Bc 61	—	William Riley	Riley	1949	1,055	Dug	25	36	do
Bc 62	—	Brady Smith	—	—	1,070	do	23.9	36	Romney shale
Bc 63	—	Pile Bros.	Ford	1949	880	Drilled	60	6	Tonoloway limestone
Bc 64	27301	J. D. Paddleford	do	1957	960	do	118	6	Helderberg limestone
Bc 65	23077	William B. Coleman	Irwin	1956	1,140	do	65	5⅝	Jennings
Bc 66	11532	Gutherie McKenzie	Carpenter	1953	1,066	do	62	5⅝	do
Bc 67	17056	Calvin Twigg	do	1954	965	do	114	5⅝	Oriskany sandstone
Bc 68	369	C. E. Sturtz	Johnson	1956	840	do	75	5⅝	McKenzie
Bd 1	—	Cumberland Brewing Co.	—	1925	660	do	182	8	Tonoloway limestone
Bd 2	—	Do	—	1900	660	do	84.6	6	do
Bd 3	—	Do	—	1906	660	do	180	—	do
Bd 4	—	Do	—	—	660	do	—	—	McKenzie
Bd 5	—	Cresap Civic Improvement Co.	—	1932	745	do	150	6	Rose Hill
Bd 6	203	John M. Barncord	Carpenter	1946	970	do	92	8–6	Tonoloway limestone
Bd 7	510	Don D. Clayton	Johnson	1946	1,180	do	39	6	Tuscarora sandstone
Bd 8	511	Dewey P. Clayton	do	—	1,230	do	57.5	6	do
Bd 9	—	Kelly-Springfield Co.	Carpenter	—	630	do	213	8	Tonoloway limestone
Bd 10	—	Do	do	1922	630	do	238	8	do
Bd 11	—	Do	—	—	630	Dug	60	36	do
Bd 12	—	Do	Carpenter	1923	630	Drilled	296	8	Wills Creek shale
Bd 13	—	Do	do	1924	630	do	208	8	Tonoloway limestone
Bd 14	—	Do	do	1924	630	do	224	8	Wills Creek shale
Bd 15	—	Do	do	—	630	do	223	8	do
Bd 16	—	Do	do	1925	630	do	261	8	do

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
6	34	7/54	S	24	6	7/54	.2	D		
.38^{m}	—	5/2/57	S	—	—	—	—	D		
6	—	4/54	S	29.5	6	4/54	—	D		
	70	4/56								
19.01^{m}	—	5/2/57	J	47	8	4/56	—	D		
30	—	10/53	J	17	5	10/53	—	D		
34	—	3/51	—	—	3	3/51	—	D		
18	—	11/53	—	24.5	4	11/53	—	D		
9.59^{m}	—	5/9/57	N	22	—	—	—	D		
6.12^{m}	—	5/15/57	J	25	12	9/56	—	D		
25	60	12/47	C	18	10	12/47	.3	D		
20	30	11/47	—	36.5	6.6	11/47	.7	C		
14	30	7/30/47	N	—	12	7/30/47	.8	N		Well abandoned because of bad water.
9.83^{m}	—	5/57	C	—	—	—	—	D		Water reported not good to drink.
26.16^{m}	40	5/57	J	49	10	1/56	—	D		Field test: iron 0.1 ppm, hardness 120 ppm, pH 6.
25	—	11/56	J	32	—	—	—	D		
48.63^{m}	—	5/57	J	26	—	—	—	D		Field test: iron 0 ppm, hardness 137 ppm, pH 6.
60	80	8/55	N	37	5	8/55	.25	N		
5	—	5/57	J	—	—	—	—	D		
6.94^{m}	—	5/57	N	—	—	—	—	N		
—	—	—	J	—	—	—	—	I		
91	108	8/57	—	111	20	8/57	1.2	D		
16	40	5/56	J	22	2	5/56	.1	D		
27	54	1/53	J	29	6	1/53	.2	D		
55	90	11/54	J	55	6	11/54	.2	D		
52	60	5/46	J	—	6	5/46	.8	D	57	See chemical analysis.
15.03^{m}	—	4/11/57	T	—	40–150	—	—	I		Yield reported to be 40 gpm July to Nov., Flows in winter. See chemical analysis.
14.04^{m}	—	10/4/46	N	—	—	—	—	O		See table 30 for temperature.
—	—	—	T	—	—	—	—	N		
—	—	—	N	—	—	—	—	N		
—	—	—	—	—	—	—	—	N		Well filled.
72	—	1/46	W	79	10	1/46	—	D		
8	—	6/14/46	—	39	1.5	6/14/46	—	D		
35	51	6/20/46	J	57.5	3	6/20/46	.2	D		
—	—	—	C	—	78	1922	—	N		
—	—	—	—	—	—	—	—	N		Do
—	—	—	—	—	—	—	—	N		Do
—	—	—	—	—	—	—	—	N		Abandoned
—	—	—	C	—	54	1924	—	N		
—	—	—	—	—	83	1924	—	N		Well filled.
—	—	—	—	—	41	1925	—	N		Do
—	—	—	—	—	16	1925	—	N		Do

TABLE 40

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Bd 17	—	Kelly-Springfield Co.	Carpenter	—	630	Drilled	251	8	Tonoloway limestone
Bd 18	—	Do	do	1926	630	do	200	6	do
Bd 19	—	Do	do	1926	630	do	202	8	Wills Creek shale
Bd 20	—	Do	do	1926	630	do	194	8	Tonoloway limestone
Bd 21	—	Do	do	—	630	do	200	6	Wills Creek shale
Bd 22	—	Do	do	—	630	do	200	—	do
Bd 23	—	Celanese Corp. of America	Irwin	1930	665	do	106	—	Rose Hill
Bd 24	—	Do	do	1929	644	do	95	8–6	McKenzie
Bd 25	—	Do	do	1929	646	do	87	8–6	Rose Hill
Bd 26	—	Do	do	1929	647	do	91.5	8–6	do
Bd 27	—	Do	do	1948	645	do	36.5	—	—
Bd 28	—	Do	do	1924	644	do	193	8–6	McKenzie
Bd 29	—	Do	Va. Machinery and Well Co.	1931	655	do	952	12	Rose Hill
Bd 30	—	Do	—	—	650	do	—	—	McKenzie
Bd 31	—	Queen City Brewing Co.	Kohl	1933	630	do	550	10	Helderberg limestone
Bd 32	—	Do	—	—	630	do	630	10	do
Bd 33	—	Do	Kohl	1933	630	do	493	10	do
Bd 36	—	Cumberland Fair Assoc.	Carpenter	1934	660	do	174	6	Wills Creek shale
Bd 37	6140	Burton's Men Store	do	1950	650	do	121	5 5/8	Romney shale
Bd 38	6140	Do	do	1950	650	do	68	5 5/8	do
Bd 39	3633	D. C. Goodfellow	do	1949	665	do	85.4	8	Tonoloway limestone
Bd 40	23838	Ronald Proud	do	1956	870	do	48	5 5/8	Romney shale
Bd 42	—	Potomac Edison Co.	Hammersmith	—	630	do	256	6–4 1/2	do
Bd 43	—	Do	—	1914	630	do	160	6	Tonoloway limestone
Bd 44	—	George A. Emerson	West and Wintermeyer	1908	760	do	55.5	4	do
Bd 45	—	Sloan Glass Co.	Hammersmith	—	620	do	265	6	Oriskany sandstone
Bd 46	—	Queen City Hotel	—	—	640	do	108	6	Romney shale
Bd 47	—	N and G Taylor Tin Mills Co.	McElfish	—	640	do	101	6	do
Bd 48	—	Esso Standard Oil Co.	do	—	650	do	82	6	Juniata
Bd 49	19600	William Lucas	Ford	1955	900	do	70	5 5/8	Romney shale
Bd 50	19889	Stanley J. Demski	Tressler	1955	960	do	57	6	Jennings
Bd 51	20232	Pittsburgh Plate Glass Co.	Carpenter	1955	634	do	103	5 5/8	do
Bd 52	—	Do	do	1955	640	do	100	5 5/8	do
Bd 53	—	Do	do	1955	635	do	100	5 5/8	do
Bd 54	—	Harvey Johnson	—	1950	605	do	17.3	8	do

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
—	—	—	—	—	—	—	—	N		Do
—	—	—	—	—	—	—	—	N		Do
15.60^{m}	—	8/6/57	—	—	80	8/57	—	N		See aquifer test. See chemical analysis.
					133	1926				
15.73^{m}	—	8/6/57	—	—	170	1926	—	N		See aquifer test. See table 30 for temperature.
—	—	—	—	—	—	—	—	N		Abandoned.
—	—	—	—	—	—	—	—	N		Do
11	—	1930	A	43	19	1930	—	N		Do
—	—	—	—	22.5	—	—	—	N		Do
—	—	—	—	36	—	—	—	N		Do
—	—	—	—	27	—	—	—	N		Do
—	—	—	—	—	—	—	—	I		Not a well. Used as a waste disposal pit.
3.89^{m}	—	4/3/57	—	28	—	—	—	N		Abandoned. See table 30 for temperature.
3.94^{m}	—	11/20/57	—	54	175	1931	—	N		Drilled into the Juniata formation. See aquifer test, chemical analysis and well log. See table 30 for temperature.
—	—	—	N	—	—	—	—	N		Abandoned.
—	—	—	T	—	400	4/16/57	—	I	58.5	Water used for cooling. See aquifer test. See chemical analysis.
—	—	—	N	—	—	—	—	N		
29.7^{m}	—	4/4/57	N	—	—	—	—	N		See aquifer test. See table 30 for temperature.
16.7^{m}	—	4/17/57	N	—	—	—	—	N		See table 30 for temperature.
12	18	7/50	J	33	6	7/50	1	N		
8	—	7/50	—	33	4	7/50	—	N		
17.3^{m}	—	5/22/57								
18	40	2/49	N	71.5	5	2/49	.2	N		
6	18	8/56	S	20	8	8/56	.7	C		
2	—	1918	N	—	17	1918	—	N		Abandoned. See Maryland Geol. Survey vol. 10, 1918, p. 457.
—	—	—	—	—	—	—	—	N		Abandoned.
15.43^{m}	—	5/1/57	N	—	—	—	—	N		
11	—	1918	N	211	—	—	—	N		Abandoned. See Maryland Geol. Survey, vol. 10, 1918, p. 457.
25	—	1918	N	75	200	1918	—	N		Do
8–10	—	1918	N	25	10	1918	—	N		Do
10	—	1918	—	20	20	1911	—	N		Water reported salty, Abandoned. See Maryland Geol. Survey, vol. 10, 1918, p. 457
42	—	7/55	J	21	—	—	—	D		
21	36	6/55	—	—	12	6/55	.8	D		
18	55	8/55	N	27	15	8/55	.4	I		
—	—	—	—	—	—	—	—	I		
—	—	—	N	—	—	—	—	I		
2.66^{m}	—	6/57	C	—	—	—	—	D		Field test: iron 0 ppm, hardness 86 ppm, pH 7.

TABLE 40

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Bd 55	—	George Worth	—	—	605	Drilled	12.3	8	Jennings
Bd 56	—	Harvey Hess	—	—	610	do	11.9	8	do
Bd 57	—	R. T. White	—	—	595	do	16.4	6	do
Bd 58	—	S. F. Hartman	—	—	595	do	31.4	6	do
Bd 59	28814	Neil Nesbit	Ford	1957	1,195	do	65	6	Tuscarora sandstone
Bd 60	—	Cumberland Race Track	Coop. Ground-Water Program	1958	650	Augered	6	4	Quaternary
Bd 61	—	Do	do	1958	650	do	18.5	4	do
Bd 62	—	Do	do	1958	650	do	8.5	4	do
Bd 63	—	W. Dolly	do	1958	590	do	6	4	do
Bd 64	—	Do	do	1958	590	do	5.5	4	do
Bd 65	—	Do	do	1958	590	do	5.5	4	do
Bd 66	—	Do	do	1958	590	do	20	4	do
Bd 67	—	Bittinger	do	1958	595	do	15	4	do
Bd 68	—	Kelly Springfield Co.	do	1958	625	do	28	4	do
Bd 69	—	Do	do	1958	625	do	30	4	do
Bd 70	33379	Cumberland Times	Carpenter	1959	620	Drilled	217	8	Romney shale
Bd 71	38197	Do	do	1959	620	do	160	8	do
Bd 72	38198	Do	do	1959	620	do	179	8	do
Be 1	5960	Franklin Cessna	Miller	1950	725	do	85	6	do
Be 2	—	Pen-Mar Brick and Supply	McElfish	1899	630	do	118	6	Jennings
Be 3	15009	Isaac Drake	Hinds	1954	1,320	do	51	—	Oriskany sandstone
Be 4	22132	Joseph A. Spooler	Carpenter	1946	680	do	64	6	Romney shale
Be 5	14556	Charleton A. Shore	Johnson	1954	690	do	53	6	do
Be 6	8775	William J. Kipe	Hinds	1951	750	do	45	5⅝	do
Be 7	24345	Lloyd Beverly	Ford	1956	720	do	100	6	do
Be 8	20064	Pittsburgh Plate Glass Co.	Carpenter	1955	630	do	200	8	Jennings
Be 9	13388	Franklin Nixon	Johnson	1953	605	do	19.9	5⅝	Romney shale
Be 10	—	Richard Gordon	—	—	735	do	—	5⅝	do
Be 11	3125	Russell Brake	Carpenter	1948	710	do	98	6	do
Be 12	22189	John E. Twigg	Tressler	1956	610	do	53	5⅝	do
Be 13	—	Do	Ford	1956	610	do	80	6	do
Be 14	—	Edward Smoller	(owner)	—	1,030	Dug	13.8	48	Oriskany sandstone
Be 15	—	W. C. Wigfield	(owner)	—	1,290	do	16.4	36	do
Be 16	25013	Howard Snider	Tressler	1956	1,570	Drilled	268	6	do
Be 18	—	Adam Staufer	(owner)	—	1,750	Dug	12.4	36	do
Be 19	—	John Robinette	—	—	1,370	do	11.7	36	do
Be 20	—	Adam Stafford	—	—	1,130	do	16.0	36	Romney shale
Be 21	6466	Jesse O. McCoy	Bryant and Co.	1950	940	Drilled	50	6	do
Be 22	—	Charles Lester	(owner)	—	875	Dug	9.4	36	do

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Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
2.19[m]	—	6/57	C	—	—	—	—	D		
3.32[m]	—	6/57	C	—	—	—	—	D		
—	—	—	C	—	—	—	—	D,F		
4.12[m]	—	6/57	C	—	—	—	—	D		
47.86[m]	—	10/3/57	J	65	10	9/57	—	D	51	See chemical analysis.
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
8.69[m]	—	2/24/59								Drilled into Oriskany sandstone. See aquifer test. See table 30 for temperature.
14	26	3/59	S	27	120	3/59	10	I		
22	100	4/59	N	22	60	4/59	.8	I		Recharge well.
30	100	5/59	N	26	85	5/59	1.2	I		Do
40	—	6/14/50	J	—	3	6/50	—	D		
12	—	1918	N	—	50	1918	—	N		Well filled. See Maryland Geol. Survey vol. 10, 1918, p. 457.
—	—	—	N	—	—	—	—	N		Well filled.
30	—	1/56	J	—	10	1/56	—	D		
12	36	3/54	J	36	6	3/54	.3	D		Field test: iron <0.1 ppm, hardness 86 ppm pH 6.5.
7	—	10/51	J	32	2	10/51	—	D		Field test: iron <0.1 ppm, hardness 68 ppm, pH 7.
15	21	12/56	J	53	15	12/56	2.3	C		
13.15[m]	—	7/2/57								See aquifer test. See table 30 for temperature.
16	65	8/55	S	42	30	8/55	.6	I	57	
2.46[m]	—	6/57	J	16.5	5.5	9/53	—	D		Well drilled to 30 ft. produced sulfur water, filled back to 20 ft. producing good water.
—	—	—	J	—	—	—	—	D		Supplies 2 homes.
62	88	9/48	J	66	4	9/48	.16	D		Field test: iron 0 ppm, hardness 102 ppm, pH 7.
12.12[m]	—	6/57								
8	30	2/56	J	—	10	2/56	.45	C		Field test: iron 0.1 ppm, hardness 137 ppm, pH 7.
10	—	6/57	J	40±	—	—	—	D		
4.37[m]	—	6/57	C	—	—	—	—	F		Field test: iron 0 ppm, hardness 68 ppm, pH 7.5.
6.52[m]	—	6/57	C	—	—	—	—	D		
200	—	11/56	C	100	1	11/56	—	D		See chemical analysis.
8.73[m]	—	6/57	C	—	—	—	—	F		Reported to go dry in summer. Have cistern.
10.03[m]	—	6/57	B	—	—	—	—	D		
14.63[m]	—	6/57	N	—	—	—	—	N		Reported to go dry occasionally.
30	—	8/50	C	21.5	2.5	8/50	—	N		
5.16	—	6/57	C	—	—	—	—	D		

TABLE 40

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Be 23	721	Roy Minke	Carpenter	1946	705	Drilled	247	6	Jennings
Be 24	—	Do	Johnson	1940	690	do	100	6	do
Be 25	6848	Joseph G. Twigg	Dilley	1951	920	do	88	5⅝	Romney shale
Be 26	14679	O. T. Haines	do	1954	940	do	88	6	do
Be 28	13243	Joseph Maffley	Carpenter	1953	720	do	74	5⅝	do
Be 30	—	Charles Davis	Ford	1956	970	do	196	6	do
Be 31	11401	George Reuschel	Carpenter	1952	720	do	66	5⅝	Jennings
Be 32	10558	Charles A. Grim, Jr.	do	1952	630	do	200	5⅝	do
Be 33	—	Joseph W. Shank	—	—	610	do	10.5	8	do
Be 34	—	W. M. Walker	—	—	610	do	11.6	8	do
Be 35	—	A. J. Fresh	—	—	610	do	45.6	6	do
Be 36	—	Frank Reuschel	—	—	610	do	16.7	8	do
Be 37	—	J. F. Bartles	—	—	605	do	67	6	do
Be 38	—	Howard Kindeman	—	—	605	do	15.9	8	do
Be 39	8776	George F. Kregline	Hinds	1951	1,070	do	40	6	Romney shale
Be 40	11250	Mary Spicer	Johnson	1952	800	do	40	5⅝	do
Be 41	6554	Michael Barker	do	1950	1,010	do	116	6	do
Be 42	3126	T. T. Holland	Carpenter	1948	770	do	146	6	do
Be 43	3127	Wallace Wolf	do	1948	690	do	71	6	do
Be 44	—	W. W. Wilson	Johnson	1957	1,880	do	90.6	6	do
Bf 2	13179	Donald McMullen	Martin	1953	850	do	58	6	do
Bf 3	—	George Yarder	—	—	1,120	Dug	18.3	36	do
Bf 6	—	John Price	—	—	820	do	16.2	36	do
Bf 7	—	Roy Harman	(owner)	—	800	do	13.3	36	do
Bf 8	27416	James A. Stallings	Carpenter	1957	960	Drilled	73.8	6	Jennings
Bf 9	—	Mr. Zaginer	—	1947	960	do	159	6	do
Bf 10	—	(unknown)	—	—	930	do	33	6	Romney shale
Bf 11	—	Thomas Arnica	—	—	930	do	50	6	do
Bf 12	27414	Albert G. Slider	Carpenter	1957	960	do	161	5⅝	do
Bf 14	—	John Heck	—	1954	965	do	65	6	do
Bf 15	—	Frank Appell	Carpenter	1953	940	do	108	6	Jennings
Bf 16	—	Do	do	—	940	do	65	6	do
Bf 17	—	Do	—	—	930	Dug	13.3	36	do
Bf 19	—	Charles True	—	—	1,200	Drilled	30	6	Wills Creek shale
Bf 20	—	Do	—	—	1,230	Dug	25.2	24	do
Bf 22	—	Jene Teeter	—	—	1,720	do	22	—	Helderberg limestone
Bf 27	—	B. B. Baker	Johnson	1953	1,140	Drilled	76.1	5⅝	Tonoloway limestone
Bf 28	—	Frank Humbertson, Jr.	Humbertson	1920	1,910	Dug	66.4	9½	Helderberg limestone
Bf 29	—	Charles Humbertson	Carpenter	1950	1,560	Drilled	—	5⅝	do
Bf 30	27433	Ralph Mullenax	do	1957	1,240	do	44	5⅝	Wills Creek shale
Bf 23	—	Thurman Davis	—	—	1,710	Cistern	—	—	—
Bf 24	—	Eston Hearner	—	—	1,070	do	—	—	—
Bf 26	—	B. B. Baker	—	—	1,140	do	—	—	—
Bg 1	—	Mrs. M. Arnold	—	—	690	Dug	9.2	24	Jennings
Bg 2	14525	Charles Hartsock	Johnson	1954	985	Drilled	50	5⅝	do
Bg 3	—	William Shryock	—	1929	695	do	90	6	do

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
80	100	8/46	S	—	20	8/46	1	D,C		Supplies water to park facilities and 101 cottages.
—	—	—	N	—	—	—	—	N		Well abandoned due to insufficient yield.
18.0^{m}	—	6/11/57								
—	50	3/51	N	14	6	3/51	—	N		Water reported bad.
40	62	5/54	J	64	3	5/54	.1	D		Water reported poor quality.
35	65	9/53	J	16	3	9/54	.1	D		Field test: iron 0 ppm, hardness 68 ppm, pH 7.
171.0^{m}	—	6/57	B	—	—	—	—	D		
22	56	12/52	J	38	6	12/52	.2	D		See chemical analysis.
40	—	8/52	C	40	1	8/52	—	D,C		
3.45^{m}	—	6/57	C	—	—	—	—	D,C		
4.80^{m}	—	6/57	J	—	—	—	—	D		Supplies 2 homes
1.92^{m}	—	6/57	C	—	—	—	—	D,F		
1.77^{m}	—	6/57	C	—	—	—	—	N		
10	—	6/57	N	—	—	—	—	N		Water reported bad.
2.92^{m}	—	6/57	C	—	—	—	—	D		
0	—	1951	—	—	0	—	—	N		"Dry hole", well filled.
16	—	11/52	J	24.5	8	11/52	—	D		
0	—	10/50	N	—	0	11/50	—	N		Well filled.
60	—	9/48	C	101	10	9/48	—	D		
12	40	9/48	J	53	10	9/48	.4	D		
68.21^{m}	—	8/22/57	—	23.5	—	—	—	—		
18.82^{m}	—	6/57	C	13	1.5	9/53	—	N		
8.12^{m}	—	6/57	N	—	—	—	—	D		
8.37^{m}	—	6/57	C	—	—	—	—	D		
5.13^{m}	—	6/57	B	—	—	—	—	D		
55	65	7/57	C	14	4	7/57	.4	D		
84.07^{m}	—	6/57	B	—	—	—	—	D		
7.06^{m}	—	6/57	C	—	—	—	—	N		
20	—	7/57	C	—	—	—	—	D		
95	150	7/57	S	18	8	7/57	.1	D		
38.12^{m}	—	6/57	J	—	—	—	—	D		
—	—	—	J	—	—	—	—	F		
30	—	6/57	C	—	—	—	—	D		
4.67^{m}	—	7/57	N	—	—	—	—	N		
—	—	—	S	—	—	—	—	D		Have cistern.
16.01^{m}	—	8/23/57	S	—	—	—	—	N		
—	—	—	S	—	—	—	—	D		
75.2^{m}	—	9/4/57	N	—	—	—	—	N		
53.4^{m}	—	9/11/57	J	—	—	—	—	D		
—	—	—	S	—	—	—	—	D		Have cistern.
18	40	7/57	S	17	2.5	7/57	.1	D		
—	—	—	—	—	—	—	—	D		
—	—	—	—	—	—	—	—	D		
—	—	—	—	—	—	—	—	D		
3.07^{m}	—	6/4/57	C	—	—	—	—	F,D		
10	—	3/54	C	14	3	3/54	—	D		
13.64^{m}	—	6/57	C	—	—	—	—	D		Reported to go dry in summer.

TABLE 40

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Bg 4	—	Annie Dickson	—	—	760	Dug	8.8	36	Jennings
Bg 5	—	Roy Shryock	—	—	720	Drilled	153	6	do
Bg 6	—	M. L. Slider	—	—	740	do	112	6	do
Bg 7	—	Quinten Rice	—	—	700	do	108	6	do
Bg 8	—	Frank Webber	—	1898	675	do	85	6	Romney shale
Bg 9	—	H. W. Burke	—	—	640	do	40	6	do
Bg 11	8647	L. L. Robinette	Hinds	1951	710	do	82	6	Jennings
Bg 12	—	Mrs. M. Arnold	Carpenter	1945	690	do	55.1	6	do
Bg 13	—	Do	do	1945	705	do	37.8	6	do
Bg 14	17058	Ralph Buser	do	1955	690	do	70	6	do
Bg 15	2652	Tom Wilson	do	1948	730	do	107	6	do
Bg 16	—	Lester Rader	Merten	—	1,365	do	84	6	do
Bg 17	—	Robert Powell	do	—	1,360	do	70	6	do
Bh 4	—	William Walizer	—	1941	1,025	do	116	6	do
Bh 5	—	Elmira Stump	—	old	500	Dug	17.8	36	do
Bh 6	—	Flora Higgins	—	—	510	do	36	36	do
Bh 9	—	Robert Kungerman	—	—	905	do	17.3	36	Hampshire
Bi 1	8221	Gerald Twiggs	Carpenter	1951	500	Drilled	106	5⅝	Jennings
Bi 2	—	A. R. Shafer	Burkhart	1948	580	do	147	6	do
Bi 3	—	Do	—	—	580	do	198	6	do
Bi 4	—	Boy Scouts of America	Ford	1951	570	do	108	6	do
Bi 5	—	Do	Carpenter	1949	810	do	180	6	do
Bi 6	—	John Vaeth	—	—	860	do	111.4	6	do
Bi 7	19153	M. E. Hofe	Carpenter	1955	875	do	175	6	do
Bi 8	—	John Purnell	—	—	870	do	62	6	do
Bi 9	—	Harold McCusker	Carpenter	—	840	do	75	6	do
Bi 10	—	Dept. of Forests and Parks	—	—	880	do	200	6	do
Bi 12	29238	O. M. Haire	Barnhart	1957	750	do	55	6	do
Bi 13	29457	Bernard McCuskey	do	1958	865	do	117	6	do
Bi 14	31550	Boy Scouts of America	Lucas	1958	605	do	140	6	Hampshire
Ca 1	16447	Robert Inskeep	Irwin	1954	1,280	do	51	5⅝	Conemaugh
Ca 2	6578	George Saville	Carpenter	1951	1,230	do	44	5⅝	do
Ca 3	—	U. S. Bureau of Mines	Pennsylvania Drilling Co.	1946	1,385	do	801	2¼	do
Ca 4	—	John Tranum	—	1880	1,070	Dug	16	36	do
Ca 5	—	Carl Helmick	Helmick	1942	1,130	do	4	36	do
Ca 6	—	J. F. Whetzel	—	—	1,135	Drilled	21.8	5⅝	do
Ca 7	—	Frank Myers	—	1900	1,320	Dug	12.5	36	do
Ca 8	—	Frank Myers	Irwin	1956	1,320	Drilled	45	4	do
Ca 9	—	J. L. Bradley	—	1900	1,270	Dug	16	36	do

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
.62[m]	—	6/57	I	—	—	—	—	D		Fied test: iron 0 ppm, hardness 51 ppm, pH 7.
87.62[m]	—	6/57	C	—	—	—	—	D		Field test: iron 0.2 ppm, hardness 103 ppm, pH 7.
36.16[m]	—	6/57	C	—	—	—	—	D		
48.36[m]	—	6/57	B	—	—	—	—	D		
10	—	6/57	C	—	—	—	—	D		
5	—	6/57	C	—	—	—	—	D		
30	—	6/57	C	9.5	8	9/57	—	D		
10.43[m]	—	6/27/57	C	—	—	—	—	D		See table 30 for temperature.
14.95[m]	—	6/27/57	C	—	—	—	—	F		See chemical analysis.
12.79[m]	—	6/27/57	J	25	.7	12/54	—	D		
42	60	5/48	J	12	5	5/48	.3	D		
—	—	—	C	—	—	—	—	D		Field test: iron 0 ppm, hardness 103 ppm, pH 7.
—	—	—	C	—	—	—	—	D		
65	—	7/57	J	—	—	—	—	D		
12.51[m]	—	7/57	C	—	—	—	—	D		
12.99[m]	—	7/57	C	—	—	—	—	D		
9.64[m]	—	7/57	B	—	—	—	—	D		
40	80	8/51	J	29	9	8/51	.2	D		
78.72[m]	—	7/57	J	—	—	—	—	D		See chemical analysis.
—	—	—	C	—	—	—	—	W		
—	—	—	C	—	—	—	—	P		
83.87[m]	—	7/57	C	—	—	—	—	P		
62.96[m]	—	7/57	B	—	—	—	—	N		
45	110	6/55	J	22	3	6/55	.05	D		
20	—	7/57	C	—	—	—	—	D		
—	—	—	C	—	—	—	—	D		
80.70[m]	—	7/57	C	—	—	—	—	P		
Flowing	—	6/25/58								
2	20	11/28/57	C	—	36	11/28/57	2	O		
30	87	4/26/58	J	17	11	4/26/58	.3	D		
110.3[m]	—	10/15/58	—	44.5	8	10/15/58	—	P	56	See aquifer test. See chemical analysis.
18	22	9/54	C	22	2	9/54	.5	D	58	
5.94[m]	—	6/5/56	I	13	—	—	—	D	54	Water reported "irony".
	32	1951								
—	—	—	—	—	—	—	—	T		Georges Creek hole 14. Drilled into Allegheny and Pottsville formations.
9.90[m]	—	7/3/56	B	—	—	—	—	D	56	Reported never gone dry. Field test: iron 0 ppm, hardness 103 ppm, pH 6.
2.64[m]	—	7/5/56	C	—	—	—	—	D	60	Reported never gone dry. Field test: iron 0.1 ppm, hardness 564 ppm, pH 6.
8.15[m]	—	7/6/56	C	—	—	—	—	N	55	Water not used due to bad odor. Field test: iron 2 ppm, hardness 445 ppm, pH 6.
10.55[m]	—	8/3/56	I	—	—	—	—	D	60	Field test: iron 0.1 ppm, hardness 137 ppm, pH 6.
—	—	—	—	30	—	—	—	D		See chemical analysis.
11.47[m]	—	8/3/56	B	—	—	—	—	D		Reported never gone dry. Field test: iron <0.1 ppm, hardness 120 ppm, pH 6.

TABLE 40

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Ca 10	—	Leo Bradley	—	—	1,280	Dug	25.5	36	Conemaugh
Ca 11	23998	Luther Metz	Irwin	1956	1,230	Drilled	38.5	$5\frac{5}{8}$	do
Ca 12	—	Mary Deniker	—	—	1,230	Dug	10	36	do
Ca 13	—	Archie M. Clark	—	—	1,300	do	22	36	do
Ca 14	—	Mrs. Freda Hyde	—	1924	1,370	do	31	36	do
Ca 16	—	J. L. Dye	—	—	1,315	do	17.5	36	do
Ca 17	—	Edward Shaw	—	1900	1,320	do	13.5	36	do
Ca 18	—	William Jones	Carpenter	1956	1,490	Drilled	44	6	do
Cb 1	—	Lonaconing Water Co.	do	1940	1,904	do	500	8	do
Cb 2	—	U. S. Bureau of Mines	Pennsylvania Drilling Co.	1946	1,905	do	831	$4\text{-}2\frac{1}{8}$	do
Cb 3	—	Lonaconing Water Co.	Carpenter	1930	1,920	do	450	8	do
Cb 4	14379 18190	Do	do	—	2,100	do	1,354	8	do
Cb 5	—	U. S. Bureau of Mines	Pennsylvania Drilling Co.	1946	1,560	do	815	$2\frac{1}{8}$	do
Cb 6	—	Do	do	1946	1,770	do	1,215	$2\frac{1}{8}$	do
Cb 7	—	Do	do	1946	1,586	do	1,050	$2\frac{1}{8}$	do
Cb 8	12926	Dept. of Forests and Parks	Ford	1953	2,400	do	86	$5\frac{5}{8}$	do
Cb 10	13227	Wilbur Beeman	Irwin	1953	1,770	do	50	6	do
Cb 11	—	Buckalew	—	old	1,620	Dug	18.1	36	do
Cb 12	—	Joseph Tenant	—	old	1,680	do	12.4	36	do
Cb 14	23383	Elmer A. McKinzie	Irwin	1956	1,770	Drilled	45	$5\frac{5}{8}$	do
Cb 17	—	Steven Llewelen	Ford	1956	2,280	do	40	6	do
Cb 18	—	Thomas Humphrey	—	old	1,530	Dug	38.6	36	do
Cb 23	—	Joseph Jones	—	old	1,390	do	6.9	36	do
Cb 24	—	Do	—	old	1,390	do	6.3	36	do
Cb 25	—	E. H. Libscomb	Ford	1950	1,085	Drilled	42	6	Romney shale
Cb 26	—	Robert Breyer	—	1940	1,010	do	39	6	do
Cb 27	—	W. C. Rodgers	—	—	990	do	18.8	6	do
Cc 1	—	Clinton Smith	—	—	730	Dug	22.5	36	do

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
15.98[m]	—	8/3/56	B	—	—	—	—	D		Field test: iron <0.1 ppm, hardness 86 ppm, pH 6.
19	28	7/18/56	J	20	15	7/18/56	1.7	D		
6.30[m]	—	8/3/56	B	—	—	—	—	D	58	Well reported to go dry in drought seasons. Field test: iron <0.1 ppm, hardness 86 ppm, pH 6.
15.46[m]	—	8/3/56	I	—	—	—	—	D	57	Reported never gone dry. Field test: iron <0.1 ppm, hardness 103 ppm, pH 5.
4.46[m]	—	8/13/56	B	—	—	—	—	D	58	Reported to have gone dry in summer of 1930. Field test: iron <0.1 ppm, hardness 68 ppm, pH 6.
5.0[m]	—	8/17/56	B	—	—	—	—	D	57	Field test: iron <0.1 ppm, hardness 274 ppm, pH 7.5.
10.0[m]	—	8/17/56	I	—	—	—	—	D	57	Field test: iron <0.1 ppm, hardness 120 ppm, pH 6.
2	—	4/24/57	J	—	—	—	—	D,C		
—	—	—	T	—	170	10/17/51	—	P		Drilled into Allegheny and Pottsville formations. See chemical analysis. See aquifer test.
—	—	—	—	—	—	—	—	T		Georges Creek hole 7. Drilled into Allegheny and Pottsville formations. Flowed 300 gpm at 585 feet.
—	—	—	C	120	33	10/17/51	—	N		
—	—	—	A	—	Flowing 20	7/5/56	—	P		Drilled into the Mauch Chunk shale. Flowed 30 gpm from 1000 ft and 17 gpm from 1354 ft. May 1955. See log, aquifer test, and table 30 for temperature.
—	—	—	—	—	—	—	—	T		Georges Creek hole 2. Drilled into Allegheny and Pottsville formations. Flowed 15 gpm at 150 ft.
40	—	1946	—	—	—	—	—	T		Georges Creek hole 6. Drilled to Mauch Chunk shale.
—	—	—	—	—	—	—	—	T		Georges Creek hole 26. Drilled into Allegheny and Pottsville formations.
37	42	10/54	J	34	7	6/13/56	1.6	P		
27	32	9/5/53	J	22	1.5	9/5/53	.3	D		
8.62[m]	—	3/27/57	N	—	—	—	—	O		
4.85[m]	—	4/16/57	C	—	—	—	—	D		
16	26	5/28/56	J	23	5	5/28/56	.2	D		Supplies 2 homes.
—	—	—	C	—	—	—	—	N		Well reported to yield a small amount.
27.32[m]	—	4/23/57	B	—	—	—	—	D		
4.90[m]	—	4/24/57	B	—	—	—	—	D		Reported to go almost dry during the summer.
5.03[m]	—	4/24/57	N	—	—	—	—	D		
20.16[m]	—	5/57	C	—	—	—	—	D		Field test: iron 1 ppm, hardness 103 ppm, pH 7.
16.39[m]	—	5/57	J	—	—	—	—	D		
8.02[m]	—	5/57	J	—	—	—	—	D		
2.45[m]	—	3/25/57	C	—	—	—	—	D	45	Field test: iron 0 ppm, hardness 102 ppm, pH 8.5.

TABLE 40

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Cc 2	22236	Gunner Gavelin	Carpenter	1956	765	Drilled	104	$5\frac{5}{8}$	Romney shale
Cc 3	21724	Edward E. Orndorff	Johnson	1955	730	do	27	$5\frac{5}{8}$	do
Cc 4	19779	Phillip Evans	do	1955	735	do	31.5	6	do
Cc 7	—	Barton Dairy	Carpenter	1945	710	do	300	8	do
Cc 8	—	Walter N. Yoder & Son	—	1935	695	Dug	18.8	36	do
Cc 9	—	Do	Miller	1947	695	Drilled	30	6	do
Cc 10	6597	Thomas G. Barton	Carpenter	1950	705	do	80	$5\frac{5}{8}$	do
Cc 11	—	Mason Dairy	Miller	1953	760	do	95	6	Wills Creek shale
Cc 12	—	Do	Ford	1950	760	do	760	6	do
Cc 13	22306	Frank H. Young	Tressler	1956	920	do	238	$5\frac{5}{8}$	Oriskany sandstone
Cc 15	—	John Reed	(owner)	1953	890	do	27	6	Romney shale
Cc 16	—	C. W. Shook	—	—	800	do	19	6	do
Cc 17	—	Paul McCoy	—	—	735	do	18.7	6	do
Cc 18	6123	Ervin R. Harvey	Johnson	1950	860	do	91	$5\frac{5}{8}$	Rose Hill
Cc 19	8511	Phillip Evans	Carpenter	1951	725	do	92	$5\frac{5}{8}$	Romney shale
Cc 20	—	Thomas G. Barton	Coop. Ground-Water Program	1958	695	Augered	3	4	Quaternary
Cc 21	—	Do	do	1958	693	do	8	4	do
Cc 22	—	Do	do	1958	689	do	9.5	4	do
Cc 23	—	Do	do	1958	683	do	12	4	do
Cc 24	—	Do	do	1958	683	do	42	4	do
Cc 25	—	Do	do	1958	671	do	37	4	do
Ce 2	273	George E. Vannoy	Carpenter	1946	700	Drilled	70	$5\frac{5}{8}$	Romney shale
Ce 3	6427	John H. Rickenberg, Jr.	Bryant & Co.	1950	820	do	120	6	do
Ce 5	6483	John R. Wolfe	Carpenter	1950	750	do	83	$5\frac{5}{8}$	Jennings
Ce 6	—	Arthur Ritchey	—	—	720	do	102	6	Romney shale
Ce 7	—	Sherman Athey	—	—	635	Dug	16.4	36	do
Ce 8	—	Jesse Shipe	Carpenter	1950	750	Drilled	49	6	do
Ce 9	—	Martha Bean	Martin	1948	880	do	73.7	6	Jennings
Ce 10	—	Russell Emerick	—	1948	800	do	153	6	do
Ce 11	20995	Henry H. Shaw	Carpenter	1955	840	do	70	$5\frac{5}{8}$	do
Ce 12	13244	John Ritchey	do	1953	600	do	37	$5\frac{5}{8}$	Romney shale
Ce 13	—	Orville Twigg	do	1952	800	do	353	6	Jennings
Ce 14	—	John Twigg	Bryant	—	850	do	60	6	do
Ce 15	—	Mildred Twigg	—	old	785	do	110	6	do
Cf 1	1345	Ralph Rader	Martin	1947	—	do	50	6	Romney shale
Cf 2	—	Clinton Taylor	Carpenter	—	—	do	85	6	do
Cf 3	—	Old Town Consolidated School	—	—	—	Dug	18	96	do
Cf 4	1346	Thurman Twigg	Martin	1947	—	Drilled	60	6	do
Cf 5	996	Boy Scouts of America	Carpenter	1946	690	do	94	6	do
Cf 6	13096	Board of Education	do	1953	570	do	100	8	do
Cf 7	25708	James Summers	Barkley	1956–7	570	do	60	$5\frac{5}{8}$	do
Cf 8	8487	Clyde L. Piper	Hinds	1951	650	do	71	6	do
Cf 9	25566	Donald L. Tressler	Tressler	1957	650	do	85	6	do

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
38	60	2/29/56	J	48	6	2/29/56	.3	D		Water reported very hard.
2.28[m]	—	3/25/57	J	17	6	12/21/55	—	D		
1.66[m]	—	2/25/57	N	18	4	7/10/55	—	N	53	See chemical analysis.
—	—	—	T	—	—	—	—	I		
6.78[m]	—	4/18/57	I	—	—	—	—	D		
4.06[m]	—	4/18/57	J	—	—	—	—	D		
3	17	9/50	J	29	4	9/50	.3	D,F		Field test: iron 0 ppm, hardness 137 ppm, pH 6.
30	—	5/57	J	—	8	5/57	—	C		
—	—	—	N	—	1	1950	—	N		Well filled.
200	210	3/56	J	—	10	3/56	1.0	D		Field test: iron 2 ppm, hardness 188 ppm, pH 6.5.
17.84[m]	—	5/57	C	—	—	—	—	D		Field test: iron 1 ppm, hardness 86 ppm, pH 6.
10.01[m]	—	5/57	C	—	—	—	—	D		
7.20[m]	—	5/57	C	—	—	—	—	D		Field test: iron 2.5 ppm, hardness 205 ppm, pH 6.
55	88	7/50	I	—	2	7/50	.06	D	54	See chemical analysis.
30	50	9/51	J	40	6	9/51	.3	D,F		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	C	13	—	—	—	D		
50	—	8/50	C	37	2.5	8/50	—	D		
18	—	8/50	J	8	1	8/50	—	D		
77.03[m]	—	6/57	B	—	—	—	—	D		
11.64[m]	—	6/57	C	—	—	—	—	F		Have cistern.
Flowing	—	6/57	J	—	—	—	—	D		
47.14[m]	—	6/57	J	—	—	—	—	D		
59.13[m]	—	6/57	J	—	—	—	—	D		
56.13[m]	—	6/57	J	—	5	6/55	—	D		Field test: iron 0 ppm, hardness 137 ppm, pH 7.
7.34[m]	—	6/57	C	8	9	9/53	—	D		
127.99[m]	—	9/57	B	—	—	—	—	D		Inadequate yield. See chemical analysis.
30	—	9/57	C	—	—	—	—	D		Inadequate yield.
66.82[m]	—	9/57	C	—	—	—	—	D		Do
25	—	4/47	N	—	2	4/47	—	D		
—	—	—	C	—	3-4	8/50	—	D		
—	—	—	I	—	—	—	—	S		
8	—	4/47	C	—	8	4/47	—	D		
40	50	11/46	C	6	10	11/46	1.0	P		
18	80	8/53	J	12	15	8/53	.2	S		
10	—	1/57	C	21	—	—	—	D		
25	—	8/51	J	8	—	—	—	D		
8	—	4/57	J	22	9	4/51	—	D		

TABLE 40

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Cf 10	25327	Richard Ross	Barkley	1956	695	Drilled	48	5⅝	Romney shale
Cf 12	—	John Landis	Bryant and Co.	1950	640	do	65	6	do
Cf 13	—	Robert Hough	Johnson	1940	730	do	47	6	do
Cf 14	—	W. W. Cooks	Ford	1951	720	do	41	6	do
Cf 15	—	Otto Buckley	do	1952	710	do	75	6	do
Cf 16	—	John Shoemaker	—	1935	780	do	54	6	do
Cf 17	13142	W. L. Wisenhurst	Martin	1953	740	do	54	6	do
Cf 18	—	William Shoemaker	Ford	1956	730	do	46	6	do
Cf 19	25184	J. J. Vanmeter	Carpenter	1956	725	do	91	5⅝	do
Cf 20	20400	Cyril Luckner	do	1955	640	do	148	5⅝	do
Cf 21	—	Charles G. Zimmerman	do	1955	645	do	160	6	do
Cf 22	—	John Devore	—	1940	600	do	34.8	6	do
Cf 23	3484	Ernest Santmyer	Carpenter	1948	600	do	110	5⅝	do
Cf 24	—	Howard Appley	do	1946	640	do	121	6	do
Cf 25	18568	Harry L. Piper	Martin	1955	635	do	55	5⅝	do
Cf 26	8531	Frank James	Hinds	1951	645	do	76	6	do
Cf 27	23516	Leroy F. Hartsock	Northcroft	1956	665	do	70.5	5⅝	do
Cf 28	6271	Joseph Schaidt	Bryant and Co.	1950	595	do	91	6	do
Cf 29	13242	James A. House	Carpenter	1953	595	do	89	5⅝	do
Cf 30	13551	Gerald R. Lewis	Martin	1953	650	do	100	5⅝	Jennings
Cf 31	15354	George Reuschel	Carpenter	1954	645	do	56	5⅝	Romney shale
Cf 32	—	Bernard Lewis	Martin	1940	660	do	111	6	do
Cf 33	1219	A. P. Mowery	do	1947	650	do	55	5⅝	do
Cf 35	—	W. L. Shryrock	—	—	925	Dug	16.3	36	do
Cf 38	25699	E. L. Zimmerman	Barkley	1957	605	Drilled	111	5⅝	do
Cf 39	8411	John Wolford	Hinds	1951	570	do	27	6	do
Cf 40	—	Simon Piper	—	—	800	do	39	6	do
Cf 41	—	Erforth Allender	—	—	760	do	22	6	do
Cf 42	—	John Leasure	—	—	805	do	63	6	do
Cf 43	23551	Chester Corder	Carpenter	1956	595	do	64	6	do
Cf 44	—	R. Santmyier	Ford	1956	640	do	74.5	5⅝	do
Cf 45	—	Raymond Duckworth	—	1950	625	do	98.6	5⅝	do
Cg 1	—	(unknown)	—	1956–7	625	do	61.8	6	do
Cg 2	13095	County Roads Department	Carpenter	1953	650	do	73	5⅝	do
Cg 3	20315	James B. Kasekamp	Johnson	1955	585	do	60	5⅝	Jennings
Cg 4	—	Noah Carder	Bryant and Co.	1955	930	do	93	6	do
Cg 5	—	Do	—	—	930	Dug	31.4	36	do
Cg 6	—	Do	—	—	920	do	26.1	36	do
Cg 7	—	Robert Carder	—	—	930	Drilled	90	6	do
Cg 8	—	Horace Teeter	Carpenter	1945	675	do	40	6	Romney shale
Cg 9	—	Morgan	—	—	690	Dug	12.4	36	do

—*Continued*

Water level (feet below land surface) Static	Pumping	Date	Pumping equipment	Length of casing below land surface (feet)	Yield Gallons a minute	Date	Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
—	—	—	J	11	5?	12/56	—	D		
12.19^{m}	—	6/57	J	—	—	—	—	D		
1.16^{m}	—	6/57	C	—	—	—		N		Field test: iron 4 ppm, hardness 1037 ppm, pH 7.
2.12^{m}	—	6/57	J	—	—	—	—	D		Reported to over flow at times.
—	—	—	J	—	—	—	—	D		
12.64^{m}	—	6/57	C	—	—	—	—	D		
20	—	8/53	J	22	3	8/53	—	D		Field test: iron 0 ppm, hardness 85 ppm, pH 7.
6.14^{m}	—	6/57	J	12	—	—	—	D		
30.17^{m}	—	6/57	J	36	6	12/56	.15	D		Field test: iron 0 ppm, hardness 86 ppm, pH 6.
	70	12/56								
60	95	8/55	J	36	6	8/55	.1	D		
—	—	—	J	—	—	—	—	—		
2.14^{m}	—	6/57	C	—	—	—	—	D		Field test: iron 5 ppm, hardness 393 ppm pH 7.
33	—	6/57	C	10	3	12/48	—	D		
28	—	3/57	J	—	—	—	—	D		
13.67^{m}	—	6/57	J	—	5	6/57	—	D		
18	—	9/51	J	14	2	9/51	—	D		
30	40	6/56	—	—	10	6/56	1	D		
20	—	7/50	J	19	3	7/50	—	D		
37.16^{m}	70	6/57	J	59	4	9/53	.1	D		
80	—	10/53	—	11	1	10/53	—	D		
18	26	7/54	J	26	4	7/54	.5	D		
13.79^{m}		6/57								
32	—	3/57	C	—	—	—	—	D		
32	—	3/47	C	26	5	3/47	—	D		
8.17^{m}	—	6/57	C	—	—	—	—	D		
20	—	1/57	C	23	7	1/57	—	D		
6.12^{m}	—	6/57	C	27	5	8/51	—	D		
11.94^{m}	—	6/57	C	—	—	—	—	D		
8.82^{m}	—	6/57	C	—	—	—	—	D		
30	—	6/57	C	—	—	—	—	D		
23.16^{m}	—	6/57	J	24	10	5/56	1.0	D		See chemical analysis.
	35	5/56								
7.81^{m}	—	8/28/57	J	19	3-4	8/28/57	—	D		See aquifer test. See chemical analysis.
38.09^{m}	—	8/29/57	J	—	2	8/29/57	—	D		
23.19^{m}	—	6/57	J	—	—	—	—	D		
28	65	8/53	J	49	3	8/53	.08	C		
33	—	8/55	C	16	5	8/55	—	C		
30	—	6/57	C	—	—	—	—	D		
1.63^{m}	—	6/57	N	—	—	—	—	N		Water reported to have sulfurous odor. Field test: iron 1 ppm, hardness 86 ppm, pH 6.5.
4.62^{m}	—	6/57	N	—	—	—	—	N		Fied test: iron 1 ppm, hardness 102 ppm, pH 7.
—	—	—	N	—	—	—	—	N		
20	—	6/57	C	—	—	—	—	D		Water reported "irony".
1.84^{m}	—	6/57	C	—	—	—	—	D		Field test: iron 0 ppm, hardness 68 ppm, pH 7.

TABLE 40

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Cg 10	—	Hemsley	—	—	810	Drilled	83	6	Romney shale
Cg 12	—	(unknown)	—	—	590	Dug	9.6	36	do
Cg 13	—	Elmer Amice	—	—	610	do	22.3	36	do
Cg 14	7730	Belmont Amice	Hinds	1951	695	Drilled	66.5	6	Jennings
Cg 15	—	John Brown	(owner)	—	700	Dug	22.4	48	do
Cg 16	7820	John Fike	Hinds	1951	670	Drilled	73	6	Romney shale
Cg 17	—	Donald Robertson	Johnson	1953	785	do	76	6	Jennings
Cg 18	13367	Charles Robertson	do	1953	760	do	80	$5\frac{5}{8}$	do
Cg 19	6391	John Ridenbaugh	Bryant and Co.	1950	670	do	106	6	Romney shale
Cg 20	—	C. Holl	—	—	870	do	85	6	Hampshire
Cg 21	—	C. K. House	Carpenter	1941	930	do	121	6	do
Cg 22	—	Lloyd Azay	—	—	990	do	134	6	do
Cg 23	—	Elroy Lewis	Carpenter	1931	1,020	do	404	6–8	do
Cg 25	—	Paul Burch	do	1950	930	do	75	6	do
Cg 26	—	Golden Russell Corp.	—	—	890	do	226	—	do
Cg 27	13250	Joseph L. Kasekamp	Johnson	1953	610	do	28.5	6	Romney shale
Cg 28	15421	Ralph Willard	Carpenter	1954	600	do	114	$5\frac{5}{8}$	Hampshire
Cg 31	—	D. M. Noland	do	1953	930	do	58.1	6	do
Ch 1	20371	Mark A. Shriver	Johnson	1955	605	Drilled	63	$5\frac{5}{8}$	Jennings
Ch 2	19953	V. R. Hoover	Martin	1955	615	do	65	6	do
Ch 3	—	Millard Weaver	—	1940	530	do	33.6	6	do
Ch 4	—	Charles E. Faith	—	—	540	do	48	6	do
Ch 5	—	Elmer Anderson	—	—	1,005	do	68.6	6	Hampshire
Ch 6	—	Frank Radir	—	—	1,085	do	70	6	do
Ch 7	—	Ralph Malcolm	—	—	1,030	do	121.3	6	do
Ch 8	—	Freda Mueller	—	—	880	do	127	6	Jennings
Ch 9	—	Elizabeth Malcolm	Carpenter	1950	615	do	107	6	do
Ch 10	18535	Oscar D. Malcolm	do	1955	640	do	190	$5\frac{5}{8}$	do
Ch 11	—	Mark A. Shriver	do	—	640	do	84	6	do
Ch 12	—	(unknown)	—	—	990	do	118.4	6	Hampshire
Ci 1	—	John Micheals	—	—	510	do	80	6	Jennings
Da 1	—	Cumberland & Penn. RR.	—	—	970	Drilled	87.6	12	Allegheny and Pottsville
Da 2	—	Do	Wolfe	1912	970	do	165	12	do
Da 3	—	West Va. Pulp and Paper Co.	—	1911	940	do	189	3	do
Da 4	—	Do	—	1911	940	do	254	3	do
Da 5	—	Do	—	1911	940	do	257	3	do
Da 6	—	Do	—	1921	950	do	253	3	do
Da 7	—	Do	Va. Machinery & Well Co.	1945	941	do	2,379	12.6	do
Da 8	16337	John Devore	Carpenter	1954	870	do	90	$5\frac{5}{8}$	Mauch Chunk shale
Da 9	10957	H. V. Reeves, Sr.	Tressler	1952	870	do	68	$5\frac{5}{8}$	do

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Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
45.86[m]	—	6/57	C	—	—	—	—	D		
2.44[m]	—	6/57	B	—	—	—	—	D		
13.89[m]	—	6/57	C	—	—	—	—	D		
15.50[m]	—	6/57	N	8	.75	3/51	—	N		
11.67[m]	—	6/57	C	—	—	—	—	D		
30	—	6/51	J	18	5	6/51	—	D		
40	—	6/57	C	—	—	—	—	D		
47.36[m]	—	6/57	C	24	6	9/53	—	D		Field test: iron 0 ppm, hardness 120 ppm, pH 7.
74	—	8/50	J	28.5	5	8/50	—	D		
—	—	—	C	—	—	—	—	D		
59.64[m]	—	6/57	C	—	—	—	—	D		Water reported "irony".
66.84[m]	—	6/57	C	—	—	—	—	D		
—	—	—	C	—	—	—	—	C		Supplies orchard.
40.44[m]	—	6/57	C	—	—	—	—	D		
—	—	—	C	—	—	—	—	N		
7	—	9/53	C	9	.3	9/53	—	D		
40.16[m]	—	7/57	J	15	2	7/54	.04	N		Field test: iron 0.1 ppm, hardness 68 ppm, pH 7.
	90	7/54								
37.57[m]	—	7/57	B	—	—	—	—	D		See chemical analysis.
33	—	9/55	J	37	5	9/55	—	D,C		
20	—	7/55	C	55	1.5	7/55	—	C		
6.43[m]	—	7/57	B	—	—	—	—	D		Reported never gone dry. Field test: iron 2 ppm, hardness 86 ppm, pH 7.5.
10	—	7/57	C	—	—	—	—	D		
25.94[m]	—	7/57	B	—	—	—	—	D		
—	—	—	—	—	—	—	—	D		Field test: iron 0 ppm, hardness 51 ppm, pH 6.5.
36.00[m]	—	7/57	C	—	—	—	—	D		
62.62[m]	—	7/57	C	—	—	—	—	D		Field test: iron 0 ppm, hardness 103 ppm, pH 7.
20	—	7/57	J	—	—	—	—	D		Supplies 2 homes
42	—	4/55	C	15	.2	4/55	—	D		
31.17[m]	—	7/57	C	—	—	—	—	D		
61.86[m]	—	8/29/57	B	—	—	—	—	N		
16.09[m]	—	7/57	C	—	—	—	—	D		
4.66[m]	—	10/4/46	N	—	—	—	—	O		Monthly record. See table 30 for temperature.
—	—	—	—	35	100	1912	—	N		Abandoned, See Maryland Geol. Survey vol. 10, 1918, p. 458.
—	—	—	A	—	—	—	—	N		Chlorides reported to be 190 ppm.
—	—	—	A	—	—	—	—	N		Chlorides reported to be 576 ppm.
—	—	—	A	—	—	—	—	N		
—	—	—	A	—	—	—	—	N		Chlorides reported to be 13 ppm.
11.33[m]	—	11/14/57	N	800	180	3/8/45	—	T		Drilled into the Pocono formation. See log. See aquifer test and chemical analysis. See table 30 for temperature.
12	60	9/54	J	31	12	9/54	.2	C		
12.82[m]	—	6/7/56	J	35	10	9/52	.4	D		
24	50	9/52								

TABLE 40

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Da 10	—	U. S. Bureau of Mines	Pennsylvania Drilling Co.	1946	1,625	Drilled	830	$2\frac{1}{8}$	Conemaugh
Da 11	21385	John Duckworth	Ford	1955	870	do	62	$5\frac{5}{8}$	Hampshire
Da 12	—	Fay Plaugher	Duckworth	1900	1,310	Dug	24	36	Conemaugh
Da 15	—	Donald Clark	Blizzard	1953	1,620	do	10.4	36	do
Da 17	—	J. H. Blizzard	do	1936	1,770	do	28	36	do
Da 19	—	William Rounds	—	1955	1,660	Drilled	90	$5\frac{5}{8}$	do
Da 20	—	Stanley E. Martin	Skipper	1955	1,670	do	55	$5\frac{5}{8}$	do
Da 21	—	Earl Youngblood	Carpenter	1946	1,530	do	150	—	do
Da 14	—	Garland Grove	—	1914	1,440	Cistern	—	—	—
Db 1	12068	C. Stanley	Carpenter	1953	920	Drilled	314	$5\frac{5}{8}$	Jennings
Db 2	19416	Julian S. Smith	Ford	1955	840	do	150	$5\frac{5}{8}$	Romney shale
Db 3	17057	H. H. Dishong	Carpenter	1954	850	do	87	$5\frac{5}{8}$	Jennings
Db 4	13094	R. T. Shugars	do	1953	1,020	do	69	$5\frac{5}{8}$	do
Db 5	—	A. Rice	—	1887	840	Dug	25.5	36	Romney shale
Db 6	—	Mrs. Leoda Carr	—	—	830	do	18.5	36	do
Db 8	19414	John Purdy	Ford	1955	835	Drilled	75	$5\frac{5}{8}$	Jennings
Db 9	—	Howard Revenscroft	do	1954	900	do	36	$5\frac{5}{8}$	Romney shale
Db 10	17961	Willis E. Beckman	Carpenter	1955	830	do	100	$5\frac{5}{8}$	Jennings
Db 11	—	L. E. Miller	Ford	1952	840	do	54	$5\frac{5}{8}$	do
Db 12	—	McCoole Grade School	—	—	835	do	97	$5\frac{5}{8}$	do
Db 13	801	Mike Chucci	Carpenter	1946	1,010	do	121	$5\frac{5}{8}$	do
Db 14	7626	W. R. Gingerich	do	1951	900	do	168	$5\frac{5}{8}$	do
Db 15	12067	Carl Douglas	do	1953	830	do	44	$5\frac{5}{8}$	do
Db 16	5295	James Frankhouser	do	1950	805	do	166	$5\frac{5}{8}$	do
Db 17	21463	Thomas H. VanPelt	do	1955	1,020	do	60	$5\frac{5}{8}$	Romney shale
Db 18	13251	John Haynes	do	1953	960	do	130	$5\frac{5}{8}$	do
Db 19	19415	Ernest Kesner	Ford	1955	770	do	88	$5\frac{5}{8}$	Oriskany sandstone
Db 20	16243	George O. Cook	do	1954	850	do	51	$5\frac{5}{8}$	do
Db 21	5349	W. M. Caldwell	Carpenter	1950	760	do	71	$5\frac{5}{8}$	Romney shale
Db 22	3663	Fred Luzader	do	1949	820	do	73	$5\frac{5}{8}$	Jennings
Db 23	16242	Robert Walker	Ford	1954	1,020	do	92	$5\frac{5}{8}$	do

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
—	—	—	—	—	—	—	—	T		Georges Creek hole 8. Drilled into Allegheny and Pottsville formations.
44	61	12/55	J	38	.1	12/55	—	D,F		Field test: iron <0.1 ppm, hardness 154 ppm, pH 7.5.
4.74^{m}	—	7/3/56	I	—	—	—	—	D		Field test: iron .2 ppm, hardness 103 ppm, pH 6.
4.0^{m}	—	7/5/56	B	—	—	—	—	D	56	Field test: iron 0.8 ppm, hardness 154 ppm, pH 7.5.
26.0^{m}	—	7/5/56	B	—	—	—	—	D	55	Reported to go nearly dry in summer. Field test: iron <0.1 ppm, hardness 34 ppm, pH 5.
—	—	—	J	20	—	—	—	D		
—	—	—	J	50	—	—	—	D		
—	—	—	J	—	—	—	—	D		
—	—	—	—	—	—	—	—	D		Dug wells reportedly not used because of near-by coal strip mines. Cistern 8 ft. in diameter.
—	—	—	N	19	.1	9/53	—	C		
95	105	12/53	J	41	9	12/55	.9	C		Field test: iron 0.2 ppm, hardness 325 ppm, pH 7.5.
40	70	12/54	J	38	5	12/54	.2	N	56	Water reported to have a bad taste. Neighbor's 18 ft. dug well reported to have good water.
22	53	8/53	J	49	3	8/53	.1	D		Field test: iron 1.5 ppm, hardness 34 ppm, pH 6.
16.38^{m}	—	6/18/56	I	—	—	—	—	D	51	Reported never gone dry. See chemical analysis.
12.90^{m}	—	6/19/56	I	—	—	—	—	D		Field test: iron 0.2 ppm, hardness 205 ppm, pH 7.5.
35	42	12/55	J	36	8	12/55	1	D		
—	—	—	I	—	—	—	—	D		Water reported "irony". Static water level in owner's 15 foot dug well measured 4.5 ft. from land surface.
30	40	2/55	J	20	10	2/55	1	C		Water reported "irony" and hard.
25	—	1952	J	30	—	—	—	D		
—	—	—	J	—	—	—	—	S		Water reported "irony".
30	40	9/22/46	J	20	4.5	9/22/46	.5	D		
40.96^{m}	—	6/20/56	J	40	10	1951	—	D		
9	30	3/29/53	—	32	6	3/29/53	.3	D		
14	—	2/10/50	I	39	3	2/10/50	—	D		
15	—	11/55	C	30	10	11/55	—	F,D		Field test: iron 0.3 ppm, hardness 103 ppm, pH 7.5.
12.5^{m}	—	6/21/56	J	15	2	9/53	—	D		
18	23	6/55	I	45	20	6/55	4	D		
32	38	12/54	I	31	3	12/54	.6	D		
8	24	2/50	—	36	8	2/50	.5	D		
32	37	2/49	J	20.5	10	2/49	.7	D		Field test: iron 0.2 ppm, hardness 239 ppm, pH 7+.
20.0^{m}	—	6/21/56	—	28	4	11/54	.5	D		
	28	11/54								

TABLE 40

Well number All-	Maryland permit number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Db 24	—	David L. Bever	Ford	1954	860	Drilled	96	5⅝	Jennings
Gar-									
Bg 1	9415 11429	Lonaconing Water Co.	Carpenter	1952-	32,000	Drilled	1,276	8	Conemaugh
Cf 1	5307	Barton Water Co.	Ensminger	1950	1,580	do	1,014	8?	do
Cf 2	—	Do	—	1952	1,570	do	300	8?	do
Cf 3	—	Do	Carpenter?	—	1,600	do	300	8?	do
Cf 5	—	U. S. Bureau of Mines	Pennsylvania Drilling Co.	1946	1,668	do	643	2½	do
Cf 6	10783	Barton Water Co.	Carpenter	1952	1,570	do	512	5⅝	do

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
3	—	9/54	J	22	4	9/54	—	D		
Flowing	—	6/23/53	—	58	300	6/23/53	—	P		
8	—	5/31/50	—	—	—	—	—	P		
—	—	—	—	—	—	—	—	P		
—	—	—	—	—	—	—	—	P		
—	—	—	—	—	—	—	—	T		Georges Creek hole 3. Drilled into Allegheny and Pottsville formations.
37	—	9/12/52	—	45	—	—	—	P		

TABLE 41

Records of Springs in Allegany County

Use of water: C, commercial; D, domestic; F, farm; I, industrial; N, none; P, puhlic supply
Method of measurement: B, bucket; C, current meter; E, estimated; W, weir.

Spring number All-	Owner or name	Altitude (feet)	Water-bearing formation (at outlet)	Use of water	Temperature		Discharge			Remarks
					Degrees F	Date	Date	Gpm	Method of measurement	
Ab 3	Harry Carey	2,300	Conemaugh	N	45.0	Mar. 22, 1951	Mar. 22, 1951	5±	E	Field test: iron 0 ppm, hardness 17 ppm, pH 6.5
Ac 17	Mt. Savage Water Co.	1,400	do	P	47	Apr. 17, 1957	Apr. 17, 1957	150	E	Field test: iron 0.1 ppm, hardness 102 ppm, pH 7
Ac 18	Roy Bear	1,530	do	D	48.5	Apr. 17, 1957	Apr. 17, 1957	10	E	Field test: iron 0 ppm, hardness 51 ppm, pH 6
Ac 19	Mt. Savage Water Co.	1,530	do	P	49	Apr. 17, 1957	Apr. 17, 1957	15	E	Flows into water line
Ac 31	Edward Weimar	1,630	do	N	49	Apr. 18, 1957	Apr. 18, 1957	10	E	Reported contaminated by near-by silo
Ac 32	Do	1,620	do	D	—	—	—	—	—	Field test: iron 0.1 ppm, hardness 102 ppm, pH 7
Ac 34	Charles V. Bittner	1,840	do	D	49	Apr. 18, 1957	Apr. 18, 1957	5	E	Field test: iron 0 ppm, hardness 85 ppm, pH 5.5
Ac 36	Sam Hutzell	1,810	do	D,F	50.0	Apr. 18, 1957	Apr. 18, 1957	5	E	
Ac 38	E. J. McKinzie	1,970	do	D	49.0	Apr. 18, 1957	Apr. 18, 1957	10	E	
Ad 33	J. J. Helmstetter	1,030	Romney shale	D	51	May 16, 1957	May 16, 1957	5	E	Field test: iron 0.1 ppm, hardness 51 ppm, pH 7
Ae 8	Rohert Wilson	730	Tonoloway limestone	D	55	Jun. 6, 1957	Jun. 6, 1957	15–20	E	Water murky after rains. See chemical analysis
Ae 34	W. M. McKenzie	1,000	Oriskany sandstone	D	—	Oct. 9, 1957	Oct. 9, 1957	—	—	Emergency water supply
Ae 35	A. E. Smith	1,050	Tonoloway limestone	D	49 54	Apr. 24, 1958 Sept. 25, 1958	Apr. 24, 1958 Sept. 25, 1958	1,385 215	C C	"Bottle Spring." See chemical analysis
Af 9	Wm. T. McLuckie	1,320	Helderherg limestone	D,F	—	—	—	—	—	Used since 1900
Af 10	T. G. Barton	1,100	Tonoloway limestone	D,F	55	Jul. 31, 1957	Jul. 31, 1957	20–30	E	
Af 15	Lester Reams	1,180	Wills Creek shale	D,F	—	—	—	—	—	
Af 18	B. O. Wallace	1,720	Oriskany sandstone	N	55	Aug. 21, 1957	Aug. 21, 1957	3	E	

Af 21	Ora Tbompson	900	Wills Creek shale	D	—	—	—	—	—	Discharge small during dry seasons
Af 23	Claude Duval	850	do	D	—	Aug. 22, 1957	Aug. 22, 1957	.06	E	Use cistern also
Af 24	E. Lester Kolb	980	do	D	60	Aug. 22, 1957	Aug. 22, 1957	15–20	E	Discharge of 2 springs gathered in a tank
Ag 14	Harry Jackson	780	Tonoloway limestone	N	72	Jun. 27, 1957	Sept. 24, 1957	400	E	Outlet spring of Flintstone Creek. See figure 24 for temperatures.
Ag 15	Do	775	do	F	54.5	Jun. 27, 1957	Sept. 24, 1957	300	W	See chemical analysis
Ag 16	Do	775	do	D	53.5	Jun. 27, 1957	Sept. 26, 1957	15–20	E	
Ag 26	B. C. Robinette	820	Wills Creek shale	N	54	Sept. 5, 1957	—	—	—	Water formerly bottled and sold as mineral water
Ag 32	W. N. Eyler	1,920	Helderberg limestone	D	62	Sept. 18, 1957	—	—	—	Use cistern also
Ag 35	W. H. Elliott	770	do	N	53.5	Sept. 19, 1957	—	—	—	Field test: iron 0.2 ppm, hardness 130 ppm, pH 7.5
Ag 36	Do	780	do	N	53.5	Sept. 19, 1957	Sept. 24, 1957	Ag 35 +Ag 36 195	W	Field test: iron 0.2 ppm, hardness 126 ppm, pH 7.5
Ag 37	Do	760	Oriskany (?) sandstone	N	65	Sept. 19, 1957	Sept. 25, 1957	150	E	See chemical analysis. "Warm spring." See figure 26 for temperatures.
Ah 16	Herman Barnes	1,285	Jennings	D	—	—	Aug. 1955	1	E	
Ai 8	Edward Mann	950	do	F	—	—	Jul. 18, 1957	5	E	
Ai 9	Robert Pierce	1,150	Hampshire	D	57	Jul. 18, 1957	Jul. 18, 1957	5	E	
Bb 12	George Sundin	2,030	Monongahela	N	51.0	Mar. 27, 1957	Mar. 27, 1957	3	E	
Bb 17	Floyd Plummer	1,785	do	D	52.0	Mar. 27, 1957	Mar. 27, 1957	3	E	Field test: iron 0 ppm, hardness 256 ppm, pH 8.5
Bb 21	Borden Mine Co.	1,860	do	N	52.0	Apr. 18, 1957	Apr. 18, 1957	50	E	Mine opening spring. Field test: iron 0.1 ppm, hardness 513 ppm, pH 3.5
Bb 22	Do	1,850	Conemaugh	N	52.0	Apr. 18, 1957	Apr. 18, 1957	75	E	Mine opening spring. Field test: iron 0.1 ppm, hardness 325 ppm, pH 3.5
Bb 24	Mary Stewart	1,840	Monongahela	P	48.5	Apr. 24, 1957	Apr. 24, 1957	10	E	Field test: iron 0 ppm, hardness 154 ppm, pH 6
Bc 1	The Clary Club		Conemaugh	D	—	—	—	—	—	
Bc 2	Alfred W. Fritz	920	Tonoloway limestone	N	—	—	Sept., 1932	7	E	
Bc 7	LaVale Sanitary Comm.	1,180	Greenbrier limestone	P	—	—	Oct. 18, 1951	65	E	
Bc 8	Do	1,240	do (?)	P	—	—	Oct. 18, 1951	5	E	
Bc 31	Town of Eckhart	1,680	Conemaugh	P,S, O	49.5	Sept. 19, 1957	Sept. 19, 1957	3.8	B	Field test: iron 2 ppm, bardness 256 ppm, pH 7.5
Bc 35	Harold Winner	2,080	do	D	—	—	Apr. 10, 1957	3	E	

TABLE 41—*Continued*

Spring number All-	Owner or name	Altitude (feet)	Water-bearing formation (at outlet)	Use of water	Temperature		Discharge			Remarks
					Degrees F	Date	Date	Gpm	Method of measurement	
Bc 36	Arthur Griffitbs	1,780	do	D	47	Apr. 10, 1957	Apr. 10, 1957	6.3	B	Field test: iron 0 ppm, hardness 120 ppm, pH 7.5
Bc 37	Jobn T. Winters	1,980	do	D	48	Apr. 10, 1957	Apr. 10, 1957	10	E	Supplies 3 homes. Field test: iron 0 ppm, bardness 34 ppm, pH 5.5
Bc 69	Hoffman drainage tunnel	1,560	Conemaugh	N	54	Apr. 17, 1958	Apr. 17, 1958	17,500	C	See table 4 for additional discharge records. See chemical analysis.
Bd 34	City of Cumberland	620	Tonoloway limestone	N	49	Oct. 8, 1957	Oct. 8, 1957	330	C	Known since 1807. See Table 4 for additional discharge records. See chemical analysis. "Cumberland Blue Spring."
Bd 35	Do	660	Tuscarora sandstone	N	53	Apr. 10, 1957	Apr. 10, 1957	40	B	See Table 4 for additional discharge records; see chemical analysis. "Sands Spring"
Bd 41	H. Dressman	880	Helderberg limestone	D	—	—	Apr. 30, 1957	1	E	Supplies 3 homes
Be 17	Herman Rice	1,450	Oriskany sandstone	D	53	Jun. 6, 1957	Jun. 6, 1957	5	E	Supplies 2 homes
Be 27	T. L. Stegmaier	1,050	do	D	53	Jun. 11, 1957	—	—	—	
Be 29	Consolidated Orchard Co.	850	Romney shale	F,D	—	—	Jun. 7, 1956	100	E	Supplies orchard, 13 homes and swimming pool
Be 45	Do	1,260	Oriskany sandstone	F	—	—	Sept. 3, 1957	1.5	E	
Bf 1	George Stickley	980	Tonoloway limestone	D,F	53.5	Oct. 8, 1957	Oct. 8, 1957	410	C	"Murley Brancb Spring." See Table 4 for additional discharge records and figure 13 for temperatures. See chemical analysis
Bf 4	Emory Rote	960	Romney shale	D	—	—	Jun. 1957	5	E	
Bf 5	Robert Kerr	925	do	D	54	Jun. 1957	Jun. 1957	12	E	Field test: iron 0 ppm, hardness 34 ppm, pH 7
Bf 13	Oliver Crabtree	1,300	Oriskany sandstone	D,C	54	Jun. 21, 1957	Jun. 21, 1957	30	E	

Bf 18	Austin D. Twigg	1,200	Helderberg limestone	D	53	Aug. 22, 1957	Aug. 22, 1957	30	E	See chemical analysis
Bf 21	G. W. Stafford	1,390	Oriskany sandstone	D	53	Sept. 4, 1957	Sept. 4, 1957	4	E	
Bf 25	Esten Heavner	1,040	Wills Creek shale	D,F	58	Sept. 4, 1957	Sept. 4, 1957	15	E	
Bf 31	H. Browning	1,400	Helderberg limestone	F	62	Sept. 20, 1957	Sept. 20, 1957	1	E	
Bg 10	Mr. Connelley	660	Romney shale	D	54	Jun. 21, 1957	Jun. 21, 1957	3	E	
Bg 18	Rutledge Yonker	980	Romney shale	F,D	60	Sept. 20, 1957	—	—	—	
Bg 19	Do	980	do	F,D	59	Sept. 20, 1957	—	—	—	
Bh 1	Owen Fisher	1,120	Hampshire	D	56	Jul. 1957	Jul. 1957	5	E	Field test: iron 0 ppm, hardness 86 ppm, pH 7
Bh 2	Dept. of Forests & Parks	1,550	Pocono	P,S	—	—	Jul. 1957	2	E	
Bh 3	Do	1,000	Jennings	P,S	—	—	Jul. 1957	0	E	"Black sulfur spring"
Bh 7	—	510	do	N	55	Jul. 16, 1957	Jul. 16, 1957	2	E	"O'Leary spring"
Bh 8	—		do	N	—	—	—	—	—	"White sulfur spring"
Bh 10	Long Pond Rod & Gun Club	910	Hampshire	C	56	Jul. 24, 1957	Jul. 24, 1957	10	E	
Bh 11	Dept. of Forests & Parks	1,000	do	P,S	57	Jul. 26, 1957	Jul. 26, 1957	2	E	
Bi 11	Edward Puffenbaugh	480	Jennings	D	56	Jul. 26, 1957	Jul. 26, 1957	1	E	
Ca 15	Andrew B. Shaw	1,480	Conemaugh	D	51	Aug. 17, 1956	—	—	—	Field test: iron <0.1 ppm, hardness 308 ppm, pH 6.5
Cb 9	Dept. of Forests & Parks	1,990	do	P	55	Jun. 13, 1956	Jun. 13, 1956	6	E	Field test: iron <0.1 ppm, hardness 51 ppm, pH 6.5
Cb 13	Coney Coal Co.	1,690	do	N	53	Apr. 16, 1957	Apr. 16, 1957	3	E	Field test: iron 0 ppm, hardness 34 ppm, pH 6
Cb 15	—	1,860	Monongahela	N	53.5	Apr. 16, 1957	Apr. 16, 1957	300	E	Field test: iron 0.2 ppm, hardness 255 ppm, pH 7.5
Cb 16	Town of Lonaconing	1,460	Conemaugh	N	—	—	Apr. 16, 1957	15	E	
Cb 19	Lester McCarty	2,460	do	D	51	Apr. 23, 1957	Apr. 23, 1957	5	E	Field test: iron 0 ppm, hardness < 17 ppm, pH 6.5
Cb 20	Do	2,710	do	N	50	Apr. 23, 1957	Apr. 23, 1957	10	E	
Cb 21	Union Coal Co.	1,720	do	D	50	Apr. 23, 1957	Apr. 23, 1957	5	E	
Cb 22	Moran Coal Co.	1,750	Monongahela	N	50	Apr. 24, 1957	Apr. 24, 1957	30	E	Field test: iron 0 ppm, hardness 513 ppm, pH 5.5
Cc 5	John Rotenberry	1,740	Allegheny-Pottsville	P	48	Apr. 24, 1957	Apr. 24, 1957	8	E	Field test: iron 0 ppm, hardness 34 ppm, pH 6.5
Cc 6	Joseph Welsh	2,580	Conemaugh	D,F	50	Apr. 24, 1957	Apr. 24, 1957	10	E	
Cc 14	Burt Mason	775	Wills Creek shale	D	—	—	May, 1957	3	E	

TABLE 41—*Continued*

Spring number All-	Owner or name	Altitude (feet)	Water-bearing formation (at outlet)	Use of water	Temperature		Discharge			Remarks
					Degrees F	Date	Date	Gpm	Method of measurement	
Ce 1	U.S. Dept. of Interior	560	Oriskany sandstone	N	—	—	Oct. 4, 1957	3,510	C	"Potomac Blue spring". See Table 4 for additional discharge records. See chemical analysis
Ce 4	George Holler	705	do	P,S	55.5	Oct. 29, 1957	Sept. 18, 1957	60	E	"Holler spring". See Table 27 for temperatures. See chemical analysis
Cf 11	E. Nixon	695	do	P,S	54	Jun. 12, 1957	Sept. 4, 1957	8	B	Temperature 56°F. Sept. 4, 1957. Water used hy about 20 families
Cf 34	John Bovelia	700	Romney shale	D,F	55	Jun. 21, 1957	Jun. 21, 1957	10	E	
Cf 36	John Zapp	610	do	D	54	Jun. 26, 1957	Jun. 26, 1957	10	E	Supplies 2 homes. Field test: iron 0 ppm, hardness 68 ppm, pH 6.5
Cf 37	H. R. Robinette	920	do	D,F	54	Jun. 24, 1957	Jun. 24, 1957	10	E	Field test: iron 0 ppm, hardness 120 ppm, pH 7
Cf 46	Charles E. Davis	670	Oriskany sandstone	N	55.5	Sept. 3, 1957	Sept. 3, 1957	300–400	E	
Cf 47	Do	670	do	D	55.5	Sept. 3, 1957	Sept. 3, 1957	70–80	E	
Cf 48	T. M. Shryock	670	do	F	56	Sept. 4, 1957	—	—	—	
Cf 49	Do	670	do	F	57	Sept. 4, 1957	—	—	—	
Cf 50	Do	670	do	F	56	Sept. 4, 1957	—	—	—	
Cf 51	Do	670	do	D	56	Sept. 4, 1957	—	—	—	
Cf 52	Alhert L. Kinser	700	do	F,D	56	Sept. 4, 1957	Apr. 23, 1958	223	C	See Table 27 for temperatures. See chemical analysis
Cg 11	Dufenbaugh	660	Romney shale	D	54	Jun. 27, 1957	Jun. 27, 1957	15	E	
Cg 24	Elroy Lewis	1,030	Hampshire	F,D	—	—	Jun. 6, 1957	50	E	Supplies orchard and 8 homes
Cg 29	Dept. of Forests & Parks	1,140	Jennings	P,S	56	Jul. 13, 1957	Jul. 13, 1957	1	E	
Cg 30	Do	1,360	do	P,S	56	Jul. 13. 1957	Jul. 1957	1	E	
Da 13	Mrs. John Wilson	1,370	Conemaugh	D	57	Jul. 3, 1956	—	—	—	Supplies 3 homes
Da 16	J. H. Blizzard	1,730	do	D,F	60	Jul. 5, 1956	—	—	—	Field test: iron <0.1 ppm, hardness 34 ppm, pH 6

Da 18	Sarah Clarke	1,560	do	D	60	Jul. 5, 1956	Jul. 5, 1956		E	Supplies 2 homes. Field test: iron 2 ppm, hardness 17 ppm, pH 7.5
Da 22	F. Ravenscroft	1,510	do	D,F	60	Jul. 6, 1956	Jul. 6, 1956	1	E	Field test: iron <0.1 ppm, hardness 462 ppm, pH 7.5.
Db 7	L. R. Llewellyn	860	Jennings	D	—	—	Jun. 19, 1956	.02	E	Field test: iron 0.1 ppm, hardness 86 ppm, pH 7.5.
Db 25	Walter Iser	950	Romney shale	D	55	Aug. 15, 1956	Aug. 15, 1956	4.5	B	Field test: iron 0.6 ppm, hardness 154 ppm, pH 7.

TABLE

Record of Wells in

Water level: Measured water levels designated by "m."
Pumping equipment: A, airlift; B, bucket; C, cylinder (piston and pitcher types); I, impeller (centrifugal); J, jet; N, none; S,
Use of water: C, commercial; D, domestic; F, farm; I, industrial; Ir, irrigation; N, not used; O, observation; P, public supply,

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Aa 1	—	John Swain	—	—	650	Dug	12.6	36	Jennings
Aa 2	—	John B. Wheeler	—	old	650	Drilled	85	6	do
Aa 3	—	(unknown)	—	—	720	Dug	27.8	48	Quaternary
Ab 2	2,018	Arthur Yantz	Barnhart	1947	650	Drilled	80	6	Hampshire
Ab 4	12,104	Marshall Hoffman	Carpenter	1953	855	do	200	6	do
Ab 5	11,312	R. S. Dillon	Roninson	1952	990	do	158	6	do
Ab 6	—	Brant Diehl	—	1927	1,590	do	128	6	Pocono
Ab 8	—	William Creek	—	old	900	do	85	6	Hampshire
Ab 9	18,803	Herman E. Younker	Barnhart	1955	600	do	95	6	Jennings
Ab 10	17,005	Robert McCusker	do	1954	680	do	125	6	do
Ab 11	22,002	Warren B. Roby	Teach	1956	710	do	160	6	do
Ab 12	—	Frank Swain	Carpenter	1956	950	do	140	6	Hampshire
Ab 13	—	Do	—	old	950	do	88	6	do
Ab 15	10,882	Porter Hill	Barnhart	1952	870	do	120	6	do
Ab 16	—	Lester McCusker	—	old	870	do	90	6	Jennings
Ab 18	—	R. S. Dillon	—	old	1,005	do	125	6	Hampshire
Ab 19	10,414	F. Russell Dyer	Barnhart	1952	970	do	120	6	do
Ab 20	17,004	Mrs. Annie Bowman	do	1955	910	do	96	6	do
Ab 21	—	Paul McCusker	do	1955	885	do	75	6	Jennings
Ab 22	8,322	Clara Bivens	Wingert	1951	590	do	100	6	Romney shale
Ab 23	19,174	Mrs. Florence Bennett	Barnhart	1955	580	do	75	6	do
Ab 24	20,403	Marshall Hoffman	do	1955	670	do	100	6	Jennings
Ab 25	19,636	John Unger	do	1955	670	do	75	6	do
Ab 26	15,763	James Mazingo	Yankey	1954	970	do	50	6	Hampshire
Ab 27	—	George Swain	—	1935	700	do	146	6	Jennings
Ab 28	—	Paul Exline	Penn. Glass Sand Co.	1957	670	do	100	6	Romney shale
Ab 29	6,526	John Caddie	Yankey	1950	535	do	35	6	do
Ab 31	—	William Ritz	—	1900	995	do	69	6	Hampshire
Ab 33	—	Lonnie Flowers	Barnhart	1950	850	do	125	6	Jennings
Ab 35	—	R. S. Dillon	—	old	890	do	110	6	Hampshire
Ab 36	—	Vern Munson	—	old	775	do	65	6	Jennings
Ab 37	—	George Mitchell	—	old	790	do	73.4	6	do
Ab 38	—	Avery McCusker	—	old	740	do	125	6	do
Ab 39	—	Austin McCusker	—	1925	720	do	110	6	Romney shale
Ac 1	—	Susan Creager	—	—	430	do	86.2	4	do
Ac 2	—	R. S. Dillon	—	1943	650	do	140	6	Oriskany sandstone
Ac 3	21,850	Do	Barnhart	1956	585	do	154	6	Tonoloway limestone
Ac 4	25,071	Do	do	1957	490	do	50	6	Romney shale
Ac 5	17,299	James Flowers	do	1955	705	do	125	6	Jennings
Ac 6	17,714	Do	do	1955	720	do	125	6	do
Ac 7	—	Clarence Devilbiss	do	—	750	do	110	6	do
Ac 9	—	Clarence Dorrier	—	—	455	Dug	11.8	48	McKenzie
Ac 14	1,509	William Crouse	Barnbart	1947	470	Drilled	90	6	Tonoloway limestone

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Washington County

submersible; T, turbine; W, windmill.
camps and institutions; S, school; T, test well.

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
4.12[m]	—	6/17/58	C	—	—	—	—	D		
—	—	—	C	—	—	—	—	D		
8.85[m]	—	6/17/58	N	—	—	—	—	N		
12	25	11/10/47	C	76	5	11/10/47	0.3	D		Reported never pumped dry.
3	60	6/28/53	J	34	3	6/28/53	.05	D,C		
40	80	11/15/52	C	14	25	11/15/52	.6	D		See chemical analysis.
61.83[m]	—	6/17/58	C	—	—	—	—	N		Reported gas in well.
—	—	—	C	—	—	—	—	D		Water reported to become cloudy in summer.
55	75	5/7/55	J	50	13	5/7/55	.65	D		
50	105	11/27/54	J	—	10	11/27/54	.2	D		
70	90	2/22/56	J	40	6	2/22/56	.3	D		
50	—	6/18/58	J	—	—	—	—	D		
36.87[m]	—	6/18/58	N	—	—	—	—	N		Yield reported inadequate.
30	—	9/13/52	C	—	1.5	9/13/52	—	D		
20	—	6/18/58	C	—	—	—	—	D		Water reported "irony."
40	—	6/18/58	C	—	—	—	—	D		
40	—	8/23/52	J	27.5	3	8/23/52	—	D		
52.64[m]	—	6/18/58								
50	70	4/8/55	C	—	3	4/8/55	0.1	D		
—	—	—	J	—	—	—	—	D		Water reported muddy at times.
38	—	8/20/51	C	7	.5	8/20/51	—	D		
20	—	6/11/55	C	—	4	6/11/55	—	D		
6	20	9/14/55	C	—	10	9/14/55	.7	D		
86	126	7/1/55	J	—	3	7/1/55	.07	D		
40	—	7/15/54	C	12	<10	7/15/54	—	D		
—	—	—	C	—	—	—	—	D		Water level reported near land surface.
6	—	8.57	S	14	—	—	—	D		
5	—	8/24/50	J	15	15	8/24/50	—	D		
30.47[m]	—	6/25/58	N	—	—	—	—	D		Water reported "irony."
25	—	6/58	C	—	—	—	—	D		
—	—	—	C	—	—	—	—	D		
15	—	6/58	C	—	—	—	—	D		
46.15[m]	—	6/25/58	W	—	—	—	—	D		Reported never dry.
40	—	6/58	C	—	—	—	—	D		
30	—	6/58	C	—	—	—	—	D		Reported never dry.
54.03[m]	—	10/2/46	N	—	—	—		O,N		Monthly record.
—	—	—	—	—	—	—	—	D		See chemical analysis.
30	110	5/14/56	S	22	17	5/14/56	0.2	C		
4	30	11/27/56	C	15	6	11/27/56	.23	D		
50	65	1/22/55	C	—	—	—	—	D		
37.46[m]	—	5/28/58	J	—	12	3/4/55	—	D		Water reported to have sulfurous odor.
55	—	5/58	C	—	—	—	—	D		
7.11[m]	—	5/28/58	C	—	—	—	—	D,F		
17.85[m]	—	5/28/58	N	80	9	6/13/47	—	N		

TABLE 42

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Ac 15	831	Iva Shifflet	Barnhart	1946	540	Drilled	147	6	Wills Creek shale
Ac 16	878	Do	do	1946	540	do	112	6	do
Ac 17	—	Mrs. M. Miller	—	old	660	do	185	6	do
Ac 18	718	John P. Casper	Barnhart	1946	625	do	97	6	do
Ac 19	—	G. H. Wilfong	—	old	690	do	80	6	do
Ac 24	—	John Locher	DeHaven	1946	450	do	120	6	McKenzie
Ac 25	—	Do	—	old	450	do	85	6	do
Ac 26	—	Do	—	old	510	do	60	6	Wills Creek shale
Ac 27	—	William Thompson	—	—	480	do	110	6	do
Ac 28	—	R. S. Dillon	—	old	900	do	60	6	do
Ac 29	—	Do	—	old	1,000	do	80	6	do
Ac 30	24,908	Ludwell O. Fling	Teach	1956	720	do	130	6	Romney shale
Ac 31	28,066	Jesse Apple	Ambrose	1957	520	do	75	6	do
Ac 32	—	Elmo Michael	—	old	560	do	100	6	do
Ac 33	—	E. W. Hepburn	Robison	1956	560	do	105	6	Tonoloway limestone
Ac 34	—	Do	do	1955	505	do	310	6	Wills Creek shale
Ac 35	—	Do	do	1953	600	do	103	6	do
Ac 36	—	Do	do	1953	600	do	80	6	Tonoloway limestone
Ac 37	—	Marshall Daniels	—	old	500	do	80	6	Jennings
Ac 38	299	Mrs. B. W. Robinson	Teach	1946	460	do	65	6	Romney shale
Ac 39	—	Town of Hancock	Harper	1912	495	do	440	8	Oriskany sandstone
Ac 40	19,974	Elmer Exline	Barnhart	1955	535	do	80	6	Romney shale
Ac 41	11,052	R. S. Dillon	do	1952	605	do	85	6	Tonoloway limestone
Ac 42	35,100	Fort Tonoloway	Hoffman	1959	560	do	330	6	Wills Creek shale
Pa-, Ac 1	—	Lem Kirk	Martin	1956	555	do	762	8–6	Tonoloway limestone
Ad 1	6,048	Hancock Drive-In Theater	Yankey	1950	420	do	60	6	Jennings
Ad 2	—	Do	—	1955	420	do	60	6	do
Ad 3	9,573	Clifford Miller	Barnhart	1952	460	do	90	6	do
Ad 4	23,620	Wilmer Kretzer	Martin	1956	415	do	69	6	do
Ad 5	16,693	Stanley Fulton	Hoffman	1954	440	do	251	6	Hampshire
Ad 6	9,112	Chet Branton	Barnhart	1952	450	do	110	6	do
Ad 7	10,322	Marshall Daniels	Wachter	1952	450	do	203	6	do
Ad 8	4,213	H. L. Mills	Hoffman	1949	450	do	70	6	Jennings
Ad 9	8,382	John A. Neubert	Yankey	1951	610	do	90	6	do
Ad 10	2,692	J. Robert Barnhart	Teach	1948	690	do	130	6	do
Ad 11	300	Otis Stanley	do	1946	485	do	150	6	do
Ad 12	—	W. J. Leatherman	—	old	670	do	125	6	Hampshire
Ad 13	—	Charles K. Stotlemeyer	—	1937	745	do	130	6	do
Ad 14	—	Stanley Fulton	—	old	730	do	80	6	do
Ad 15	28,065	James Weller	Ambrose	1957	740	do	85	6	do
Ad 16	—	Marshall Trails	—	—	530	do	135	6	Jennings
Ad 17	—	M. E. Gladhill	—	—	680	do	70	6	Hampshire
Ad 18	15,653	James H. Eddy	Ambrose	1954	760	do	82	6	Jennings
Ad 19	2,693	Mrs. Edith Weller	Teach	1948	770	do	100	6	do
Ad 20	2,691	Walter E. Wilson	do	1948	790	do	92	6	do
Ad 21	10,163	Robert Alton	Wachter	1952	750	do	61	6	Hampshire
Ad 22	23,045	Mrs. Nellie M. Keefer	Martin	1956	630	do	89	6	Jennings
Ad 23	—	John McCarty	—	1950	760	do	65	8	Hampshire
Ad 24	—	Stanley Fulton	—	old	770	do	140	6	do

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
75	120	11/23/46	C	30	4	11/23/46	.09	N		
50	95	11/9/46	C	31	5	11/9/46	.1	D		
90	—	5/58	J	—	—	—	—	D		
57	87	8/31/46	C	—	10	8/31/46	.3	D		
—	—	—	C	—	—	—	—	D		
30.4^{m}	—	6/9/58	J	—	—	—	—	D,C		Supplies 3 homes and packing plant
—	—	—	J	—	—	—	—	D		Supplies 3 homes.
—	—	—	J	—	—	—	—	F		
—	—	—	C	—	—	—	—	D		
—	—	—	C	—	—	—	—	D		
—	—	—	C	—	—	—	—	D		
32.34^{m}	—	6/9/58	C	21	5	10/15/56	—	D		
20	70	8/20/57	C	24	5	8/20/57	.1	D		
30	—	6/58	C	—	—	—	—	D		
Flowing	—	6/10/58	J	—	25	1956	—	F		
Flowing	—	6/10/58	T	—	70	1955	—	F		Flow estimated 10 gpm.
19.67^{m}	—	6/10/58	W	—	20	1953	—	F		
.67^{m}	—	6/10/58	J	—	—	—	—	C		
20	—	1955	N	—	—	—	—	N		Well filled.
20	—	4/11/46	C	21	20	4/11/46	—	C,F		
38.18^{m}	—	6/13/58	N	430	200	1912	—	N		See Maryland Geol. Survey vol. 10, 1918, p. 464.
30	55	8/2/55	J	—	30	8/2/55	1.0	D		
25	35	10/10/52	C	—	20	10/10/52	2.0	D		
99	275	5/23/59	N	63.5	12	5/23/59	.07	P		See aquifer test. See Table 16 for temperature.
26.47^{m}	—	6/18/58	N	—	—	—	—	T		Oil and gas test hole. See well log. See Table 16 for temperature.
30	30?	6/19/50	—	13	10	6/19/50	—	N		Well reported to have collapsed.
—	—	—	J	—	—	—	—	C		
10	30	4/8/52	J	22	3.3	4/8/52	—	D		See chemical analysis.
24	24?	6/23/56	—	50	11	6/23/56	—	D		
65	240	10/54	J	—	8	10/54	0.05	C		
30	110	3/25/52	C	19	6	3/25/52	.06	C		
85	115	8/29/52	C	20	4	8/29/52	.13	C		
10	20	6/27/49	C	21	20	6/27/49	2.0	C		
60	80	8/23/51	J	14.5	10	8/23/51	.5	D		
50	70	5/25/48	—	41	5	5/25/48	.25	D		
60	60?	4/5/46	J	58	6	4/5/46	—	D		
—	—	—	J	—	—	—	—	D		
60	—	6/10/58	C	—	—	—	—	D		
—	—	—	J	—	—	—	—	D		
22	65	8/16/57	J	19	5	8/16/57	.1	D		
77.34^{m}	—	6/10/58	J	—	—	—	—	D		
15	—	6/58	J	—	—	—	—	D		
38	80	7/15/54	J	33	2	7/15/54	.05	D		Reported pumps dry on occasion.
40	55	6/10/48	C	59	8	6/10/48	1.0	D		
20	30	6/2/48	C	48	6	6/2/48	.6	D		
14	40	7/10/52	J	16	2	7/10/52	.08	D		
30	40	5/14/56	C	42	8	5/14/56	.8	D		
20.59^{m}	—	6/11/58	J	—	—	—	—	D		
30	—	6/58	C	—	—	—	—	D,F		

TABLE 42

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Ad 25	10,162	Walter E. Wilson	Wachter	1952	755	Drilled	81	6	Hampshire
Ad 26	—	Robert Wietman	DeHaven	1947	640	do	103	6	Jennings
Ad 27	—	J. E. Snyder	Teach	1958	700	do	140	6	Romney shale
Ad 29	12,866	Oscar Weller	do	1953	520	do	50	6	do
Ad 30	2,966	James L. Younker	do	1948	530	do	42	6	do
Ad 31	—	Richard E. Hull	do	1955	510	do	145	6	do
Ad 32	30,115	Do	do	1958	590	do	115	6	Jennings
Ad 33	23,311	Ray A. Grove	do	1956	575	do	70	6	Romney shale
Ad 34	—	Ben Moats	—	1950	595	do	60	6	do
Ad 35	5,049	Elsie E. Golden	Teach	1950	550	do	70	6	Oriskany sandstone
Ad 36	—	Emmett Keefer	—	—	590	do	28	6	Romney shale
Ad 37	28,661	Leo McCormick	Martin	1957	540	do	96	6	Jennings
Ad 38	—	James F. Weller	Schultz	1915	580	do	122	8	do
Ad 39	—	Dr. L. M. Shaffer	—	1938	465	do	80	6	do
Ad 40	12,868	Raymond Moats	Teach	1953	450	do	70	6	do
Ad 41	—	Do	Prater & Niemyer	1895	450	do	57	6	do
Ad 42	—	George Egolf	Ramsburg	1916	470	do	33	6	Romney shale
Ad 43	1,252	William Everett	Teach	1947	480	do	70	6	do
Ad 44	11,561	L. M. Shaffer	Barnhart	1953	495	do	109	6	Jennings
Ad 45	—	Do	Schultz	1945	605	do	185	6	do
Ad 46	—	State Roads Commission	—	old	460	do	107.8	6	do
Ae 2	22,362	Leonard Haines	Teach	1956	650	do	45	6	McKenzie
Ae 3	4,187	Minnie Kidwell	do	1949	620	do	90	6	Wills Creek shale
Ae 4	16,519	William A. Shoemaker	do	1954	610	do	53	6	Romney shale
Ae 5	—	Do	—	1943	510	do	50	6	do
Ae 6	—	Lowell Shoemaker	Teach	1949	510	do	98	6	Oriskany sandstone
Ae 7	—	J. H. Tillou	—	1915	570	do	187	6	Romney shale
Ae 8	24,871	Donald Weller	Hoffman	1956	660	do	125	6	Jennings
Ae 9	—	Elizabeth Weller	—	1930	660	do	110	6	do
Ae 10	24,976	Harvey Barnhart, Jr.	Hoffman	1956	570	do	146	6	Romney shale
Ae 11	25,091	Webster Barnhart	do	1956	720	do	84	6	Jennings
Ae 12	2,285	Herbert Pillman	Teach	1948	640	do	85	6	do
Ae 13	13,408	Leroy Moats	do	1953	470	do	85	6	Romney shale
Ae 14	—	R. S. Dillon	—	old	720	do	40	6	Jennings
Ae 15	—	Do	—	1953	570	do	96	6	do
Ae 16	3,519	B. H. Revell	Teach	1948	570	do	70	6	Romney shale
Ae 17	3,357	Nevin L. McCarty	do	1948	450	do	60	6	do
Ae 18	11,703	Wayne O. Shives	do	1953	450	do	50	6	do
Ae 19	27,867	J. E. Warner	do	1958	405	do	45	6	do
Ae 21	3,520	Bud V. Weller	do	1948	445	do	77	6	do
Ae 22	—	Albert C. Mills	—	old	530	do	75	6	do
Ae 23	—	James Beard	—	1920	585	do	80	6	do
Ae 24	—	Theodore R. Beard	—	old	595	do	90	6	do

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
18.73^{m}	—	6/11/58								
17	47	6/9/52	J	16	4	6/9/52	0.1	D		
—	—	—	J	—	—	—	—	D		
45.26^{m}	—	6/11/58	N	—	—	—	—	D		
10	—	7/7/53	C	24	5	7/7/53	—	D		
10	—	9/15/48	C	20	10	9/15/48	—	D,F		
—	—	—	J	—	—	—	—	D		
60	—	3/17/58	C	25	6	3/17/58	—	D		
20	25	5/29/56	J	40	5	5/24/56	1.0	D		
15	—	6/58	C	—	—	—	—	D		
30	40	1/20/50	J	20	10	1/20/50	1.0	D		
8	—	6/58	J	—	—	—	—	D		
40	60	10/3/57	N	19	10	10/3/57	.5	N		
79.65	—	6/20/58								
80	—	1915	C	18	28	1915	—	D		
68	—	Summer 1957	J	—	—	—	—	D		
20	—	7/57	C	—	—	—	—	D		
17	—	1895	N	16	—	—	—	N		Yield reported inadequate. Well filled.
8	—	1916	J	—	—	—	—	D		
30	38	3/20/47	J	25	6	3/20/47	.75	D		
5	80	2/1/53	J	—	40	2/1/53	.9	F		
—	—	—	C	—	—	—	—	D		Yield reported very good.
55.09^{m}	—	4/6/59	N	—	—	—	—	N		
45	—	2/28/56	C	26	7	2/28/56	—	D		
60	—	7/2/49	J	13	20	7/2/49	—	D		
30	—	9/15/54	C	24	5	9/15/54	—	F		
—	—	—	J	—	—	—	—	D		
—	—	—	J	—	—	—	—	D		Reported to go dry on occasion.
30	—	6/12/58	J		—	—	—	D,F		
40	120	10/56	C	46	7	10/56	0.09	D		
20	—	1958	J	—	—	—	—	D		
75	140	10/56	C	20	5	10/56	.09	D		
40	70	10/56	J	41	10	10/56	.3	D		
27.77^{m}	—	6/12/58								
50	—	2/18/48	J	24	10	2/18/48	—	D,F		
—	—	—	—	28	2	10/53	—	D		
4.52^{m}	—	6/26/58	C	—	—	—	—	D		
					10	6/26/58				
Flowing	—	7/31/58	J	—	4	7/31/58	—	F		See chemical analysis.
25	—	12/20/48	J	27	10	12/20/48	—	D		Water reported encountered at 65 feet.
40	—	12/19/48	J	32	40	12/19/48	—	D		Water reported encountered at 50 feet.
30	—	6/53								
23.66^{m}	—	7/15/58	C	23	33	6/53	—	D		
20	—	7/27/58	C	10	5	7/27/58	—	D		
35	41	12/26/48	C	30	5	12/26/48	.8	D		
20	—	—	C	—	—	—	—	D		Water reported "irony."
—	—	—	J	—	—	—	—	D		
—	—	—	C	—	—	—	—	D		

TABLE 42

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Ae 25	—	Frank Shives	—	—	485	Drilled	40	6	Romney Shale
Ae 26	—	Clifford Weller	—	old	470	do	80	6	do
Af 1	29,287	Lewis Rowland	Hoffman	1957	640	do	27.5	6	McKenzie
Af 2	—	Camp Singewald	—	old	760	do	41	6	Wills Creek shale
Af 3	—	John Repp	—	—	645	Dug	135.3	48	Elbrook limestone
Af 4	—	H. Eichelberger	—	—	635	Drilled	183	6	do
Af 5	11,591	Russell Snyder	Teach	1953	640	do	103	6	do
Af 8	—	James Mellott	Rowland	1957	640	Dug	18	48	McKenzie
Af 9	8,484	Pearl Williams	Teach	1951	670	Drilled	60	6	Rose Hill
Af 12	—	C. G. Braqunier	—	old	750	Dug	15.3	60	Martinsburg shale
Af 16	886	Russell F. Mizell, Jr.	Pike	1946	690	Drilled	150	6	Wills Creek shale
Af 18	31,606	George Wilkinson	Teach	1958	680	Drilled	90	6	Elbrook limestone
Af 19	34,812	Guy F. Suffecool	Hoffman	1959	570	do	240	6	Conococheague limestone
Af 20	—	Do	—	old	570	do	200	6	do
Ag 3	—	Jacob Carbaugh	Hoffman	1949	545	do	67	6	Rockdale Run
Ag 4	16,907	Do	do	1954	540	do	180.3	6	do
Ag 5	14,423	Jacob Ankeney	Teach	1954	570	do	120	6	do
Ag 6	—	Do	—	old	570	do	144	6	do
Ag 7	—	Do	—	old	565	Dug	19.1	48	do
Ag 8	21,037	Mrs. Alice Hawbaker	Provard	1955	690	Drilled	58	6	Conococheague limestone
Ag 9	—	Robert Hastings	Teach	1954	660	do	73	6	Martinsburg shale
Ag 10	—	Do	—	old	670	Dug	26	48	Conococheague limestone
Ag 11	20,022	Advian Faith	Ambrose	1955	725	Drilled	201	6	Elbrook limestone
Ag 13	8,085	Tom Burkett	Robison	1951	725	do	45	6	do
Ag 14	—	Walter Hose	—	—	750	Dug	30.7	48	do
Ag 15	17,228	Ronald Manning	Hoffman	1955	615	Drilled	101	6	Conococheague limestone
Ag 16	—	Advian Strite	Teach	1955	615	do	175	6	do
Ag 18	1,253	Daniel E. Yetter	do	1947	780	do	200	6	Elbrook limestone
Ag 19	—	Do	—	old	770	Dug	33.7	48	do
Ag 20	—	Charles E. Strite	—	old	570	do	25.7	48	Conococheague limestone
Ag 21	—	Do	—	old	580	do	32.0	48	do
Ag 22	—	Tom Seibert	—	old	575	do	32.0	48	do
Ag 25	—	H. W. McMullan	Hoffman	1958	530	Drilled	60	6	Martinsburg shale
Ag 26	184	Daniel S. Secrest	Pike	1946	525	do	150	6	Chambersburg limestone
Ag 27	—	Do	—	old	530	Dug	49.7	48	St. Paul group
Ag 28	15,601	Mary Campion	Cowan	1954	525	Drilled	154	6	Stonehenge limestone
Ah 1	—	Donald Martin	Hoffman	—	590	Dug (and) Drilled	50	48-6	Rockdale Run

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Date	Gallons a minute				
10	—	—	C	—	—	—	—	D		
—	—	—	C	—	—	—	—	D		
10	25	11/57								
8.33^{m}	—	6/4/58	J	28	20	11/57	1.3	D		
12.26^{m}	—	10/16/58	J	—	2	10/16/58	—	P		See aquifer test.
49.03^{m}	—	11/20/58	J	—	—	—	—	D		
39.66^{m}	—	11/20/58	J	—	—	—	—	D		
20	—	1/12/53	C	74	20	1/12/53	—	D		
10	—	1957	J	—	—	—	—	D		
5	15	9/1/51	C	30	5	9/1/51	.7	D		
12.14^{m}	—	11/20/58	J,C	—	—	—	—	D		Reported never dry. See chemical analysis.
119	146	10/23/46	C	11	2	10/23/46	.07	D		Water reported encountered at 140 feet.
80.02^{m}	—	11/20/58	J	90	5	8/5/58	—	D,F		Yield reported inadequate.
53.57^{m}	—	7/21/59								
50	235	5/59	S	55	2.5	5/59	.01	D,F		
30	—	7/57	C	—	—	—	—	D,F		Yield reported larger than Af 19.
24	40	5/16/49	C	21	10	5/16/49	0.6	D,F		Well 60 feet away 225 feet deep, reported inadequate. Now filled in.
30	—	11/16/54	C	4	—	—	—	D		Yield reported inadequate at 7 gals./hour.
40	—	1958	J	61	2	1954	—	D,F		
—	—	—	C	—	—	—	—	D,F		Yield reported inadequate.
18.33^{m}	—	11/13/57	C	—	—	—	—	D,F		Do
28	40	11/27/55	J	42	—	—	—	D		Yield reported inadequate at 20 gals./hour. Reported to pump dry in 14 mins at 3 gpm.
60	—	1954	J	21	5	1954	—	D,F		
10	—	1958	C	—	—	—	—	D,F		
52	115	8/25/55	J	42	8	8/25/55	.1	D		Supplies 2 homes.
27	—	6/12/51	—	12	15	6/12/51	—	D		
30.17^{m}	—	11/20/57	B	—	—	—	—	D		
14	101	1/55	C	8	.5	1/55	—	D		Supplies 2 homes.
18.15^{m}	—	11/20/58	J	13	10	3/11/55	—	D,F		
154	162	3/21/47	C	18	5	3/21/47	.62	D,F		
No water	—	11/21/58	B	—	—	—	—	D		
9.68^{m}	—	11/21/58	S	—	—	—	—	F		Reported to flow in spring season and cannot pump dry.
15.35^{m}	—	11/21/58	J	—	—	—	—	D		
9.90^{m}	—	11/21/58	C	—	—	—	—	D		
30	—	12/58	J	—	—	—	—	D		Yield reported adequate.
28	—	1946	C	6	2	3/12/46	—	D,F	52.5	Field test: hardness 304 ppm.
38.13^{m}	—	4/21/59	C	—	—	—	—	S	—	Field test: hardness 473 ppm.
24	—	7/31/54	S	25	10	7/31/54	—	D,F		
35.60^{m}	—	8/1/57	C	—	—	—	—	N		Dug well 30 feet deep.

TABLE 42

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Ah 2	25,743	Donald Martin	Martin	1957	590	Drilled	80	6	Rockdale Run
Ah 3	25,637	Do	Hoffman	1956	590	do	170	6	do
Ah 4	—	Do	do	1936	590	do	180	6	do
Ah 5	—	Do	Martin	1957	590	do	180	6	do
Ah 6	—	Do	Hoffman	1942	590	do	330	6	do
Ah 7	—	Do	Martin	1957	590	do	760	6	do
Ah 8	15,599	Lloyd A. McCawley	Ambrose	1954	535	do	55	6	Martinsburg shale
Ah 12	1,426	S. H. Charles	Hoffman	1948	545	do	68	6	do
Ah 13	18,299	Kenneth Angle	Teach	1955	545	do	103	6	do
Ah 14	315	Clyde Buchanan	do	1946	545	do	85	6	do
Ah 15	5,107	Ellsworth Durboraw	Pike	1950	525	do	65	6	do
Ah 16	5,106	Samuel Barnhart	do	1950	525	do	60	6	do
Ah 17	15,536	Grayson W. Smith	Hoffman	1954	545	do	85	6	do
Ah 18	16,971	Miss Orvetta Faulder	French	1954	520	do	80	6	do
Ah 19	17,246	Faith Temple	Teach	1954	495	do	100	6	St. Paul group
Ah 20	9,768	Glenn A. Devilbiss	Hoffman	1952	515	do	94	6	Chambersburg limestone
Ah 21	4,290	Stuart H. Mason	Teach	1949	565	do	55	6	Martinsburg shale
Ah 22	6,720	Alfred Henson	do	1950	550	do	65	6	do
Ah 23	4,291	M. T. Sours	do	1949	550	do	52	6	do
Ah 24	3,537	David Hoffman	Pike	1949	520	do	90	6	do
Ah 25	—	Mrs. Harry Wolford	—	1945	505	do	77.2	6	do
Ah 26	22,005	John R. Horst	Hoffman	1956	505	do	80	6	do
Ah 27	962	Paul Green	Pike	1947	505	do	65	6	do
Ah 28	963	Mrs. Harry Wolford	do	1946	505	do	68	6	do
Ah 29	3,881	Alvery R. Mowen	do	1949	505	do	78	6	do
Ah 30	10,152	Boy Scouts of America	Hoffman	1952	395	do	97	6	do
Ah 31	3,104	Benevolent & Protective Order of Eagles	do	1948	440	do	50	6	do
Ah 34	27,560	Samuel C. Seibert	Martin	1957	555	do	151	6	Rockdale Run
Ah 35	22,416	Harry A. Airey	Hoffman	1956	560	do	136	6	do
Ah 36	32,617	J. Clyde Cunningham	do	1958	525	do	186	6	do
Ah 37	30,713	Jonas H. Bishop	Provard	1958	565	do	57	6	Martinsburg shale
Ah 38	31,598	Leon A. Thomas	Hoffman	1958	450	do	48	6	do
Ah 39	32,579	Alfred E. Summers	do	1958	505	do	61	6	do
Ah 40	—	Do	—	1925	490	do	46	6	do
Ah 41	31,604	George Lightner	Teach	1958	520	do	100	6	do
Ah 42	31,305	John D. Martin	Hoffman	1958	565	do	65	6	do
Ah 43	31,802	Lester L. Myers	Ambrose	1958	550	do	70	6	do
Ah 44	9,981	H. W. McMullan	Hoffman	1952	525	do	94	6	do
Ah 45	—	Do	—	old	525	do	80	6	do
Ah 46	—	Charles A. Gibney	—	1927	510	do	130	6	Rockdale Run
Ah 47	—	Do	—	1930	510	do	120	6	do
Ah 48	27,330	Do	Landis	1957	510	do	50	6	do
Ah 49	6,291	Hiram Wantz	Hoffman	1950	560	do	105	6	Martinsburg shale
Ah 52	28,457	Daniel Peck	Landis	1957	550	do	95	6	Rockdale Run
Ah 53	—	C. W. Lorshman	—	—	420	Dug	36.4	48	Martinsburg shale
Ah 54	12,935	Harry Sloan	Pike	1953	485	Drilled	51	6	do

—*Continued*

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
30	35	5/25/57								
31.04[m]	—	8/1/57	C	10	5	5/25/57	1	D,F		
28.93[m]	—	8/1/57	—	—	—	—	—	N		Yield reported inadequate. Considered a "dry hole" by driller.
—	—	—	—	—	—	—	—	N		Yield reported inadequate—filled in.
—	—	—	—	—	—	—	—	N		Do
26.22[m]	—	2/3/58	N	—	—	—	—	D,N		Yield reported inadequate. See Table 16 for temperature.
23	—	1957	N	—	—	—	—	N		Capped.
21	43	6/24/54	J	36.5	15	6/24/54	.7	D		See chemical analysis.
43	58	5/26/48	C	31	5	5/26/48	.3	D		
—	—	—	J	31	10	4/4/55	—	D		
35	—	4/18/46	J	30	10	4/18/46	—	D		
32	51	1/25/50	—	23	15	1/25/50	.7	D		
29	45	1/18/50	J	20	15	1/18/50	.9	D		
30	60	6/54	C	42	20	6/54	.6	D		
40	50	11/10/54	J	47.5	10	11/10/54	1.0	F		
50	—	11/30/54	J	18	6	11/30/54	—	D		
20	30	4/10/52	J	43	20	4/10/52	2.0	D		
15	20	7/27/49	—	19	6	7/27/49	1.2	D		
55	60	9/28/50	C	26	10	9/28/50	2.0	D		
38	42	7/4/49	C	14	5	7/4/49	1.2	D		
40	45	1/6/49	—	43	10	1/6/49	2.0	D		
47.72[m]	—	10/28/58	N	—	—	—	—	N		
35	75	1/56	—	35	2.5	1/56	0.06	D		
20	62	11/16/47	C	45	2	11/16/47	.05	D		
28.5	60	11/23/47	C	50	5	11/23/47	0.1	N		
38	52	4/15/49	C	30	10	4/15/49	.7	D		
40	80	6/10/52	C	21	10	6/10/52	.25	P		
5	30	9/48	J	22	10	9/48	.4	P		See aquifer test.
10	70	7/18/57	—	9	1	7/18/57	.01	D		
30	130	3/56	S	7	4.5	3/56	.04	D		
—	—	—	N	—	—	—	—	N		Considered "dry hole" by driller.
15	30	5/16/58	—	21	20	5/16/58	1.33	D		
30	45	7/58	J	25	8	7/58	.53	D		
30	50	10/58	J	18	20	10/58	1.0	F		
20.37[m]	—	4/15/59	C	—	—	—	—	D		
50	70	7/23/58	C	38	5	7/23/58	.25	D		
30	40	6/58	J	23	30	6/58	3.0	D		
18.91[m]	—	4/15/59								
30	40	8/8/58	C	40	10	8/8/58	1.0	D		
45	65	5/10/52	J	32	20	5/10/52	1.0	D		
25	—	1958	C	—	—	—	—	F		Reported to be a good well.
—	—	—	C	—	—	—	—	C		
12.32[m]	—	4/16/59	S	—	—	—	—	D,C		
15	—	7/20/57	J	14	24	7/20/57	—	D,C		
20	90	8/2/50	J	15	10	8/2/50	.14	D,F		
10	—	1959	C	3	—	—	—	D		Considered "dry hole" by driller.
15.37[m]	—	4/21/59	C	—	—	—	—	D,F		Considered "dry hole" by driller. Field test: hardness 122 ppm.
3	38	7/24/53	J	20	15	7/24/53	.4	D		Field test: hardness 111 ppm.

TABLE 42

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Ah 55	21,530	Claude Edwards	Hoffman	1953	570	Drilled	200	6	Rockdale Run
Ah 56	21,530	Do	do	1955	575	do	135	6	do
Ah 57	29,909	Raymond Martin	Teach	1948	510	do	50	6	do
Ah 58	—	Do	—	old	515	Dug	35	48	do
Ah 59	29,470	R. C. Rohrer	Hoffman	1957	530	Drilled	156	6	do
Ah 60	25,159	Clinton Keener	Landis	1958	530	do	220	6	do
Ah 61	25,159	Do	do	1956	530	do	75	6	do
Ah 63	25,574	Raymond Martin	Teach	1956	515	do	25	6	do
Ah 68	14,091	Mrs. Amos A. Miller	do	1954	560	do	120	6	do
Ah 69	14,267	Oscar Clark	Hoffman	1954	565	do	140	6	do
Ah 70	—	Joseph Horst	—	old	610	do	330	6	do
Ah 71	—	Do	Teach	1958	610	do	60	6	do
Ah 72	35,340	Richard Martin	Hoffman	1959	530	do	200	6	do
Ah 73	35,450	Do	do	1959	520	do	79	6	do
Ah 74	—	Do	—	old	530	do	180	6	do
Ai 1	720	Martin Showalter	Teach	1946	705	do	35	6	do
Ai 2	—	Do	do	1946	705	do	185	6	do
Ai 3	—	Do	do	1933	700	do	349	6	do
Ai 4	17,260	Mrs. Susan M. Martin	Provard	1954	625	do	79	6	Conococheague limestone
Ai 5	29,587	R. Charles Hull	Hoffman	1957	630	do	80	6	do
Ai 6	—	Maugansville School	do	1936	620	do	175	6	Rockdale Run
Ai 7	24,862	Horst Sinclair Service	Landis	1956	615	do	48	6	do
Ai 8	28,008	Fairchild Aircraft Corp.	Kohl	1957	695	do	500	12	do
Ai 9	23,509	Do	Hoffman	1956	595	do	400	6½	do
Ai 11	9,084	Do	Kohl	1953	594	do	305	8	Stonehenge limestone
Ai 13	—	Walter Showalter	Teach	1942	690	do	38.4	6	Rockdale Run
Ai 14	—	Do	Huyett	1920	620	do	79	6	do
Ai 15	10,515	The Martin Co.	Teach	1952	625	do	76	8	Stonehenge limestone
Ai 16	30,100	Fountainhead Country Club	Martin	1958	600	do	300	8	Conococheague limestone
Ai 17	—	Roger Cook	Hoffman	1947	600	do	58	6	Stonehenge limestone
Ai 18	16,859	R. S. Boutelle	Cowan	1954	650	do	83	6	do
Ai 19	—	Menno A. Martin	—	—	650	do	184	6	Rockdale Run
Ai 21	27,442	John Waltersdorf	Hoffman	1957	600	do	190	6	Stonehenge limestone
Ai 22	27,556	R. W. Parks	do	1957	590	do	211	6	do
Ai 23	—	Lee Stein	do	—	600	do	25–30	6	do

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
—	—	—	N	—	—	—	—	N		Considered "dry hole" by driller.
—	—	—	—	—	—	—	—	N		Do
7.5	—	6/10/59			50+	6/10/59				
20	25	2/8/58	I	17	6	2/8/58	1.2	F		See aquifer test. See Table 16 for temperature.
10	—	1959	C	—	—	—	—	D,F		Field test: hardness 287 ppm.
30	140	12/57	J	20	1	12/57	.01	D		
—	—	—	—	—	—	—	—	—		Considered "dry hole" by driller.
22.62^{m}	—	4/22/59								
25	75	12/4/56	J	75	1.7	12/4/56	—	D		
5.45^{m}	—	4/22/59	N	1	50+	6/11/59				
					6	12/6/56	—	N		Reported contaminated. See aquifer test.
—	—	—	J	18	14	2/54	—	D		
20	140	2/54	J	—	1	2/54	—	D		
100	—	1959	C	—	—	—	—	N		Yield reported inadequate.
25	—	8/58	S	12	—	—	—	D,F		
—	—	—	—	—	—	—	—	N		Considered "dry hole" by driller, filled in.
35	50	7/59	J	9	60	7/59	4.0	F		
50	—	7/59	C	—	—	—	—	D		
20.02^{m}	—	3/7/51	C	14	5	8/14/46	—	D,F	51	See chemical analysis.
—	—	—	N	—	—	—	—	N		Filled in.
—	—	—	N	—	—	—	—	N		Do
49	—	12/6/54	J	10	20	12/6/54	—	D		See chemical analysis.
30	50	12/29/57	J	15	30	12/29/57	0.6	D		
35–40	—	Summer 1957	C	—	18	Summer 1957	—	S		
12	—	10/2/56	J	15	32	10/2/56	—	C		
28.38^{m}	—	4/7/59								
40	200	10/29/57	N	40	20?	10/29/57	.1	N,O		See aquifer test. See Table 16 for temperature.
22.66^{m}	—	3/17/59								
15	390	7/56	S	23	3.5	7/56	.01	I		See aquifer test.
14	80	12/51	T	15	385	12/51	6	I		See well log.
23.78^{m}	—	10/16/58	S	—	16.6	1942	—	C		
22.47^{m}	—	10/10/58	N	—	—	—	—	N		
66	—	7/31/52	J	—	—	—	—	F		
48.0^{m}	198^{m}	9/17/58	N	59	370	9/17/58	2.4	I		See aquifer test and well log.
—	—	—	J	—	10	1947	—	D,F		
24	—	11/2/54	—	20	18	11/2/54	—	D		
—	—	—	C	—	3–4	1958	—	D		See chemical analysis.
45	185	7/57	S	35	1.5	7/57	.01	D		
45	200	10/57	J	30	1	10/57	—	D		
—	—	—	N	—	—	—	—	N		Reported to yield a large amount of water.

TABLE 42

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Ai 24	34,127	Mennonite School	Hoffman	1959	625	Drilled	146	6	Conococheague limestone
Ai 25	22,567	Daniel M. Eby	do	1956	618	do	119	6	Rockdale Run
Ai 26		Do	do	1956	620	do	119	6	do
Ai 27	30,316	Donald Grover	do	1958	640	do	180	6	Conococheague limestone
Ai 28	15,320	J. D. Stites, Jr.	do	1954	570	do	41	6	Rockdale Run
Ai 29	14,898	H. B. Lefler	do	1958	585	do	71	6	Conococheague limestone
Ai 30	20,145	Calvin H. Shank	do	1955	605	do	360	6	Stonehenge limestone
Ai 31	—	Norman M. Diller	—	old	680	do	220	6	Rockdale Run
Ai 32	22,004	Do	Hoffman	1956	680	do	230	6	do
Ai 33	26,487	Charles P. Schaffer	Teach	1957	635	do	138	6	do
Ai 34	—	A. S. Cosen	(owner)	1959	615	do	19	8	do
Ai 35	33,575	John W. Little	Hoffman	1959	625	do	156	6	do
Ai 36	18,882	Howard Jones	Teach	1955	620	do	370	6	do
Ai 37	27,228	Glenn L. Krout	Hoffman	1957	625	do	110	6	do
Ai 38	19,864	J. Elmer Diller	do	1955	565	do	152	6	Stonehenge limestone
Aj 1	—	Brook Lane Farm	—	1949	590	do	30	6	Conococheague limestone
Aj 2	18,851	Do	Hoffman	1955	600	do	144	6	do
Aj 3	19,508	Do	do	1955	610	do	82	6	do
Aj 4	—	Leitersburg School	—	—	620	do	200–300	6	do
Aj 5	—	Sinclair Service Station	Teach	1958	520	do	173	6	do
Aj 6	17,539	Harry Dubel	do	1954	730	do	153	6	do
Aj 7	18,852	Riley Bitner	Hoffman	1955	600	do	101	6	do
Aj 8	24,583	Wm. R. Shoop	Cowan	1956	605	do	91	6	do
Aj 9	25,401	Donald McElvaine	Hoffman	1956	630	do	70	6	do
Aj 10	27,975	Adin Horst	Martin	1957	600	do	100	6	do
Aj 11	24,045	Paul Sagi, Jr.	Ambrose	1956	615	do	50	6	do
Aj 12	21,268	Brewer Leatherman	Teach	1955	545	do	165	6	do
Aj 13	28,305	A. B. Helsley	Smith	1957	575	do	94	6	do
Aj 14	30,074	George Rishell	Hoffman	1958	590	do	90	6	do
Aj 15	30,884	William C. Fleigh	do	1958	590	do	210	6	dn
Aj 16	17,101	Marshall C. Strite	do	1954	545	do	155	6	do
Aj 17	28,010	S. C. Clevenger	Landis	1957	645	do	87	6	do
Aj 18	17,878	David K. Poole, Jr.	Martin	1955	570	do	133	6	do
Aj 19	—	Milman Plastics, Inc.	Funt	1950	605	do	175	6	do
Aj 20	—	Martin Eshelman	—	—	650	do	78.4	6	do
Ak 1	17,022	J. Elmer Newcomer	Funt	1954	675	dn	325	6	Elbrook limestone
Ak 2	7,222	Pen Rock Hotel	Hiner —	1951	1,310	do	227	6	Weverton quartzite
Ak 8	—	Department of Defense	—	1942	1,362.1	do	340	8	Catoctin metabasalt
Ak 9	27,443	David H. Ridenour	Martin	1957	705	do	164	6	Waynesboro
Ak 10	33,374	Harold Taber, Jr.	Hoffman	1959	770	do	80	6	Tomstown dolomite

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
30	130	4/59	N	12	15	4/59	—	S		See Table 16 for temperature.
40	110	6/21/56	S	26	10	6/21/56	0.14	D		
39.47[m]	—	6/15/59								
30	110	7/56	S	35	15	7/56	.19	F		Field test: hardness 346 ppm.
40	100	5/58	J	42	15	5/58	.25	D		Field test: hardness 425 ppm.
19.39[m]	—	6/18/59								
21	—	6/54	J	21	30	6/54	—	D		
51.24[m]	—	6/18/59								
45	50	4/23/54	J	30	30	4/23/54	6.0	D		
35	340	9/55	S	52	8	9/55	.02	D,C		
50	—	1959	C	—	—	—	—	D		
60	230	2/56	J	9	.16	2/56	—	F		
80	85	4/29/57	—	24	6	4/29/57	1.20	D		
13.27[m]	—	6/17/59	S	12	20	5/59	—	D		
20	150	3/59	J	27	3	3/59	.02	D		
250	350	5/9/55	S	12	1	5/9/55	—	D		
28	100	6/57	J	5	4	6/57	.05	D		
45	85	7/55	J	8	20+	7/55	.50+	D,F		Field test: hardness 255 ppm.
—	—	—	J	—	—	—	—	D,F		
25	140	9/55	J	37	9	9/55	0.08	D,F		See chemical analysis.
22	50	9/55	J	15	50	9/55	1.7	D,F		
—	—	—	C	—	—	—	—	S		
—	—	—	J	—	—	—	—	C		
100	—	10/23/54	J	—	15	10/23/54	—	D		
80	82	6/55	C	22	20	6/55	10.0	D		
48	—	10/1/56	C	4	24	10/1/56	—	D		
8.75[m]	—	6/5/58								
15	65	12/56	S	12	6	12/56	.1	D		
53	58	9/17/57	S	69	20	9/17/57	4.0	D		
40	—	8/28/56	—	48	10	8/28/56	—	D		
65.48[m]	—	6/16/59								
100	—	12/4/55	J	22	6	12/4/55	—	D		Field test: hardness 423 ppm.
39	74	9/16/57	J	14	2	9/16/57	.07	D		
40	80	7/58	J	13	6	7/58	.15	D		
70	210	6/58	J	12	1.5	6/58	.01	D		
55	155	12/54	J	3	2	12/54	.02	D		
62.29[m]	—	6/17/59								
64	—	8/17/57	C	10	8	8/17/57	—	D		Field test: hardness 520 ppm.
76.02[m]	—	6/18/59								
85	95	3/5/55	J	129	10	3/5/55	1.25	D,F		Field test: hardness 280 ppm.
30	—	7/58	J	24	—	—	—	C		
27.64[m]	—	7/17/59	C	—	—	—	—	N		
60	300	12/20/54	—	53	8	12/20/54	0.03	D		
156	178	5/2/51	—	—	9	5/2/51	.4	C		
3.5	73	10/56	T	82	28	10/56	.7	P		See chemical analysis.
95	—	7/2/57	J	63	5	7/2/57	—	D		
40	60	2/59	J	60	20	2/59	1.0	D		Field test: hardness 177 ppm.

TABLE 42

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Ak 11	—	Harold Taber, Jr.	—	—	770	Dug	23.8	48	Quaternary
Ak 12	32,070	Paul R. Wade	Funt	1958	1,610	Drilled	56	6	Catoctin metabasalt
Ak 13	—	George Barkdoll	—	1946	770	do	84	6	Waynesboro
Ak 14	—	Daniel Bell	—	old	760	do	90	6	do
Ak 15	34,499	C. E. Marker	Cromwell	1959	890	do	70	6	Tomstown dolomite
Al 1	36,924	Camp Louise	—	1959	1,420	do	254	6	Weverton quartzite
Al 2	—	Board of Education	—	—	1,340	do	45	5⅝	Catoctin metabasalt
Al 3	—	Western Maryland R. R.	—	—	1,360	do	256	10	do
Al 4	—	Dan Flohr	—	—	1,490	do	250	6	do
Al 5	—	Blue Ridge Water Co.	Kohl	1940	1,373	do	200	8	do
Al 6	—	Do	do	1935	1,405	do	200	8	do
Al 7	—	Department of Defense	—	1942	1,321.1	do	300	8	do
Al 8	—	Do	—	1942	1,299.0	do	402	8	do
Al 9	—	Do	—	1942	1,313.4	do	200	8	do
Al 10	—	Do	—	1942	1,324.7	do	191	8	do
Al 11	—	Do	—	—	1,339.9	do	200	8	do
Al 12	—	Do	—	1942	1,344.5	do	187	8	do
Bb 1	—	Woodmont Rod & Gun Club	Deneen	1930	590	do	225	6	Jennings
Bb 2	609	Do	DeHaven	1946	590	do	184	6	do
Bb 3	—	Do	—	—	590	do	—	6	do
Bb 4	—	L. F. Woolford	—	old	490	do	38	6	Hampshire
Bb 5	—	B. A. Wills	—	—	590	do	52.6	6	Romney shale
Bb 6	—	Arlie Spade	—	1945	530	do	40	6	Wills Creek shale
Bb 7	—	Woodmont Rod & Gun Club	Swartz	1890	580	do	85	6	Jennings
Bb 8	—	Raymond Divel	—	old	640	do	67	6	Wills Creek shale
Bb 9	—	Do	—	old	640	do	80	6	do
Bb 10	21,165	R. S. Dillon	Barnhart	1955	680	do	99	6	do
Bb 11	—	Do	—	old	635	do	125	6	do
Bb 13	—	Albert McCusker	—	old	705	do	65	6	Romney shale
Bb 14	687	Joseph Donegan	DeHaven	1946	475	do	83	6	Hampshire
Bb 15	—	Western Maryland R. R.	—	1941	460	do	125	6	do
Bb 16	—	Woodmont Rod & Gun Club	—	1935	820	do	85	6	do
Bb 17	24,966	Tonoloway Rod & Gun Club	Martin	1956	660	do	87.5	6	Romney shale
Be 1	—	A. L. Dayhoff	—	—	530	Dug	37.5	36	Oriskany sandstone
Be 2	—	Dept. of Forests and Parks	—	—	500	do	42.7	42	Romney shale
Be 3	5,321	Warren E. Reid	Teach	1950	530	Drilled	130	6	do
Be 4	—	Western Maryland R. R.	—	—	400	do	37.6	6	do
Be 5	84	Do	Hoffman	1945	400	do	57	6	do
Be 6	3,356	Franklin M. Hort	Teach	1948	540	do	110	6	do
Be 7	13,407	John Weller	do	1953	520	do	130	6	do
Be 8	11,605	Robert O. Mills	do	1953	520	do	90	6	do
Be 9	27,868	Robert Carson	do	1957	520	do	85	6	do
Be 10	27,865	Calvin M. Myers	do	1957	520	do	130	6	do
Be 11	3,338	Martin	do	1948	450	do	95	6	do

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
11.86^{m}	—	6/19/59	C	—	—	—	—	N		Water reported polluted.
24	42	9/17/58	J	29	35	9/17/58	1.84	D		
46.09^{m}	—	7/17/59	C	—	—	—	—	D		
25	—	7/59	C	—	—	—	—	D		
18	70	5/11/59	J	20	5	5/11/59	.10	D,C		
75	250	11/16/59	C	—	5	11/16/59	—	P		See chemical analysis.
21.03^{m}	—	6/12/58	N	—	—	—	—	N		
20.13^{m}	—	6/12/58	N	—	—	—	—	N		See aquifer test. See Table 16 for temperature.
—	—	—	N	—	—	—	—	N		
10–15	—	3/47	T	—	90–100	1940	—	P	50	See aquifer test.
—	—	—	C	—	50–60	1947	—	P		
8	18	1942	T	8.5	30	9/28/42	3.0	P	56	See chemical analysis.
14	140	1957	T	20	33	1957	.25	P	55	Do
6	53	3/19/57	T	42.5	55	9/18/58	1.2	P	53	See aquifer test and chemical analysis.
8	57	3/19/57	T	40	37	9/28/42	.75	P	52	Do
8	35	3/19/57	T	24.5	27	9/28/42	1.0	P	52	Do
3	29	3/19/57	T	34.5	29	9/28/42	1.1	P	53	See chemical analysis.
—	—	—	—	—	—	—	—	N		Well plugged.
65	155	7/46	J	63.5	15	7/46	0.17	D		See chemical analysis.
—	—	—	J	—	—	—	—	D		
—	—	—	C	—	—	—	—	D		
40.62^{m}	—	6/19/58	C	—	—	—	—	D		
5	—	1945	C	—	—	—	—	D		
—	—	—	C	—	—	—	—	D		
50	—	6/58	J	—	—	—	—	D		
—	—	—	C	—	—	—	—	F		
8	70	12/1/55	J	14	6	12/1/55	.9	D		
20	—	6/58	C	—	—	—	—	D		
10	—	6/58	C	—	—	—	—	D		
35	70	8/12/46	J	38.5	20	8/12/46	.6	D		
50	—	6/58	C	—	10	1941	—	D		
—	—	—	C	—	—	—	—	F,D		
14	35	11/12/56	J	17	10	11/12/56	.5	C		
28.89^{m}	—	10/2/46	C	—	—	—	—	N,O		
34.37^{m}	—	12/1/49	N	—	—	—	—	N,O		Observation well.
72	85	1950	C	58	10	1950	0.8	D		See chemical analysis.
5.45^{m}	—	3/18/58	C	—	—	—	—	N		
20	27	9/26/45	J	24	20	9/26/45	3	C		See chemical analysis.
68	80	11/7/48	J	26	10	11/7/48	.8	D		
—	—	—	J	55	—	—	—	D		
30	75	1/20/53	J	69	20	1/20/53	.45	D		
30	—	8/57	J	39	5	8/57	—	D		
60	75	7/30/57	J	64	6	7/30/57	.4	D		
85	—	11/20/48	C	33	8	11/20/48	—	D		

TABLE 42

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Be 12	463	Paul Hovermale	Pike	1946	425	Drilled	73	6	Romney Shale
Be 13	17,248	James Snyder	Teach	1954	425	do	110	6	do
Be 14	29,474	Roy Wilson Snyder	do	1957	550	do	85	6	do
Be 15	2,284	Rodger D. Tedrick	do	1948	490	do	90	6	do
Be 16	1,255	Milburn	do	1946	530	do	70	6	Helderberg limestone
Be 17	8,808	Robert Shives	do	1951	430	do	115	6	Jennings
Be 18	—	E. L. Heiston	—	old	450	do	60	6	do
Be 19	—	Dale Shives	Teach	1953	440	do	40	6	Romney shale
Be 20	16,457	Daniel Shank	Martin	1954	535	do	202	6	Oriskany sandstone
Be 21	—	Do	—	old	535	do	64	6	do
Be 22	—	Do	—	old	520	Dug	60	48	do
Be 23	15,659	Mrs. C. H. Weber	Brannon	1954	450	Drilled	132	6	do
Be 24	—	Fort Frederick State Park	Civilian Conservation Corp.	1936	465	do	140	6	Romney shale
Be 25	—	Do	Coop. Ground-Water Program	1958	380	Augered	27	4	Quaternary
Be 26	—	Western Maryland R.R.	do	1958	400	do	15.5	4	do
Be 27	—	U. S. Dept. of Interior	do	1958	420	do	25	4	do
Be 28	—	State Roads Commission	do	1958	420	do	13	4	do
Be 29	—	Board of Education	—	—	540	Drilled	144	6	Oriskany sandstone
Bf 1	—	State Roads Commission	—	—	600	Dug	35.3	—	Conococheague limestone
Bf 4	—	Clear Spring School	—	—	590	Drilled	—	6	do
Bf 5	3,358	Charles C. James	Huffman	1948	625	do	70	6	Wills Creek shale
Bf 9	—	Stephen C. Sandala	do	1932	1,030	do	80	6	Rose Hill
Bf 10	—	H. A. Seiler	Pike	1938	830	do	156	8	Romney shale
Bf 11	8,038	Miss Bessie Forsythe	Hoffman	1951	670	do	91	6	Wills Creek Shale
Bf 12	2,229	Miss Mary Bester	do	1948	405	do	93	6	Romney shale
Bf 13	—	Do	—	—	405	Dug	22.4	48	Quaternary
Bf 14	5,821	Harry L. Rhodes	Teach	1950	410	Drilled	66	6	Romney shale
Bf 15	5,317	John F. Kaylor	—	1950	550	do	41	6	do
Bf 17	32,271	H. Page Smith	Hoffman	1958	505	do	210	6	Conococheague limestone
Bf 18	31,754	Toston	do	1958	470	do	51	6	do
Bf 19	—	Do	—	—	470	Dug	20	36	do
Bf 21	34,952	Lee W. Kalmey	Hoffman	1959	405	Drilled	63	6	do
Bf 22	24,196	R. Alfred Poole	do	1956	620	do	212	6	Elbrook limestone
Bf 23	34,692	Dr. A. R. Cohen	Teach	1959	625	do	143	6	do
Bg 1	8,994	S. Dorsey Martin	Hoffman	1951	440	do	160	6	Martinsburg shale
Bg 2	26,844	George Teach	Teach	1957	500	do	50	6	do
Bg 3	—	Pinesburg Ruritan Club	—	—	500	do	—	6	do
Bg 4	—	Hagerstown Water Pumping Station	Coop. Ground-Water Program	1958	360	Augered	21	4	Quaternary
Bg 5	—	Do	do	1958	360	do	27	4	do
Bg 6	—	Conococheague Park	do	1958	366	do	7.5	4	do
Bg 7	—	Do	do	1958	425	do	14.5	4	do
Bg 8	21,749	Fry Coal and Stone Co.	Hoffman	1956	475	Drilled	508	6	Chambersburg limestone

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
37	51	6/27/46	C	23	25	6/27/46	1.7	D		
40	—	12/54	J	29	5	12/54	—	D		
40	—	12/15/57	C	56	6	12/15/57	—	D		
50	60	2/12/48	J	35	10	2/12/48	1.0	D		
20	—	3/31/46	C	19	10	3/31/46	—	C		
20	35	12/3/51	J	32	—	—	—	D		
30	—	1958	C	—	—	—	—	D		
8	—	1953	J	—	—	—	—	D		
99	150	10/9/54	J	111	10	10/9/54	.2	D		
61.36[m]	—	7/23/58	C	—	—	—	—	N		Reported to go dry in summer.
60.84[m]	—	7/23/58	C	—	—	—	—	N		
70	—	7/12/54	J	36	4	7/12/54	—	C		
53.0[m]	—	1/10/59	C	—	17.5	1/10/59	—	D		See aquifer test and chemical analysis.
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	C	—	5	1958	—	S		See chemical analysis.
29.69[m]	—	5/23/49	—		—	—	—	N,O		
—	—	—	—	—	—	—	—	N		Well filled.
30	50	11/23/48	J	41	8	11/23/48	0.4	D		See chemical analysis.
15	—	6/3/58	C	—	—	—	—	N		Have cistern. Water "irony."
30–50	—	1938	S	60	10–15	1938	—	D,C		Do
31	85	7/51	S	84	10	7/51	.02	D		Water reported to be muddy after pumping two tubs.
15	45	2/16/48	C	45	7	2/16/48	.2	D		
10.28[m]	—	11/14/58	C	—	—	—	—	D		
30	—	5/6/50	C	45	30?	5/6/50	—	D		
10	—	2/25/50	J	40	—	—	—	D		
25	200	9/13/58	S	20	6	9/13/58	.03	D,F		Have cistern and dug well 75.5 feet deep. Depth to water 67 feet on Apr. 16, 1959.
23.45[m]	—	4/21/59			25±	4/21/59				
20	50	8/58	J	29	13	8/58	.4	D,F		
19.5[m]	—	4/21/59	—	—	—	—	—	N		
56.18[m]	—	7/23/59								
55	60	7/11/59	N	11	5+	7/11/59	1	D		
70	200	9/56	S	—	2	9/56	—	D		Have cistern.
70	—	5/20/59	—	40	24	5/20/59	—	D		
120	150	11/7/51	C	18	6	11/7/51	0.2	D		See chemical analysis.
25	30	6/10/57	C	15	7	6/10/57	1.4	D		Do
—	—	—	—	—	—	—	—	C		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
10	500	2/56	C	4.5	6	2/56	.01	C		

TABLE 42

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Bg 9	27,648	Raymond R. Staley	Teach	1957	455	Drilled	65	6	Chambersburg limestone
Bg 10	2,287	Charles Tabler	do	1948	545	do	100	6	Martinsburg shale
Bg 11	—	Do	—	—	460	Dug & drilled	50	48-6	do
Bg 12	29,790	Donald J. Baute	Hoffman	1958	460	Drilled	125	6	do
Bg 14	10,200	Orville Ernest	Teach	1952	490	do	68	6	Conococheague limestone
Bg 15	5,729	Glenn O. Tosten	do	1950	490	do	70	6	do
Bg 16	1,697	Orville Ernest	do	1948	496	do	153	6	do
Bg 17	21,270	James Repp	do	1955	510	do	134	6	Stonehenge limestone
Bg 18	634	Roy Myers	do	1946	490	do	72	6	Conococheaque limestone
Bg 19	—	James Mallot	do	1958	520	do	115	6	Rockdale Run
Bg 20	—	Washington County	—	—	480	do	35	6	Martinsburg shale
Bg 21	31,607	Lester E. Myers	Teach	1958	505	do	40	6	Rockdale Run
Bg 22	2,395	Paul B. Heironimus	Hoffman	1948	450	do	49	6	Martinsburg shale
Bg 23	30,454	E. F. Goetz	do	1958	370	do	41	6	do
Bg 24	27,339	Izaak Walton League	do	1957	450	do	89	6	do
Bg 25	12,330	Fred J. Schwartz	do	1953	465	do	67	6	Rockdale Run
Bg 26	25,573	Lewis Wiles	Teach	1957	460	do	200	6	do
Bg 27	31,475	Lynn Amsley	Pike	1958	390	do	60	6	Martinsburg shale
Bg 28	—	Do	—	old	385	do	55.7	6	do
Bg 29	24,269	Oscar H. St. Clair	Hoffman	1956	410	do	100	6	do
Bg 30	14,491	Richard St. Clair	do	1954	420	do	113	6	. do
Bg 31	33,548	Gene T. Randall	Robison	1959	485	do	139	6	Rockdale Run
Bg 32	—	Floyd Joy	Teach	1953	490	do	96	6	do
Bg 33	25,682	Do	Martin	1956	485	do	150	6	do
Bg 34	25,681	Reuben L. Mills	do	1956	480	do	107	6	do
Bg 35	32,584	Russell E. Keefer	Hoffman	1958	500	do	240	6	Martinsburg shale
Bg 36	31,232	M. G. Hoffman	Teach	1958	540	do	55	6	do
Bg 37	29,965	E. E. Knepper	do	1958	520	do	50	6	do
Bg 38	31,253	Mary A. Miles	Hoffman	1958	520	do	52	6	Rockdale Run
Bg 39	7,006	Mrs. E. Dimon	do	1951	500	do	155	6	do
Bg 40	14,093	William Tederick	Teach	1954	475	do	145	6	do
Bg 41	15,740	F. W. Robinson	do	1954	450	do	200	6	do
Bg 42	—	Do	do	—	450	do	200	6	do
Bh 1	—	Western Maryland R.R.	Hoffman	1940	540	do	82	6	do
Bh 2	—	Do	do	1940	530	do	56	6	do
Bh 3	—	Garland Groh	—	—	545	Dug & drilled	218	6	do
Bh 4	—	Western Maryland R.R.	—	1940	580	Drilled	32	6	do
Bb 5	—	Victor Cushwa	—	1842	445	Dug	44.3	48	do
Bh 6	—	Victor Cushwa & Sons	Downin	1905	395	Drilled	141	6	Martinsburg shale
Bh 7	—	Do	do	1917	395	do	120	6	do
Bh 8	17,778	George F. Bricker	Hoffman	1955	555	do	96	6	Rockdale Run
Bh 9	1,096	Frank James	Holtzman	1947	420	do	80	6	do
Bh 10	387	Harold C. Miner	Hoffman	1946	550	do	85	6	do
Bh 11	—	W. F. Pryor Co., Inc.	—	1925	545	do	50	6	do
Bh 12	2,339	Md. Lime and Fertilizer Co.	Hoffman	1948	470	do	88	6	do
Bb 17	3,304	Hagerstown Nursery Co.	Teach	1948	560	do	110	6	do
Bh 22	—	Western Maryland R.R.	—	—	400	do	48	6	Martinsburg shale

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
30	—	7/16/57	J	44	6	7/16/57		C		
12	30	2/25/48	J	26	20	2/25/48	1.1	D,F		Reported to flow during the Spring.
9.68[m]	—	10/30/58	C	—	—	—	—	N		Dug well 22 feet deep.
50	120	3/58	—	10	18	3/58	.2	D		
18	38	4/19/52	J	12	—	—	—	C		See chemical analysis.
45	—	4/5/50	J	26	30	4/5/50	—	D		
60	152	8/15/48	C	50	8	8/15/48	.1	D		Reported to have gas in water.
70	—	11/23/55	J	31	5	11/23/55	—	D		
7	42	7/19/46	J	44	5	7/19/46	.1	D		
40.06[m]	—	11/18/58	J	—	5	11/18/58	—	C		
13.05[m]	—	10/15/58	S	—	—	—	—	N		
30	—	8/23/58	J	11	6	8/23/58	—	D		
25	45	3/22/48	J	19	10	3/22/48	.9	D		
5	30	4/58	—	31	30	4/58	1.2	C		
40	80	9/57	—	41	18	9/57	.4	C		
35	60	5/53	—	11	20	5/53	.8	D		
100	—	1/26/57	C	10	5	1/26/57	—	D		
30	56	6/21/58	S	24	8	6/21/58	.3	D		
17.61[m]	—	4/16/59	J	—	—	—	—	D		
40	80	8/56	S	10	20	8/56	.5	D		
40	110	3/23/54	J	11	4	3/23/54	.14	D		
35	139	3/24/59	J	20	2	3/29/59	.02	D		
43.16[m]	—	4/21/59	J	60	—	—	—	D		Field test: hardness 320 ppm.
—	—	—	N	34	—	—	—	N		Yield reported 7 gal/hr. Plugged.
30	50	12/27/56	J	20	8	12/27/56	.4	D		Field test: hardness 298 ppm.
35	235	10/58	S	23	2	10/58	—	D		
25	—	6/17/58	J	22	6	6/17/58	—	F,D		
30	—	2/15/58	J	13	6	2/15/58	—	I		
20	30	6/58	S	15	30	6/58	3	D		
6	150	3/9/58	J	20	1	3/9/58	—	D		
100	—	2/54	J	22	1	2/54	—	F		
30.7[m]	—	6/18/59	N	10	1	7/54	—	N		
—	—	—	S	—	—	—	—	F		
50	—	8/9/40	C	10?	24	8/9/40	—	C		
30	—	8/17/40	C	10	6	8/17/40	—	C		
20.81[m]	—	10/1/46	C	—	—	—	—	D,F,O		Dug well 40 feet deep. Observation well.
22.9[m]	—	12/18/56	N	—	—	—	—	N		Abandoned
42.07[m]	—	7/31/57	N	—	—	—	—	N,O		Observation well.
95	—	1905?	N	—	9	1905	—	N		Well destroyed. See Maryland Geol. Survey vol. 10, 1918, p. 465.
10	—	1917?	N	—	50	1917?	—	N		
30	60	4/55	N	21	30	4/55	1	D		
55	65	1/30/47	J	40	6	1/30/47	.6	D		
20	25	5/9/46	J	7	10	5/9/46	2.0	D		
—	—	—	N	—	—	—	—	N		
32	45	4/48	N	25	10	4/48	.8	N		
20	23	10/27/48	J	26	10	10/27/48	—	D,C		See chemical analysis.
14.6[m]	—	10/23/58	C	—	2	10/23/58	—	P,S		See aquifer test.

TABLE 42

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Bh 27	32,583	Harold Newkirk	Hoffman	1958	490	Drilled	55	6	St. Paul group
Bh 33	36,158	Cosgrove	Robison	1959	475	do	240	6	Rockdale Run
Bh 34	31,940	Mrs. Helen Dibo	Landis	1958	485	do	65	6	Pinesburg station dolomite
Bh 35	33,013	Roy C. Stine	Hoffman	1958	485	do	67	8	do
Bh 36	29,720	William A. Byers	do	1958	530	do	162	6	Martinsburg shale
Bh 37	32,270	Do	do	1958	480	do	110	6	Pinesburg station dolomite
Bh 38	32,956	Ross Mellott	do	1958	475	do	80	6	Martinsburg shale
Bh 39	3,094	William Russell	do	1948	560	do	120	6	Rockdale Run
Bh 40	11,004	L. E. Snook	Robison	1952	550	do	53	6	do
Bh 41	30,989	Donald E. Bennett	Hoffman	1958	545	do	99	6	do
Bh 42	649	D. M. Huffman	Pike	1946	485	do	51	6	Pinesburg station dolomite
Bh 43	389	E. W. Huffman	do	1946	525	do	57	6	Martinsburg shale
Bh 44	8,978	Russell Gigous	Hoffman	1951	525	do	50	6	do
Bh 45	2,408	George S. Fockler	do	1948	485	do	86	6	do
Bh 46	14,307	Ronald Knicely	do	1954	420	do	82	6	do
Bh 47	26,273	Frank Zello	do	1957	415	do	60	6	do
Bh 48	4,246	George C. Good	do	1949	490	do	66	6	do
Bh 49	29,124	C. F. Wintermeyer	do	1957	465	do	91	6	Rockdale Run
Bh 50	2,361	F. W. Higgins	do	1948	560	do	90	6	do
Bh 51	27,840	A. G. Ryon	do	1957	625	do	210	6	do
Bh 52	29,551	Marvin Bostetter	Martin	1957	570	do	90	6	do
Bh 53	—	F. W. Higgins	—	old	545	Dug & drilled	67.4	48-6	do
Bh 54	33,767	Halfway Little League	Hoffman	1959	580	Drilled	45	6	do
Bh 55	18,680	L. T. Tarbart	Teach	1955	520	do	32	6	do
Bh 56	30,037	Guy Eichelberger	do	1958	480	do	45	6	do
Bh 57	23,544	Gerald W. Doub	Hoffman	1956	515	do	150	6	do
Bh 58	32,192	Paul E. Plotner	do	1958	560	do	85	6	do
Bh 59	18,681	Robert L. Sponaugle	Teach	1955	570	do	159	6	do
Bi 1	—	Baer Bros. Cold Storage	Downin	—	575	do	137	6	Stonehenge limestone
Bi 2	—	Do	do	1904	575	do	120	4	do
Bi 3	—	Do	—	1904	575	do	151	8	do
Bi 4	—	Do	Downin	1904?	575	do	108	—	do
Bi 5	—	Potomac Edison Co.	do	1912	540	do	103	6	do
Bi 6	—	Hagerstown Ice & Storage Co.	do	1913	530	do	160	6	do
Bi 7	—	Do	do	1910	530	do	193	6	do
Bi 8	—	Cromer Silk Mills	do	1915	540	do	111	6	do
Bi 9	—	Fairchild Corporation	do	1911	540	do	281	6	do
Bi 10	—	Do	do	1913	540	do	281	6	do
Bi 11	—	Do	do	1913	540	do	326	6	do
Bi 12	—	Do	do	1911	540	do	323	6	do
Bi 13	—	Do	do	1911	540	do	910	6	do

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
34	50	11/58	N	8	2	11/58	.12	C		
33.55[m]	—	7/15/59								
65	—	4/23/59	—	8	5	4/23/59	—	D		See Table 16 for temperature.
24.13[m]	—	4/15/59								
25	—	9/12/58	C	21	27	9/12/58	—	D		
42	62	12/58	J	55	8	12/58	.4	D		
55	150	2/58	J	10	5	2/58	.05	D		
30	100	9/58	J	33	12	9/58	.17	S		
32.37[m]	—	4/15/59								
25	70	11/58	S	25	10	11/58	.2	D		
49	50	8/8/48	J	30	12	8/8/48	12	D		
23	—	10/15/52	J	25	10	10/15/52	—	D		
40	95	6/58	J	51	2.5	6/58	.04	D		
24.5	40	7/23/46	—	22	12	7/23/46	0.75	D		
32	39	5/7/46	J	22	25	5/7/46	3.57	D,C		
15	25	10/51	J	22	10	10/51	1.00	D		
25	—	3/22/48	C	40	10	3/22/48	—	F		
10	75	3/54	J	17	7	3/54	.10	D		
30	50	3/57	J	22	30	3/57	1.5	D		
32	60	7/6/49	J	19	4	7/6/49	.1	D		
10	60	11/57	—	34	30	11/57	.6	D,F		
37.67[m]	—	4/17/59								
35	50	3/27/48	J	19	10	3/27/48	.7	D		Field test: hardness 385 ppm.
58.53[m]	—	4/17/59								
90	200	8/57	J	8	20	8.57	.2	D		Field test: hardness 330 ppm.
20	—	12/28/57	J	11	15	12/28/57	—	D		
40.84[m]	—	4/22/59	N	—	—	—	—	N		
20	25	2/59	—	22	20+	3/59	—	C		
10	—	4/14/55	—	1.5	5	4/14/55	—	D		
30	35	3/15/58	J	28	6	3/15/58	—	D		
20	140	7/56	J	2	.7	7/56	—	D		
35	75	9/58	J	10	20	9/58	.5	D		
100	—	4/19/55	J	12	10	4/19/55	—	D		
—	—	—	—	14	125	6/15/44	—	C		Yield reported 200 gpm, in 1918. See Maryland Geol. Survey vol. 10, 1918, p. 464.
					35	7/24/58				
12	—	1904	—	—	150	1904	—	N		Well filled. See Maryland Geol. Survey vol. 10, 1918, p. 464
28.69[m]	—	6/15/44	—	—	125	1904	—	N		Abandoned.
40	—	1904?	—	—	75	1904?	—	N		Do
20	—	1912?	—	10	265	1912?	—	N		Do
20	—	1913	—	18	150	1913	—	N		Abandoned. See Maryland Geol. Survey vol. 10, 1918, p. 464.
20	—	1910	—	—	180	1910	—	N		Do
—	—	—	—	13	55	1915	—	N		Do
6	—	1911	—	8	200	1911	—	N		Do
8	—	1913	—	10	116	1913	—	N		Do
5	—	1913	—	5	18	1913	—	N		Do
3	—	1911	—	1.5	18	1911	—	N		Do
20	—	1911	—	20	1	1911	—	N		Do

TABLE 42

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Bi 14	—	Hagerstown Table Works	—	1910	590	Drilled	500	8	Conococheague limestone
Bi 15	—	H. M. Artz	—	—	490	Dug	32	60	Stonehenge limestone
Bi 16	6,005	Southern States Petroleum Corp.	Hoffman	1950	520	Drilled	175	6	do
Bi 17	—	State Roads Commission	—	—	570	Dug	42.8	48	do
Bi 18	—	Western Maryland R.R.	—	1940	615	Drilled	52	6	Conococheague limestone
Bi 19	5,140	Central Chemical Corp.	Hoffman	1950	618	do	318	8-6	do
Bi 20	91	Hagerstown Block Co.	do	1945	510	do	35	6	Stonehenge limestone
Bi 21	3,626	Do	do	1949	510	do	71	6	do
Bi 22	15,895	Mrs. Ridenour	Ambrose	1954	500	do	50	6	do
Bi 23	19,769	George Weddles	do	1955	500	do	35	6	do
Bi 24	15,020	William Vance	Holtzman	1954	540	do	109	6	Conococheague limestone
Bi 25	—	Bordens Ice Cream Co.	Pike	1943?	540	do	70	8	Stonehenge limestone
Bi 26	—	Victor Products Corp.	Hoffman	1941	510	do	115	8	do
Bi 27	—	Do	do	1942	510	do	103	8	do
Bi 28	—	Hagerstown Rubber Co.	do	1944	550	do	190	8?	Conococheague limestone
Bi 29	—	Superior Dairy Inc.	Pike	1940	530	do	327	6?	Stonehenge limestone
Bi 30	—	Hagerstown Dairy Co.	Hoffman	1938	530	do	211	6?	do
Bi 39	—	H. L. Warrenfeltz	—	—	575	do	200	6	Conococheague limestone
Bi 41	31,917	Allen F. Secor	Hoffman	1958	505	do	200	6	Stonehenge limestone
Bi 43	33,605	Minnich Funeral Home	do	1959	635	do	280	6	do
Bi 44	29,589	Harold Lum	do	1958	635	do	85	6	do
Bi 45	33,311	Ray S. Eshelman	do	1959	610	do	230	6	Rockdale Run
Bi 46	32,924	Josiah O. Smith	do	1958	605	do	50	6	do
Bi 47	28,782	Wood Point Gospel Church	do	1957	600	do	75	6	do
Bi 48	—	Supreme Concrete Block & Products Co.	do	1950	475	do	70	6	Conococheague limestone
Bi 49	6,799	Do	do	1950	475	do	41.1	6	do
Bi 50	17,537	Stuart Abraham	Cowan	1950	520	do	150	6	do
Bi 51	9,555	W. L. Metz	Hoffman	1955	480	do	72	6	do
Bi 52	3,097	Auto Show, Inc.	do	1952	490	do	90	6	do
Bi 53	31,378	Eston E. Fox	do	1948	460	do	105	6	Stonehenge limestone
Bi 54	32,538	George B. Hockman	do	1958	465	do	104	6	Conococheague limestone
Bi 55	29,355	James Adler	do	1958	530	do	100	6	Rockdale Run
Bi 56	33,265	Robert B. Helm	do	1957	560	do	112	6	Conococheague limestone
Bi 57	30,734	Roy Dawson	do	1958	565	do	363	6	do

—*Continued*

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
60	—	1910	—	160±	56	1910	—	N		See Maryland Geol. Survey vol. 10, 1918, p. 464.
20.34[m]	20.41[m]	6/16/44	—	—	6	6/16/44	—	D,F	52	
40	—	7/50	—	20	.5	7/50	—	C		See chemical analysis.
30.84[m]	—	12/18/56	C	—	—	—	—	N		
—	—	—	—	—	—	—	—	N		Abandoned.
30	220	2/50	T	38	45	2/50	.3	I		8 inch hole to 118 feet, 6 inch hole to 318 feet. See chemical analysis.
15	—	12/45	J	19.5	10	12/45	—	I		
20	65	3/49	S	25	10	3/49	.2	I		See chemical analysis.
22	28	7/28/54	C	22	45	7/28/54	7.5	D		
17	22	7/2/55	J	26	25	7/2/55	5.0	D		
59	60	5/54	C	53	30	5/54	3.0	N		
—	—	—	T	—	60	1943?	—	I		
—	—	—	T	20	200	1941	—	I		Driller reported well produced 400 gpm for short time. See aquifer test.
14.00	—	7/29/58	N	20	250	1942	—	N,O		See aquifer test and chemical analysis. See Table 16 for temperature.
—	—	—	T	105	235	1958	—	I		
8	—	1940	T	90	50	7/58	—	I		Reported yield 50 gpm for 15 minutes of pumping.
35–40	—	1938	T	—	1.5	1938	—	I		
—	—	—	C	—	—	—	—	D		
44.8[m]	—	9/9/58								
42	120	8/58	N	9	20	8/58	.3	D		
33.0[m]	—	3/18/59								
60	100	3/59	N	60	25+	3/59	.5	C		See Table 16 for temperature.
20	50	1/58	J	4	30	1/58	1.0	D		
40	220	1/59	S	7	1.7	1/59	.01	D		
25	45	12/58	J	10	5	12/58	.25	D		
45	65	11/19/57	J	23	30	11/19/57	1.5	D		Field test: hardness 369 ppm.
35.41[m]	—	6/15/59	J	—	—	—	—	C		
27.62[m]	—	6/16/59								
25	35	11/1/50	N	20	15	11/1/50	1.5	N		Water reported to have muddied.
47	—	2/20/55	J	127	15	2/20/55	—	D		
26.64[m]	—	6/17/59								
20	65	3/1/52	J	4	8	3/1/52	.16	D		
25	30	8/21/48	N	16	30	8/21/48	6.0	N		
25	50	7/58	S	2	30	7/58	1.2	D,F		
50	70	10/58	S	50	15+	10/58	.75	D		
50	85	12/57	—	22	20	12/57	.58	D		
73.94[m]	—	7/9/59	S	0	20	1/59	—	D		
—	—	—	—	0	—	—	—	N		Considered "dry hole" by driller.

TABLE 42

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Bi 58	—	John Young	Hoffman	1955	585	do	197	6	Conococheague limestone
Bi 59	35,634	H. M. Mullendore	do	1959	500	do	65	6	Elbrook limestone
Bi 60	5,793	Potomac Creamery	do	1950	495	do	150	6	Stonehenge limestone
Bj 1	23,587 A	David Ridenour	Smith	1956	735	Drilled	152	6	Waynesboro
Bj 3	—	Mary Oswald	Hoffman	1947	520	do	241	6	Elbrook limestone
Bj 9	—	Samuel Winters	—	—	665	Dug	40.2	48	Quaternary
Bj 10	—	John Ambrosian	—	—	655	Dug & drilled	37.6	48–6	do
Bj 11	—	William M. Parker	—	—	640	Dug	50.7	48	do
Bj 12	—	Do	—	—	650	Drilled	55.7	6	do
Bj 13	—	Isaac Miller	—	—	630	Dug	32.6	48	do
Bj 14	—	Mrs. Margaret Jacques	—	—	620	do	49.4	48	do
Bj 15	—	W. J. Graybill	—	—	600	do	31.3	48	do
Bj 16	25,429	Robert Evans	Cowan	1956	640	Drilled	200	6	Elbrook limestone
Bj 17	—	Clarence Easterday	—	—	640	Dug & drilled	200	6	Conococheague limestone
Bj 18	—	Do	—	1951	640	Drilled	250	6	do
Bj 19	—	H. E. Ridenour	—	—	615	Dug	47.3	48	Quaternary
Bj 21	—	John Needy	—	—	565	do	31.8	48	do
Bj 22	—	Henry V. Winters	—	—	600	do	28.6	48	do
Bj 23	—	Do	—	1931	600	Drilled	87	6	Tomstown dolomite
Bj 24	—	H. L. Mills	—	—	565	Dug	51.1	48	Elbrook limestone
Bj 25	—	Do	—	—	565	Drilled	250	6	do
Bj 26	26,633	Bertie Grimm	Hoffman	1957	670	do	101	5⅝	Tomstown dolomite
Bj 27	27,101	Singleton	Keyser	1957	760	do	52.5	5⅝	Quaternary
Bj 28	20,125	Clarence Widdows	Teach	1955	520	do	70	6	Conococheague limestone
Bj 29	28,381	Marshall E. Hurd	Hoffman	1957	595	do	90	6	do
Bj 30	—	Hugh A. Bowman	—	1930	605	do	220	6	do
Bj 31	18,782	Sharon W. Bowman	Ambrose	1955	670	do	55	6	Quaternary
Bj 32	—	Edwin Poffenberger	Hoffman	1950	605	do	134	6	Conococheague limestone
Bj 33	—	Charles Stotler, Jr.	—	old	580	Dug & drilled	100	48-6	do
Bj 34	35,350	Hugh A. Bowman	Robison	1959	605	Drilled	175	6	do
Bk 1	—	Western Maryland R.R.	—	—	805	do	90	6	Tomstown dolomite
Bk 2	—	Mrs. Thimple	—	—	1,600	do	41	6	Catoctin metabasalt
Bk 5	20,152	Joseph Hessong	Smith	1955	835	do	101	6	Tomstown dolomite
Bk 6	16,212	Leonard Gibbs	Martin	1954	960	do	286	6	Antietam quartzite
Bk 8	31,129	John C. Fraver	Funt	1958	1,180	do	82	6	Catoctin metabasalt
Bk 9	31,599	Doubleday Co., Inc.	Hoffman	1958	792	do	501	6	Tomstown dolomite
Bk 10	32,884	Do	do	1958	762	do	87	6–6	do
Bk 11	—	Town of Smithsburg	Cowan	—	970	do	225.5	6	Harpers
Bk 12	—	M. N. Jacques	—	1935	940	do	80	6	Antietam quartzite
Bk 13	—	H. H. Lewis	—	1943	810	do	90	6	Tomstown dolomite

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
52.09^{m}	—	9/2/58	—	30	35	1955	—	N		
31.40^{m}	60	8/6/59	S	23	30+	8/6/59	1	D		
8	75	7/50	T	19	100–600	7/50	—	C		Reported to pump dry in dry summers.
35	120	7/31/58	C	20	3	7/31/58	.04	F		See chemical analysis.
—	—	—	C	—	5–6	5/28/58	—	D		
14.14^{m}	—	10/21/58	C	—	—	—	—	N		
26.32^{m}	—	10/21/58	C	—	—	—	—	D		
28.52^{m}	—	10/21/58	J,C	—	—	—	—	D		
16.60^{m}	—	10/21/58	C	—	—	—	—	D		
28.42^{m}	—	10/21/58	C	—	—	—	—	D		Reported dry, summer of 1957.
39.63^{m}	—	10/21/58	C	—	—	—	—	D,F		
25.35^{m}	—	10/21/58	C	—	—	—	—	D		Reported dry, summer of 1957.
95	—	12/56	C	73	10–15	12/56	—	D,F		
53.09^{m}	—	10/21/58	C	—	—	—	—	D,F		
—	—	—	C	—	—	—	—	F		
27.52^{m}	—	10/21/58	J	—	—	—	—	D		
25.63^{m}	—	10/21/58	J	—	—	—	—	D,F		
19.97^{m}	—	10/21/58	N	—	—	—	—	N		
40	—	10/58	C	—	—	—	—	D,F		
39.72^{m}	—	10/21/58	C	—	—	—	—	D,C		
—	—	—	C	—	—	—	—	C		
35	100	4/57	S	26	4	4/57	—	D		
30	35	6/1/57	S	52.5	10	6/1/57	0.50	D		
43.12^{m}	—	6/15/59	J	12	7	7/31/55	—	D		
40	—	7/30/55								
50	80	9/57	J	90	15	9/57	.50	D		
70	—	1959	N	—	—	—	—	N		Yield reported inadequate. Well filled.
30	49	4/28/55	J	51	8	4/28/55	.42	D		
35	—	1959	J	—	—	—	—	D,F		
20	—	4/59	C	4	—	—	—	D,F		
23	—	7/29/59	N	16	10	7/29/59	—	D		
59.0^{m}	—	8/28/58	C	—	—	—	—	N		
—	—	—	—	—	—	—	—	D		
85	93	8/9/58	N	69	8	8/9/58	1	N		
246	250	8/28/54	C	86	2.5	8/28/54	.6	D		
15	24	6/16/58	J	44.5	30	6/16/58	3	D		
68.0^{m}	—	9/16/58	S	72	10	1958	.07	N		See aquifer test and chemical analysis. See Table 16 for temperature.
80	235	1958								
20	90	1958	T	55	300	1958	4.06	C		See aquifer test and well log. See Table 16 for temperature. Field test: iron 10.1 ppm, hardness 147 ppm, chloride 13 ppm, pH 7.
					—	—	—			
90.68^{m}	—	8/28/58	N	—	20+	10/7/58	—	N		See aquifer test and chemical analysis. See Table 16 for temperature.
—	—	—	C	—	—	—	—	D,F		
—	—	—	J	—	—	—	—	D		Supplies 3 families.

TABLE 42

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Bk 14	—	Doubleday Co., Inc.	Coop. Ground-Water Program	1958	765	Augered	4	4	Quaternary
Bk 15	—	Do	do	1958	765	do	3	4	do
Bk 16	—	Do	do	1958	765	do	3.5	4	do
Bk 18	—	City of Hagerstown	—	—	800	Drilled	435	8–6	Tomstown dolomite
Bk 19	24,889	Merle R. Pryor	Smith	1956	675	do	36	6	Waynesboro
Bk 20	33,869	H. Donald Kline	Funt	1959	1,325	do	60	6	Catoctin metabasalt
Bk 21	32,484	Jacob M. Hopkins	Hoffman	1958	1,610	do	64	6	do
Bk 22	36,726	Doubleday Co., Inc.	Kohl	1960	762	do	500	12–8	Tomstown dolomite
Cg 1	672	Pentecostal Assembly of God	Hoffman	1946	400	do	56	6	Stonehenge limestone
Cg 2	—	F. Swope	—	1900	545	do	90	6	Martinsburg shale.
Cg 3	32,560	Paul Schetrompf	Teach	1958	390	do	30	6	do
Cg 4	—	Do	do	1957	390	do	197	6	do
Cg 5	—	Potomac Fish and Game Club	Hoffman	—	470	do	97	6	do
Cg 6	—	Floyd Harrell	—	—	430	Dug	38.5	36	Conococheague limestone
Cg 7	—	Stanley Weimer	Hoffman	1957	440	Drilled	200	6	Rockdale Run
Cg 8	—	Do	do	—	435	Dug & drilled	40 190	36–6	do
Cg 9	30,036	K. Rhodes	Teach	1957	440	Drilled	200	6	Stonehenge limestone
Cg 10	25,402	Dr. William H. Ditto	Hoffman	1956	410	do	99	6	Rockdale Run
Cg 11	23,376	Leo Riffle	do	1956	380	do	237	6	Stonehenge limestone
Ch 1	—	E. E. Vickers	—	—	415	Dug	21	48	Conococheague limestone
Ch 3	—	Downsville School	Hoffman	1941	480	Drilled	300	6	Rockdale Run
Ch 4	22,192	Myron L. Bloom	do	1956	460	do	120	6	do
Ch 5	22,374	John S. Ferry	do	1956	495	do	35	6	Stonehenge limestone
Ch 9	—	Pennsylvania R.R.	—	—	450	do	85	6	Rockdale Run
Ch 10	31,944	James A. Barkwell	Hoffman	1958	520	do	165	5⅝	Stonehenge limestone
Ch 12	—	Myers	—	1957	460	do	55	6	Conococheague limestone
Ch 15	—	H. W. McCubbin	—	—	530	Dug	37	36	do
Ch 18	—	J. G. Malone	Hoffman	1954	450	Drilled	138	6	do
Ch 21	—	Ralph Delauder	—	—	425	Dug	18.1	6	do
Ch 22	—	Peter Ruffner	Pike	1950	400	Drilled	80	6	do
Ch 23	—	Lawrence Downey	—	—	370	Dug	53.5	6	Rockdale Run
Ch 24	—	John Otzelberger	—	1900	475	Drilled	100	6	Conococheague limestone
Ch 25	—	J. H. Burkholder	—	1951	450	do	268+	6	Rockdale Run
Ch 28	32,923	Charles Cavanaugh	Hoffman	1958	495	do	265	6	do
Ch 29	32,618	Glen O. Anderson	do	1958	495	do	77	6	do
Ch 30	32,699	Lawrence B. Izer	do	1958	440	do	350	6	do
Ch 31	16,708	Lewis Wingert	do	1954	430	do	76	6	Conococbeague limestone
Ch 32	30,855	Charles H. Shantz	Teach	1958	350	do	80	6	do
Ch 33	18,955	Lester Hammond	Hoffman	1955	460	do	70	6	Rockdale Run

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
—	—	—	—	—	—	—	—	T		
60	—	1900?	N	—	—	—	—	N		See well log. Well used until Edgemont Reservoir built. Abandoned.
24	30	10/8/56	J	30	8	10/8/56	1.25	D		
26.04[m]	—	6/19/59	J	27	10	3/28/59	.38	D		Field test: hardness 128 ppm.
24	50	3/28/59								
25	60	10/58	—	14	8	10/58	.23	D		
18	170	2/28/60	T	101	100	2/28/60	.6	I		
36	—	8/14/46	C	29	20	8/14/46	—	P		
—	—	—	J	—	—	—	—	D,F		
70	—	11/58	S	21	8	11/58	—	F		Have cistern. See chemical analysis.
—	—	—	N	—	—	—	—	N		
—	—	—	S	—	—	—	—	C		
35.66[m]	—	12/17/58	J	—	—	—	—	D,F		Reported dry, summer 1957.
—	—	—	S	—	—	—	—	N		
—	—	—	C	—	—	—	—	D,F		
80	85	3/12/58	J	0	6	3/12/58	—	D		Have cistern.
40	50	12/56	J	38	20+	12/56	2.0	D,F		
80	230	6/56	S	20	1	6/56	.01	D,F		
13.95[m]	—	5/10/56	J	—	4–5	5/10/56	—	D		
—	—	—	C	—	—	—	—	P		Gas reported in water.
15	30	2/23/56	S	3	30	2/23/56	2	D		
20	30	3/56	J	28	15	3/56	1.5	D		
—	—	—	C	—	4–5	10/58	—	D,I		See chemical analysis.
50	160	8/58	—	17	2	8/58	.02	D		
—	—	—	—	—	15+	4/58	—	D		
33.15[m]	—	12/4/58	C	—	—	—	—	D		Have cistern.
30	—	12/5/58	S	15	2	12/5/58	—	D,F		
12.22[m]	—	12/10/58	C	—	—	—	—	D,F		Reported never to go dry. Have cistern.
—	—	—	J	1.5	—	—	—	D,F		Have cistern.
44.88[m]	—	12/10/58	J	—	—	—	—	D,F		
70	—	12/10/58	J	—	5–7	12/10/58	—	D,F		Have cistern.
—	—	—	C	—	—	—	—	D,F		Do
—	—	—	—	—	—	—	—	N		Considered "dry hole" by driller.
30	40	11/58	—	20	25	11/58	2.5	D		
35	340	11/58	S	6	3	11/58	—	D,F		Well drilled nearly to 166 feet was considered a "dry hole."
25	50	9/54	J	18	20	9/54	.8	D,F		
40	45	6/14/58	J	44	6	6/14/58	1	D		
40	65	5/55	J	9	4	5/55	.16	D		

TABLE 42

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Ch 34	32,377	Bruce S. Saunders	Hoffman	1958	530	Drilled	55	6	Rockdale Run
Ch 35	19,496	Samuel B. Berger	do	1955	455	do	281	6	do
Ch 36	22,773	Paul E. Mills	Pike	1956	370	do	47	6	Conococheague limestone
Ch 37	24,104	Orville Kyler	Provard	1956	525	do	74	6	Rockdale Run
Ch 38	32,403	Elston E. Hess	Hoffman	1958	470	do	240	6	Conococheague limestone
Ci 1	—	Harry W. Hutson	—	1954	460	do	65	6	do
Ci 2	—	Leo Pope	Pike	1931	450	do	180	6	do
Ci 3	—	Do	do	1915	450	do	80	6	do
Ci 4	—	E. K. Bushong	—	—	490	do	78	6	do
Ci 5	—	St. Marks Church	—	1927	500	do	125	6	do
Ci 6	3,374	Fairplay School	Holland	1948	505	do	166	6	do
Ci 7	29,074	Benevola Church	do	1957	470	do	75	6	Waynesboro
Ci 8	—	Kline Brothers	—	—	445	Dug & drilled	62	6	Elbrook limestone
Ci 9	—	Manor Church	—	—	440	Dug	9.2	48	Conococheague limestone
Ci 10	—	Harry Toms, Sr.	—	—	490	Drilled	—	6	Elbrook limestone
Ci 12	26,828	Shirley S. Shifler	Teach	1957	510	do	57	6	Tomstown dolomite
Ci 13	25,132	Crider Brothers	Hoffman	1956	490	do	61	5⅜	do
Ci 14	—	C. E. Routzahn	do	—	480	do	89	6	Conococheague limestone
Ci 15	22,001	J. S. Murdock	Teach	1956	485	do	95	6	Elbrook limestone
Ci 16	28,860	R. Hutzell	do	1957	460	do	130	6	Conococheague limestone
Ci 21	33,144	U. S. Army	Sydnor	1955	490	do	303	8–6	do
Ci 22	—	Charles E. Shaffer, Jr.	—	old	490	do	230	6	do
Ci 23	—	Do	—	old	490	do	65	—	do
Ci 24	—	Do	—	—	455	Dug	32.7	60	Stonehenge limestone
Ci 25	—	David E. Baker	Hoffman	1946	495	Drilled	191	6	Conococheague limestone
Ci 26	—	Do	Cromwell	1950	490	do	128.4	6	do
Ci 27	—	Do	do	1950	480	do	41	6	do
Ci 28	—	John Griffith	—	—	465	do	110	6	Townstown dolomite
Ci 29	—	Do	—	—	465	Dug	48.3	48	do
Ci 31	—	Alvin Thumma	Hoffman	1953	525	Drilled	130	6	Conococheague limestone
Ci 32	—	Do	do	old	525	do	180	6	do
Ci 33	—	U. S. Army	do	1952	490	do	74	6	do
Ci 34	33,768	Calvin Mahaney	do	1959	480	do	65	6	do
Ci 35	22,052	George F. Stotter	do	1958	510	do	210	6	do
Ci 36	—	Leonard Embry	Pike	1954	510	do	83	6	Stonehenge limestone
Ci 37	—	Nelson Rhoton	—	old	490	do	60	6	Conococheague limestone
Ci 38	34,880	Floyd E. Miller	Hoffman	1959	505	do	120	6	do
Ci 39	34,722	Alvin Thumma	do	1959	525	do	429	6	do
Cj 3	—	Fahrney-Keedy Mem. Home	—	—	540	Dug	19.5	48	Quaternary

—*Continued*

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
30	50	9/58	J	22	12	9/58	.6	D		
60	255	7/55	S	7	10	7/55	.05	D		
32.8m	—	7/15/59	C	22	10	4/24/56	.5	D		
28	47	4/24/56								
30	40	7/3/56	—	21	20	7/31/56	2	D		
110	230	10/58	S	18	1.5	10/58	—	D		
—	—	—	C	—	—	—	—	D		
—	—	—	—	—	—	—	—	D,F		
—	—	—	—	—	—	—	—	D,F		
—	—	—	S	—	—	—	—	D		
—	—	—	J	—	—	—	—	D		
60	65	11/19/48	J	21	10	11/19/48	2	P		
50	60	10/57	—	32	20	10/57	2	P		
16.80m	—	6/6/58	J	—	—	—	—	D		
3.09m	—	6/6/58	C	—	—	—	—	P		
—	—	—	—	—	5–7	6/6/58	—	D		
30	—	5/57	—	36	6	5/57	—	D		See chemical analysis.
20	50	11/56	—	16	25	11/56	—	C		
—	—	—	—	—	—	—	—	C,D		
50	60	1/30/56	S	24	8	1/30/56	.8	D		
80	85	10/29/57	C	25	6	10/29/57	1.2	D		See chemical analysis.
46.0m	—	11/24/58	S	0–83 of 8 inch	23	11/24/58	.4	P		Do
48	108	7/55		0–125 of 6 inch						
27	—	12/58	C	—	—	—	—	N		Yield reported inadequate.
30	—	12/58	J	—	—	—	—	D,F		
15.84m	—	12/10/58	C	—	—	—	—	D,F		Reported well has never had less than 7 feet of water.
70	—	12/58	—	—	1–2	12/58	—	D,F		
66.52m	—	12/9/58	N	0	—	—	—	N		Reported to pump dry in 5 minutes.
20	—	12/58	J	—	12	12/58	—	D,F		
47.50m	—	12/10/58	J	—	—	—	—	D,F		
—	—	—	N	—	—	—	—	N		
40	—	12/58	C	—	—	—	—	D,F		Yield reported fair.
30	—	12/58	C	—	—	—	—	D,F		
—	—	—	N	—	50	1952	—	N		See chemical analysis.
35	50	3/59	S	26	20+	3/59	1.33+	D		
60	200	8/58	S	51	1	8/58	.01	C		
25	—	1954	J	17	—	—	—	D		
26.0m	—	7/17/59	C	—	—	—	—	D,F		
60	100	6/59	S	59	20	6/59	.50	D		
80	400	5/59	N	6	8	5/59	.02	D,F		See Table 16 for temperature.
6.56m	—	12/18/56	N	—	—	—	—	N		

TABLE 42

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Cj 7	2,607	Hiway Drive-In Theatre	Jos. Holland	1948	540	Drilled	98	5⅝	Tomstown dolomite
Cj 8	31,303	R. L. Morrison	Cromwell	—	600	do	123	6	do
Cj 14	31,943	Beaver Creek Country Club	Hoffman	1958	560	do	250	6¼	Elbrook limestone
Cj 15	21,045	W. R. Snyder	Cowan	1955	640	do	97	6	Antietam quartzite
Cj 16	16,818	M. S. Cadden	Ambrose	1955	680	do	85	5⅝	Quaternary
Cj 17	16,641	Appalachian Trail Inn	Easterday	1954	860	do	110	6	Antietam quartzite
Cj 18	25,869	John E. Brewbaker	Ambrose	1957	750	do	140	6	Quaternary
Cj 19	—	D. A. Stickell & Sons, Inc.	—	1954	530	do	—	6?	Waynesboro
Cj 20	—	Herschel Dean	—	—	—	Dug	41		Tomstown dolomite
Ch 21	19,700	Farmers Live stock Exchange	Hoffman	1955	520	Drilled	110	5⅝	do
Cj 22	19,977	John Reese	do	1955	520	do	138	5⅝	do
Cj 24	31,392	Ned V. Horne	Cromwell	1958	760	do	175	6	Antietam quartzite
Cj 25	24,105	John H. Miller	Shaff	1956	670	do	159	6	Tomstown dolomite
Cj 26	31,390	John E. Brewbaker	Cromwell	1958	660	do	70	6	Quaternary
Cj 27	33,520	Albert Summers	Hoffman	1959	600	do	177	6	Tomstown dolomite
Cj 28	29,982	Harold C. Beachley	do	1958	620	do	170	6	Antietam quartzite
Cj 29	31,123	William F. Lizer	do	1958	570	do	81	6	Waynesboro
Cj 30	34,748	Robert Orndorff	Shaff	1959	570	do	51	6	Tomstown dolomite
Cj 34	35,648	Beaver Creek Country Club	Hoffman	1959	540	do	84.5	6	Elbrook limestone
Cj 35	35,649	Do	do	1959	520	do	65	6	do
Dh 1	—	John Murphy	—	—	498	Dug	28.5	36	Conococheague limestone
Dh 4	—	H. E. Miller	—	old	410	Drilled	80	—	do
Dh 5	—	F. B. Bittner	Ambrose	1951	480	do	91	6	do
Dh 11	21,779	Fred Morrison	Martin	1956	430	do	527	6	do
Dh 12	33,310	Mary A. Tyne	Hoffman	1959	505	do	290	6	Elbrook limestone
Dh 13	33,917	Francis Bittner	do	1959	485	do	328	6	Conococheague limestone
Di 1	—	U. S. Dept. of Int.	—	1932	480	do	254	—	Elbrook limestone
Di 2	—	Do	—	1927	480	do	310	—	do
Di 3	21,842	Calvin F. Valentine	Ambrose	1956	415	do	65	6	Tomstown dolomite
Di 4	25,809	Walter L. Lohman	do	1957	410	do	43.5	6	do
Di 5	26,645	Clarence Miller, Jr.	Keyser	1957	610	do	100	5⅝	Catoctin metabasalt
Di 9	16,638	McClellan's Gun Club	Cromwell	1954	900	do	135	6	Antietam quartzite
Di 10	14,832	John W. Long, Sr.	do	1954	480	do	92	6	Tomstown dolomite
Di 11	—	Town of Antietam	—	old	300	Dug	13	48	Waynesboro
Di 12	—	Marvin Hohn	—	—	560	do	22.4	48	Weverton quartzite
Di 13	—	Do	Cromwell	1954	560	Drilled	66	6	do
Di 14	20,100	Howard Ebersole	Hoffman	1955	465	do	137	6	Conococheague limestone
Di 15	22,284	Richard D. Smith	Ambrose	1956	490	do	100	6	Waynesboro
Di 16	—	Do	—	old	490	Dug & drilled	85	48–6	do
Di 17	29,334	F. Raymand Scheller	Ambrose	1957	490	Drilled	75	6	Tomstown dolomite

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
5	10	5/14/48	J	20	20	5/14/48	4.0	C		
76.17^{m}	—	6/10/58	—	44	30	6/11/58	—	D		See chemical analysis.
57.0^{m}	—	9/3/58	—	11	35	8/58	.17	C		See Table 16 for Temperature.
40	240	8/58								
54	—	10/20/55	J	60	2+	10/20/55	—	D		See chemical analysis.
18	—	2/15/55	C	81	16	2/15/55	—	D		Do
70	85	10/22/54	J	75	10	10/22/54	.66	C		Do
9	120	3/57	J	130	8	3/57	.07	D,C		Also supplies 2 trailers. See chemical analysis.
—	—	—	C	—	3-4	9/58	—	C		
21.5^{m}	—	10/1/58	N	—	—	—	—	N		
45	65	7/55	S	16	20+	7/55	1.0+	C		See chemical analysis.
70	120	7/55	J	26	15+	7/55	3.0+	D,C		
30	175	7/26/58	J	44	3	7/26/58	.02	D		Field test: hardness 88 ppm.
18	—	7/21/56	J	126	25	7/21/56	—	D		
10	70	7/7/58	J	70	3	7/7/58	.05	D		
55.87^{m}	—	7/10/59	N	18	25	2/59	.25	D		
50	150	2/59								
56.62^{m}	—	7/9/59	J	40	2	2/58	.02.	D		
45	165	2/58								
46	75	6/58	J	44.5	2.5	6/58	.01	D		
20	26	5/25/59	J	18	12	5/25/59	2.0	D		
40.5^{m}	—	8/6/59	N	21.5	20	7/59	.7	C		
30	60	7/59								
25	50	7/59	N	18	10	7/59	.4	C		
25.27^{m}	—	10/22/46	B	—	—	—	—	D		
40	—	12/58	J,E	—	—	—	—	D,F		Reported never dry.
—	—	—	N	70	—	—	—	N		
145	200	4/5/56	C	32	3	4/5/56	0.05	C		See chemical analysis.
90	—	2/59	S	47	12	2/59	—	D,F		
165	250	4/59	S	50	20+	4/59	.23	D,F		
—	—	—	C	—	—	—	—	P		
—	—	—	C	—	—	—	—	P		
37	42	2/16/56	J	24	19	2/16/56	3.8	D,C		
31	—	1/15/57	—	41	24	1/15/57	—	D		
40	90	5/3/57	—	89	10	5/3/57	.2	D		See chemical analysis.
70	125	10/54	C	10	4	10/54	.07	D		
15.5	76	5/29/54	J	14	4	5/29/54	2.00	D		See chemical analysis.
10.33^{m}	—	10/1/58	N	—	—	—	—	N		Do
22.11^{m}	—	10/8/58	—	—	—	—	—	N		
—	—	—	J	—	—	—	—	D		
38	130	10/55	—	4	8	10/55	.08	D		
70	92	4/14/56	J	100	10	4/14/56	.13	D,F		
63.29^{m}	—	12/10/58	J	—	—	—	—	N		Yield reported inadequate.
15.69	—	12/10/58	J	—	8	12/13/57	.2	D,F		
18	62	12/13/57								

TABLE 42

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Di 19	26,559	Floyd Myers	Cromwell	1957	710	Drilled	57	6	Antietam quartzite
Di 21	29,004	Harry Reeder	Keyser	1957	565	do	96	6	do
Di 22	—	Max Marshall	Shaff	1953	600	do	64	6	Tomstown dolomite
Di 23	29,746	Drury Wyand	Keyser	1958	475	do	251	6	do
Di 24	—	Holmes	—	old	760	do	90	6	Weverton quartzite
Di 25	—	Donald N. Griffith	Shaff	1955	600	do	75	6	Catoctin metabasalt
Di 27	—	George Lowery	—	—	430	Dug	36.4	36	Antietam quartzite
Di 29	—	Keedysville El. School	—	—	410	Drilled	—	6?	Tomstown dolomite
Di 31	—	Town of Keedysville	Cromwell	1946–8	445	do	—	6?	do
Di 32	—	C & P Telephone Co.	—	1948	420	do	85	6	do
Di 33	—	Keith Meyers	—	old	425	do	220	6	Elbrook limestone
Di 34	30,917	George E. Fetter	Hoffman	1958	550	do	50	6	Antietam quartzite
Dj 1	—	Dept. of Forests and Parks	—	old	1,460	Drilled	400	6	Weverton quartzite
Dj 2	—	Wm. Dodson	—	—	1,070	Dug	61.3	48	do
Dj 3	2,469	Rohrersville Elementary School	Holland	1948	670	Drilled	137	5⅝	Catoctin metabasalt
Dj 4	—	E. A. Stone	—	old	540	Dug	52.5	—	Tomstown dolomite
Dj 5	13,291	Marlen Wageman	Hoffman	1953	790	Drilled	220	6	Harpers
Dj 9	—	Paul Slifer	—	—	575	Dug	33.5	48	Tomstown dolomite
Dj 10	—	Luther Slifer	—	—	570	do	57.7	48	do
Dj 11	—	Paul Miller	—	—	570	do	53.7	36	do
Dj 12	—	Mary P. Miller	—	—	650	do	38.6	36	Harpers
Dj 13	—	Harry Sines	—	1940	700	Drilled	125	6	do
Dj 14	29,356	Elwood C. House	Hoffman	1957	1,000	do	120	6	Weverton quartzite
Dj 15	26,991	Iva Angle	Shaff	1957	630	do	67	6	Catoctin metabasalt
Dj 16	—	Lloyd Poffenberger	—	—	620	do	80	6	do
Dj 17	—	George Bear	—	old	615	Dug	23.8	48	do
Dj 18	—	John Rohrer	—	old	620	do	22.6	48	do
Dj 22	32,646	V. R. Mumma	Keyser	1958	540	Drilled	78	6	Tomstown dolomite
Dj 23	29,357	George W. Zittle	Hoffman	1957	1,030	do	72	6	Harpers
Dj 24	32,156	Donald R. Dailey	do	1958	850	do	165	6	do
Dj 25	31,009	John Keedy	Shaff	1958	625	do	45	6	Catoctin metabasalt
Ei 1	12,011	William L. Lewin	Holland	1953	320	Drilled	66	5⅝	Waynesboro
Ei 2	14,627	I.B.P.O.E.W. Grand Lodge	Hoffman	1954	610	do	76	5⅝	Harpers
Ei 4	—	Camp Manadokan	do	1949	465	do	250	—	do
Ei 5	30,067	Do	do	1958	470	do	223	6	do
Ei 6	—	Myers Pool Room	—	—	366	Dug	7.8	36	do
Ei 7	33,729	George Kelbough	Harley	1959	830	Drilled	82	6	Catoctin metabasalt
Ei 11	—	L. Ebersole	—	1953	670	Dug	25.5	6	Harpers
Ei 12	—	George Jenkins	—	old	440	do	26	6	do
Ei 13	32,062	John Coulter	Keyser	1958	525	Drilled	216	6	Granitic gneiss
Ei 14	7,295	Calvin Tritapoe	do	1951	480	do	44	6	Catoctin metabasalt
Ei 15	730	Charles W. Moore	Hoffman	1946	565	do	90	6	Harpers
Ei 16	731	Harry Martin	do	1946	555	do	73	6	do
Ei 17	—	John Glenn	Shaff	1956	550	Drilled	75	6	do
Ei 18	9,833	John F. Jones	do	1952	575	do	67.5	6	do
Ei 20	—	Charles E. Ingram	—	—	540	Dug	37.6	48	do

—Continued

Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
20	55	3/20/57	—	20	4	3/20/57	.1	D		
45	60	10/57	—	96.5	10	10/57	.7	D		
12	—	12/58	C	—	—	—	—	D		
20	40	3/3/58	N	14	2	3/3/58	.1	D		
20	—	12/58	C	—	—	—	—	D		
1.0	—	12/58	J	—	—	—	—	D		Have cistern.
—	—	—	C	—	—	—	—	D		
—	—	—	C	—	—	—	—	S		
—	—	—	S	—	—	—	—	P		
55	—	1954	J	85	—	—	—	C		
30	—	12/58	C	—	—	—	—	D,F		
24.17[m]	—	7/14/59	J	14	2	7/58	.1	D		
20	40	7/58								
138	—	4/27/56	C	—	1.5	4/27/56	—	D		
41.25[m]	—	12/18/56	C	—	—	—	—	D		
34	133	5/1/48	C	5	10	5/1/48	.10	S		
33.01[m]	—	9/9/58	J	—	—	—	—	D		
85	210	10/53	J	78	1	10/53	—	D		
31.60[m]	—	12/17/58	B	—	—	—	—	D		Have cistern.
54.78[m]	—	12/17/58	J	—	—	—	—	D		
50.39[m]	—	12/17/58	B	—	—	—	—	D		Supplies two familes. Have cistern.
32.63[m]	—	12/17/58	B	—	—	—	—	D		Yield reported adequate.
30	—	Summer 1957	C	—	—	—	—	D		Yield reported adequate. Have cistern.
60	100	11/57	J	70	10	11/57	.25	D		
35	50	6/21/57	C,J	34	7	6/21/57	.5	D		
21.91[m]	—	12/19/58	J	14	—	—	—	D		Yield reported adequate.
21.31[m]	—	12/19/58	J	—	—	—	—	D		Reported to have yielded water during summer of 1930.
19.62[m]	—	12/19/58	J	—	—	—	—	D		
45	55	10/20/58	J	56	10	10/20/58	—	D		
40	65	11/57	J	36	5	11/57	0.20	D		
60	150	9/58	J	49	5+	9/58	.01	D		
38	50	6/9/58	J	22	8	6/9/58	.66	D		
20	30	4/9/53	C	31.5	20	4/9/53	2	D	55	See chemical analysis.
26	46	6/54	J	25	20	6/54	1.0	D		Do
—	—	—	C	—	—	—	—	P		
50	215	3/58	S	21	5	3/58	.03	P		See chemical analysis.
5.20[m]	—	10/1/58	—	—	—	—	—	N		
56	66	3/14/59	—	43	10	3/14/59	—	D		
—	—	—	J	—	—	—	—	D		
—	—	—	S	—	—	—	—	D		
20	216	10/2/58	J	37.5	4	10/2/58	.04	D		
20	30	1/21/51	J	12	4	1/21/51	.4	D		
30	90	12/20/46	C	35	1	12/20/46	—	D		
45	73	10/14/46	C	65	1	10/14/46	—	D		
60	—	1956	J	—	—	—	—	D		
42	47	4/21/52	—	18	10	4/21/52	2.0	D		
25.39[m]	—	12/18/58	B	—	—	—	—	D		

TABLE 42

Well number Wa-	Maryland Permit Number	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing formation
Ei 21	—	Mr. Hudson	—	—	405	Dug	10.1	48	Harpers
Ei 22	31,889	F. M. Heck	Shaff	1958	650	Dug & Drilled	165	48–6	do
Ei 24	—	G. W. Holmes	(owner)	1930	760	Dug	15.5	48	Catoctin metabasalt
Ei 25	—	Glenn Haynes	Shaff	1953	570	Drilled	43	6	Granitic gneiss
Ei 27	17,498	John Redmond	Harris	1954	730	do	60	6	Catoctin metabasalt
Ei 28	26,840	Thomas Best	Keyser	1957	510	do	64	6	Granitic gneiss
Ei 29	7,294 A	Richard Harris	du	1951	395	do	45	6	do
Ei 30	—	Donald F. Thompson	Shaff	1950	530	do	63	6	do
Ei 32	—	John Anderson	do	1955	540	do	90	6	do
Ei 33	—	J. H. Rickerds	—	old	540	do	70	6	do
Ei 34	23,105	Linford Best	Harley	1956	560	do	54	6	Catoctin metabasalt
Ei 37	—	Ralph Holbrunner	Beckley	1950	435	Dug & Drilled	66	48–6	Harpers
Ei 38	29,883	Charles W. Cordell	Cromwell	1958	645	Drilled	71	6	Catoctin metabasalt
Ei 39	33,203	Donald R. Smith	Harley	1958	520	do	66.4	6	Granitic gneiss
Ei 40	33,242	Joseph Himes	do	1959	440	do	240	6	Catoctin metabasalt
Ei 41	29,963	Leonard Higdon	Cromwell	1958	665	do	60	6	Granitic gneiss
Ei 42	33,933	Gale W. Cook	Harley	1958	400	do	40	6	Harpers
Ei 43	33,966	Lottie Crampton	Ambrose	1959	330	do	25	6	Tomstown dolomite
Ei 44	35,080	Walter S. Giffet	Harley	1959	750	do	80	6	Harpers
Ei 45	35,401	Austin Abbott	do	1959	740	do	90	6	do
Ej 1	32,347	L. C. Spielman	Cromwell	1958	700	do	150	6	Catoctin metabasalt
Ej 10	—	Everitt Daganhart	—	old	610	Dug	32.2	48	Granitic gneiss
Ej 11	—	B. G. Lapole	Keyser	1953	670	Drilled	48	6	do
Ej 12	34,479	Peter R. Hagan	Shaff	1959	650	do	62.5	6	Catoctin metabasalt
Fi 1	21,849	B & O Railroad	Myers	1956	270	Drilled	30	6	Weverton quartzite
Fi 4	—	C. Himes	Keyser	—	280	do	70.5	6	Granitic gneiss
Fi 5	—	W. L. Hughes	—	—	280	Dug	10	36	do
Fi 6	—	G. Deener	—	—	285	do	25.30	36	do
Fi 7	—	J. L. Phillips	—	—	285	do	12.0	36	do
Fi 8	37,922	Q. Norris	Cromwell	1960	285	Drilled	50.5	6	do
Fi 9	9,680	M. I. Bartlett	Keyser	1952	285	do	21.5	6	do
Fi 11	—	(unknown)	—	—	300	Dug	24.0	36	Catoctin metabasalt

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Water level (feet below land surface)			Pumping equipment	Length of casing below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date			Gallons a minute	Date				
10.05[m]	—	12/17/58	B	—	—	—	—	D		
40.41[m]	—	12/17/58	J	22	10	8/15/58	—	D		
7.48[m]	—	12/18/58	S	—	—	—	—	D		
10	—	12/58	J	—	—	—	—	D		Yield reported adequate.
36	48	1/12/54	C	22	—	—	—	D		
40	50	5/31/57	J	52	7	5/31/57	.70	D		
10	25	1/15/51	—	25	4	1/15/51	.27	D		
—	—	—	J	—	—	—	—	D		Yield reported adequate.
18.38[m]	—	12/18/58	J	—	—	—	—	D		
15	—	12/58	C	—	—	—	—	D		Yield reported adequate.
20	30	4/24/56	J	21	10	4/24/56	1.0	D		
32.27[m]	—	12/19/58	J	—	—	—	—	D		Yield reported adequate.
33	—	2/11/58	J	33	15	2/11/58	—	D		
30	50	1/3/59	N	36	8	1/3/59	.40	D		
6	175	2/28/59	J	20.5	1.5	2/28/59	.01	D		
30	60	3/7/59	C	21	2	3/7/59	.66	D		
8	30	4/4/58	J	19	2	4/4/58	.09	D		
15	—	3/13/59	J	17	5	3/13/59	—	D		
25	60	6/27/59	J	22.5	4	6/27/59	.13	D		
40	60	7/31/59	—	86	15	7/31/59	.75	D		
30	150	10/8/58	S	30	7	10/8/58	—	D		
11.88[m]	—	12/18/58	J,C	—	—	—	—	D		Yield reported adequate.
10	—	12/58	J	48	—	—	—	D		Do
23	25	5/5/59	J	29	12	5/5/59	6.0	D		
18	20	3/6/56	—	18	10	3/6/56	5	I		
—	—	—	J	—	—	—	—	D,C		
—	—	—	J	—	—	—	—	D		
—	—	—	J	—	—	—	—	D		
9.57[m]	—	5/7/60	J	—	—	—	—	D	53.5	Reported to go dry.
7.70[m]	—	5/7/60	—	—	4	2/15/60	—	D	54.5	
10	—	5/52	J	13	1	5/52	—	D		
14.90[m]	—	5/7/60	B	—	—	—	—	P	53.5	

TABLE 43

Records of Springs in Washington County

Use of water: C, commercial; D, domestic; F, farm; I, industrial; N, none; P, public supply, camp, and school.
Method of measurement: B, bucket; C, current meter; E, estimated; W, weir.

Spring number Wa-	Owner or name	Altitude (feet)	Water-bearing formation (at outlet)	Use of water	Temperature		Discharge			Remarks
					Degrees F	Date	Date of measurement	Gpm	Method of measurement	
Ab 1	Thurman Swain	630	Jennings	D	55	Jun. 17, 1958	—	—	—	
Ab 3	Albert Jerome	910	Hampshire	D,F	53	Jun. 17, 1958	Jun. 17, 1958	—	—	Reported never dry.
Ab 7	Thomas Creek	960	do	D,F	54	Jun. 17, 1958	Jun. 17, 1958	5	E	
Ab 14	George Aixon	1,000	do	D	54	Jun. 18, 1958	Jun. 18, 1958	20	E	Supplies 3 bomes.
Ab 17	R. S. Dillon	990	do	F	56	Jun. 18. 1958	Jun. 18, 1958	5	E	Flows into orchard pond.
Ab 30	Do	930	do	C	54	Jun. 25, 1958	Jun. 25, 1958	20	E	Used for orchard.
Ab 32	Samuel N. Bernard	895	do	D	—	—	—	—	—	See chemical analysis.
Ab 34	R. S. Dillon	860	do	C	53	Jun. 25, 1958	Jun. 25, 1958	2	E	"Munson spring." Used for orchard.
Ab 40	Do	580	Wills Creek shale	D	55	Jun. 26, 1958	Jun. 26, 1958	30	E	
Ac 8	Linn Munson	530	do	D,F	54	May 28, 1958	May 28, 1958	2	E	
Ac 10	Herman Dorrier	450	do	D,F	54	May 28, 1958	May 28, 1958	20	E	
Ac 11	E. M. McCorty	500	do	D	51	May 28, 1958	May 28, 1958	75	E	
Ac 12	Robert Stauffer	520	do	D	52	May 28, 1958	May 28, 1958	3	E	
Ac 13	Lem Kirk	480	Tonoloway limestone	D	52	May 28, 1958	May 28, 1958	200–300	E	
Ac 20	Felippe Cohill	580	Wills Creek shale	D	53	May 29, 1958	May 29, 1958	50	E	
Ac 21	John P. Caspar	575	do	F	—	—	May 29, 1958	10	E	Flows into orchard pond.
Ac 22	Do	550	do	F	—	—	May 29, 1958	8	E	
Ac 23	Ernest Morriss		do	D	50	May 29, 1958	May 29, 1958	4	E	
Ad 28	Frank P. Bivens	520	Romney shale	D,F	53	Jun. 11, 1958	Jun. 11, 1958	20	E	
Ae 1	John Keefer	670	Wills Creek shale	D,F	55	Jul. 17, 1958	Jul. 17, 1958	3	E	
Ae 20	J. B. Murray	420	Helderberg limestone	—	59	Jul. 15, 1958	Jul. 15, 1958	400–500	E	
Ae 27	Game and Inland Fish. Comm.	575	do	D	52	Jul. 16, 1958	Jul. 16, 1958	5	E	
Ae 28	George Hose	630	do	D	55	Jul. 16, 1958	Jul. 16. 1958	2	E	

Ae 29	John Halser	635	do	D	53	Jul. 16, 1958	Jul. 16, 1958	15	E	
Ae 30	The Darby Co.	570	Wills Creek shale	C,D	53.5	Jul. 17, 1958	Jul. 17, 1958	50	E	
Af 6	Jim Deeds	690	Rose Hill	D	54	Nov. 20, 1958	Nov. 20, 1958	10	E	
Af 7	John Rohver	675	McKenzie	D	55	Nov. 20, 1958	Nov. 20, 1958	5	E	
Af 10	Howard Snyder	750	Martinsburg shale	D	55	Nov. 20, 1958	Nov. 20, 1958	10	E	
Af 11	C. G. Bragunier	740	do	D	55	Nov. 20, 1958	Nov. 20, 1958	2	E	
Af 13	T. R. Bragunier	815	do	D	54	Nov. 20, 1958	Nov. 20, 1958	2	E	
Af 14	John Sword	695	do	D	54	Nov. 20, 1958	Nov. 20, 1958	2	E	
Af 15	Earl Repp	960	do	D	55	Nov. 20, 1958	Nov. 20, 1958	1	E	
Af 17	Chester Ernest	575	Elbrook limestone	D,F	54	Nov. 20, 1958	Nov. 20, 1958	50	E	
Af 21	Camp Singewald	740	Wills Creek shale	P	—	—	—	—	—	Small flow.
Ag 1	Dennis Water Cress Co.	395	Chambersburg limestone	C	53	May 23, 1958	May 23, 1958	2,430	C	See Table 5 for additional discharge records, figure 10 for hydrograph, and figure 11 for temperatures.
Ag 2	R. Leon Cushwa	500	Stonehenge limestone	C	52.5	May 23, 1958	May 23, 1958	1,050	C	See Table 5 for additional discharge records and figure 10 for hydrograph. Used for growing water cress. See chemical analysis.
Ag 12	Lloyd E. Clark	630	Conococheague limestone	D,F	54	Nov. 20, 1958	Nov. 20, 1958	25	E	
Ag 17	Adrian Faith	680	Elbrook limestone	D,F	55	Nov. 21, 1958	Nov. 21, 1958	100	E	
Ag 23	Tom Seibert	570	Conococheague limestone	D	55	Nov. 21, 1958	Nov. 21, 1958	10	E	
Ag 24	Do	635	do	N	56	Nov. 21, 1958	Nov. 21, 1958	100	E	
Ag 29	John Roney	490	Rockdale Run	F,D	54	Apr. 30, 1959	Jun. 23, 1959	210	C	See Table 5 for additional discharge records.
Ag 30	Do	490	do	F,D	—	—	Feb. 13, 1959	75	E	
Ag 31	Robert K. Fiery	475	St. Paul group	F,D	—	—	Feb. 13, 1959	200	E	
Ah 9	G. Troupe	445	St. Paul group	N	52.5	May 23, 1958	May 23, 1958	200–300	E	Field test: iron 0 ppm, hardness 248 ppm, chloride 12 ppm, pH 7.
Ah 10	Do	445	do	D,F	52.5	May 23, 1958	May 23, 1958	200–300	E	Field test: hardness 270 ppm, cbloride 14 ppm, pH 7.
Ah 11	Stanley Schetrompf	400	Chambersburg limestone	F	54	May 23, 1958	May 23, 1958	100–150	E	
Ab 32	Jonas Horst	498	Rockdale Run	D	55	Oct. 30, 1958	—	—	—	
Ah 33	Edgar Keener	498	do	D	55	Oct. 30, 1958	Nov. 12, 1958	240	C	Discharge includes -Ah 32 and -Ah 76. See Table 5 for additional discbarge records and figure 9 for hydrograpb. Field test: bardness 263 ppm, chloride 13 ppm, pH 7.

TABLE 43—*Continued*

Spring number Wa-	Owner or name	Altitude (feet)	Water-bearing formation (at outlet)	Use of water	Temperature: Degrees F	Temperature: Date	Discharge: Date of measurement	Discharge: Gpm	Discharge: Method of measurement	Remarks
Ah 50	Amos A. Miller	580	Rockdale Run	D,C	54	Apr. 17, 1959	Apr. 17, 1959	100	E	
Ah 51	John Peachey	585	do	D,F	53.5	Apr. 17, 1959	Apr. 17, 1959	50	E	
Ah 62	Victor Beard	475	Martinsburg shale	—	—	—	—	—	—	Field test: hardness 58 ppm.
Ah 64	Mongan	520	do	F,D	—	—	—	—	—	Field test: hardness 374 ppm. Small flow.
Ah 65	Reuben Eby	485	Rockdale Run	F,D	50.5	Jun. 12, 1959	Jun. 12, 1959	200	E	
Ab 66	Do	475	do	F,D	51.5	Jun. 12, 1959	—	—	—	
Ah 67	Do	475	do	F,D	—	—	—	—	—	Small flow.
Ah 75	Roy Sowers	565	do	F,D	52.5	Jun. 12, 1959	Jun. 12, 1959	175	E	
Ah 76	Robert Martin	500	do	F,D	—	—	May 7, 1960	10–15	E	
Ai 10	Walter L. Martin	595	Conococheague limestone	F	54	Sept. 29, 1958	Oct. 24, 1958	290	C	Zone of 4 springs went dry summer 1958. See Table 5 for additional discharge records, figure 9 for hydrograph, and figure 11 for temperature. Field test: iron 0 ppm, hardness 244 ppm, chloride 10 ppm, pH 7.1.
Ai 12	Rest Haven Cemetery	594	do	N	53.5	Aug. 29, 1958	Oct. 17, 1958	115	C	See Table 5 for additional discharge records.
Ai 20	R. Paul Smith	580	do	F	—	—	Sept. 17, 1958	50	E	See chemical analysis.
Ak 3	Elvin R. Gelvin	645	Tomstown dolomite	D	49	Mar. 5, 1959	Jun. 12, 1958	1,610	C	Field test: iron 0.1 ppm, hardness 110 ppm, chloride 7 ppm, pH 7.5. See Table 5 for additional discharge records.
Ak 4	Zecher	640	do	D	52.5	Mar. 5, 1959	Jun. 5, 1958	50–100	E	Field test: iron 0.1 ppm, hardness 1 ppm, chloride 6 ppm, pH 7.5.
Ak 5	R. A. Henson	646	do	D	53	Apr. 17, 1959	Apr. 17, 1959	175	W	Field test: iron 0.1 ppm, hardness 175, chloride 5 ppm, pH 7.2. See Table 5 for additional discharge records and figure 9 for hydrograph.

Ak 6	Dept. of Defense	1,632	Catoctin metabasalt	N	—	—	Sept. 18, 1958	2-3	E	See figure 7 for hydrograph. See chemical analysis.
Ak 7	Do	1,604	do	N	50	Jan. 5, 1960	Sept. 18, 1958	10	E	See figure 7 for hydrograph. See chemical analysis.
Bb 12	Tonoloway Rod & Gun Club	710	Romney shale	D	54	Jun. 25, 1958	Jun. 25, 1958	30	E	
Be 30	Fort Frederick State Park	400	Quaternary	P,S	54	Nov. 18, 1958	Nov. 18, 1958	1	E	
Be 31	C. A. Snyder	540	Helderberg limestone	N	52	May 7, 1960	May 7, 1960	50	E	One of "Indian Springs."
Be 32	Do	540	do	D,C	52.5	May 7, 1960	May 7, 1960	20–30	E	Do
Bf 2	Town of Clear Spring	720	Oriskany sandstone	P	55	May 9, 1956	May 9, 1956	45	B	Collection of 2 springs. See chemical analysis.
Bf 3	LeRoy P. Clark	431	Conococheague limestone	D	53.5	May 26, 1958	May 26, 1958	1,100	C	See Table 5 for additional discharge records and figure 10 for hydrograph. See chemical analysis.
Bf 6	J. C. Montgan		Oriskany sandstone	F,D	54.5	Apr. 25, 1958	Apr. 25, 1958	235	C	See Table 5 for additional discharge and temperature records.
Bf 7	Stephen C. Sandala	1,200	Rose Hill	N	52	Jun. 3, 1958	Jun. 3, 1958	15–20	E	
Bf 8	Mrs. Cearfoss	1,300	Tuscarora sandstone	N	—	—	Jun. 3, 1958	30	E	
Bf 16	Green Spring Water Co.	490	Romney shale	C	—	—	—	—	—	
Bf 20	Toston		Conococheague limestone	N	52	May 6, 1959	May 6, 1959	400	E	
Bf 24	Town of Clear Spring	570	do	N	53	May 7, 1960	May 7, 1960	10–15	E	Original "Clear Spring."
Bg 13	Paul C. Reid	510	Rockdale Run	D,F	54.5	Nov. 13, 1958	Nov. 13, 1958	25	E	
Bh 13	B. I. Everly	370	do	D,F	52	Jun. 6, 1958	Jun. 6, 1958	150	E	
Bh 14	Wallace Taylor	420	do	N	52	Jun. 6, 1958	Jun. 6, 1958	400–500	E	
Bh 15	F. Nelson Drury	410	do	D,F	51.75	Jun. 6, 1958	Jun. 19, 1958	210	C	
Bh 16	S. Palmer	370	do	D,F	52	Jun. 6, 1958	Jun. 6, 1958	150–200	E	
Bh 18	W. D. Bryon & Sons, Inc.	375	do	I	54	Nov. 6, 1958	Nov. 6, 1958	150	E	
Bh 19	Taylor	380	do	I	54	Nov. 6, 1958	Nov. 6, 1958	250	E	See chemical analysis
Bh 20	Town of Williamsport	380	do	N	54	Nov. 6, 1958	Nov. 11, 1958	65	C	
Bh 21	James E. Byron	315	do	D,F	—	—	—	—	—	
Bh 23	Paul Thomas	540	do	D,F	54	Nov. 6, 1958	—	—	—	
Bh 24	Richard Doub	470	do	D,F	54	Nov. 6, 1958	Nov. 6, 1958	<25	E	
Bh 25	Paul Anderson	475	Stonehenge limestone	D,F	53	Nov. 6, 1958	Nov. 6, 1958	50	E	
Bh 26	Do	485	Rockdale Run	F	53	Nov. 6, 1958	Nov. 6, 1958	50–75	E	
Bh 28	Sam Shonk	543	Conococheague limestone	D	55	Dec. 4, 1958	Dec. 4, 1958	100–150	E	See Table 5 for additional discharge records.
Bh 29	Do	543	do	N	54	Dec. 4, 1958	Dec. 4, 1958	150	E	Do
Bh 30	Do	543	do	N	54.5	Dec. 4, 1958	Dec. 4, 1958	100	E	Do

TABLE 43—*Continued*

Spring number Wa-	Owner or name	Altitude (feet)	Water-bearing formation (at outlet)	Use of water	Temperature		Discharge			Remarks
					Degrees F	Date	Date of measurement	Gpm	Method of measurement	
Bh 31	John Landis	543	do	D,F	54	Dec. 4, 1958	Dec. 4, 1958	50–75	E	See Table 5 for additional discharge records
Bh 32	Do	545	do	N	54.5	Dec. 4, 1958	Dec. 4, 1958	30–40	E	Do
Bi 31	City of Hagerstown	490	Stonehenge limestone	N	55.5	Jul. 30, 1958	—	—	—	Combined discharge of -Bi 31 and -Bi 32 21 gpm. Sept. 4, 1958. See aquifer test.
Bi 32	Do	490	do	N	56	Jul. 30, 1958	—	—	—	
Bi 33	Do	550	do	N	54	Jul. 30, 1958	—	—	W	See Table 5 for combined discharge records of Bi 33–Bi 37
Bi 34	Do	542	do	N	54	Jul. 30, 1958	—	—	W	Do
Bi 35	Do	540	do	N	53.5	Jul. 30, 1958	—	—	W	Do
Bi 36	Do	535	do	N	56	Jul. 30, 1958	—	—	W	Do
Bi 37	Do	540	do	N	54.5	Jul. 30, 1958	—	—	W	Do
Bi 38	Do	490	do	N	54	Aug. 5, 1958	Aug. 5, 1958	50–60	E	
Bi 40	Sam Pashen	469	Elbrook limestone	D,F	53	May 15, 1958	Jan. 22, 1959	970	C	See Table 5 for additional discharge records and figure 11 for temperatures. Field test: iron 0 ppm, hardness 298 ppm, chloride 12 ppm. pH 7.0.
Bi 42	City of Hagerstown	540	Stonehenge limestone	D	56	Jan. 29, 1959	Jul. 29, 1958	72	C	See Table 5 for additional discharge records.
Bj 2	unknown	645	Tomstown dolomite	F	54	Mar. 12, 1958	Mar. 12, 1958	200–300	E	See chemical analysis.
Bj 4	Beaver Creek Hatchery	505	Elbrook limestone	P	53	Oct. 16, 1960	Jun. 25, 1958	3,300	C	See Table 5 for additional discharge records and plate 7 for hydrograph. See chemical analysis.
Bj 5	Artz	510	do	F,D	54	Jun. 15, 1958	Jun. 15, 1958	150	B	Dry—late summer of 1958.
Bj 6	Mt. Aetna Acad.	715	Wererton quartzite, Harpers formation, and Antietam quartzite	P	54.5	May 21, 1958	May 21, 1958	400–500	E	Combined discharge of about 12 springs

Bj 7	Harry English	590	Tomstown dolomite	F,D	51	Feb. 16, 1959	Jun. 12, 1958	300	E	See chemical analysis.
Bj 8	Beaver Creek Hatchery	505	Elbrook limestone	P	—	—	Mar. 9, 1959	75–100	E	
Bj 20	T. H. Beck	590	Tomstown dolomite	D	56	Oct. 21, 1958	—	—	—	
Bj 35	Harry English	589	do	F,D	53	Feb. 16, 1959	—	—	W	See Table 5 for additional discharge records. Field test: iron 0 ppm, hardness 137 ppm, chloride 10 ppm pH 7.2.
Bj 36	Do		do	F,D	51	Feb. 16, 1959	Feb. 16, 1959	50	E	
Bj 37	Do	589	do	F,D	52	Feb. 16, 1959	—	—	W	See Table 5 for additional discharge records.
Bj 38	Do		do	F,D	52	Feb. 16, 1959	Feb. 16, 1959	15	E	
Bk 3	Barth Spring	1,000	Harpers	D	—	—	Mar. 12, 1958	50–75	E	See chemical analysis
Bk 4	Diffendahl		do	N	51	Mar. 21, 1958	Mar. 12, 1958	100–150	E	Do
Bk 7	City of Hagerstown	960	do	P	—	—	Apr. 17, 1959	3,500	C	Combined discharge of many small springs feeding Raven Rock Run.
Bk 17	Do	980	Catoctin metabasalt	P	—	—	—	—	W	Combined discharge of many small springs. See figure 4 for hydrograph Field test: iron 0 ppm, hardness 24 ppm, chloride 6 ppm, pH 7.
Ch 2	St. James School	490	Conococheague limestone	P	54	May 29, 1958	May 29, 1958	860	C	See Table 5 for additional discharge records and figure 9 for hydrograph. See chemical analysis.
Ch 6	Henry Dellinger	410	Rockdale Run	F,D	53	Jun. 6, 1958	Jun. 6, 1958	75–100	E	Reported dry during July 1955
Ch 7	Harshman	425	do	F,D	53.5	Jun. 6, 1958	Jun. 24, 1959	140	C	See Table 5 for additional discharge records and figure 9 for hydrograph. See chemical analysis.
Ch 8	Daniel H. Downey	482	Stonehenge limestone	F,D	52.5	Jun. 6, 1958	Jan. 15, 1959	150	C	See Table 5 for additional discharge records.
Ch 11	Clyde Myers	430	Conococheague limestone	F,D	54	Dec. 2, 1958	Dec. 2, 1958	300	E	
Ch 13	Robert Knippenberger	410	Stonehenge limestone	F,D	54	Dec. 2, 1958	Dec. 2, 1958	100	E	Reported never dry.
Ch 14	Courtney Myers	412	do	N	—	—	Dec. 2, 1958	150	E	Reported gone dry summer of 1957.
Ch 16	S. H. Witmer	430	do	F	55.5	Dec. 5, 1958	Dec. 5, 1958	30–40	E	
Ch 17	J. G. Malone	425	Conococheague limestone	F	53.5	Dec. 5, 1958	Dec. 5, 1958	40	E	
Ch 19	Do	420	do	D	53.5	Dec. 5, 1958	Dec. 5, 1958	30–40	E	
Ch 20	J. C. Houser	430	do	F,D	54.5	Dec. 5, 1958	Dec. 5, 1958	100–150	E	Reported gone dry summer of 1957.
Ch 26	U. S. Dept. of Interior	303	do	N	53.5	Dec. 11, 1958	Dec. 12, 1958	960	C	See Table 5 for additional discharge records.

TABLE 43—*Continued*

Spring number Wa-	Owner or name	Altitude (feet)	Water-bearing formation (at outlet)	Use of water	Temperature: Degrees F	Temperature: Date	Discharge: Date of measurement	Discharge: Gpm	Discharge: Method of measurement	Remarks
Ch 27	K. Bloyer	425	Rockdale Run	F,D	—	—	Dec. 17, 1958	100	E	"Natural Well."
Ci 11	Hubert Toms	442	Elbrook limestone	F,D	53.5	May 20, 1958	Aug. 26, 1958	870	C	See Table 5 for additional discharge records and Plate 7 for hydrograph Field test: iron 0 ppm, hardness 303 ppm, chloride 12 ppm, pH 7.
Ci 17	E. A. Eakle	445	Conococheague limestone	F,D	55	Dec. 5, 1958	Dec. 5, 1958	50–75	E	Reported to go dry during droughts.
Ci 18	Do	440	do	F	55	Dec. 5, 1958	Dec. 5, 1958	20–30	E	
Ci 19	Do	430	do	F	54.5	Dec. 5, 1958	Dec. 5, 1958	30–50	E	
Ci 20	C. T. Poffenberger	440	do	F,D	54	Jan. 1, 1959	Jan. 1, 1959	85	C	
Ci 30	George Schlosser	410	Waynesboro	D	51	Dec. 9, 1958	Dec. 9, 1958	50	E	
Cj 1	Black Rock Hotel #1	1,540	Weverton quartzite	P	—	—	Jun. 20, 1954	3–5	E	
Cj 2	Black Rock Hotel #2	1,500	do	P	—	—	Jun. 20, 1954	20–25	E	
Cj 4	Fahrney-Keedy Mem. Home	780	Harpers	D	—	—	Dec. 18, 1956	75–100	E	
Cj 5	County Orphan's Home	520	Tomstown dolomite	N	54	Mar. 4, 1957	Dec. 18, 1956	200–300	E	Observation spring Jan. 1957 to Jan. 1960. Dry Nov. 1957. Temperature range 57.5°F to 47.0°F.
Cj 6	Warrenfeltz	528	do	P	—	—	Jul. 28, 1959	150	C	See Table 5 for additional discharge records.
Cj 9	Roy C Wegley	490	Elbrook limestone	D,F	—	—	Jun. 6, 1958	10–12	E	
Cj 10	C. H. Cosens	531	Tomstown dolomite	D	53.5	May 21, 1958	May 26, 1959	950	C	See Table 5 for additional discharge records and Plate 7 for hydrograph. Field test: iron 0 ppm, hardness 133 ppm, chloride 11 ppm, pH 7.5.
Cj 11	Do	520	do	D,F	53	May 21, 1958	May 21, 1958	150	E	
Cj 12	Town of Boonsboro	900	Harpers	P	51	May 22, 1958	May 22, 1958	32.5	B	"Snively Spring."
Cj 13	Do	800	do	P	—	—	May 22, 1958	200–300	E	"Smith Spring."
Cj 23	Alfred Papa	535	Tomstown dolomite	D	54	Mar. 24, 1959	Mar. 24, 1959	565	C	"Black Rock Spring."
Cj 31	H. V. Davis	515	do	F	49.5	Dec. 11, 1958	Dec. 11, 1958	300–400	E	

Cj 32	Town of Boonsboro	820	Harpers	P	54.5	Aug. 12, 1959	Aug. 12, 1959	10	B	"Monument Spring."
Cj 33	Do	820	do	P	51.5	Aug. 12, 1959	Aug. 12, 1959	10	E	"Mint Spring."
Dh 2	U. S. Dept. of Interior	300	Conococheague limestone	D	54	Dec. 11, 1958	Dec. 11, 1958	250–300	E	
Dh 3	Do	340	do	P	49	Dec. 11, 1958	Dec. 11, 1958	15–20	E	Reported to go dry.
Dh 6	L. P. Morgan	355	do	P	54	Dec. 11, 1958	Dec. 11, 1958	30–40	E	Reported dry summer of 1957.
Dh 7	Conococheague Sportsmen's Club	320	Elbrook limestone	C	53.5	Dec. 16, 1958	Dec. 16, 1958	15	E	
Dh 8	Col. Sbipper	320	do	D,F	54.75	Dec. 16, 1958	Dec. 16, 1958	150	E	"Lime Mill Spring."
Dh 9	unknown	310	do	—	—	—	Dec. 18, 1958	100	E	
Dh 10	J. W. Shaw	335	do	P	54.5	Dec. 16, 1958	Dec. 16, 1958	150	E	Spring used by about 10 families.
Di 6	Mrs. H. Remsburg	374	Tomstown dolomite	P	54	May 22, 1958	Aug. 26, 1959	880	C	See Table 5 for additional discharge records and Plate 7 for hydrograpb. Field test: iron 0 ppm, bardness 222 ppm, chloride 11 ppm, pH 7.2. See figure 11 for temperatures.
Di 7	Taylor	380	do	D	54.5	May 22, 1958	May 22, 1958	300–500	E	
Di 8	Town of Sharpsburg	405	Conococheague limestone	C,D	54.5	Aug. 12, 1958	Apr. 29, 1959	145	C	See Table 5 for additional discharge records and Plate 7 for hydrograph. Field test: iron 0 ppm, hardness 248 ppm, chloride 14 ppm, pH 7.0, See figure 11 for temperatures.
Di 18	Lester Shimp	340	Tomstown dolomite	D,F	54	Dec. 10, 1958	Dec. 10, 1958	25	E	
Di 20	J. B. Wagner	465	Elbrook limestone	D	53	Dec. 11, 1958	Dec. 11, 1958	100	E	
Di 26	Roy Reeder	420	Antietan quartzite	N	—	—	Dec. 17, 1958	100–200	E	
Di 28	M. D. Kefauver	450	Conococheague limestone	D,F	—	—	Dec. 18, 1958	100–150	E	Reported never dry.
Di 30	R. B. Taylor	375	Tomstown dolomite	N	54.5	Dec. 18, 1958	Dec. 18, 1958	300	E	
Di 35	W. D. Dorsey	370	do	D,F	54.5	Aug. 6, 1959	Aug. 6, 1959	20	E	
Di 36	W. L. Griffith	320	Elbrook limestone	D,F	54.5	Aug. 6, 1959	Aug. 6, 1954	2	E	
Di 37	Albert Sinnisen	430	Tomstown dolomite	D,F	54.5	Dec. 11, 1958	Dec. 11, 1958	40	E	
Di 38	Do	440	do	D,F	52.5	Dec. 11, 1958	Dec. 11, 1958	30–40	E	
Dj 6	M. E. Munson	950	Harpers	D	54	Dec. 11, 1958	Dec. 11, 1958	20	E	
Dj 7	Loy Zittle	990	do	D	—	—	Dec. 11, 1958	20	E	
Dj 8	Harold Haynes	650	do	D	51	Dec. 11, 1958	Dec. 11, 1958	10	E	
Dj 19	R. E. Botts	475	Tomstown dolomote	D,F	54	Dec. 19, 1958	Dec. 19, 1958	75–100	E	
Dj 20	John Lowery	465	do	D,F	54	Dec. 19, 1958	Dec. 19, 1958	75–100	E	
Dj 21	Biser	450	do	D	50	Dec. 19, 1958	Dec. 19, 1958	10	E	
Ei 3	Camp Manadokan	400±	Harpers	P	—	—	Oct. 1, 1958	<2	E	

TABLE 43—*Continued*

Spring number Wa	Owner or name	Altitude (feet)	Water-bearing formation (at outlet)	Use of water	Temperature: Degrees F	Temperature: Date	Discharge: Date of measurement	Discharge: Gpm	Discharge: Method of measurement	Remarks
Ei 8	Tom Jones	505	Granitic gneiss	D,F	—	—	Dec. 12, 1958	20	E	
Ei 9	John Coulter	575	Catoctin metabasalt	D,F	52	Dec. 12, 1958	Dec. 12, 1958	35	E	
Ei 10	Marvin Jones	540	do	D,F	53	Dec. 12, 1958	Dec. 12, 1958	5	E	
Ei 19	John Ingram	535	Harpers	D	52	Dec. 17, 1958	Dec. 17, 1958	10	E	Supplies 2 homes.
Ei 23	A. N. Gifft	680	do	D	51	Dec. 17, 1958	Dec. 17, 1958	2	E	
Ei 26	Fred. Younkins	605	Granitic gneiss	D	54	Dec. 18, 1958	Dec. 18, 1958	2	E	
Ei 31	Robert Wheeler	510	do	D	52	Dec. 18, 1958	Dec. 18, 1958	10	E	
Ei 35	Howell G. Pierce	315	Tomstown dolomite	D	52	Dec. 19, 1958	Dec. 19, 1958	10	E	
Ei 36	Larry Knight	440	Harpers	D	51	Dec. 19, 1958	Dec. 19, 1958	3	E	
Ej 2	Mrs. Walter Brown	540	Granitic gneiss	D	53	Dec. 11, 1958	Dec. 11, 1958	15	E	Supplies several bomes.
Ej 3	James Sier	660	Catoctin metabasalt	D	53	Dec. 11, 1958	Dec. 11, 1958	20	E	
Ej 4	Town of Brunswick	588	Catoctin contact	P	54.5	Dec. 11, 1958	Dec. 11, 1958	15–20	E	
Ej 5	Do	588	do	P	—	—	Jan. 8, 1958	170	W	"Yourtee Spring." Principal source of water for Brunswick. See Table 5 for additional discharge records.
Ej 6	Norman Spielman	610	Granitic gneiss	P	53	Dec. 18, 1958	—	—	—	Supplies about 10 homes.
Ej 7	unknown	570	do	D	53	Dec. 18, 1958	Dec. 18, 1958	10	E	Supplies 4 bomes.
Ej 8	Stanley Haines	640	do	D	52	Dec. 18, 1958	Dec. 18, 1958	10	E	
Ej 9	John Vogt	670	do	D	53	Dec. 18, 1958	Dec. 18, 1958	15	E	
Fi 2	Alpha Mumau	450	do	D	53	Dec. 12, 1958	Dec. 12, 1958	15	E	
Fi 3	B & O Railroad	270	Weverton quartzite	D	62.5	Sept. 1, 1959	Sept. 1, 1959	5	E	
Fi 10	M. Scarlett	285	Granitic gneiss	D	53	May 7 1960	May 7, 1960	20	E	Supplies 11 homes. Reported never dry.

TABLE 44

Drillers' Logs of Wells in Allegany and Washington Counties

	Thickness (feet)	Depth (feet)
All-Ac 16; P 21,262 (Altitude: 1,450 feet)		
Quaternary system:		
Alluvial mountain wash:		
Clay and boulders	38	38
Pennsylvanian system:		
Conemaugh formation:		
Shale, blue	22	60
Clay, fine, hard	55	115
Sandstone, hard, gray	45	160
Coal	3	163
Slate, black, water, 5 gpm	41	204
Sandstone, white	86	290
Clay, fine	35	325
Sandstone, very hard, blue	45	370
Shale, soft, blue, water, 4 gpm	38	408
Sandstone, gray	42	450
Coal	4	454
Slate, black	21	475
Shale, sandy, gray, water	25	500
All-Bd 29 (Altitude: 655 feet)		
Quaternary system:		
Alluvium:		
Clay and gravel	18	18
Boulders	2	20
Mud, wet	8	28
Mud, soft, gray	12	40
Silurian system:		
Rose Hill formation:		
Shale, green and gray	35	75
Slate, hard	23	98
Slate and mud seams	12	110
Slate	11	121
Limestone, green	2	123
Slate, gray, and mud seams	120	243
Slate, solid, brown	13	256
Mud, brown	4	260
Slate, green	13	273
Slate, gray	7	280
Mud, gray	6	286
Slate, green	14	300
Slate, gray	7	307
Slate, dark-gray	38	345
Iron oxide and mud seams (Cresaptown iron sandstone)	21	366
Rock, gray	11	377
Slate, green	3	380

TABLE 44—*Continued*

	Thickness (feet)	Depth (feet)
Mud, gray with pieces of green slate	40	420
Slate, dark-gray	10	430
Slate, green	42	472
Sandstone, dark-gray	14	486
Shale with streaks of hard iron oxide	12	498
Tuscarora sandstone:		
Sandstone, hard, gray	382	890
Ordovician system:		
Juniata formation:		
Sandstone, hard, red	10	890
Sandstone, crystalline, black	20	910
Sandstone, hard, fine-grained, red	42	952
All-Cb 4; P 14,379 and 18,190 (Altitude: 2,100 feet)		
Pennsylvanian system:		
Allegheny and Pottsville formations undifferentiated:		
No record	203	203
Clay, fine	8	211
Soapstone	31	242
Clay, fine	26	268
Slate, black, and coal	7	275
Slate, sandy, black	22	297
Clay, fine	25	322
Coal	1	323
Soapstone, white	15	338
Clay, fine	27	365
Sandstone, hard	3	368
Clay, fine	11	379
Sandstone, hard	36	415
Sandstone, soft	19	434
Coal and slate	3	437
Sandstone, hard	13	450
Slate, sandy, black	7	457
Clay, fine	14	471
Soapstone, white	32	503
Slate, gray	14	517
Sandstone, white	71	588
Clay, fine	38	626
Soapstone, white	22	648
Mississippian system:		
Mauch Chunk shale:		
Shale, red	35	683
Slate, gray	8	691
Shale, red	42	733
Sandstone, red	37	770
Shale, red	115	885
Slate, gray	24	909

TABLE 44—*Continued*

	Thickness (feet)	Depth (feet)
Sandstone, flinty, light-gray	91	1,000
Sandstone, gray	32	1,032
Soapstone, white	16	1,048
Rock, clayey, red	152	1,200
Limestone, blue	14	1,214
Soapstone, white	22	1,236
Rock, clayey, red	3	1,239
Sandstone, red	3	1,242
Rock, clayey, red	3	1,245
Rock, sandy, red	2	1,247
Rock, clayey, red with gray streaks	40	1,287
Sandstone, hard, brown	18	1,305
Shale, sandy, red	49	1,354
All-Da 7 (Altitude: 941 feet)		
Recent:		
Fill	10	10
Quaternary system:		
Alluvium:		
Rock and boulders, light-yellow	7	17
Sandstone, light-gray	3	20
Rock, light-yellow	4	24
Pennsylvanian system:		
Allegheny and Pottsville formations undifferentiated:		
Sandstone, light-gray	10	34
Slate, black	17	51
Slate, light-gray, and clay seams	9	60
Coal and slate, black	8	68
Slate, black	69	137
Sandstone, dark-gray	68	205
Sandstone, light-gray	4	209
Slate, dark-gray and black	32	241
Sandstone, light-gray	29	270
Sandstone and flint, dark-gray	1	271
Mississippian system:		
Mauch Chunk shale:		
Slate, dark-gray	7	278
Slate, light-gray	6	284
Slate, sandy, light-gray	7	291
Slate, light-gray	7	298
Slate, sandy, light-gray	22	320
Slate, light-red, with iron ore and clay seams	18	338
Slate, light-gray, with gray clay seams	11	349
Slate, light-red, and clay seams	5	354
Slate, light-red, with red clay seams	115	469
Slate, sandy, light-gray, and clay seams	13	482
Slate, light-red	28	510

TABLE 44—*Continued*

	Thickness (feet)	Depth (feet)
Slate, sandy, light-gray	1	511
Slate, light-red, with sticky clay seams	24	535
Slate, sandy, light-red	33	568
Slate, light-red, with sticky clay seams	26	594
Slate rock, sandy, light-red	17	611
Slate, red, and clay seams	130	741
Sandstone, gray	59	800
Sandstone, red	46	846
Sandstone, gray	23	869
Sandstone, red	22	891
Sandstone, gray	36	927
Greenbrier limestone:		
Rock, gray and red	22	949
Rock, gray	53	1,002
Rock, red	2	1,004
Rock, gray	42	1,046
Rock, red	17	1,063
Rock, gray	8	1,071
Rock, red	139	1,210
Limestone, gray, and sandstone	37	1,247
Limestone, gray, sandstone, and black slate	46	1,293
Pocono formation:		
Sandstone, gray and pink	38	1,331
Rock, red, and clay seams	20	1,351
Rock, red and gray, and clay seams	39	1,390
Sandstone, gray	145	1,535
Rock, gray and red, and clay seams	8	1,543
Sandstone, gray	104	1,647
Rock, red	143	1,790
Sandstone, gray	51	1,841
Rock, red	14	1,855
Sandstone, gray	84	1,939
Sandstone, red	28	1,967
Sandstone, gray	53	2,020
Rock, red	30	2,050
Sandstone, red and gray	65	2,115
Sandstone, gray	17	2,132
Sandstone, red and gray	99	2,231
Rock, red	45	2,276
Sandstone, red and gray	103	2,379
Wa-Ai 11; P 9,084 (Altitude: 595 feet)		
Quaternary system:		
Soil	3	3
Ordovician system:		
Beekmantown group:		
Stonehenge limestone:		

TABLE 44—*Continued*

	Thickness (feet)	Depth (feet)
Rock	3	6
Clay	5	11
Rock	51	62
Water, 3 gpm		62
Rock	228	290
Rock, soft, water		290
Rock	10	300
Rock, soft, water		300
Rock	5	305
Wa-Ai 16; P 30,100 (Altitude: 625 feet)		
Cambrian system:		
Conococheague limestone:		
Limestone, shaly, and clay	50	50
Limestone, blue	15	65
Opening, water	2	67
Limestone	5	72
Opening, water	1.5	73.5
Limestone, sandy, yellow	6.5	80
Opening, water	8	88
Limestone, blue	8	96
Opening, water	1	97
Limestone, blue	3	100
Limestone, light-gray	11	111
Opening, water	3	114
Limestone, light-gray	7	121
Opening, water	2	123
Limestone, light-gray	8	131
Opening, water	2	133
Limestone, light-gray	11	144
Opening, water	5	149
Limestone, light-gray	12	161
Opening, water	1	162
Limestone, light-gray	28	190
Limestone, blue	3	193
Limestone, light-gray	15	208
Opening, water	3	211
Limestone, light-gray	5	216
Opening, water	2	218
Limestone, light-gray	36	254
Opening, water	1	255
Limestone, light-gray	45	300
Wa-Bk 10; P 32,884 (Altitude: 762 feet)		
Quaternary system:		
Alluvium:		
Earth, gravel, and rock	16	16
Cambrian system:		

TABLE 44—*Continued*

	Thickness (feet)	Depth (feet)
Tomstown dolomite:		
Rock	22	38
Opening, water; 20 gpm	2	40
Rock	2.5	42.5
Opening, water; 300 gpm	12.5	55
Rock	4	59
Small crevice		59
Rock	4	63
Opening, water; 300 gpm	1	64
Rock	13	77
Opening, cavernous, water; 199 gpm	8	85
Wa-Bk 18 (Altitude: 800 feet)		
Quaternary system:		
Alluvial mountain wash:		
Gravel and loose rock	74	74
Gravel	11	85
Cambrian (?) system:		
Antietam quartzite:		
Sand rock	18.5	103.5
Opening	2	105.5
Cambrian system:		
Tomstown (?) dolomite		
Rock	19	124.5
Opening	2	126.5
Rock	2.5	129
Opening	6.5	135.5
Rock	79.5	215
Opening	11	226
Rock	4	230
Opening	6	236
Rock	62.5	298.5
Opening	1.5	300
Rock	88	388
Opening	2	390
Rock	45	435
Pa.-1 (Altitude: 555 feet)		
Quaternary system:		
Alluvial mountain wash:		
Clay, yellow; boulders, soft	19	19
Silurian system:		
Tonoloway limestone:		
Limestone, hard, blue	4	23
Opening, dry	5	28
Limestone, hard, blue	5	33
Opening, dry	3	36
Limestone, hard, blue	10	46

TABLE 44—*Continued*

	Thickness (feet)	Depth (feet)
Opening, dry	2	48
Limestone, hard, blue	30	78
Water	3	81
Sandrock, soft, brown	5	86
Limestone, hard, blue	142	228
Water	7	235
Limestone, soft, blue	14	249
Sand, soft, brown, water	3	252
Limestone, sandy, hard, gray	28	280
Limestone, hard, gray	8	288
Limestone, soft, blue	3	291
Water	1	292
Limestone, hard, gray	40	332
Limestone, flinty, blue	3	335
Limestone, hard, blue	10	345
Limestone, soft, blue	4	349
Limestone, hard, blue	19	368
Limestone, soft, blue and black	5	373
Limestone, hard, blue	22	395
Water	5	400
Limestone, flinty, hard, black and white	8	408
Limestone, hard, blue	22	430
Limestone, soft, blue	28	458
Clay, soft, yellow	3	461
Limestone, hard, blue	24	485
Water	2	487
Limestone, soft, blue	25	512
Wills Creek shale:		
Shale, soft, green	8	520
Sand, soft, green, water	1	521
Shale, hard, green	4	525
Shale, hard, gray	7	532
Limestone, hard, blue	4	536
Limestone, sandy, hard, gray	4	540
Limestone, hard, blue	26	566
Substance, dark gray (like putty)	1	567
Limestone, hard, blue	93	660
Limestone, sandy, soft, white	3	663
Limestone, hard, blue	92	755
Stone, soft, green	7	762

The Surface-Water Resources

BY

JOHN M. DARLING

ABSTRACT

The surface-water resources of Allegany and Washington Counties have been studied through the records from 23 gaging stations in and adjacent to the counties. The data collected at these stations consist of continuous records of stage and periodic discharge measurements. Daily mean discharges have been computed after establishing stage-discharge relations.

Allegany and Washington Counties are completely within the Potomac River basin. The main tributaries to the Potomac River in this area are North Branch Potomac River, and Wills, Conococheague, and Antietam Creeks.

The principal developments of surface-water resources are in the Cumberland and Hagerstown areas which are the centers of industry in the counties. Irrigation is insignificant in Allegany County, where less than 100 acres is irrigated. It is very important in Washington County, where more than 2,000 acres is irrigated, most of which is orchard land.

Regional flood frequency studies for Maryland indicate that the probable 25-year frequency flood for a site with a 200-square mile drainage area in these counties may range from 7,300 to 16,200 cfs, depending upon the flood frequency region and hydrologic area in which the site is located.

Tables of monthly discharge through September 1959 are presented, supplementing or superseding those published in Bulletins 1 and 13 and in the publication entitled, "The Physical Features of Washington County".

INTRODUCTION

Man's progress through the ages has been dependent upon water. Advances in civilization have greatly increased the demand for development of water resources. The limits of supply are often approached in densely populated areas. The development of areas with little or no supply is slow as the cost of transporting water may be uneconomical. An adequate water supply is a prerequisite to the development and growth of cities.

Many complex problems arise from the increasing demands for water, such as pollution and contamination from known and unknown sources within a drainage basin. Although the water precipitated as rain is essentially pure, man has a difficult task to maintain its quality. Impure drinking water has been the source of many outbreaks of sickness and epidemics. Clean, pure streams and lakes are important assets to a community, not only as sources of public water supplies, but also for their recreational value.

Generally, the low-flow characteristics of a stream govern its utilization and have a major influence on the cost of development. The magnitude, duration, and frequency of low flows are used to determine whether a project can be operated with natural flow or to compute the amount of storage required. The frequency and duration of low flows affect the economics of both the design and operation of a water-utilization project.

Navigation was one of the earliest uses of surface waters, but with increased farming and industry the use of streams for irrigation and industrial purposes has become more important. There are numerous industrial uses of surface waters in cities for which temperature and chemical quality have become important factors.

The never-ending circulation of water in various forms from ocean and land surfaces to the atmosphere by evaporation and transpiration, from the atmosphere to the land by precipitation, and then back to the ocean is called the hydrologic cycle. As water travels from the land to the ocean, a part runs off directly into the streams and a part enters ground-water storage before later appearing as streamflow.

Streamflow in excessive amounts can cause tremendous damage and even loss of life. Man has tended to establish his home on or near a stream in order to have a readily accessible supply of water or a means of transportation. As settlements grow along rivers, the usual trend is to encroach upon the flood plains of the stream, and even to reduce the carrying capacity of the normal stream channel by erecting structures of various kinds. Thus the tendency to flood is aggravated, and the actual or potential flood damages are increased. The problem of flood control then arises. For the proper planning of flood control works such as dams, levees, or channel improvements, and the designing of bridges with adequate waterways, records of streamflow for a sufficient number of years to establish the flood-flow characteristics of the stream are essential.

DEFINITION OF TERMS AND ABBREVIATIONS

Terms used in streamflow and other hydrologic data are defined as follows:

Cubic foot per second (cfs) or second-foot is the rate of discharge of a stream whose channel is 1 square foot in cross-sectional area and whose average velocity is 1 foot per second.

Cubic feet per second per square mile (cfsm) is the average number of cubic feet of water flowing per second from each square mile of area drained, assuming that the runoff is distributed uniformly in time and area.

Million gallons per day per square mile (mgdsm) is the average number of millions of gallons of water flowing per day from each square mile of area drained, assuming a uniform runoff distribution. One million gallons per day (mgd) is equivalent to 1.5472 cfs. Conversely, 1 cfs flowing for 1 day is equal to 0.646317 million gallons (mg).

Runoff in inches is the depth to which an area would be covered if all the water draining from it in a given period were uniformly distributed on its surface. The term is used for comparing runoff with rainfall, which is also usually expressed in inches.

Drainage area of a stream at a specified location is that area, measured in a horizontal plane, and usually expressed in square miles, which is so enclosed by a topographic divide that direct surface runoff from precipitation normally would drain by gravity into the stream above the specified point.

Stage or gage-height of a stream is the height of the water surface above a chosen datum corresponding to the zero of the gage. The mean sea level elevation of the zero of the gage is determined either by leveling to an established bench mark or from a topographic map.

Stage-discharge relation is the relation between gage height and the amount of water flowing in a channel, expressed as volume per unit time.

Control designates a feature downstream from the gage that determines the stage-discharge relation at the gage. This feature may be a natural constriction of the channel, a long reach of the channel, or an artificial structure.

Water-year is a special annual period selected to facilitate water studies, commencing October 1 and ending September 30. The minimum flow at most streams usually occurs near the end of the water year. Another annual period, April 1 to March 31, normally containing the entire low-flow season, is sometimes used in the study of low-flow characteristics.

STREAMFLOW MEASUREMENT STATIONS

The U. S. Geological Survey operates a nationwide network of stream-gaging stations to provide an inventory of the total surface-water resources, and to provide a record of the variations of available supply with respect to time and areal distribution. In cooperation with the Maryland Department of Geology Mines and Water Resources, and other State, Federal and municipal agencies, 78 gaging stations are operated in Maryland and the District of Columbia. Six others are maintained in Pennsylvania or Delaware on streams which subsequently flow through Maryland.

Gaging stations in Maryland are equipped with continuous water-stage recorders. The base data collected consist of continuous records of stage and periodic measurements of discharge. In addition, observations of factors affecting the stage-discharge relation, weather records, and other information are used to supplement base data in determining the daily flow. The stations are usually inspected at intervals of 4 to 6 weeks to measure the flow and service the recorders. Segments of typical water-stage recorder charts for three streams are shown in figure 19.

Most water-stage recorders in Maryland are housed in concrete structures whose inside dimensions are 4 feet square. These structures are connected to the stream by one or more horizontal intake pipes so that the water level in

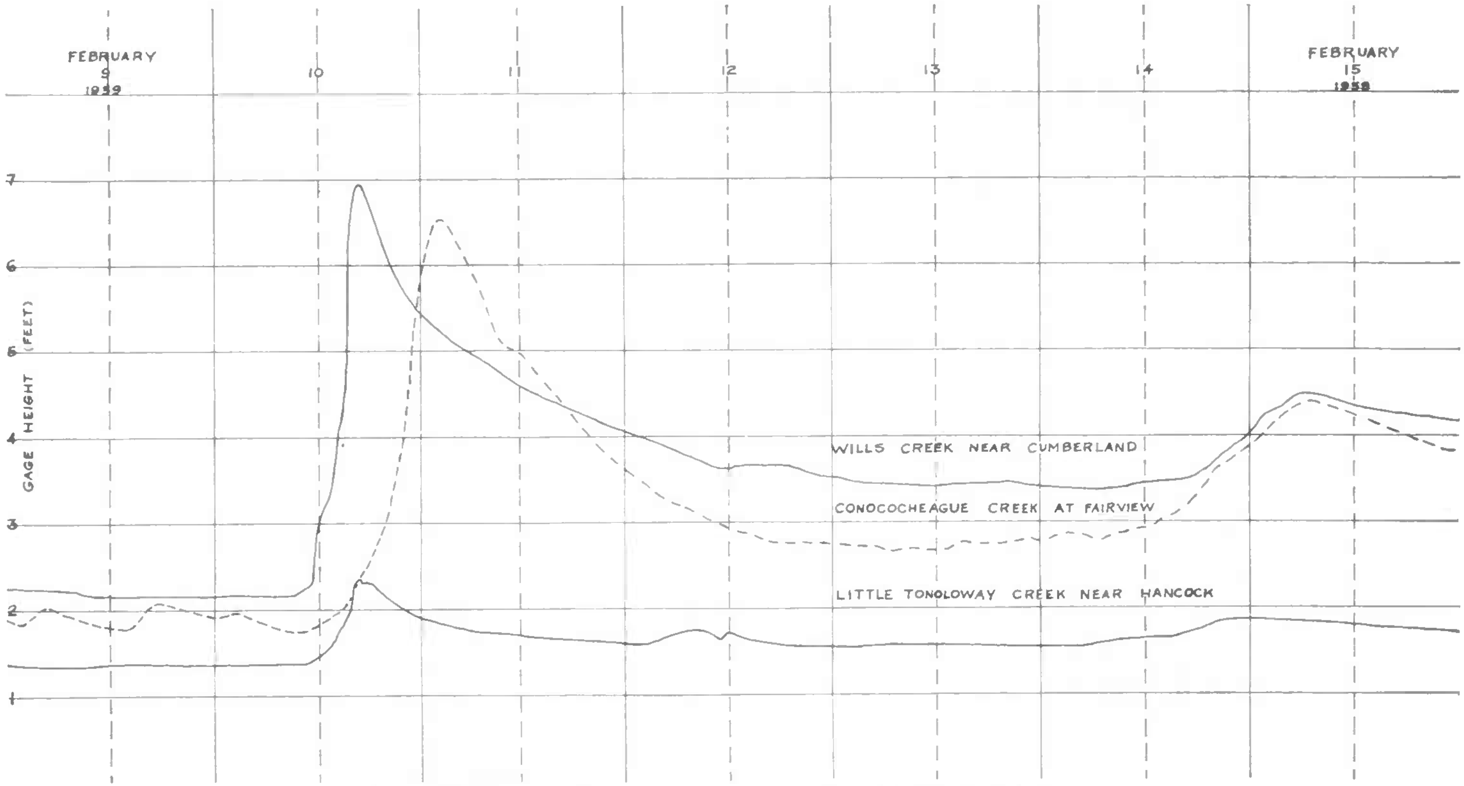

FIGURE 19. Graphs of River Stages from Continuous Water Stage Recorders

the gage well can fluctuate simultaneously with the stream. These fluctuations are transmitted to the recorder by means of a float and cable. The gage well is usually equipped with a flushing device for removing silt from the intake pipes. The height of the structure is determined on the basis of anticipated flood stages (Pl. 8, fig. 1). Where short-term records are desired, a temporary structure is provided. This usually consists of a vertical corrugated culvert pipe to act as a stilling well with a small box-like shelter attached to the top to house the recorder.

Measurements of discharge are made with a current meter and graduated rods or lines by which the mean velocity, depth, and width at preselected points in the stream cross section can be determined. The product obtained by multiplying the area and the mean velocity of a part of the cross section constitutes the discharge of that part. The summation of discharges for 20 to 30 or more parts of the total cross section defines, with acceptable accuracy, the discharge of the stream at that location. Plate 8, figure 2, shows a standard Price current meter and the smaller pygmy current meter used for making discharge measurements, the latter designed for use in shallow depths. Figures 1 and 2 of Plate 9 illustrate the use of the current meter by wading and from a bridge.

Discharge measurements are made periodically and throughout the range in stage of the stream in order to establish a stage-discharge relation for the station. A typical relation, or rating, curve is shown in figure 20. A rating table giving the discharge for any stage is prepared from the rating curve. If extensions to the rating curves are necessary in order to define the upper extremes

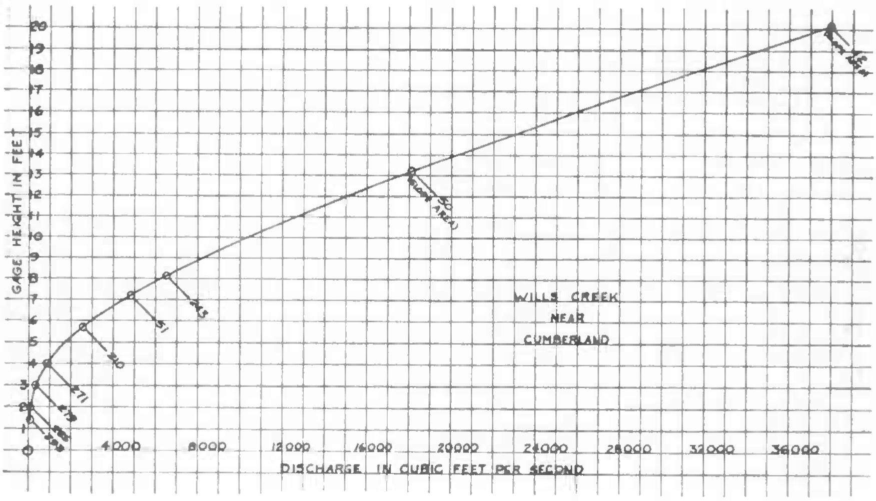

FIGURE 20. Typical Rating Curve Showing Stage-Discharge Relation

of discharge, they are made on the basis of indirect measurements of peak discharge (such as slope-area or contracted-opening measurements, computation of flow over dams or weirs, or by other methods), velocity-area studies, and logarithmic plotting. The application of the daily mean stage, or gage height, to the rating table gives the daily mean discharge, from which the monthly and yearly mean discharges are computed.

The selection of a gaging station site requires careful appraisal of various conditions: the stability of the stream channel; height of banks, their relative freedom from overflow, and suitability of conditions for installation and maintenance of gage structures; the range in stage within which current meter measurements can be obtained by wading; and the availability and accessibility of structures suitable for use in making measurements at higher stages. The site may not meet all requirements. Some type of low weir may be necessary to stabilize the stage-discharge relation, especially for low flows. For a channel subject to frequent or continual change and where an artificial control is not feasible, more frequent measurements are required in order to maintain a definition of the stage-discharge relation. If there is no suitable bridge near the gage site, a cableway from which high-stage measurements can be made may be required.

TOPOGRAPHY AND DRAINAGE

Allegany County

Allegany County lies entirely within the Appalachian Highlands physiographic province. The streams draining Allegany County are characterized by their steep slopes and flashy nature. The Appalachian Highlands province is divided into three provinces: the Appalachian Plateau, the Ridge and Valley, and the Blue Ridge (figs. 1 and 2).

The western section of Allegany County from the eastern foot of Dans and Piney Mountains is in the Appalachian Plateau province and is drained principally by Georges Creek, North Branch Potomac River, Braddock Run, and Jennings Run. Other than the North Branch Potomac River, Georges Creek is the largest stream in this section, draining the greater portion of it and flowing between and parallel to Dans and Big Savage Mountains southwestward to join the North Branch at Westernport. The northern portion of the Appalachian Plateau province is drained by Braddock and Jennings Runs, two tributaries to Wills Creek. These two streams contrast with Georges Creek by leaving the Plateau province through gaps in the ridges of Little Allegheny, Piney, and Dans Mountains as they flow eastward to join Wills Creek. This crossing of ridges is more typical of the streams draining the Ridge and Valley province.

The Ridge and Valley province includes all of Allegany County east of the Plateau province. The streams in this province flow in a generally southerly direction parallel to the ridges occasionally turning sharply and cutting through a ridge and then resuming their parallel course. The principal streams are Wills, Evitts, Town, and Sideling Hill Creeks.

Washington County

Washington County includes part of the Ridge and Valley province and part of the Blue Ridge province. The portion of the county in the Ridge and Valley province which lies east of Powell and Fairview Mountains is part of the Great Valley which in Maryland is known as the Hagerstown Valley.

Conococheague and Antietam Creeks have their sources in Pennsylvania, the former draining the western portion of the Great Valley and the latter the eastern portion as they flow southward into the Potomac River. In contrast to the streams in the Ridge and Valley and Appalachian Plateau provinces, which have steep slopes, these streams are characterized by meanders and gentle slopes.

The Blue Ridge province includes the area from the foot of South Mountain to its ridge line, which forms the boundary with Frederick County. This area is drained by tributaries to Antietam Creek. These tributaries have steeper gradients than the main stem of Antietam Creek.

All of Allegany and Washington counties are drained by the Potomac River and its tributaries. The North Branch Potomac River flows generally southeasterly combining with the South Branch Potomac River to form the Potomac River. The drainage area of the North Branch Potomac River at the western tip of Allegany County is 403 sq mi, and the drainage area of the Potomac River at the east boundary of Washington County is about 9,500 sq mi. This increase includes more than 7,000 sq mi which drains from the south through West Virginia and Virginia.

The more important streams of Allegany and Washington Counties and their drainage areas at selected points are listed in Table 45, which is based chiefly on data in the "Report to the General Assembly of Maryland by the Water Resources Commission of Maryland, January 1933". The principal streams are shown in figure 21.

SURFACE-WATER UTILIZATION

Surface water would be available in sufficient quantity in Allegany and Washington Counties for most if not all needs if it were uniformly distributed on the basis of time. However, it may not exist in sufficient quantity during periods of low flow without being augmented by water stored during periods of high runoff. The cost of building storage reservoirs must be weighed against their economic advantages. For example, Stony River and Savage River Reservoirs, located in the drainage areas above Allegany County, help maintain a higher minimum flow in the North Branch Potomac River than under natural con-

TABLE 45

Drainage Areas of Streams in Allegany and Washington Counties

Name of stream (listed in downstream order)	Tributary to	Drainage areas (square miles)	
		At point	Outside of Md.
North Branch Potomac River at Bloomington	Potomac River	*287	182
Savage River Dam at Outlet	N. Br. Potomac River	105	—
Savage River below Savage River Dam near Bloomington	do	*106	—
Savage River at Bloomington	do	*115	—
Savage River at mouth	do	116	—
North Branch Potomac River at Luke	Potomac River	*404	N.d.
Georges Creek at Franklin	N. Br. Potomac River	*72.4	—
Georges Creek at Westernport	do	*72.7	—
Georges Creek at mouth	do	73.9	—
North Branch Potomac River at Pinto	Potomac River	*596	N.d.
North Branch Potomac River above Wills Creek	do	619	N.d.
Wills Creek at Hyndman, Pa.	N. Br. Potomac River	*100	100
Little Wills Creek at mouth	Wills Creek	45.6	45.6
Wills Creek below Hyndman, Pa. (B & O RR)	N. Br. Potomac River	*146	146
Wills Creek at Pa. State line	N. Br. Potomac River	184	183
Jennings Run at mouth	Wills Creek	37.7	8.97
Braddock Run at mouth	do	17.5	—
Wills Creek near Cumberland (R.R. br.)	N. Br. Potomac River	*247	193
Wills Creek at mouth	do	*254	193
North Branch Potomac River at Cumberland	Potomac River	*873	N.d.
North Branch Potomac River near Cumberland (Wiley Ford Br.)	do	875	461
Evitts Creek near Centerville, Pa.	N. Br. Potomac River	*30.2	30.2
Lake Thomas W. Koon outlet	do	44.8	44.8
Lake Gordon outlet	do	49	49
Evitts Creek at Pa. State line	do	54.3	54.3
Evitts Creek near Cumberland	do	*89.0	63.4
Evitts Creek at mouth	N. Br. Potomac River	94.0	63.4
North Branch Potomac River above South Branch Potomac River	Potomac River	1,328	827
South Branch Potomac River at mouth	do	1,488	1,488
Town Creek at Pa. State line	Potomac River	60.9	60.9
Flintstone Creek at mouth	Town Creek	31.1	25.0
Town Creek near Oldtown	Potomac River	*148	88.8
Sawpit Run near Oldtown	Town Creek	*5.0	—

TABLE 45—*Continued*

Name of stream (listed in downstream order)	Tributary to	Drainage areas (square miles)	
		At point	Outside of Md.
Town Creek at mouth	Potomac River	156	88.8
Potomac River at Paw Paw, W. Va.	Chesapeake Bay	*3,109	N.d.
Fifteen mile Creek at Pa. State line	Potomac River	8.29	8.29
Fifteen mile Creek at mouth	do	61.2	12.0
Sideling Hill Creek at Pa. State line	do	74.9	72.5
Sideling Hill Creek near Belle Grove	do	83.7	N.d.
Bear Creek near Belle Grove	Sideling Hill Creek	9.11	N.d.
Sideling Hill Creek at mouth	Potomac River	104	80.5
Potomac River at Great Cacapon, W. Va.	Chesapeake Bay	*4,027	3,342
Tonoloway Creek near Hancock	Potomac River	*16.9	9.88
Tonoloway Creek at mouth	do	25.9	9.88
Potomac River at Hancock	Chesapeake Bay	*4,073	N.d.
Great Tonoloway Creek at mouth	Potomac River	114	112
Licking Creek near Sylvan, Pa.	do	158	157
Licking Creek at Pa. State line	do	188	185
Licking Creek at mouth	do	213	186
Little Conococheague Creek at mouth	do	18.0	1.26
Potomac River above Conococheague Creek	Chesapeake Bay	4,945	N.d.
Conococheague Creek at Pa. State line	Potomac River	491	490
Conococheague Creek at Fairview	do	*494	492
Conococheague Creek at mouth	do	563	498
Marsh Run at mouth	do	20.2	—
Potomac River at Shepherdstown, W. Va.	Chesapeake Bay	5,936	5,041
Antietam Creek at Pa. State line	Potomac River	93.3	85.9
Antietam Creek at Waynesboro, Pa.	do	*93.5	85.9
Little Antietam Creek at mouth	Antietam Creek	25.0	—
Antietam Creek at Security (upstream from Marsh Run)	Potomac River	134	N.d.
Marsh Run at mouth	Antietam Creek	31.2	18.2
Beaver Creek at mouth	do	33.5	—
Little Antietam Creek at mouth	Antietam Creek	32.2	—
Antietam Creek at Burnside Bridge near Sharpsburg	Potomac River	*281	105
Antietam Creek at mouth	do	292	105
Potomac River above Shenandoah River	Chesapeake Bay	6,308	5,189
Shenandoah River at Millville, W. Va.	Potomac River	*3,040	3,040
Shenandoah River at mouth	do	3,054	3,054

* At gaging station.
N.d. Not determined.

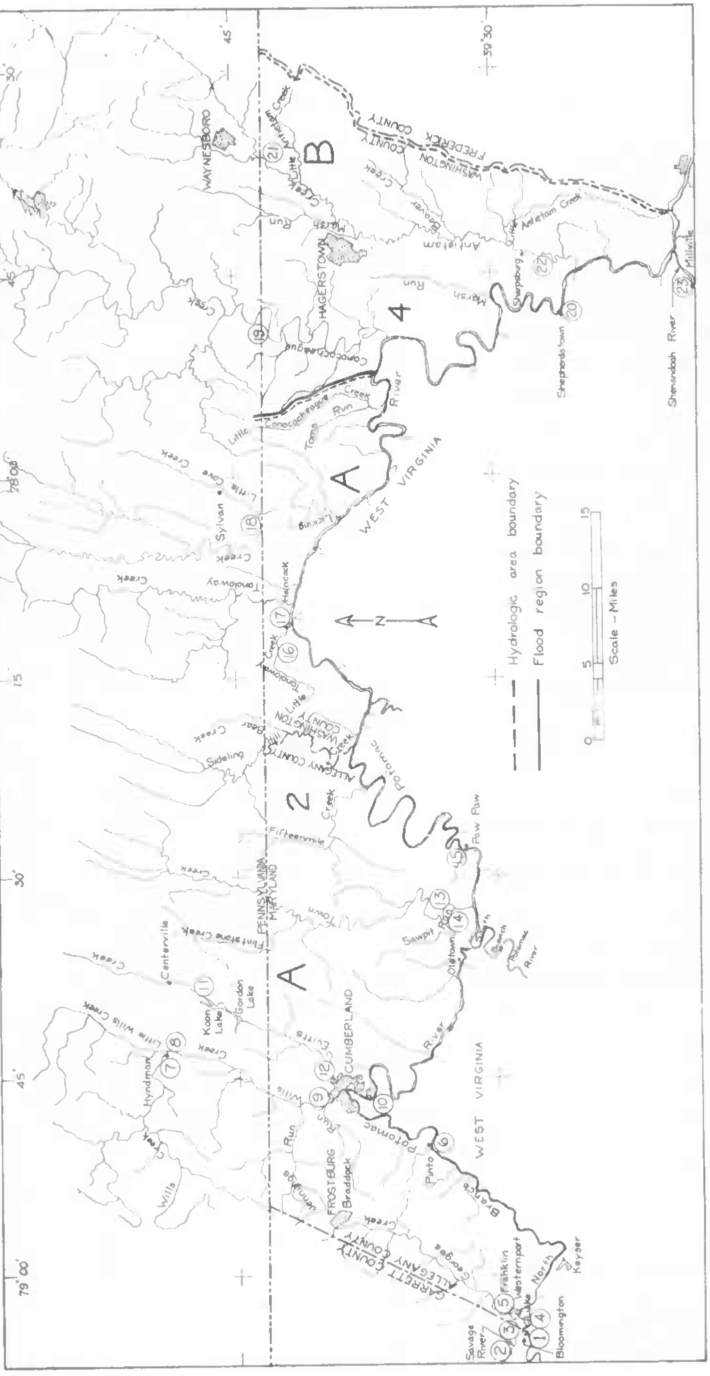

FIGURE 21. Map of Allegany and Washington Counties Showing Principal Streams, Gaging Stations, Flood Frequency Regions, and Hydrologic Areas

ditions. This flow aids in the dilution of wastes and waste effluent dumped into the North Branch by industries and municipalities which would otherwise cause greater pollution problems.

Cumberland and Hagerstown are the centers of population and industry in Allegany and Washington Counties, respectively. The municipal water supply for Cumberland is obtained from Lakes Koon and Gordon, formed by dams on Evitts Creek, with a total capacity of approximately 3,700 mg. In 1950 Cumberland had twelve 1-mgd filters, and the water consumption was about 12 mgd. Now Cumberland has 18 filters with a total capacity of 20 mgd. The present consumption is about 15 mgd, approximately 40 percent of which is used by industries. The principal source of water for the municipal supply of Hagerstown is the Potomac River, supplemented by water from the western slope of South Mountain in the Antietam Creek basin. The water systems of both cities supply water for neighboring communities.

Surface water is the principal source of water supplies in Allegany and Washington Counties. Industrial and domestic uses of water predominate in Allegany County owing to the extensive industrial development. Use of water for irrigation comprises a small part of the total water used. In Washington County, the expansion of irrigation systems for furnishing supplemental water to growing crops has resulted in extensive use of surface water for agricultural purposes. Industrial and domestic uses now share their importance with this agricultural use. Bohanan (1955) reported that in 1949 only 697 acres on 30 farms in the entire State were irrigated. In 1955, Washington County alone had about 2,000 acres on 28 farms under irrigation. Surface water was the source of supply for about 82 per cent of the irrigated acreage, which was composed chiefly of peach and apple orchards. In Allegany County, there were less than 100 acres irrigated, principally in production of small fruits and vegetables.

QUALITY OF SURFACE WATER

The chemical and physical characteristics of surface waters vary with time in response to the influence of environmental factors such as rainfall, geology, land and water use, and climatic season. Data on the various chemical and physical characteristics of surface water in Allegany and Washington Counties include (1) the analysis of weekly samples collected from Antietam Creek near Waynesboro, Pa., and Conococheague Creek at Fairview between 1948 and 1951, and (2) the continuous record of temperature of Potomac River at Hancock since July 1952. There are little or no data available on the sediment loads in the Potomac River basin.

During the period April 1948 to June 1951, the U. S. Geological Survey, in cooperation with the Pennsylvania Department of Forests and Waters, collected and analysed 144 samples from Antietam Creek near Waynesboro, Pa., and 114 samples from Conococheague Creek at Fairview. These analyses have

TABLE 46

Antietam Creek near Waynesboro, Pa., Maximum, Minimum, and Average Values of Chemical Constituents and Related Physical Measurements

(chemical constituents in parts per million)

Period of collection	Apr. 1948 to Sept. 1948		Oct. 1948 to Sept. 1949			Oct. 1949 to Sept. 1950			Oct. 1950 to June 1951	
Number of samples	23		48			43			30	
	Maximum	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Minimum
Silica (SiO_2)	7.6	4.0	7.0	—	1.4	12	—	6.5	8.5	5.7
Iron (Fe)	.10	.04	.22	—	.05	.20	—	.04	.16	.03
Calcium (Ca)	53	34	47	—	24	48	—	23	39	30
Magnesium (Mg)	17	11	15	—	7.1	16	—	7.2	12	8.9
Sodium (Na) and Potassium (K)	3.8	1.6	8.9	—	1.3	13	—	2.3	7.3	.6
Bicarbonate (HCO_3)	203	78	208	152	56	204	149	88	200	70
Sulfate (SO_4)	20	13	19	—	8.4	25	—	12	24	11
Chloride (Cl)	5.0	3.5	8.0	—	3.0	5.5	—	2.5	4.5	2.5
Fluoride (F)	.1	0	.1	—	.0	.0	—	.0	.0	.0
Nitrate (NO_3)	11	4.0	12	8.6	3.5	16	9.8	4.7	11	4.4
Dissolved solids	212	160	207	—	125	244	—	115	182	134
Suspended solids	12	4	120	24	3	66	22	6	258	2
Hardness as $CaCO_3$	257	81	257	149	51	186	138	82	182	68
Specific conductance (micromhos at 25°C)	361	172	391	279	130	373	278	174	357	151
pH	8.1	7.4	8.2	—	7.0	8.2	—	7.2	8.1	7.2
Color	15	1	35	8	1	20	7	2	25	2
Dissolved Oxygen	13.9	8.1	13.4	10.5	6.3	14.6	10.5	8.0	14.4	8.6
Bio-Chemical Oxygen Demand (5 days of 20°C)	4.4	.0	10.1	2.2	.4	6.0	2.1	.6	4.4	.9
Temperature (°F)	68	46	70	55	38	74	55	38	69	39
Discharge (cfs)	376	40	446	138	52	296	110	34	442	36

been published in U. S. Geological Survey Water-Supply Papers 1132, 1162, 1186, and 1192 which are in the annual series entitled, "Quality of Surface Waters of the United States, Part 1–4". The data obtained in these analyses are summarized in Tables 46 and 47. An average and a range is shown for those properties analysed on a weekly basis during complete water years and a range is shown for those properties determined monthly or determined weekly during incomplete water years.

A water-temperature thermograph has been operated since July 1952, as an integral part of the water-stage recorder, on Potomac River at Hancock in cooperation with the Maryland Department of Research and Education. Records of daily water temperature extremes are published in the quality-of-water series of water-supply papers. A summary of the monthly temperature variation of Potomac River at Hancock is shown in Table 48.

TABLE 47

Conococheague Creek at Fairview Maximum, Minimum and Average Values of Chemical Constituents and Related Physical Measurements

(chemical constituents in parts per million)

Period of collection	Apr. 1948 to Sept. 1948		Oct. 1948 to Sept. 1949			Oct. 1949 to Sept. 1950		
	23		48			43		
	Maximum	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum
Silica (SiO_2)	7.0	1.2	9.0	—	0.4	12	—	1.3
Iron (Fe)	.10	.03	.31	—	.07	.67	—	.03
Calcium (Ca)	48	36	51	—	28	51	—	24
Magnesium (Mg)	12	7.7	12	—	5.6	13	—	4.9
Sodium (Na) and Potassium (K)	4.5	3.3	9.7	—	.3	9.0	—	1.4
Bicarbonate (HCO_3)	196	77	198	142	83	200	145	78
Sulfate (SO_4)	19	14	31	—	12	25	—	13
Chloride (Cl)	7.0	2.5	9.0	—	4.0	7.5	—	2.0
Fluoride (F)	.0	.0	.2	—	.0	.0	—	.0
Nitrate (NO_3)	8.6	3.0	14	6.6	1.2	10	9.6	2.9
Dissolved solids	206	160	200	—	118	217	—	120
Suspended solids	8	1	136	22	2	246	29	2
Hardness as $CaCO_3$	257	82	232	143	92	178	134	80
Specific conductance (micromhos at 25°C)	342	180	364	268	200	351	274	175
pH	8.5	7.0	8.6	—	7.1	8.4	—	7.0
Color	20	1	35	8.4	1	50	12	4
Dissolved oxygen	17.2	7.2	15.1	11.0	6.6	15.5	10.2	7.7
Bio-chemical oxygen Demand (5 days at 20°C)	4.5	.0	9.1	2.2	.2	6.2	2.1	.3
Temperature (°F)	79	47	83	59	39	79	57	35
Discharge (cfs)	2,560	74	1,900	474	104	3,740	565	100

GAGING STATIONS IN OR ADJACENT TO ALLEGANY AND WASHINGTON COUNTIES

The U. S. Geological Survey began in 1888 systematic work in collecting records of streamflow, mainly in the West, and in studying the problems related to the utilization of water for irrigation and other purposes. The State of Maryland began cooperation with the Survey in 1896 by payment for the services of gage readers.

In the 1959 water year 14 gaging stations were in operation in or adjacent to Allegany and Washington Counties. Six of these stations are in Allegany County, four in Washington County and the rest nearby. Nine other stations

TABLE 48

Monthly Temperature Variation of Potomac River at Hancock

(degrees Fahrenheit)

		1952	1953	1954	1955	1956	1957	1958	1959
Jan.	max.		42	38	41	33	39	39	32
	min.		33	34	33	33	32	33	32
Feb.	max.		42	47	43	42	46	36	41
	min.		37	34	33	33	37	32	32
Mar.	max.		53	54	53	48	50	45	51
	min.		37	37	40	38	39	35	37
Apr.	max.		61	71	64	64	70	64	59
	min.		48	47	43	42	46	44	46
May	max.		71	76	79	71	77	74	80
	min.		59	53	57	57	60	52	56
June	max.		88	82	81	84	87	82	90
	min.		57	66	60	60	68	62	64
July	max.	93	89	91	92	87	90	89	89
	min.	70	73	74	79	71	74	73	75
Aug.	max.	87	85	89	92	83	88	83	91
	min.	69	71	70	68	69	69	71	72
Sept.	max.	77	89	86	80	83	85	84	86
	min.	60	60	64	65	57	59	62	62
Oct.	max.	72	72	79	72	68	68	68	77
	min.	45	54	51	49	55	48	50	51
Nov.	max.	54	57	51	54	62	58	58	54
	min.	39	—	40	32	32	39	33	38
Dec.	max.	44	—	41	39	43	45	38	42
	min.	33	33	33	32	33	35	32	33
Annual	max.	—	89	91	92	87	90	89	91
	min.	—	33	33	32	32	32	32	32

have been operated in this area but are now discontinued. The drainage areas, periods of record, and map identification numbers for all stream-gaging stations in Allegany and Washington Counties are listed in Table 49. Their locations, indicated by the map identification numbers, are shown in figure 21. Thirty or more years of continuous record have been collected at six of the stations. As of September 1959, a total of 457 station-years of record have been accumulated, 169 in Allegany County, 136 in Washington County, and the remainder in the adjacent area. Although this is a large volume of streamflow data, there is a lack of information on medium and small drainage areas in Washington County especially in the Antietam Creek and Conococheague Creek basins.

CHARACTERISTICS OF RUNOFF

Floods

The annual series of reports entitled, "Surface Water Supply of the United States," contains the maximum gage heights and discharges for the report year

TABLE 49

Stream-gaging Stations in or Adjacent to Allegany and Washington Counties

Map identification No.	Stream-gaging station	Drainage area (sq mi)	Records available
1	North Branch Potomac River at Bloomington	287	Oct. 1924 to Sept. 1927, July 1929 to Sept. 1950
2	Savage River below Savage River Dam near Bloomington	106	October. 1948—
3	Savage River at Bloomington	115	May 1905 to July 1906, Oct. 1924 to Sept. 1927, Aug. 1929 to Sept. 1950
4	North Branch Potomac River at Luke	404	June 1899 to July 1906, Oct. 1949—
5	Georges Creek at Franklin	72.4	May 1905 to July 1906, Oct. 1929—
6	North Branch Potomac River at Pinto	596	Oct. 1938—
7	Wills Creek at Hyndman, Pa.	100	Aug. 1948 to Sept. 1951
8	Wills Creek below Hyndman, Pa.	146	June 1951—
9	Wills Creek near Cumberland	247	May 1905 to July 1906, Oct. 1929—
10	North Branch Potomac River near Cumberland	875	May 1929—
11	Evitts Creek near Centerville, Pa.	30.2	Sept. 1932—
12	Evitts Creek near Cumberland	89.0	Aug. 1929 to Nov. 1932
13	Town Creek near Oldtown	148	July 1928 to Sept. 1935
14	Sawpit Run near Oldtown	5.0	Oct. 1947 to Dec. 1958
15	Potomac River at Paw Paw, W. Va.	3,109	Oct. 1938—
16	Little Tonoloway (Tonoloway) Creek near Hancock	16.9	Aug. 1947—
17	Potomac River at Hancock	4,073	Oct. 1932—
18	Licking Creek near Sylvan, Pa.	158	June 1930 to Jan. 1942
19	Conococheague Creek at Fairview	494	June 1928—
20	Potomac River at Shepherdstown, W. Va.	5,936	Aug. 1928 to Sept. 1953
21	Antietam Creek near Waynesboro, Pa.	93.5	May 1948 to Sept. 1951
22	Antietam Creek near Sharpsburg	281	June 1897 to Aug. 1905, Aug. 1928—
23	Shenandoah River at Millville, W. Va.	3,040	April 1895 to Mar. 1909, Aug. 1928—

Note.—Stations without closing date are still in operation.

and, since 1938, a listing of peak discharges above a base so selected that an average of about three peaks a year are included.

Detailed information on the stage and discharge of many streams during major floods has been included in special reports of the U. S. Geological Survey. Most of these reports contain other pertinent hydrologic information and analyses, and compilation of data relating to earlier notable floods. The following reports contain data on streams in Allegany and Washington Counties:

Water-supply Paper 771: Floods in the United States, magnitude and frequency.

Water-supply Paper 800: The floods of 1936, Part 3, Potomac, James, and upper Ohio Rivers.

Water-supply Paper 1420: Floods of August-October 1955, New England to North Carolina.

Flood studies indicate that the flood of March 29, 1924, was extremely severe on the North Branch Potomac River upstream from Cumberland. There is little known about the earlier flood of June 1, 1889, except that at Cumberland the river stage was 0.8 foot higher than the 1924 high-water mark. The flood of March 1936 is the maximum recorded for the main stem of Potomac River but the flood of June 1889 was nearly as high. The maximum flood of record on Antietam Creek, one of the main tributaries to the Potomac River, occurred on July 20, 1956, as a result of intense thunder shower activity. This flood reached a stage of 16.73 ft at the gage downstream from Burnside Bridge and a peak discharge of 12,600 cfs. The previous maximum stage known was 11.9 ft, from floodmarks, in July 1928.

A knowledge of the magnitude and frequency of floods is necessary for the economic design of structures bordering on stream channels or encroaching on flood plains. The flood history at a particular gaging station is an accurate record of past events at the site, but if the period of record is not typical of a long-term period, the record is a poor basis for predicting future events. A flood-frequency curve based on regional characteristics is superior to one based only on the floods at a particular site. However, flood-frequency curves for individual stations are necessary to derive the regional curve.

A regional flood-frequency analysis of Maryland streams made by the U. S. Geological Survey in cooperation with the Maryland Department of Geology, Mines and Water Resources was released in October 1959, as an open-file report entitled "Floods in Maryland, Magnitude and Frequency", by John M. Darling. This report together with a similar low-flow frequency analysis of Maryland streams will be published by the Department of Geology, Mines and Water Resources. The regional flood-frequency curves pertaining to Allegany and Washington counties are shown in figures 22 and 23. The hydrologic area curves are shown in figures 24 and 25. The flood regions and hydrologic areas for these counties are designated in figure 21. The regional flood-frequency curve is a plot on extreme value probability paper with the recurrence interval in years as abscissa and the ratio to mean annual flood as ordinate. The hydrologic area curve is a plot on log-log paper with the drainage area, in square miles, as abscissa and the mean annual flood, in cubic feet per second, as ordinate. The recurrence interval is the average interval in which a flood of a given size may be expected to recur as an annual flood. The mean annual flood

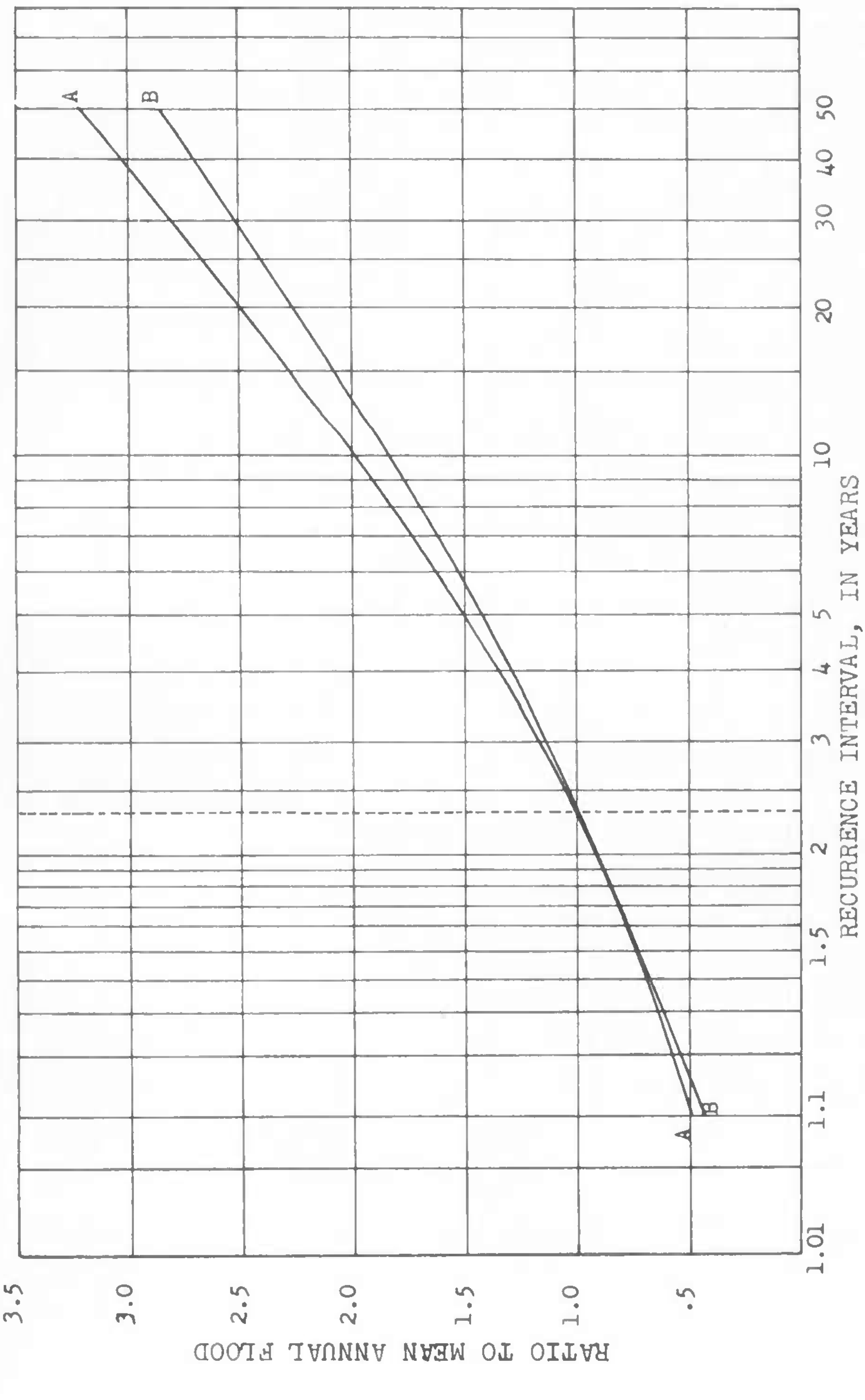

FIGURE 22. Frequency of Annual Floods, Regions A and B (Figure 21), Period 1928–1958

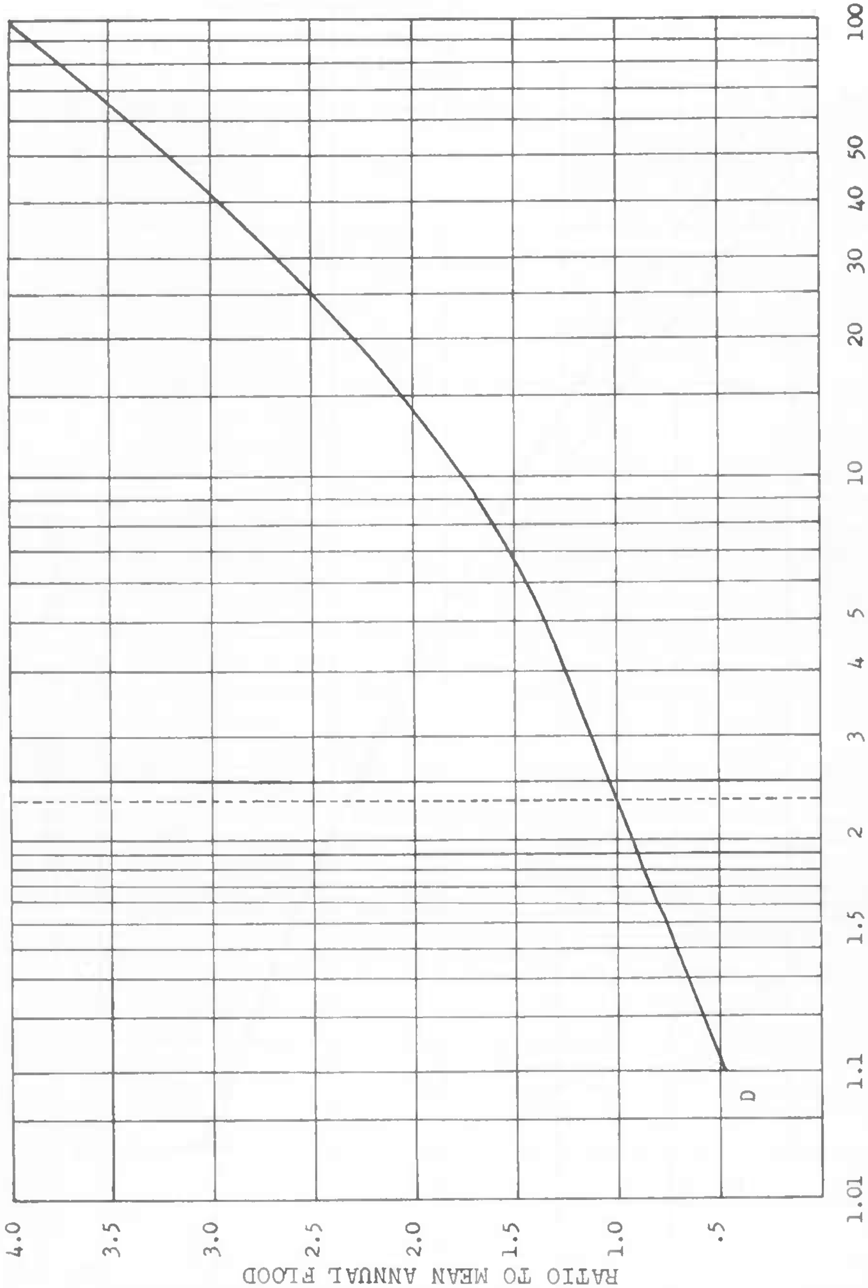

FIGURE 23. Frequency of Annual Floods, Main Stem Potomac River, Period 1895–1958

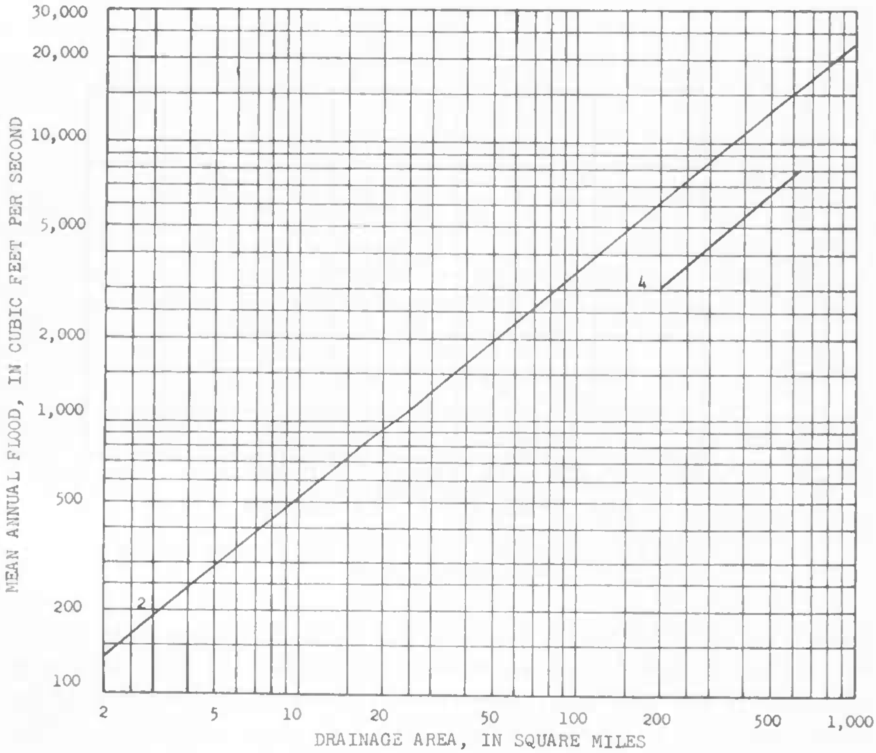

FIGURE 24. Variations of Mean Annual Flood with Drainage Area in Hydrologic Areas 2 and 4 (Figure 21)

is considered to be one having a recurrence interval of 2.33 years. The statistical theory of extreme values and some practical applications have been discussed by Gumbel (1954).

Regional flood-frequency curve D and hydrologic-area curve 7 pertain only to the main stem of the Potomac River. Regional flood-frequency curve A and hydrologic-area curve 2 pertain to all of Allegany County and to Washington County as far east as the divide between Little Conococheague and Conococheague Creeks. The area of Washington County east of this divide is covered by regional flood-frequency curve B, which also pertains to areas extending east of the Washington-Frederick county line, and by hydrologic-area curve 4, which pertains only to the area extending to the Washington-Frederick county line. Area curve 4 is undefined for drainage areas below 200 square miles, owing to the lack of streamflow information on small streams in this hydrologic area.

These curves are used in the following manner: For example, to find the magnitude of a flood with a 25-year frequency on a stream in Allegany County at a site where the drainage area is 100 square miles; first consult figure 21 from

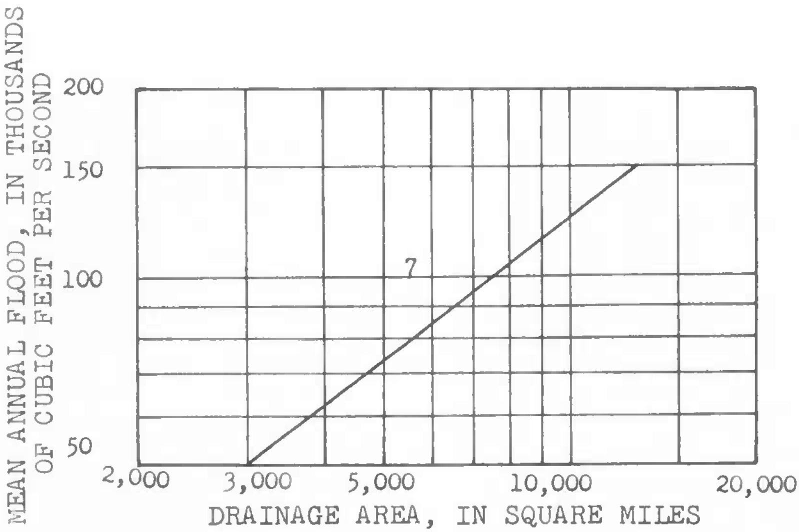

FIGURE 25. Variation of Mean Annual Flood with Drainage Area on Main Stem Potomac River

which it will be found that the site lies in region A and hydrologic area 2; next, refer to curve 2, figure 24, and determine the mean annual flood for a 100 square mile drainage area (3,400 cfs); from curve A, figure 22, find the ratio of the mean annual flood to the 25-year flood (2.66); the product of this ratio and the mean annual flood is the probable magnitude of the 25-year frequency flood ($2.66 \times 3{,}400 = 9{,}040$ cfs). These steps can be followed to determine a flood of any frequency for any size drainage area in Allegany or Washington Counties within the limits of the curves which apply to these areas.

Average Runoff

The streamflow records in this report are for various intervals during the period 1895 to 1959. Because of the year-to-year variation in precipitation and consequent runoff, comparisons between different streams should be made for identical periods of time.

In general, the streams in Washington County have an average runoff of about 1 cfsm. Although the average runoff for some streams in Allegany County also is about 1 cfsm, the majority have much higher runoff. For the period 1930–59, for example, Antietam Creek near Sharpsburg, in Washington County, had an average runoff of 0.824 cfsm and Wills Creek near Cumberland, in Allegany County, had an average runoff of 1.26 cfsm.

Low Flow

Maryland experienced extreme drought conditions throughout the State from 1930 to 1934 The drought began in 1930 when the annual precipitation for the

State averaged only 24 inches compared with a 54-year average of 42 inches. A study of the hydrologic conditions during this period was published by the U. S. Geological Survey in Water-Supply Paper 680, "Droughts of 1930–34". Sustained periods of subnormal streamflow were experienced as recently as 1954, 1957, and 1959 but they were not as prolonged as those in the 1930–34 period.

DISCHARGE RECORDS

Daily discharge records for the gaging stations in Allegany and Washington Counties are published in Part 1 (Part 1B subsequent to 1950) of the annual series of water-supply papers of the U. S. Geological Survey entitled, "Surface Water Supply of the United States".

Monthly discharge records prior to October 1943 were published in Bulletin 1 of the Maryland Department of Geology, Mines and Water Resources. Similar data for the period since October 1943 are contained in the following pages. A summary table of annual data for the entire period of record is presented for each station. Some monthly discharge figures prior to October 1943 are republished herein, either because of a drainage area revision, which necessitated revision of the previously published unit runoff figures, or because a recent area-wide review and compilation disclosed discrepancies in the data. Monthly data subsequent to October 1943 for some stations have been published in Bulletin 13 and in the publication entitled, "Physical Features of Washington County," and are not repeated here unless revisions have been made. Reference to the Bulletins or publication in which specific records may be found is contained in the "Records available" paragraph of the individual station records.

POTOMAC RIVER BASIN

1. North Branch Potomac River at Bloomington

Location.—Lat 39°28′48″, long 79°04′08″, on right bank at highway bridge at Bloomington, Garrett County, 600 ft upstream from Savage River, and 2 miles upstream from Piedmont, W. Va.

Drainage area.—287 sq mi.

Records available.—October 1924 to September 1927, July 1929 to September 1950 (discontinued). Monthly records November 1924 to September 1927 and July 1929 to September 1943 published in Bulletin 1 (1925, 1926, 1929, 1931, revised herein); October 1943 to September 1950, in Bulletin 13.

Gage.—Water-stage recorder. Datum of gage is 951.98 ft above mean sea level, adjustment of 1912. Prior to Sept. 1, 1929, chain gage at same site and datum.

Average discharge.—24 years (1924–27, 1929–50), 492 cfs.

Extremes.—Maximum discharge, 22,500 cfs Mar. 17, 1936, Oct. 28, 1937 (gage height, 14.85 ft, 1936 stage from floodmarks), from rating curve extended above 10,000 cfs on basis of slope-area measurements at gage heights, 10.85 and 14.85 ft; minimum, 5.4 cfs Sept. 22, 1932 (gage height, 1.81 ft).

Maximum stage known, 20.3 ft on left bank from floodmarks (equivalent to stage of about 17 ft in gage well on right bank) Mar. 29, 1924 (discharge, 29,000 cfs, from rating curve extended as explained above).

Remarks.—Low flow affected by Stony River Reservoir (capacity 1,948 million gallons of which 1,681 million gallons is controlled storage). Yearly figures published as they are not appreciably affected by change in storage.

Monthly discharge of North Branch Potomac River at Bloomington

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1924–25						
October‡	—	—	150			
November	484	30	102			
December	806	66	334			
January	2,340	84	389			
February	2,780	330	1,010			
March	1,420	312	530			
April	1,590	183	516			
May	2,240	180	704			
June	696	41	188			
July	548	56	119			
August	312	41	90.0			
September	104	40	61.3			
The year	2,780	30	346	1.21	16.35	0.782

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of North Branch Potomac River at Bloomington—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1925–26						
October	3,640	46	530			
November	4,560	315	830			
December	806	—	328			
January	3,770	—	694			
February*	4,030	282	1,150			
March	1,760	350	939			
April	3,020	236	809			
May	236	80	148			
June	332	70	142			
July	864	37	129			
August	4,700	34	912			
September	1,340	121	379			
The year	4,700	34	579	2.02	27.36	1.31
1929						
June‡	368	50	94.9			
July	155	39	65.3			
August	269	—	53.7			
1930–31						
October	35	17	23.5			
November	32	12	18.8			
December	309	17	81.6			
January	1,570	—	253			
February	1,500	—	488			
March	2,400	200	615			
April	2,770	341	1,080			
May*	2,700	435	1,140			
June	827	72	309			
July	753	28	106			
August	580	32	120			
September	1,300	29	211			
The year	2,770	12	369	1.29	17.45	0.834

* Revised.

‡ Not previously published

POTOMAC RIVER BASIN—*Continued*

Yearly discharge of North Branch Potomac River at Bloomington

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1925	346	1.21	16.35	0.782	437	1.52	20.68	0.982
1926	579	2.02	27.36	1.31	621	2.16	29.35	1.40
1927	661	2.30	31.24	1.49	—	—	—	—
1930	361	1.26	17.07	.814	231	.805	10.93	.520
1931	369	1.29	17.45	.834	424	1.48	20.05	.957
1932	486	1.69	23.04	1.09	490	1.71	23.24	1.11
1933	597	2.08	28.25	1.34	607	2.11	28.70	1.36
1934	370	1.29	17.48	.834	369	1.29	17.47	.834
1935	552	1.92	26.10	1.24	541	1.89	25.59	1.22
1936	573	2.00	27.17	1.29	586	2.04	27.81	1.32
1937	589	2.05	27.84	1.32	708	2.47	33.49	1.60
1938	561	1.95	26.51	1.26	395	1.38	18.66	.892
1939	498	1.74	23.54	1.12	504	1.76	23.85	1.14
1940	468	1.63	22.18	1.05	511	1.78	24.25	1.15
1941	430	1.50	20.34	.969	388	1.35	18.36	.873
1942	424	1.48	20.03	.957	593	2.07	28.07	1.34
1943	601	2.09	28.40	1.35	405	1.41	19.17	.911
1944	450	1.57	21.33	1.01	538	1.87	25.50	1.21
1945	572	1.99	27.08	1.29	574	2.00	27.13	1.29
1946	426	1.48	20.17	.957	344	1.20	16.29	.776
1947	292	1.02	13.82	.659	314	1.09	14.84	.704
1948	505	1.76	23.97	1.14	595	2.07	28.22	1.34
1949	566	1.97	26.78	1.27	515	1.79	24.38	1.16
1950	523	1.82	24.73	1.18	—	—	—	—
Highest	661	2.30	31.24	1.49	708	2.47	33.49	1.60
Average	492	1.71	23.27	1.11	486	1.69	23.00	1.09
Lowest	292	1.02	13.82	.659	231	.805	10.93	.520

POTOMAC RIVER BASIN

2. Savage River below Savage River Dam, near Bloomington

Location.—Lat 39°30′05″, long 79°07′25″, on left bank 0.7 mile downstream from Savage River Dam, 1.1 miles downstream from Crabtree Creek, and 3.2 miles northwest of Bloomington, Garrett County.

Drainage area.—106 sq mi.

Records available.—October 1948 to September 1959. Monthly records October 1948 to September 1952 published in Bulletin 13 (1951, 1952 adjustments included herein).

Gage.—Water-stage recorder and concrete control. Datum of gage is 1,276.40 ft above mean sea level (Corps of Engineers bench mark).

Average discharge.—11 years, 165 cfs (adjusted for storage).

Extremes.—Maximum discharge, 6,530 cfs Oct. 16, 1954 (gage height, 7.70 ft); minimum, 0.5 cfs July 31, Aug. 1, 1951; minimum daily, 0.6 cfs July 27–31, Aug. 5, 6, 9, 10, 1951.

Remarks.—Diversions above station by Baltimore & Ohio Railroad and by cities of Frostburg and Westernport for municipal supply. Information regarding quantities of water diverted can be obtained from the office of Chief Engineer, Maryland Department of Health, Baltimore. Flow regulated by Savage River Reservoir beginning December 1950 (capacity, 20,280 acre-ft). Reservoir began filling July 15, 1951, and was completely filled Jan. 3, 1952. Dam construction was completed Jan. 11, 1952, by the Corps of Engineers, U. S. Army.

Monthly discharge of Savage River below Savage River Dam, near Bloomington

Month	Discharge in cfs				Runoff in inches	Change in contents for Savage River Reservoir equivalent in cfs
	Maximum	Minimum	Mean	Per square mile		
1950–51						
October	179	23	84.5			0
November	245	17	128			0
December	384	54	317			+32.8
January	412	280	354			+82.2
February	458	424	447			+26.5
March	441	319	382			−48.0
April	429	322	394			−47.0
May	408	44	271			−45.5
June	2,280	31	298			0
July	91	.6	23.4			+37.9
August	17	.6	6.37			+4.4
September	45	7.9	11.7			−6.0
The year	2,280	.6	225	2.12	28.79	+3.1

Monthly discharge of Savage River below Savage River Dam, near Bloomington—*Continued*

Month	Discharge in cfs				Runoff in inches	Change in contents for Savage River Reservoir equivalent in cfs
	Maximum	Minimum	Mean	Per square mile		
1951–52						
October	12	5.7	8.14			0
November	17	6.0	8.88			+24.9
December	598	8.5	28.9			+148
January	2,890	8.7	713			−140
February	701	8.1	142			+5.2
March	1,420	8.8	278			+173
April	1,480	12	295			+69.1
May	1,110	97	351			+12.8
June	244	19	70.4			−.9
July	87	27	64.4			−60.0
August	68	11	30.4			−20.2
September	105	21	78.8			−73.1
The year	2,890	5.7	173	1.63	22.24	+11.7
1952–53						
October	65	41	49.5			−48.7
November	88	20	52.2			−7.8
December	582	62	132			−39.9
January	1,190	80	362			+8.6
February	954	74	285			−15.8
March	1,070	82	407			+78.1
April	108	13	89.0			+166
May	269	44	130			+15.8
June	235	19	55.2			−13.7
July	64	30	55.3			−51.4
August	63	10	45.5			−40.1
September	84	38	68.5			−66.0
The year	1,190	10	144	1.36	18.45	−1.4
1953–54						
October	90	40	69.7			−68.6
November	59	22	51.0			−47.1
December	48	7.3	12.7			+.1
January	84	7.2	23.7			+34.6
February	229	7.0	38.7			+2.6
March	1,920	12	246			+72.6
April	12	11	11.9			+84.2
May	116	12	30.1			+90.8
June	845	35	147			−.4
July	76	12	34.4			−14.3
August	111	12	65.8			+.5
September	113	69	103			−69.1
The year	1,920	7.0	69.7	0.658	8.93	+7.4

Monthly discharge of Savage River below Savage River Dam, near Bloomington—*Continued*

Month	Discharge in cfs				Runoff in inches	Change in contents for Savage River Reservoir equivalent in cfs
	Maximum	Minimum	Mean	Per square mile		
1954–55						
October	3,790	74	446			−87.2
November	947	34	220			−43.0
December	1,130	91	242			+89.7
January	1,690	41	306			−148
February	778	43	306			+14.2
March	1,590	12	581			+55.0
April	23	12	14.5			+184
May	391	15	82.4			+21.9
June	1,320	23	223			−.1
July	69	12	35.4			−15.4
August	861	12	180			−22.8
September	1,110	39	132			−103
The year	3,790	12	231	2.18	29.59	−4.8
1955–56						
October	88	76	85.2			−64.5
November	66	10	32.7			−1.4
December	110	11	83.2			−48.4
January	1,000	10	55.3			+8.8
February	1,520	29	596			−2.4
March	694	106	286			+81.7
April	1,060	6.7	154			+146
May	1,330	6.4	286			+24.4
June	548	79	207			−1.4
July	108	14	60.9			−.6
August	2,390	34	262			−34.8
September	139	62	122			−74.1
The year	2,390	6.4	184	1.74	23.65	+2.7
1956–57						
October	123	113	118			−74.1
November	635	11	111			−30.4
December	1,480	51	426			−63.0
January	1,330	11	316			+24.9
February	2,470	103	456			+4.5
March	575	12	164			+54.0
April	813	10	119			+198
May	172	12	75.0			+2.1
June	74	16	37.8			+.1
July	83	11	49.1			−31.5
August	86	47	73.9			−65.5
September	67	50	60.3			−50.4
The year	2,470	10	166	1.57	21.23	−3.0

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of Savage River below Savage River Dam, near Bloomington—*Continued*

Month	Discharge in cfs				Runoff in inches	Change in contents for Savage River Reservoir equivalent in cfs
	Maximum	Minimum	Mean	Per square mile		
1957–58						
October	661	10	134			−55.5
November	98	43	72.4			−26.1
December	1,870	12	370			−28.8
January	401	89	130			−.9
February	388	38	140			−4.9
March	654	8.3	244			+76.1
April	2,720	16	418			+170
May	1,950	18	320			+20.4
June	66	12	26.6			−.9
July	58	11	26.7			+1.2
August	566	16	120			−52.9
September	104	28	60.5			−54.5
The year	2,720	8.3	172	1.62	22.08	+3.4
1958–59						
October	93	40	85.5			−77.1
November	93	34	64.4			−46.7
December	62	39	50.3			−27.1
January	613	54	130			−6.9
February	1,310	80	254			−2.4
March	873	11	173			+71.6
April	1,180	13	88.5			+171
May	375	12	91.9			+27.4
June	171	19	50.9			−15.7
July	67	13	52.1			−40.4
August	73	33	60.8			−51.9
September	70	37	63.9			−56.0
The year	1,310	11	96.1	0.907	12.31	−4.7

POTOMAC RIVER BASIN—*Continued*

Yearly discharge of Savage River Below Savage River Dam near Bloomington (Unadjusted)

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1949	173	1.63	22.12	1.05	150	1.42	19.16	0.918
1950	162	1.53	20.78	.989	182	1.72	23.36	1.11
1951	225	2.12	28.79	1.37	184	1.74	23.57	1.12
1952	173	1.63	22.24	1.05	189	1.78	24.27	1.15
1953	144	1.36	18.45	.879	135	1.27	17.35	.821
1954	69.7	.658	8.93	.425	135	1.27	17.30	.821
1955	231	2.18	29.59	1.41	171	1.61	21.96	1.03
1956	184	1.74	23.65	1.12	222	2.09	28.57	1.35
1957	166	1.57	21.23	1.01	159	1.50	20.38	.969
1958	172	1.62	22.08	1.05	141	1.33	17.99	.860
1959	96.1	.907	12.31	.586				
Highest	231	2.18	29.59	1.41	222	2.09	28.57	1.35
Average	163	1.54	20.92	.899	167	1.57	21.39	1.02
Lowest	69.7	.658	8.93	.425	135	1.27	17.30	.821

Yearly change in contents of Savage River Reservoir, equivalent in cfs

Year	Year Ending Sept. 30	Calender Year	Year	Year Ending Sept. 30	Calender Year
	Adjustments in cfs	Adjustments in cfs		Adjustments in cfs	Adjustments in cfs
1949	0		1955	−4.8	−11.2
1950	0	+2.8	1956	+2.7	−1.7
1951	+3.1	+14.9	1957	−3.0	+1.8
1952	+11.7	−11.0	1958	+3.4	+.1
1953	−1.4	−2.9	1959	−4.7	
1954	+7.4	+13.7			

POTOMAC RIVER BASIN

3. Savage River at Bloomington

Location.—Lat 39°29′00″, long 79°04′24″, on left bank at Bloomington, Garrett County, 2,200 ft upstream from mouth, and 1½ miles west of Piedmont, W. Va.

Drainage area.—115 sq mi.

Records available.—May 1905 to July 1906, October 1924 to September 1927, August 1929 to September 1950 (discontinued). Monthly records May 1905 to July 1906, November 1924 to September 1943 published in Bulletin 1 (May 1905, completed, 1906, 1925, 1926, 1927, 1931, revised herein); October 1943 to September 1950, in Bulletin 13.

Gage.—Water-stage recorder. Datum of gage is 978.76 ft above mean sea level (Corps of Engineers bench mark). May 3, 1905, to July 15, 1906, chain gage at bridge 1,400 ft downstream at different datum. October 31, 1924, to September 30, 1927, staff gage 800 ft downstream from present site at different datum. August 19, 1929, to September 6, 1929, staff gage at present site and datum.

Average discharge.—24 years (1924–27, 1929–50), 163 cfs.

Extremes.—Maximum discharge, 14,800 cfs Mar. 17, 1936 (gage height 10.8 ft) from rating curve extended above 3,500 cfs on basis of slope area measurements of peak flow; minimum, 0.7 cfs Sept. 21, 1932, Dec. 16, 1943 (result of freezeup); minimum daily, 0.7 cfs Sept. 21, 1932.

Maximum stage known, about 13 ft Mar. 29, 1924, present site and datum, from information by employee of West Virginia Pulp and Paper Co. (discharge not determined).

Remarks.—Diversions above station by Baltimore & Ohio Railroad and by cities of Frostburg, Piedmont, and Westernport for municipal supply. Some reduction of flood peaks since about 1941, and occasional regulation of low flow since 1949 by partly completed Savage River Dam.

Monthly discharge of Savage River at Bloomington

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1905						
May‡	399	34	95.6			
1905–06						
October*	509	10	84.8			
November	418	13	51.1			
December*	924	38	229			
January*	2,204	66	332			
February	103	24	43.8			
March	2,260	36	348			
April	1,380	163	521			
May	174	23	69.9			
June	884	28	138			

Monthly discharge of Savage River at Bloomington—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1924–25						
October‡	—	—	38			
November	46	7.0	14.1			
December	120	13.5	50.8			
January	408	12.5	57.8			
February	1,480	30	389			
March	487	158	222			
April	436	52	139			
May	714	38	222			
June	140	9.2	25.0			
July	65	6.5	15.4			
August	20	2.8	7.92			
September	4.6	2.4	3.23			
The year	1,480	2.4	96.9	0.843	11.44	0.545
1925–26						
October	1,170	2.7	190			
November	2,250	94	310			
December	332	—	126			
January	1,480	—	220			
February	1,580	—	346			
March	487	—	232			
April	672	49	230			
May*	47	18	30.3			
June	44	13	24.4			
July	480	11	50.8			
August	844	10	151			
September	457	32	175			
The year	2,250	2.7	172	1.50	20.21	0.969
1926–27						
October	529	42	183			
November	918	80	261			
December	881	48	286			
January	1,820	—	331			
February	1,760	175	523			
March	965	166	361			
April	2,090	198	481			
May	1,540	166	298			
June	920	40	193			
July	128	12	31.9			
August	73	10	25.9			
September*	15	5	8.3			
The year	2,090	5	246	2.14	29.09	1.38

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of Savage River at Bloomington—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1930-31						
October	3.8	1.6	2.24			
November	5.0	2.0	3.56			
December	35	—	11.6			
January	395	10	65.6			
February	490	37	143			
March	1,050	57	250			
April*	1,050	72	366			
May	1,160	94	365			
June	146	13	47.6			
July	247	5.8	33.6			
August	64	3.1	17.5			
September	145	4.1	22.9			
The year	1,160	1.6	110	0.957	13.04	0.619

* Revised.

‡ Not previously published.

POTOMAC RIVER BASIN—*Continued*

Yearly discharge of Savage River at Bloomington

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1925	96.9	0.843	11.44	0.545	141	1.23	16.59	0.795
1926	172	1.50	20.21	.969	181	1.57	21.38	1.01
1927	246	2.14	29.09	1.38				
1930	116	1.01	13.74	.653	65.2	.567	7.70	.366
1931	110	.957	13.04	.619	120	1.04	14.15	.672
1932	133	1.16	15.77	.750	148	1.29	17.51	.834
1933	196	1.70	23.13	1.10	185	1.61	21.81	1.04
1934	106	.922	12.51	.596	114	.991	13.44	.641
1935	178	1.55	21.04	1.00	175	1.52	20.63	.982
1936	213	1.85	25.21	1.20	224	1.95	26.54	1.26
1937	207	1.80	24.48	1.16	236	2.05	27.85	1.32
1938	156	1.36	18.47	.879	103	.896	12.16	.579
1939	148	1.29	17.44	.834	150	1.30	17.71	.840
1940	166	1.44	19.61	.931	190	1.65	22.51	1.07
1941	162	1.41	19.07	.911	138	1.20	16.25	.776
1942	146	1.27	17.21	.821	216	1.88	25.53	1.22
1943	205	1.78	24.17	1.15	128	1.11	15.12	.717
1944	145	1.26	17.21	.814	171	1.49	20.23	.963
1945	202	1.76	23.85	1.14	209	1.82	24.73	1.18
1946	153	1.33	18.03	.860	128	1.11	15.10	.717
1947	115	1.00	13.63	.646	118	1.03	13.91	.666
1948	182	1.58	21.50	1.02	219	1.90	25.95	1.23
1949	185	1.61	21.86	1.04	161	1.40	19.04	.905
1950	177	1.54	20.89	.995				
Highest	246	2.14	29.09	1.38	236	2.05	27.85	1.32
Average	163	1.42	19.28	.917	160	1.39	18.90	.899
Lowest	96.9	.843	11.44	.545	65.2	.567	7.70	.366

POTOMAC RIVER BASIN

4. North Branch Potomac River at Luke

Location.—Lat 39°28′45″, long 79°03′55″, on right bank 0.2 mile downstream from Savage River, 0.5 mile northwest of Luke, Allegany County.

Drainage area.—404 sq mi. At site used June 27, 1899 to July 15, 1906, 405 sq mi.

Records available.—June 1899 to July 1906 (published as "at Piedmont, W. Va."), October 1949 to September 1959. June 1899 to July 1906 published in Bulletins 1 and 13 (1905, 1906 revised herein), October 1949 to September 1952 in Bulletin 13 (1949–52 adjustments included herein).

Gage.—Water-stage recorder and concrete control. Datum of gage is 946.25 ft above mean sea level, adjustment of 1912. June 27, 1899, to July 15, 1906, chain gage at bridge 1.1 miles downstream at datum about 35 ft lower.

Average discharge.—16 years (1899–1905, 1949–59), 684 cfs (adjusted for storage since 1949).

Extremes.—Maximum discharge, 39,400 cfs Oct. 15, 1954 (gage height, 17.15 ft); minimum daily, 6 cfs Sept. 4, 1904.

Remarks.—Flow regulared since 1913 by Stony River Reservoir, 45 miles above station (see Remarks for station at Bloomington) and, since December 1950, by Savage River Reservoir, 5 miles above station (see Remarks for Savage River below Dam), some regulation at low flow by West Virginia Pulp and Paper Company at site used 1899–1906.

Monthly discharge of North Branch Potomac River at Luke

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1904–05						
October	68	12	27.6	0.068	0.08	0.044
November	51	15	33.5	.083	.09	.054
December	1,660	15	243	.600	.69	.388
January	3,210	99	360	.889	1.02	.575
February	200	80	99.8	.246	.26	.159
March	7,420	110	2,427	5.99	6.91	3.87
April	830	425	620	1.53	1.71	.989
May	1,914	191	496	1.22	1.41	.789
June	1,605	242	588	1.45	1.62	.937
July	2,460	161	653	1.61	1.86	1.04
August	1,775	88	376	.928	1.07	.600
September	1,020	51	195	.481	.54	.311
The year	7,420	12	515	1.27	17.26	

Monthly discharge of North Branch Potomac River at Luke—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1905–06						
October	1,718	36	348	0.859	0.99	0.555
November	1,385	148	267	.659	.74	.426
December	2,895	208	815	2.01	2.32	1.30
January	7,500	327	1,255	3.10	3.57	2.00
February*	488	121	225	.556	.58	.359
March*	5,710	224	1,166	2.88	3.32	1.86
April	4,515	700	2,013	4.97	5.54	3.21
May	740	109	323	.798	.92	.516
June	2,078	160	413	1.02	1.14	.659
						Change in contents for Savage River Reservoir equivalent in cfs
1949–50						
October	679	72	143			−25.1
November	2,960	173	455			+18.4
December	1,830	415	807			−7.4
January	3,970	360	866			+7.7
February	5,180	512	1,636			−9.0
March	5,680	505	1,552			+9.1
April	2,030	372	758			+16.8
May	2,280	594	1,091			+1.1
June	1,240	216	543			−.6
July	608	94	183			0
August	167	61	83.3			−23.7
September	4,430	42	472			+24.0
The year	5,680	42	710	1.76	23.85	+.9
1950–51						
October	748	107	279			−28.1
November	1,820	140	446			−10.4
December	4,350	270	1,261			+35.4
January	3,690	556	1,511			+85.9
February	5,530	875	1,605			+25.7
March	3,120	732	1,345			−33.7
April	2,680	717	1,463			−41.2
May	1,840	212	868			−32.1
June	7,020	144	1,125			+1.5
July	647	65	188			+25.0
August	132	48	61.4			−18.7
September	252	42	66.9			−28.0
The year	7,020	42	846	2.09	28.43	−1.6

Monthly discharge of North Branch Potomac River at Luke—*Continued*

Month	Discharge in cfs				Runoff in inches	Change in contents for Savage River Reservoir equivalent in cfs
	Maximum	Minimum	Mean	Per square mile		
1951–52						
October	86	36	45.5			−16.6
November	735	58	174			+28.8
December	4,400	126	630			+190
January	5,260	616	2,276			−148
February	2,190	214	727			+1.8
March	4,810	185	1,300			+175
April	4,690	440	1,377			+107
May	2,630	560	1,175			+12.0
June	688	95	214			−2.2
July	119	81	99.9			−63.1
August	161	63	86.4			−40.4
September	172	67	115			−86.9
The year	5,260	36	687	1.70	23.15	+13.2
1952–53						
October	125	74	89.2			−65.9
November	1,930	65	212			−4.1
December	2,240	150	477			−24.4
January	4,750	215	1,517			+6.8
February	3,260	595	1,286			−15.8
March	3,280	540	1,728			+79.9
April	2,890	526	1,123			+177
May	1,550	270	789			+42.4
June	694	72	169			−14.2
July	122	84	91.4			−64.3
August	310	87	110			−55.0
September	103	90	96.1			−73.0
The year	4,750	65	638	1.58	21.43	−1.2
1953–54						
October	106	90	93.4			−85.1
November	125	81	91.8			−65.0
December	430	76	131			+5.8
January	1,800	72	390			+60.5
February	684	135	358			+12.4
March	4,870	557	1,387			+78.3
April	977	270	449			+97.5
May	1,280	315	467			+101
June	3,450	157	704			−.4
July	1,520	92	179			−14.8
August	1,550	106	560			+.7
September	431	161	247			−84.0
The year	4,870	72	422	1.04	14.19	+9.1

Monthly discharge of North Branch Potomac River at Luke—*Continued*

Month	Discharge in cfs: Maximum	Minimum	Mean	Per square mile	Runoff in inches	Change in contents for Savage River Reservoir equivalent in cfs
1954–55						
October	13,400	165	1,423			−86.0
November	1,710	331	701			−59.3
December	6,460	380	1,148			+104
January	3,490	185	913			−165
February	2,800	245	1,329			+23.9
March	4,450	614	2,087			+50.1
April	2,140	260	595			+197
May	1,570	227	478			+35.5
June	2,920	118	712			+2.4
July	771	92	180			−15.7
August	18,400	96	1,401			−39.8
September	1,170	97	206			−114
The year	18,400	92	932	2.31	31.31	−6.0
1955–56						
October	163	112	125			−66.0
November	544	100	178			−6.6
December	480	145	238			−47.2
January	4,100	100	348			+8.2
February	4,950	640	2,421			+3.6
March	3,030	680	1,449			+90.9
April	4,100	373	1,110			+150
May	6,770	330	1,307			+41.5
June	2,820	320	790			−3.4
July	1,270	133	281			+.07
August	10,300	185	1,047			−34.8
September	389	200	256			−83.0
The year	10,300	100	789	1.95	26.59	+4.4
1956–57						
October	923	218	391			−121
November	1,000	157	387			−25.1
December	3,450	188	1,467			−52.0
January	5,000	330	1,524			+35.6
February	8,690	634	2,003			−.9
March	1,430	439	827			+53.6
April	2,900	332	1,012			+216
May	1,150	160	345			+15.4
June	826	95	240			+4.8
July	388	92	122			−35.0
August	116	95	101			−84.2
September	104	92	95.6			−73.4
The year	8,690	92	702	1.74	23.59	−6.0

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of North Branch Potomac River at Luke—*Continued*

Month	Discharge in cfs				Runoff in inches	Change in contents for Savage River Reservoir equivalent in cfs
	Maximum	Minimum	Mean	Per square mile		
1957–58						
October	771	95	285			−78.1
November	314	123	188			−23.7
December	3,500	178	1,122			+8.3
January	1,060	290	487			−1.5
February	1,450	340	577			−7.1
March	2,380	400	1,092			+77.9
April	9,190	701	2,442			+193
May	5,760	175	1,270			+24.3
June	506	86	178			−.4
July	1,450	89	402			+2.0
August	2,610	211	598			−53.6
September	293	108	178			−95.4
The year	9,190	86	736	1.82	24.73	+3.7
1958–59						
October	229	108	137			−87.4
November	410	99	167			−38.0
December	400	110	179			−24.1
January	3,040	160	696			−5.3
February	2,950	400	1,079			−4.2
March	3,040	424	975			+76.4
April	2,420	445	855			+178
May	1,400	257	567			+43.4
June	1,080	86	227			−15.4
July	168	86	98.0			−40.2
August	129	86	95.5			−62.4
September	256	86	96.6			−66.9
The year	3,040	86	427	1.06	14.34	−4.1

* Revised.

POTOMAC RIVER BASIN—*Continued*

Yearly discharge of North Branch Potomac River at Luke

(Unadjusted)

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1900	536	1.32	17.98	0.853	589	1.45	19.75	0.937
1901	818	2.02	27.42	1.31	836	2.06	28.00	1.33
1902	748	1.85	25.04	1.20	803	1.98	26.90	1.28
1903	962	2.38	32.26	1.54	806	1.99	27.04	1.29
1904	469	1.16	15.76	.750	459	1.13	15.41	.730
1905	515	1.27	17.26	.821	610	1.51	20.45	.976
1950	710	1.76	23.85	1.14	759	1.88	25.51	1.22
1951	846	2.09	28.43	1.35	750	1.86	25.21	1.20
1952	687	1.70	23.15	1.10	681	1.69	22.94	1.09
1953	638	1.58	21.43	1.02	599	1.48	20.13	.957
1954	422	1.04	14.19	.672	672	1.66	22.57	1.07
1955	932	2.31	31.31	1.49	701	1.74	23.57	1.12
1956	789	1.95	26.59	1.26	933	2.31	31.44	1.49
1957	702	1.74	23.59	1.12	647	1.60	21.75	1.03
1958	736	1.82	24.73	1.18	642	1.59	21.56	1.03
1959	427	1.06	14.34	.685				
Highest	962	2.38	32.26	1.54	933	2.31	31.44	1.49
Average	684	1.69	22.96	1.09	699	1.73	23.48	1.12
Lowest	422	1.04	14.19	.672	459	1.13	15.41	.730

Yearly change in contents of Stony River and Savage River Reservoirs, equivalent in cfs

Year	Year Ending Sept. 30	Calendar Year	Year	Year Ending Sept. 30	Calendar Year
	Ajustments in cfs	Adjustments in cfs		Adjustments in cfs	Adjustments in cfs
1950	+0.9	+1.9	1955	−6.0	−12.7
1951	−1.6	+15.8	1956	+4.4	−2.1
1952	+13.2	−11.8	1957	−6.0	+2.9
1953	−1.2	−5.2	1958	+3.7	−1.0
1954	+9.1	+17.7	1959	−4.1	

5. Georges Creek at Franklin

Location.—Lat 39°29′38″, long 79°02′42″, on right bank at Franklin, Allegany County, 1¼ miles upstream from Westernport and mouth.

Drainage area.—72.4 sq mi. At site used prior to 1929, 72.7 sq mi.

Records available.—May 1905 to July 1906 (published as "at Westernport"), October 1929 to September 1959. Monthly records May 1905 to July 1906, October 1929 to September 1943 published in Bulletins 1 and 13 (May 1905, October 1929 completed, 1940 revised herein); October 1943 to September 1952; in Bulletin 13.

Gage.—Water-stage recorder. Datum of gage is 958.96 ft above mean sea level (West Virginia Pulp and Paper Co. bench mark). May 4, 1905, to July 15, 1906, chain gage at bridge three-quarters of a mile downstream at different datum. Oct. 16, 1929, to Oct. 1, 1937, water-stage recorder at site 95 ft downstream at present datum.

Average discharge.—30 years (1929–59), 76.4 cfs.

Extremes.—Maximum discharge, 8,500 cfs. Mar. 17, 1936, (gage height, 9.6 ft, site then in use), from rating curve extended above 2,000 cfs on basis of slope-area measurement of peak flow; minimum, 1.6 cfs Oct. 2, 4–8, 1930.

Flood of Mar. 29, 1924 reached a stage of about 10 ft, from floodmarks at site 95 ft downstream (discharge not determined).

Remarks.—Records include about half a cubic foot per second of sewage from city of Frostburg, which obtains its water supply from Big Piney Run (Monongahela River basin) and Savage River. A negligible discharge diverted above station by Frostburg Water Co. for municipal supplies of Eckhart and Welch Hill. Records include drainage from numerous active and abandoned coal mines.

History.—Information on local floods for Lonaconing, Maryland, about 7 miles upstream from gaging station was noted in 1923 publication by Thomas and Williams "History of Allegany County" as follows: "During the past 100 years Georges Creek has been at flood stages numerous times, notably in 1810, 1823, 1861, but in July 1884, the greatest high water ever known rushed through the valley. Three feet of water covered the Cumberland and Pennsylvania Railroad tracks, at the depot following rain for three days and nights." This was believed to have been about 9 feet higher than the flood of March 17, 1936.

Monthly discharge of Georges Creek at Franklin

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1905						
May‡	92	26	45.0	0.619	0.71	0.400
1929–30						
October‡	450	13	71.7	0.990	1.14	0.640
November	413	—	87.4	1.21	1.35	.782
December	294	—	90.2	1.25	1.44	.808
January	113	—	53.2	.735	.85	.475
February	110	—	50.5	.698	.73	.451
March	113	37	72.2	.997	1.15	.644
April	120	34	68.3	.943	1.05	.609
May	60	16	31.0	.428	.49	.277
June	108	6.4	16.2	.224	.25	.145
July	14	1.9	5.19	.072	.08	.046
August	10	1.8	3.97	.055	.06	.036
September	11	1.6	2.80	.039	.04	.025
The year	450	1.6	46.0	.635	8.63	.410

Monthly discharge of Georges Creek at Franklin—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1939–40						
October	26	4.7	9.28	0.128	0.15	0.083
November	27	6.9	11.8	.163	.18	.105
December	26	9.8	13.7	.189	.22	.122
January	33	7.0	10.9	.151	.17	.098
February*	209	7.2	68.0	.939	1.01	.607
March	476	40	183	2.53	2.92	1.64
April	1,030	112	291	4.02	4.48	2.60
May	563	39	86.4	1.19	1.37	.769
June	354	32	107	1.48	1.65	.957
July	232	10.0	28.7	.396	.46	.256
August	165	8.3	29.9	.413	.48	.267
September	135	8.6	29.4	.406	.45	.262
The year	1,030	4.7	72.0	.994	13.54	.642
1952–53						
October	12	5.2	6.56	0.091	0.10	0.059
November	340	5.2	34.6	.478	.53	.309
December	311	13	41.4	.572	.66	.370
January	720	16	187	2.58	2.98	1.67
February	432	81	145	2.00	2.08	1.29
March	900	89	282	3.90	4.50	2.52
April	313	62	149	2.06	2.29	1.33
May	220	40	98.3	1.36	1.57	.879
June	146	11	40.6	.561	.63	.363
July	34	6.0	10.1	.140	.16	.090
August	40	3.9	8.13	.112	.13	.072
September	7.9	3.0	4.41	.061	.07	.039
The year	900	3.0	83.7	1.16	15.70	.750
1953–54						
October	6.6	3.6	3.83	0.053	0.06	0.034
November	11	4.1	4.81	.066	.07	.043
December	33	4.6	8.37	.116	.13	.075
January	68	4.6	12.6	.174	.20	.112
February	17	4.5	8.78	.121	.13	.078
March	960	41	132	1.82	2.09	1.18
April	102	16	40.0	.552	.62	.357
May	191	26	57.9	.800	.92	.517
June	285	10	53.5	.739	.82	.478
July	44	5.1	11.4	.157	.18	.101
August	96	4.7	19.0	.262	.30	.169
September	51	7.9	16.8	.232	.26	.150
The year	960	3.6	30.9	.427	5.78	.276

Monthly discharge of Georges Creek at Franklin—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1954–55						
October	1,390	7.5	114	1.57	1.82	1.01
November	215	29	77.1	1.06	1.19	.685
December	726	47	131	1.81	2.08	1.17
January	317	22	90.8	1.25	1.45	.808
February	305	30	140	1.93	2.01	1.25
March	1,080	129	341	4.71	5.43	3.04
April	416	53	115	1.59	1.78	1.03
May	137	26	57.8	.798	.92	.516
June	741	14	112	1.55	1.73	1.00
July	140	9.4	22.9	.316	.37	.204
August	1,400	7.5	120	1.66	1.91	1.07
September	99	9.8	19.3	.267	.30	.173
The year	1,400	7.5	112	1.55	20.99	1.00
1955–56						
October	21	8.3	10.4	0.144	0.17	0.093
November	20	8.3	12.9	.178	.20	.115
December	16	7.0	9.70	.134	.15	.087
January	300	6.2	21.8	.301	.35	.195
February	615	77	261	3.60	3.89	2.33
March	327	93	185	2.56	2.95	1.65
April	720	59	182	2.51	2.81	1.62
May	240	53	114	1.57	1.82	1.01
June	224	44	87.2	1.20	1.34	.776
July	68	16	28.2	.390	.45	.252
August	663	14	82.4	1.14	1.31	.737
September	65	14	26.4	.365	.41	.236
The year	720	6.2	84.2	1.16	15.85	.750
1956–57						
October	46	14	20.8	0.287	0.33	0.185
November	164	19	50.5	.698	.78	.451
December	507	17	148	2.04	2.36	1.32
January	584	52	144	1.99	2.29	1.29
February	982	89	246	3.40	3.54	2.20
March	209	77	123	1.70	1.95	1.10
April	365	61	163	2.25	2.52	1.45
May	109	22	42.5	.587	.68	.379
June	172	16	35.3	.488	.54	.315
July	31	6.7	12.3	.170	.20	.110
August	14	3.5	5.53	.076	.09	.049
September	30	3.2	6.11	.084	.09	.054
The year	982	3.2	82.0	1.13	15.37	.730

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of Georges Creek at Franklin—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1957–58						
October	206	4.7	35.1	0.485	0.56	0.313
November	58	11	22.8	.315	.35	.204
December	594	16	120	1.66	1.91	1.07
January	140	26	61.8	.854	.98	.552
February	176	27	61.9	.855	.89	.553
March	394	75	183	2.53	2.91	1.64
April	690	83	277	3.83	4.27	2.48
May	890	42	236	3.26	3.76	2.11
June	59	14	26.5	.366	.41	.237
July	78	10	23.7	.327	.38	.211
August	396	9.8	53.8	.743	.86	.480
September	22	6.7	8.91	.123	.14	.080
The year	890	4.7	92.9	1.28	17.42	.827
1958–59						
October	13	6.3	7.38	0.102	0.12	0.066
November	20	6.4	9.73	.134	.15	.087
December	22	4.0	7.44	.103	.12	.067
January	114	6.0	25.0	.345	.40	.223
February	342	17	81.0	1.12	1.17	.724
March	289	28	104	1.44	1.65	.931
April	385	51	113	1.56	1.74	1.01
May	215	24	75	1.04	1.19	.672
June	182	9.3	40.0	.552	.62	.357
July	19	6.7	10.3	.142	.16	.092
August	55	4.3	9.28	.128	.15	.083
September	303	2.9	13.7	.189	.21	.122
The year	385	2.9	40.9	.565	7.68	.365

* Revised.

‡ Not previously published.

POTOMAC RIVER BASIN—*Continued*

Yearly discharge of Georges Creek at Franklin

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1930	46.0	0.635	8.63	0.410	26.3	0.363	4.93	0.235
1931	50.8	.702	9.51	.454	52.1	.720	9.76	.465
1932	57.6	.796	10.83	.514	66.2	.914	12.45	.591
1933	93.3	1.29	17.51	.834	86.5	1.19	16.25	.769
1934	42.4	.586	7.94	.379	48.7	.673	9.13	.435
1935	85.0	1.17	15.95	.756	82.0	1.13	15.40	.730
1936	109	1.51	20.57	.976	110	1.52	21.24	.982
1937	109	1.51	20.51	.976	127	1.75	23.84	1.13
1938	73.0	1.01	13.70	.653	45.8	.633	8.57	.409
1939	62.2	.859	11.66	.555	63.2	.873	11.82	.564
1940	72.0	.994	13.54	.642	82.0	1.13	15.41	.730
1941	68.1	.941	12.75	.608	58.3	.805	10.93	.520
1942	61.0	.843	11.45	.545	99.5	1.37	18.66	.885
1943	99.2	1.37	18.59	.885	59.0	.815	11.05	.527
1944	66.7	.921	12.54	.595	74.0	1.02	13.92	.659
1945	85.1	1.18	15.95	.763	91.8	1.27	17.21	.821
1946	79.1	1.09	14.83	.704	68.1	.941	12.77	.608
1947	48.0	.663	9.00	.429	50.1	.692	9.39	.447
1948	85.8	1.19	16.13	.769	99.9	1.38	18.77	.892
1949	93.2	1.29	17.49	.834	81.3	1.12	15.24	.724
1950	74.1	1.02	13.87	.659	83.2	1.15	15.60	.743
1951	108	1.49	20.32	.963	94.5	1.31	17.71	.847
1952	95.6	1.32	17.97	.853	98.5	1.36	18.51	.879
1953	83.7	1.16	15.70	.750	78.2	1.08	14.67	.698
1954	30.9	.427	5.78	.276	56.6	.782	10.61	.505
1955	112	1.55	20.99	1.00	87.5	1.21	16.42	.782
1956	84.2	1.16	15.85	.750	99.9	1.38	18.80	.892
1957	82.0	1.13	15.37	.730	78.5	1.08	14.72	.698
1958	92.9	1.28	17.42	.827	79.9	1.10	14.99	.711
1959	40.9	.565	7.68	.365				
Highest	112	1.55	20.99	1.00	127	1.75	23.84	1.13
Average	76.4	1.06	14.33	.682	76.8	1.06	14.44	.685
Lowest	30.9	.427	5.78	.276	26.3	.363	4.93	.235

POTOMAC RIVER BASIN

6. North Branch Potomac River at Pinto

Location.—Lat 39°33′59″, long 78°50′25″, on right bank at downstream side of Western Maryland Railway bridge at Pinto, Allegany County, 2.8 miles downstream from Mill Run.

Drainage area.—596 sq mi.

Records available.—October 1938 to September 1959. Monthly records October 1938 to September 1943 published in Bulletin 1 (1943 revised herein).

Gage.—Water-stage recorder. Datum of gage is 648.23 ft above mean sea level (Corps of Engineers bench mark). Prior to Dec. 10, 1938, wire-weight gage at highway bridge 250 ft downstream at same datum.

Average discharge.—21 years, 861 cfs (unadjusted).

Extremes.—Maximum discharge, 37,000 cfs Oct. 16, 1954 (gage height, 23.23 ft); minimum 31 cfs Dec. 18, 1943 (gage height, 1.37 ft), result of freezeup; minimum daily, 35 cfs Dec. 19, 1943.

Flood of Mar. 29, 1924, reached a stage of about 24 ft (discharge, about 55,000 cfs). Flood of Mar. 17, 1936, reached a stage of about 23.5 ft, from floodmarks (discharge, about 50,000 cfs).

Remarks.—Some regulation at low flow by Stony River Reservoir, 66 miles above station and since December 1950, by Savage River Reservoir. Unadjusted figures are published as the affect on the annual figures is insignificant (see North Branch Potomac River at Luke for change in contents).

Monthly discharge of North Branch Potomac River at Pinto

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1942–43						
October*	21,500	181	2,265			
November	1,820	369	722			
December	11,600	360	1,982			
January	5,220	616	1,698			
February	6,100	840	1,906			
March	4,270	505	1,403			
April	7,150	414	1,380			
May	1,570	364	732			
June	638	85	212			
July	1,210	85	371			
August	821	74	229			
September	159	47	78.2			
The year	21,500	47	1,080	1.81	24.60	1.17

* Revised.

Monthly discharge of North Branch Potomac River at Pinto—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1943–44						
October	209	39	67.3			
November	382	72	148			
December	409	35	98.4			
January	6,110	100	624			
February	7,900	260	1,449			
March	8,220	1,200	2,855			
April	4,440	970	1,910			
May	10,200	556	1,630			
June	2,330	232	521			
July	248	45	116			
August	67	35	45.3			
September	206	38	83.5			
The year	10,200	35	793	1.33	18.12	0.860
1944–45						
October	5,350	114	595			
November	2,080	127	311			
December	7,600	370	1,075			
January	3,740	373	921			
February	12,200	270	2,429			
March	11,200	765	2,446			
April	2,260	475	891			
May	4,120	495	1,292			
June	545	149	330			
July	2,040	74	295			
August	2,600	74	490			
September	10,300	188	1,596			
The year	12,200	74	1,048	1.76	23.86	1.14
1945–46						
October	792	191	383			
November	3,060	191	1,113			
December	1,760	378	807			
January	5,650	355	1,507			
February	3,890	329	1,034			
March	2,510	850	1,409			
April	1,160	321	567			
May	3,530	418	1,412			
June	3,770	378	1,215			
July	688	72	219			
August	594	54	133			
September	228	43	71.0			
The year	5,650	43	822	1.38	18.71	0.892

Monthly discharge of North Branch Potomac River at Pinto—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1946–47						
October	828	63	161			
November	147	70	94.2			
December	2,200	55	295			
January	3,290	422	1,141			
February	1,130	191	427			
March	5,580	222	1,322			
April	2,830	355	885			
May	2,750	422	904			
June	1,100	116	317			
July	1,140	68	260			
August	1,360	68	237			
September	316	63	130			
The year	5,580	55	517	0.867	11.78	0.560
1947–48						
October	137	54	64.2			
November	1,330	86	513			
December	815	150	328			
January	9,340	170	1,090			
February	5,600	170	1,567			
March	6,740	738	1,767			
April	10,700	600	2,144			
May	3,180	342	1,314			
June	1,860	312	792			
July	1,970	212	623			
August	616	84	248			
September	516	79	173			
The year	10,700	54	881	1.48	20.12	0.957
1948–49						
October	1,640	102	348			
November	1,390	144	512			
December	13,500	600	2,094			
January	7,940	792	2,125			
February	2,910	1,100	1,784			
March	2,110	580	1,036			
April	1,660	440	986			
May	2,140	225	507			
June	11,400	118	1,179			
July	9,700	212	1,104			
August	1,060	116	312			
September	330	96	149			
The year	13,500	96	1,008	1.69	22.96	1.09

Monthly discharge of North Branch Potomac River at Pinto—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1949–50						
October	474	94	161			
November	2,700	220	515			
December	2,120	500	965			
January	4,120	460	1,067			
February	7,750	680	2,331			
March	7,840	600	2,046			
April	2,140	455	940			
May	2,890	762	1,417			
June	1,790	254	592			
July	500	118	210			
August	176	63	91.6			
September	5,200	59	583			
The year	7,840	59	901	1.51	20.52	0.976
1950–51						
October	909	125	350			
November	2,300	145	562			
December	7,510	320	1,595			
January	4,200	678	1,855			
February	6,160	1,140	2,215			
March	4,980	1,020	1,802			
April	4,330	906	1,943			
May	2,920	349	1,225			
June	9,570	227	1,519			
July	765	114	256			
August	140	57	84.5			
September	221	48	82.9			
The year	9,570	48	1,116	1.87	25.42	1.21
1951–52						
October	114	45	57.6			
November	880	67	204			
December	5,000	145	680			
January	6,900	813	2,787			
February	2,950	373	1,033			
March	7,470	300	1,998			
April	7,240	696	1,999			
May	3,670	876	1,717			
June	1,130	173	366			
July	218	89	129			
August	188	69	99.3			
September	179	74	127			
The year	7,470	45	935	1.57	21.36	1.01

Monthly discharge of North Branch Potomac River at Pinto—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1952–53						
October	135	83	100			
November	2,880	76	267			
December	2,700	173	549			
January	5,690	245	1,955			
February	4,050	759	1,670			
March	4,570	754	2,413			
April	3,540	674	1,504			
May	2,030	363	1,048			
June	1,060	116	278			
July	166	100	119			
August	335	98	129			
September	140	102	109			
The year	5,690	76	842	1.41	19.17	0.911
1953–54						
October	130	100	107			
November	153	104	115			
December	427	78	152			
January	1,780	89	435			
February	813	150	385			
March	5,150	742	1,683			
April	1,190	322	561			
May	1,770	387	586			
June	4,220	221	839			
July	1,250	114	214			
August	1,920	118	600			
September	529	192	287			
The year	5,150	78	499	0.837	11.35	0.541
1954–55						
October	19,800	186	1,632			
November	1,990	387	890			
December	8,760	490	1,436			
January	4,170	190	1,070			
February	3,250	252	1,571			
March	7,390	881	2,809			
April	3,490	407	914			
May	1,590	308	623			
June	4,140	150	1,045			
July	827	110	234			
August	20,500	107	1,788			
September	804	120	258			
The year	20,500	107	1,190	2.00	27.11	1.29

Monthly discharge of North Branch Potomac River at Pinto—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1955–56						
October	180	130	146			
November	500	116	207			
December	540	161	264			
January	4,200	121	371			
February	6,730	1,050	3,157			
March	4,810	940	1,976			
April	6,160	540	1,617			
May	8,310	498	1,530			
June	3,130	402	958			
July	1,120	183	337			
August	11,400	231	1,196			
September	447	224	301			
The year	11,400	116	996	1.67	22.74	1.08
1956–57						
October	940	259	432			
November	1,270	214	503			
December	4,080	231	1,816			
January	5,260	489	1,791			
February	11,300	836	2,522			
March	1,820	617	1,129			
April	3,600	489	1,389			
May	1,160	238	452			
June	986	169	344			
July	504	125	173			
August	169	110	126			
September	175	108	123			
The year	11,300	108	890	1.49	20.27	0.963
1957–58						
October	818	116	339			
November	390	145	229			
December	4,690	214	1,355			
January	1,390	330	629			
February	1,820	414	728			
March	3,190	585	1,550			
April	9,690	932	2,993			
May	8,430	272	1,727			
June	554	126	232			
July	1,470	113	431			
August	3,530	232	681			
September	275	123	193			
The year	9,690	113	926	1.55	21.08	1.00

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of North Branch Potomac River at Pinto—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1958–59						
October	246	123	149			
November	420	118	184			
December	446	130	197			
January	4,110	180	764			
February	3,890	442	1,190			
March	3,770	442	1,150			
April	3,130	539	1,055			
May	2,040	307	713			
June	1,590	100	299			
July	178	93	121			
August	163	96	117			
September	276	96	108			
The year	4,110	93	499	0.837	11.37	0.541

Yearly discharge of North Branch Potomac River at Pinto

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1939	819	1.37	18.66	0.885	832	1.40	18.94	0.905
1940	858	1.44	19.59	.931	945	1.59	21.58	1.03
1941	761	1.28	17.34	.827	673	1.13	15.33	.730
1942	693	1.16	15.78	.750	1,056	1.77	24.05	1.14
1943	1,080	1.81	24.60	1.17	686	1.15	15.63	.743
1944	793	1.33	18.12	.860	934	1.56	21.33	1.01
1945	1,048	1.76	23.86	1.14	1,073	1.80	24.44	1.16
1946	822	1.38	18.71	.892	676	1.13	15.39	.730
1947	517	.867	11.78	.560	546	.916	12.44	.592
1948	881	1.48	20.12	.957	1,055	1.77	24.09	1.14
1949	1,008	1.69	22.96	1.09	897	1.50	20.42	.969
1950	901	1.51	20.52	.976	974	1.63	22.19	1.05
1951	1,116	1.87	25.42	1.21	984	1.65	22.42	1.07
1952	935	1.57	21.36	1.01	933	1.57	21.31	1.01
1953	842	1.41	19.17	.911	796	1.34	18.13	.866
1954	499	.837	11.35	.541	801	1.34	18.24	.866
1955	1,190	2.00	27.11	1.29	909	1.53	20.69	.989
1956	996	1.67	22.74	1.08	1,176	1.97	26.85	1.27
1957	890	1.49	20.27	.963	821	1.38	18.69	.892
1958	926	1.55	21.08	1.00	807	1.35	18.39	.873
1959	499	.837	11.37	.541				
Highest	1,190	2.00	27.11	1.29	1,176	1.97	26.85	1.27
Average	861	1.44	19.61	.933	879	1.47	20.03	.952
Lowest	499	.837	11.35	.541	546	.916	12.44	.592

7. Wills Creek at Hyndman, Pa.

Location.—Lat 39°49′20″, long 78°43′05″, at downstream side of highway bridge, 0.4 mile northeast of Hyndman, Bedford County, and 0.75 mile upstream from Little Wills Creek.

Drainage area.—100 sq mi.

Records available.—August 1948 to September 1951 (discontinued).

Gage.—Wire-weight gage and crest-stage indicator; gage read twice daily.

Extremes.—Maximum discharge, 4,800 cfs Dec. 7, 1950 (gage height, 8.11 ft), from rating curve extended above 1,900 cfs by logarithmic plotting; minimum daily, 1.4 cfs Sept. 29, 1951.

Flood of March 1936 reached a stage of approximately 16 ft, from information by local residents.

Monthly discharge of Wills Creek at Hyndman, Pa.

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1948						
August 17–31	56	6.1	14.2	0.142	0.08	0.092
September	38	4.1	8.64	.086	.10	.056
1948–49						
October	204	5.5	34.8	0.348	0.40	0.225
November	294	15	113	1.13	1.26	.730
December	1,620	80	329	3.29	3.79	2.13
January	1,480	85	402	4.02	4.64	2.60
February	615	160	280	2.80	2.91	1.81
March	250	74	149	1.49	1.72	.963
April	348	76	176	1.76	1.97	1.14
May	107	33	52.7	.527	.61	.341
June	618	12	102	1.02	1.14	.659
July	467	26	93.5	.935	1.08	.604
August	1,020	9.9	100	1.00	1.15	.646
September	61	11	21.3	.213	.24	.138
The year	1,620	5.5	154	1.54	20.91	.995
1949–50						
October	68	9.6	20.5	0.205	0.24	0.132
November	214	32	63.6	.636	.71	.411
December	438	50	159	1.59	1.83	1.03
January	390	43	151	1.51	1.74	.976
February	880	92	378	3.78	3.94	2.44
March	1,990	48	306	3.06	3.53	1.98
April	750	44	162	1.62	1.81	1.05
May	352	76	192	1.92	2.22	1.24
June	256	16	70.9	.709	.79	.458
July	54	9.2	19.3	.193	.22	.125
August	55	5.5	13.6	.136	.16	.088
September	522	8.5	65.5	.655	.73	.423
The year	1,990	5.5	132	1.32	17.92	.853

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of Wills Creek at Hyndman, Pa.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1950–51						
October	282	15	72.4	0.724	0.83	0.468
November	650	32	108	1.08	1.20	.698
December	2,630	38	353	3.53	4.07	2.28
January	792	40	333	3.33	3.84	2.15
February	982	100	394	3.94	4.10	2.55
March	1,130	75	250	2.50	2.88	1.62
April	760	95	291	2.91	3.25	1.88
May	470	33	134	1.34	1.55	.866
June	1,590	28	216	2.16	2.41	1.40
July	90	11	28.0	.280	.32	.181
August	55	3.2	8.87	.089	.10	.058
September	15	1.4	3.73	.037	.04	.024
The year	2,630	1.4	181	1.81	24.59	1.17

Yearly discharge of Wills Creek at Hyndman, Pa.

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1949	154	1.54	20.91	0.995	134	1.34	18.24	0.866
1950	132	1.32	17.92	.853	157	1.57	21.24	1.01
1951	181	1.81	24.59	1.17				

8. Wills Creek below Hyndman, Pa.

Location.—Lat 39°48′43″, long 78°43′00″, on left bank 150 ft upstream from county highway bridge, 150 ft downstream from Pennsylvania Railroad bridge, 0.35 mile downstream from Little Wills Creek, and half a mile south of Hyndman, Bedford County.

Drainage area.—146 sq mi.

Records available.—June 1951 to September 1959.

Gage.—Water-stage recorder. Datum of gage is 891.37 ft above mean sea level (Pennsylvania Railroad bench mark).

Average discharge.—8 years, 185 cfs.

Extremes.—Maximum discharge, 11,600 cfs. Oct. 15, 1954 (gage height, 11.02 ft), from rating curve extended above 6,000 cfs by logarithmic plotting; minimum, 0.8 cfs Sept. 9, 1957 (gage height, 1.16 ft).

Monthly discharge of Wills Creek below Hyndman, Pa.

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1951						
June 20–30	162	52	89.1	0.610	0.25	0.394
July	207	20	51.5	.353	.41	.228
August	84	5.0	14.5	.099	.11	.064
September	24	2.2	5.85	.040	.04	.026
1951–52						
October	19	2.2	5.88	0.040	0.05	0.026
November	86	7.6	25.3	.173	.19	.112
December	840	23	104	.712	.82	.460
January	2,360	124	549	3.76	4.33	.243
February	720	66	194	1.33	1.43	.860
March	4,310	56	602	4.12	4.76	2.66
April	1,290	174	500	3.42	3.82	2.21
May	872	188	363	2.49	2.86	1.61
June	551	26	114	.781	.87	.505
July	62	3.6	20.6	.141	.16	.091
August	45	3.0	14.1	.097	.11	.063
September	67	3.0	11.9	.082	.09	.053
The year	4,310	2.2	209	1.43	19.49	.924
1952–53						
October	13	3.0	6.39	0.044	0.05	0.028
November	1,330	5.4	115	.788	.88	.509
December	1,170	29	154	1.05	1.21	.679
January	1,600	43	462	3.16	3.65	2.04
February	738	155	294	2.01	2.10	1.30
March	2,760	132	664	4.55	5.24	2.94
April	597	168	287	1.97	2.19	1.27
May	4,260	88	342	2.34	2.70	1.51
June	2,480	18	230	1.58	1.76	1.02
July	367	4.9	32.5	.223	.26	.144
August	23	1.2	7.69	.053	.06	.034
September	33	1.1	6.81	.047	.05	.030
The year	4,260	1.1	217	1.49	20.15	.963

Monthly discharge of Wills Creek below Hyndman, Pa.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1953–54						
October	6.3	2.2	3.66	0.025	0.03	0.016
November	24	3.9	6.49	.044	.05	.028
December	54	5.2	14.1	.097	.11	.063
January	150	7.0	36.5	.250	.29	.162
February	119	12	47.6	.326	.34	.211
March	3,240	119	395	2.71	3.12	1.75
April	310	64	131	.897	1.00	5.80
May	271	66	144	.986	1.14	.637
June	338	21	91.4	.626	.70	.405
July	102	6.4	20.9	.143	.17	.092
August	182	6.4	41.9	.287	.33	.185
September	81	9.8	27.1	.186	.21	.120
The year	3,240	2.2	80.4	.551	7.49	.356
1954–55						
October	3,020	16	311	2.13	2.45	1.38
November	910	88	250	1.71	1.91	1.11
December	2,820	96	372	2.55	2.94	1.65
January	788	38	168	1.15	1.33	.743
February	918	43	311	2.13	2.22	1.38
March	2,930	160	766	5.25	6.05	3.39
April	910	67	240	1.64	1.84	1.06
May	242	38	88.7	.608	.70	.393
June	1,130	22	245	1.68	1.87	1.09
July	166	13	37.8	.259	.30	.167
August	1,160	8.6	146	1.00	1.15	.646
September	84	7.0	17.8	.122	.14	.079
The year	3,020	7.0	246	1.68	22.90	1.09
1955–56						
October	38	9.8	14.4	0.099	0.11	0.064
November	60	13	31.4	.215	.24	.139
December	45	10	21.0	.144	.17	.093
January	800	8.0	49.4	.338	.39	.218
February	1,320	217	574	3.93	4.24	2.54
March	1,240	206	514	3.52	4.06	2.28
April	1,850	148	475	3.25	3.63	2.10
May	1,080	172	404	2.77	3.19	1.79
June	420	41	144	.986	1.10	.637
July	126	19	52.7	.361	.42	.233
August	294	14	92.7	.635	.73	.410
September	137	40	66.7	.457	.51	.295
The year	1,850	8.0	202	1.38	18.79	.892

Monthly discharge of Wills Creek below Hyndman, Pa.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1956–57						
October	110	33	54.4	0.373	0.43	0.241
November	305	35	90.7	.621	.69	.401
December	2,430	35	423	2.90	3.34	1.87
January	842	92	260	1.78	2.05	1.15
February	1,850	125	417	2.86	2.98	1.85
March	654	142	294	2.01	2.32	1.30
April	1,130	144	457	3.13	3.49	2.02
May	211	48	91.0	.623	.72	.403
June	120	20	48.1	.329	.37	.213
July	40	3.2	10.8	.074	.09	.048
August	7.6	1.2	2.68	.018	.02	.012
September	8.0	.9	3.42	.023	.03	.015
The year	2,430	.9	178	1.22	16.53	.789
1957–58						
October	172	2.9	27.1	0.186	0.21	0.120
November	48	12	24.5	.168	.19	.109
December	1,580	13	298	2.04	2.35	1.32
January	610	62	195	1.34	1.54	.866
February	513	80	185	1.27	1.32	.821
March	1,040	136	460	3.15	3.63	2.04
April	1,870	134	647	4.43	4.94	2.86
May	2,840	54	529	3.62	4.17	2.34
June	330	14	70.4	.482	.54	.312
July	157	16	41.9	.287	.33	.185
August	332	14	71.4	.489	.56	.316
September	80	5.5	15.5	.106	.12	.068
The year	2,840	2.9	214	1.47	19.90	.950
1958–59						
October	24	5.9	10.4	0.071	0.08	0.046
November	66	11	29.2	.200	.22	.129
December	90	16	30.5	.209	.24	.135
January	640	22	141	.966	1.11	.624
February	1,230	61	290	1.99	2.07	1.29
March	1,150	100	345	2.36	2.73	1.53
April	1,630	132	432	2.96	3.30	1.91
May	679	59	240	1.64	1.89	1.06
June	248	8.4	53.6	.367	.41	.237
July	38	6.9	15.2	.104	.12	.067
August	85	5.0	20.9	.143	.17	.092
September	72	1.8	6.80	.047	.05	.030
The year	1,630	1.8	133	.911	12.39	.589

POTOMAC RIVER BASIN—*Continued*

Yearly discharge of Wills Creek below Hyndman, Pa.

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1952	209	1.43	19.49	0.924	221	1.51	20.57	0.976
1953	217	1.49	20.15	.963	196	1.34	18.20	.866
1954	80.4	.551	7.49	.356	157	1.08	14.60	.698
1955	246	1.68	22.90	1.09	173	1.18	16.12	.763
1956	202	1.38	18.79	.892	244	1.67	22.73	1.08
1957	178	1.22	16.53	.789	159	1.09	14.82	.704
1958	214	1.47	19.90	.950	190	1.30	17.69	.840
1959	133	.911	12.39	.589				
Highest	246	1.68	22.90	1.09	244	1.67	22.73	1.08
Average	185	1.27	17.20	.819	191	1.31	17.82	.847
Lowest	80.4	.551	7.49	.356	157	1.08	14.60	.698

POTOMAC RIVER BASIN

9. Wills Creek near Cumberland

Location.—Lat 39°40′07″, long 78°47′18″, on right bank at downstream side of Western Maryland Railway Bridge, 2 miles upstream from Cumberland, Allegany County, and mouth.

Drainage area.—247 sq. mi.

Records available.—May 1905 to July 1906 (published as "at Cumberland"), October 1929 to September 1959. Monthly records May 1905 to July 1906, October 1929 to September 1943 published in Bulletin 1. (May 1905, October 1929 completed and 1906, 1930, 1936, 1937 revised herein).

Gage.—Water-stage recorder. Datum of gage is 640.89 ft above mean sea level (Corps of Engineers bench mark). May 6, 1905, to July 14, 1906, chain gage at highway bridge 700 ft upstream at different datum.

Average discharge.—30 years (1929–59), 312 cfs.

Extremes.—Maximum discharge, 38,100 cfs Mar. 17, 1936 (gage height, 20.2 ft., from floodmarks at present site), from rating curve extended above 6,500 cfs on basis of slope-area measurements at gage heights 13.45 and 20.2 ft; minimum, 9 cfs Oct. 14, 1930.

Remarks.—Records include drainage from numerous active and abandoned coal mines. Slight diurnal fluctuations at low flow caused by quarry upstream.

Monthly discharge of Wills Creek near Cumberland

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1905						
May‡	747	91	206	0.834	0.96	0.539
June	1,355	104	272	1.10	1.23	.711
July	1,905	96	353	1.43	1.65	.924
August	1,045	36	174	.704	.81	.455
September	647	34	128	.518	.58	.335
1905–06						
October	595	30	149	0.603	0.70	0.390
November	570	48	115	.466	.52	.301
December	2,407	63	529	2.14	2.47	1.38
January	2,720	256	637	2,58	2,97	1,67
February*	256	70	106	.429	.45	.277
March	3,640	88	626	2.53	2.92	1.64
April	1,905	219	806	3.26	3.64	2.11
May	256	60	126	.510	.59	.330
June	1,785	60	207	.838	.94	.542
July 1–14	66	32	44.6	.181	.09	.117

Monthly discharge of Wills Creek near Cumberland—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1929–30						
October‡	1,620	25	322	1.30	1.50	0.840
November	1,670	156	396	1.60	1.78	1.03
December	605	—	314	1.27	1.46	.821
January	479	—	207	.838	.97	.542
February	585	—	283	1.15	1.20	.743
March	645	177	396	1.60	1.84	1.03
April	510	166	305	1.23	1.37	.795
May	238	63	121	.490	.56	.317
June	352	41	80.7	.327	.36	.211
July	38	16	25.0	.101	.12	.065
August	35	12	16.6	.067	.08	.043
September	26	11	15.8	.064	.07	.041
The year	1,670	11	206	.834	11.31	.539
1935–36						
October	108	40	49.1	0.199	0.23	0.129
November	379	44	115	.466	.52	.301
December	920	50	224	.907	1.05	.586
January	1,080	110	407	1.65	1.90	1.07
February	4,000	70	598	2.42	2.61	1.56
March	14,800	600	2,410	9.76	11.25	6.31
April	3,900	198	770	3.12	3.48	2.02
May	186	62	104	.421	.49	.272
June	760	46	122	.494	.55	.319
July	290	21	52.9	.214	.25	.138
August*	116	28	53.0	.215	.25	.139
September	116	18	34.3	.139	.16	.090
The year	14,800	18	412	1.67	22.74	1.08
1936–37						
October	2,390	22	191	0.773	0.89	0.500
November	2,530	46	249	1.01	1.13	.653
December	1,430	42	507	2.05	2.37	1.32
January	4,470	492	1,477	5.98	6.89	3.86
February	1,240	210	441	1.79	1.86	1.16
March	1,490	175	418	1.69	1.95	1.09
April	13,700	254	1,245	5.04	5.62	3.26
May	955	159	388	1.57	1.81	1.01
June	147	56	94.2	.381	.43	.246
July	98	28	50.3	.204	.24	.132
August	971	21	110	.445	.51	.288
September	227	27	68.8	.279	.31	.180
The year	13,700	21	437	1.77	24.01	1.14

Monthly discharge of Wills Creek near Cumberland—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1943–44						
October	109	12	27.2	0.110	0.13	0.071
November	215	22	48.9	.198	.22	.128
December	26	12	18.4	.074	.09	.048
January	2,360	26	207	.838	.97	.542
February	1,710	80	377	1.53	1.65	.989
March	2,290	461	1,079	4.37	5.03	2.82
April	3,250	314	890	3.60	4.02	2.33
May	2,960	133	583	2.36	2.72	1.53
June	206	60	115	.466	.52	.301
July	125	26	47.2	.191	.22	.123
August	56	16	23.4	.095	.11	.061
September	60	15	25.0	.101	.11	.065
The year	3,250	12	286	1.16	15.79	.750
1944–45						
October	1,350	28	150	0.607	0.70	0.392
November	244	34	68.0	.275	.31	.178
December	899	104	242	.980	1.13	.633
January	416	119	199	.806	.93	.521
February	4,160	100	902	3.65	3.80	2.36
March	3,400	314	947	3.83	4.42	2.48
April	851	235	467	1.89	2.11	1.22
May	1,400	147	454	1.84	2.12	1.19
June	245	72	116	.470	.52	.304
July	148	47	72.7	.294	.34	.190
August	445	29	109	.441	.51	.285
September	2,840	41	412	1.67	1.86	1.08
The year	4,160	28	341	1.38	18.75	.892
1945–46						
October	196	55	92.6	0.375	0.43	0.242
November	1,550	54	400	1.62	1.81	1.05
December	740	147	338	1.37	1.58	.885
January	1,600	150	541	2.19	2.52	1.42
February	2,110	127	330	1.34	1.39	.866
March	1,220	397	731	2.96	3.41	1.91
April	510	119	228	.923	1.03	.597
May	2,030	108	507	2.05	2.37	1.32
June	1,990	147	535	2.17	2.42	1.40
July	206	34	75.4	.305	.35	.197
August	798	38	137	.555	.64	.359
September	119	23	37.9	.153	.17	.099
The year	2,110	23	330	1.34	18.12	.866

Monthly discharge of Wills Creek near Cumberland—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1946–47						
October	673	28	96.3	.390	.45	0.252
November	106	37	56.4	.228	.25	.147
December	824	28	115	.466	.54	.301
January	914	166	408	1.65	1.91	1.07
February	365	56	157	.636	.66	.411
March	1,500	79	457	1.85	2.13	1.20
April	420	128	244	.988	1.10	.639
May	1,020	186	490	1.98	2.29	1.28
June	402	60	143	.579	.65	.374
July	417	41	129	.522	.60	.337
August	1,010	55	311	1.26	1.45	.814
September	156	38	79.6	.322	.36	.208
The year	1,500	28	225	.911	12.39	.589
1947–48						
October	58	28	33.5	0.136	0.16	0.088
November	329	35	136	.551	.61	.356
December	134	50	92.0	.372	.43	.240
January	2,860	70	385	1.56	1.80	1.01
February	1,130	66	442	1.79	1.93	1.16
March	3,100	304	670	2.71	3.13	1.75
April	4,290	314	1,066	4.32	4.82	2.79
May	1,450	145	555	2.25	2.59	1.45
June	688	86	208	.842	.94	.544
July	620	40	164	.664	.77	.429
August	247	32	77.1	.312	.36	.202
September	106	27	41.3	.167	.19	.108
The year	4,290	27	321	1.30	17.73	.840
1948–49						
October	524	30	106	0.429	0.49	0.277
November	546	46	257	1.04	1.16	.672
December	2,960	262	754	3.05	3.52	1.97
January	3,030	278	946	3.83	4.42	2.48
February	1,460	493	788	3.19	3.32	2.06
March	566	262	396	1.60	1.85	1.03
April	788	183	414	1.68	1.87	1.09
May	220	98	135	.547	.63	.354
June	1,180	53	252	1.02	1.14	.659
July	729	78	207	.838	.96	.542
August	1,410	46	189	.765	.88	.494
September	139	43	62.5	.253	.28	.164
The year	3,030	30	374	1.51	20.52	.976

Monthly discharge of Wills Creek near Cumberland—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1949–50						
October	126	38	54.4	0.220	0.25	0.142
November	325	64	107	.433	.49	.280
December	862	105	278	1.13	1.30	.730
January	631	132	313	1.27	1.46	.821
February	1,880	223	845	3.42	3.56	2.21
March	2,890	143	678	2.74	3.16	1.77
April	1,320	139	370	1.50	1.67	.969
May	762	225	456	1.85	2.13	1.20
June	416	58	144	.583	.65	.377
July	139	39	59.4	.240	.28	.155
August	165	24	39.6	.160	.18	.103
September	1,280	33	161	.652	.73	.421
The year	2,890	24	289	1.17	15.86	.756
1950–51						
October	709	48	176	0.713	0.82	0.461
November	1,360	87	251	1.02	1.13	.659
December	3,920	105	703	2.85	3.28	1.84
January	1,600	191	833	3.37	3.89	2.18
February	2,050	421	954	3.86	4.02	2.49
March	2,440	333	687	2.78	3.21	1.80
April	1,600	314	723	2.93	3.26	1.89
May	1,280	126	379	1.53	1.77	.989
June	4,520	98	595	2.41	2.69	1.56
July	288	56	108	.437	.50	.282
August	265	28	50.7	.205	.24	.132
September	51	18	25.7	.104	.12	.067
The year	4,520	18	454	1.84	24.93	1.19
1951–52						
October	38	18	23.0	0.093	0.11	0.060
November	141	28	50.6	.205	.23	.132
December	1,140	44	150	.607	.70	.392
January	3,700	235	874	3.54	4.08	2.29
February	1,140	136	363	1.47	1.59	.950
March	6,530	128	1,048	4.24	4.89	2.74
April	2,230	306	864	3.50	3.90	2.26
May	1,360	371	654	2.65	3.05	1.71
June	770	69	201	.814	.91	.526
July	126	33	61.0	.247	.28	.160
August	88	26	40.5	.164	.19	.106
September	88	21	34.1	.138	.15	.089
The year	6,530	18	364	1.47	20.08	.950

Monthly discharge of Wills Creek near Cumberland—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1952–53						
October	30	19	23.0	0.093	0.11	0.060
November	1,880	19	163	.660	.74	.427
December	1,440	58	214	.866	1.00	.560
January	2,340	70	759	3.07	3.54	1.98
February	1,230	272	526	2.13	2.22	1.38
March	4,100	272	1,172	4.74	5.47	3.06
April	1,020	290	533	2.16	2.41	1.40
May	5,540	154	535	2.17	2.50	1.40
June	3,340	56	362	1.47	1.63	.950
July	510	32	69.5	.281	.32	.182
August	76	15	34.0	.138	.16	.089
September	41	14	22.3	.090	.10	.058
The year	5,540	14	367	1.49	20.20	.963
1953–54						
October	23	13	15.6	0.063	0.07	0.041
November	45	17	22.0	.089	.10	.058
December	84	19	30.2	.122	.14	.079
January	210	17	59.7	.242	.28	.156
February	144	26	65.8	.266	.28	.172
March	3,460	165	525	2.13	2.45	1.38
April	421	94	190	.769	.86	.497
May	471	116	219	.887	1.02	.573
June	393	50	148	.599	.67	.387
July	607	25	64.4	.261	.30	.169
August	228	25	66.9	.271	.31	.175
September	138	26	53.8	.218	.24	.141
The year	3,460	13	122	.494	6.72	.319
1954–55						
October	4,920	36	447	1.81	2.09	1.17
November	1,360	132	371	1.50	1.67	.969
December	3,550	168	566	2.29	2.64	1.48
January	1,230	72	295	1.19	1.38	.769
February	1,200	90	463	1.87	1.95	1.21
March	4,320	341	1,231	4.98	5.75	3.22
April	1,340	159	395	1.60	1.78	1.03
May	431	94	179	.725	.83	.469
June	2,030	67	440	1.78	1.99	1.15
July	223	44	83.4	.338	.39	.218
August	1,490	36	213	.862	.99	.557
September	169	32	52.7	.213	.24	.138
The year	4,920	32	395	1.60	21.70	1.03

Monthly discharge of Wills Creek near Cumberland—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1955–56						
October	61	34	41.3	0.167	0.19	0.108
November	93	36	52.9	.214	.24	.138
December	62	23	35.1	.142	.16	.092
January	800	21	69.7	.282	.33	.182
February	1,850	251	855	3.46	3.73	2.24
March	1,540	372	766	3.10	3.58	2.00
April	2,890	254	754	3.05	3.40	1.97
May	1,320	254	558	2.26	2.60	1.46
June	596	104	258	1.04	1.16	.672
July	203	59	117	.474	.55	.306
August	560	52	166	.672	.77	.434
September	224	64	111	.449	.50	.290
The year	2,890	21	313	1.27	17.21	.821
1956–57						
October	138	52	77.4	0.313	0.36	0.202
November	464	62	146	.591	.66	.382
December	2,800	64	603	2.44	2.82	1.58
January	1,550	165	419	1.70	1.96	1.10
February	2,710	251	713	2.89	3.01	1.87
March	970	262	524	2.12	2.45	1.37
April	1,380	277	741	3.00	3.35	1.94
May	422	99	183	.741	.86	.479
June	183	52	95.7	.387	.43	.250
July	62	23	36.8	.149	.17	.096
August	31	14	19.6	.079	.09	.051
September	47	13	19.9	.081	.09	.052
The year	2,800	13	296	1.20	16.25	.776
1957–58						
October	254	15	55.7	0.226	0.26	0.146
November	86	30	48.3	.196	.22	.127
December	2,340	36	457	1.85	2.14	1.20
January	865	88	291	1.18	1.36	.763
February	810	140	287	1.16	1.21	.750
March	1,600	254	770	3.12	3.59	2.02
April	2,470	254	964	3.90	4.35	2.52
May	4,420	120	857	3.47	4.00	2.24
June	469	57	126	.510	.57	.330
July	192	40	74.2	.300	.35	.194
August	729	52	160	.648	.74	.419
September	117	31	48.4	.196	.22	.127
The year	4,420	15	346	1.40	19.01	.905

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of Wills Creek near Cumberland—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1958-59						
October	43	23	29.9	0.121	0.14	0.078
November	78	28	39.7	.161	.18	.104
December	109	28	44.6	.181	.21	.117
January	827	32	173	.700	.81	.452
February	1,400	92	396	1.60	1.67	1.03
March	1,470	147	518	2.10	2.42	1.36
April	2,240	226	629	2.55	2.84	1.65
May	1,120	123	379	1.53	1.77	.989
June	435	36	110	.445	.50	.288
July	72	31	42.4	.172	.20	.111
August	207	27	50.1	.203	.23	.131
September	284	13	28.3	.115	.13	.074
The year	2,240	13	202	.818	11.10	.529

‡ Not previously published; partly estimated.

* Revised.

POTOMAC RIVER BASIN—*Continued*

Yearly discharge of Wills Creek near Cumberland

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1930	206	0.834	11.31	0.539	125	0.506	6.85	0.327
1931	225	.911	12.38	.589	239	.968	13.14	.626
1932	252	1.02	13.85	.659	282	1.14	15.52	.737
1933	394	1.60	21.66	1.03	365	1.48	20.06	.957
1934	170	.688	9.34	.445	204	.826	11.20	.534
1935	326	1.32	17.91	.853	304	1.23	16.74	.795
1936	412	1.67	22.74	1.08	459	1.86	25.33	1.20
1937	437	1.77	24.01	1.14	452	1.83	24.82	1.18
1938	285	1.15	15.67	.743	200	.810	10.96	.524
1939	301	1.22	16.51	.789	307	1.24	16.87	.801
1940	301	1.22	16.59	.789	346	1.40	19.09	.905
1941	278	1.13	15.25	.730	231	.935	12.66	.604
1942	261	1.06	14.32	.685	425	1.72	23.37	1.11
1943	484	1.96	26.60	1.27	313	1.27	17.23	.821
1944	286	1.16	15.79	.750	317	1.28	17.49	.827
1945	341	1.38	18.75	.892	372	1.51	20.43	.976
1946	330	1.34	18.12	.866	283	1.15	15.54	.743
1947	225	.911	12.39	.589	225	.911	12.35	.589
1948	321	1.30	17.73	.840	394	1.60	21.70	1.03
1949	374	1.51	20.52	.976	316	1.28	17.39	.827
1950	289	1.17	15.86	.756	347	1.40	19.05	.905
1951	454	1.84	24.93	1.19	377	1.53	20.74	.989
1952	364	1.47	20.08	.950	379	1.53	20.89	.989
1953	367	1.49	20.20	.963	340	1.38	18.66	.892
1954	122	.494	6.72	.319	233	.943	12.81	.609
1955	395	1.60	21.70	1.03	289	1.17	15.89	.756
1956	313	1.27	17.21	.821	372	1.51	20.46	.976
1957	296	1.20	16.25	.776	273	1.11	15.03	.717
1958	346	1.40	19.01	.905	308	1.25	16.92	.808
1959	202	.818	11.10	.529				
Highest	484	1.96	26.60	1.27	459	1.86	25.33	1.20
Average	312	1.26	17.15	.816	313	1.27	17.21	.819
Lowest	122	.494	6.72	.319	125	.506	6.85	.327

POTOMAC RIVER BASIN

10. North Branch Potomac River near Cumberland

Location.—Lat 39°37′16″, long 78°46′24″, on left bank at downstream side of Wiley Ford Bridge, 2 miles south of Cumberland, Allegany County, and 2.1 miles downstream from Wills Creek.

Drainage area.—875 sq mi.

Records available.—May 1929 to September 1959. Monthly records May 1929 to September 1943, published in Bulletin 1. Monthly records for Chesapeake and Ohio Canal October 1929 to September 1934, published in Bulletin 1.

Gage.—Water-stage recorder. Datum of gage is 585.22 ft above mean sea level (Corps of Engineers bench mark). Prior to June 18, 1929, chain gage at same site and datum.

Average discharge.—30 years, 1,205 cfs (unadjusted).

Extremes.—Maximum discharge, 88,200 cfs Mar. 17, 1936 (gage height, 29.1 ft), from rating curve extended above 21,000 cfs on basis of slope-area measurement of peak flow; minimum (river only), 12 cfs Sept. 22, 1932; minimum daily (including flow in canal), 38 cfs Sept. 24, 1932.

Maximum stage known, 29.2 ft June 1, 1889 (discharge, about 89,000 cfs). Flood of Mar. 29, 1924, reached a stage of 28.4 ft (discharge, about 82,000 cfs).

Remarks.—Some regulation by reservoir on Stony River, about 79 miles above station, and since December 1950, by reservoir on Savage River. Prior to July 1957, small amount of inflow from industrial wastes and sewage from city of Cumberland from water diverted from Evitts Creek, mouth of which is below station. Unadjusted figures are published as the effect on the annual figures is insignificant (see North Branch Potomac River at Luke for change in contents).

Monthly discharge of North Branch Potomac River near Cumberland

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1943–44						
October	301	61	110			
November	467	119	213			
December	515	59	137			
January	7,600	145	879			
February	8,280	385	1,900			
March	10,600	1,800	4,116			
April	7,970	1,550	2,925			
May	13,100	708	2,331			
June	2,160	355	637			
July	350	90	183			
August	119	71	84.4			
September	233	69	123			
The year	13,100	59	1,134	1.30	17.63	0.840

Monthly discharge of North Branch Potomac River near Cumberland—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1944–45						
October	6,200	157	755			
November	2,010	176	381			
December	8,500	473	1,335			
January	4,770	497	1,181			
February	17,200	350	3,488			
March	15,200	1,120	3,657			
April	2,580	743	1,382			
May	5,570	666	1,787			
June	715	248	449			
July	2,300	126	355			
August	3,510	129	612			
September	12,300	272	2,036			
The year	17,200	126	1,439	1.64	22.34	1.06
1945–46						
October	1,020	248	479			
November	4,370	248	1,524			
December	2,640	473	1,140			
January	7,970	473	2,128			
February	6,450	416	1,347			
March	3,880	1,350	2,180			
April	1,700	461	821			
May	4,470	527	1,918			
June	6,530	551	1,824			
July	841	116	309			
August	1,160	112	286			
September	293	81	115			
The year	7,970	81	1,172	1.34	18.19	0.866
1946–47						
October	1,310	102	265			
November	252	124	162			
December	3,010	102	397			
January	4,160	589	1,537			
February	1,600	248	585			
March	7,600	305	1,787			
April	3,170	515	1,154			
May	3,590	624	1,402			
June	1,450	193	465			
July	1,380	124	404			
August	2,550	126	571			
September	412	124	223			
The year	7,600	102	750	0.857	11.62	0.554

Monthly discharge of North Branch Potomac River near Cumberland—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1947–48						
October	196	92	111			
November	1,480	132	647			
December	874	229	437			
January	12,900	230	1,507			
February	5,250	250	2,049			
March	9,240	1,080	2,461			
April	15,500	937	3,322			
May	4,460	485	1,921			
June	2,180	479	1,028			
July	2,190	272	772			
August	694	124	324			
September	527	114	223			
The year	15,500	92	1,228	1.40	19.13	0.905
1948–49						
October	2,250	146	471			
November	1,900	203	787			
December	16,300	889	2,931			
January	11,300	1,080	3,184			
February	4,310	1,750	2,637			
March	2,400	889	1,455			
April	2,460	659	1,455			
May	2,360	310	660			
June	12,000	196	1,515			
July	11,000	350	1,438			
August	2,190	182	565			
September	555	166	246			
The year	16,300	146	1,440	1.65	22.33	1.07
1949–50						
October	606	160	244			
November	2,940	310	598			
December	3,030	659	1,331			
January	3,940	639	1,421			
February	9,370	939	3,306			
March	10,100	888	2,758			
April	3,570	653	1,399			
May	3,690	1,200	1,982			
June	2,000	321	765			
July	616	182	293			
August	303	107	146			
September	6,130	103	779			
The year	10,100	103	1,239	1.42	19.20	0.918

Monthly discharge of North Branch Potomac River near Cumberland—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1950–51						
October	1,320	189	566			
November	3,390	261	829			
December	12,600	433	2,358			
January	5,240	922	2,726			
February	8,220	1,710	3,227			
March	7,520	1,510	2,509			
April	5,790	1,360	2,713			
May	3,570	504	1,675			
June	15,400	340	2,180			
July	1,070	182	392			
August	329	97	144			
September	308	83	122			
The year	15,400	83	1,609	1.84	24.96	1.19
1951–52						
October	149	83	93.5			
November	1,190	111	260			
December	5,690	209	831			
January	9,150	1,210	3,669			
February	3,930	548	1,466			
March	13,900	445	3,101			
April	9,630	1,110	2,909			
May	4,970	1,510	2,467			
June	1,710	290	636			
July	359	143	213			
August	238	113	164			
September	261	113	184			
The year	13,900	83	1,336	1.53	20.78	0.989
1952–53						
October	179	111	132			
November	4,710	111	456			
December	3,670	257	786			
January	8,350	369	2,750			
February	5,510	1,110	2,234			
March	7,110	1,140	3,623			
April	4,840	1,040	2,090			
May	6,250	562	1,628			
June	4,580	185	674			
July	764	138	200			
August	456	125	175			
September	169	128	138			
The year	8,350	111	1,237	1.41	19.14	0.911

Monthly discharge of North Branch Potomac River near Cumberland—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1953–54						
October	143	116	123			
November	195	118	132			
December	492	118	190			
January	2,220	111	510			
February	879	206	466			
March	7,900	1,010	2,280			
April	1,760	450	794			
May	2,240	575	840			
June	4,020	286	1,035			
July	1,730	149	295			
August	2,240	146	679			
September	610	226	346			
The year	7,900	111	643	0.735	9.98	0.475
1954–55						
October	26,800	223	2,133			
November	2,970	522	1,314			
December	12,300	746	2,083			
January	5,520	340	1,493			
February	4,330	375	2,136			
March	11,900	1,350	4,179			
April	4,840	568	1,343			
May	1,780	422	855			
June	6,320	223	1,535			
July	956	176	349			
August	17,100	169	2,028			
September	741	163	320			
The year	26,800	163	1,649	1.88	25.52	1.22
1955–56						
October	253	168	196			
November	699	155	278			
December	676	195	328			
January	5,110	149	456			
February	8,210	1,850	4,046			
March	6,820	1,350	2,813			
April	8,770	956	2,477			
May	9,500	948	2,139			
June	3,530	582	1,283			
July	1,430	261	475			
August	11,700	308	1,360			
September	588	308	422			
The year	11,700	149	1,344	1.54	20.90	0.995

Monthly discharge of North Branch Potomac River near Cumberland—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1956–57						
October	1,220	312	521			
November	1,760	286	679			
December	7,120	299	2,368			
January	5,950	680	2,208			
February	15,100	1,120	3,274			
March	2,560	913	1,666			
April	5,080	822	2,131			
May	1,370	358	645			
June	1,060	256	452			
July	608	156	222			
August	204	132	149			
September	224	125	150			
The year	15,100	125	1,192	1.36	18.50	0.879
1957–58						
October	1,050	131	423			
November	490	184	288			
December	7,290	250	1,859			
January	1,770	471	931			
February	2,540	552	1,030			
March	4,930	846	2,352			
April	12,600	1,240	4,087			
May	14,200	450	2,753			
June	934	250	393			
July	1,600	180	511			
August	4,360	302	851			
September	385	144	250			
The year	14,200	131	1,314	1.50	20.38	0.969
1958–59						
October	265	148	192			
November	556	188	256			
December	596	202	277			
January	4,550	260	953			
February	5,500	556	1,602			
March	5,000	652	1,744			
April	5,270	924	1,764			
May	3,430	540	1,144			
June	2,010	152	445			
July	240	135	180			
August	496	139	193			
September	404	109	135			
The year	5,500	109	734	0.839	11.39	0.542

POTOMAC RIVER BASIN—*Continued*

Yearly discharge of North Branch Potomac River near Cumberland

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1930	799				483			
1931	852				939			
1932	1,060				1,134			
1933	1,480				1,423			
1934	760				834			
1935	1,356	1.55	21.03	1.00	1,310	1.50	20.33	0.969
1936	1,570	1.79	24.42	1.16	1,627	1.86	25.31	1.20
1937	1,574	1.80	24.42	1.16	1,823	2.08	28.29	1.34
1938	1,218	1.39	18.90	.898	817	.934	12.68	.604
1939	1,113	1.27	17.26	.821	1,134	1.30	17.58	.840
1940	1,175	1.34	18.26	.866	1,316	1.50	20.46	.969
1941	1,087	1.24	16.86	.801	946	1.08	14.68	.698
1942	986	1.13	15.30	.730	1,556	1.78	24.13	1.15
1943	1,652	1.89	25.62	1.22	1,045	1.19	16.20	.769
1944	1,134	1.30	17.63	.840	1,304	1.49	20.28	.963
1945	1,439	1.64	22.34	1.06	1,493	1.71	23.17	1.11
1946	1,172	1.34	18.19	.866	979	1.12	15.20	.724
1947	750	.857	11.62	.554	780	.891	12.10	.576
1948	1,228	1.40	19.13	.905	1,481	1.69	23.05	1.09
1949	1,440	1.65	22.33	1.07	1,270	1.45	19.68	.937
1950	1,239	1.42	19.20	.918	1,372	1.57	21.29	1.01
1951	1,609	1.84	24.96	1.19	1,392	1.59	21.60	1.03
1952	1,336	1.53	20.78	.989	1,351	1.54	20.96	.995
1953	1,237	1.41	19.14	.911	1,159	1.32	17.92	.853
1954	643	.735	9.98	.475	1,072	1.23	16.70	.795
1955	1,649	1.88	25.52	1.22	1,250	1.43	19.41	.924
1956	1,344	1.54	20.90	.995	1,577	1.80	24.54	1.16
1957	1,192	1.36	18.50	.879	1,109	1.27	17.20	.821
1958	1,314	1.50	20.38	.969	1,157	1.32	17.95	.853
1959	734	.839	11.39	.542				
1935–59								
Highest	1,652	1.89	25.62	1.22	1,823	2.08	28.29	1.34
Average	1,248	1.43	19.36	.922	1,263	1.44	19.61	.932
Lowest	643	.735	9.98	.475	780	.891	12.10	.576

11. Evitts Creek near Centerville, Pa.

Location.—Lat 39°47′23″, long 78°38′48″, on left bank 2 miles upstream from Thomas W. Koon Dam, 3 miles south of Centerville, Bedford County, and 7 miles upstream from Rock Gully Creek.

Drainage area.—30.2 sq mi.

Records available.—September 1932 to September 1959. Prior to October 1952, published as "near Beford Valley". Monthly records September 1932 to September 1943 published in Bulletin 1 (September 1932 completed herein).

Gage.—Water-stage recorder and concrete control. Datum of gage is 1,027.59 ft above mean sea level (city of Cumberland bench mark).

Average discharge.—27 years, 30.2 cfs.

Extremes.—Maximum discharge, 5,240 cfs Mar. 17, 1936 (gage height 7.13 ft), from rating curve extended above 400 cfs on basis of slope-area measurements at gage heights 4.64 and 7.13 ft; minimum, 1.2 cfs July 27, 1934 (gage height, 0.96 ft).

Maximum stage known, about 8 ft, from floodmark, date unknown.

Monthly discharge of Evitts Creek near Centerville, Pa.

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1932						
September‡	3.2	1.7	1.89	0.063	0.07	0.041
1943–44						
October	16	2.6	4.43	0.147	0.17	0.095
November	23	3.5	5.54	.183	.20	.118
December	9.7	2.0	3.46	.115	.13	.074
January	276	3.6	23.9	.791	.91	.511
February	82	9.0	24.8	.821	.89	.531
March	323	34	85.0	2.81	3.25	1.82
April	287	33	83.8	2.77	3.09	1.79
May	473	16	74.0	2.45	2.82	1.58
June	28	5.4	12.3	.407	.45	.263
July	16	3.0	5.13	.170	.20	.110
August	5.4	2.3	3.12	.103	.12	.067
September	6.6	2.3	3.33	.110	.12	.071
The year	473	2.0	27.4	.907	12.35	.586
1944–45						
October	90	3.0	9.00	0.298	0.34	0.193
November	25	4.3	6.75	.224	.25	.145
December	34	9.9	15.3	.507	.58	.328
January	57	9.9	17.0	.563	.65	.364
February	334	5.0	68.2	2.26	2.35	1.46
March	209	28	69.8	2.31	2.66	1.49
April	104	26	47.1	1.56	1.74	1.01
May	230	22	55.7	1.84	2.13	1.19
June	23	6.6	13.6	.450	.50	.291
July	203	4.5	17.9	.593	.68	.383
August	159	6.4	24.2	.801	.92	.518
September	284	6.2	32.7	1.08	1.21	.698
The year	334	3.0	31.2	1.03	14.01	.666

Monthly discharge of Evitts Creek near Centerville, Pa.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1945–46						
October	20	7.2	11.4	0.377	0.44	0.244
November	115	7.2	29.3	.970	1.08	.627
December	71	15	30.8	1.02	1.17	.659
January	156	17	45.3	1.50	1.73	.969
February	166	14	29.4	.974	1.01	.630
March	114	39	58.4	1.93	2.23	1.25
April	45	13	22.1	.732	.82	.473
May	153	12	42.2	1.40	1.61	.905
June	235	12	40.9	1.35	1.51	.873
July	14	3.9	7.16	.237	.27	.153
August	31	3.7	8.06	.267	.31	.173
September	12	2.7	4.35	.144	.16	.093
The year	235	2.7	27.5	.911	12.34	.589
1946–47						
October	118	3.4	10.1	0.334	0.39	0.216
November	9.0	5.1	6.46	.214	.24	.138
December	54	3.7	8.69	.288	.33	.186
January	66	15	28.0	.927	1.07	.599
February	32	7.0	16.6	.550	.57	.355
March	122	9.0	35.1	1.16	1.34	.750
April	29	14	19.7	.652	.73	.421
May	66	20	34.8	1.15	1.33	.743
June	61	8.7	18.2	.603	.67	.390
July	18	3.9	8.37	.277	.32	.179
August	50	3.2	10.8	.358	.41	.231
September	9.0	3.2	5.25	.174	.19	.112
The year	122	3.2	16.9	.560	7.59	.362
1947–48						
October	6.1	3.0	3.45	0.114	0.13	0.074
November	21	3.6	7.62	.252	.28	.163
December	8.3	3.8	5.38	.178	.21	.115
January	128	5.8	20.9	.692	.80	.447
February	60	5.6	23.0	.762	.82	.492
March	200	25	44.2	1.46	1.69	.944
April	289	35	89.3	2.96	3.30	1.91
May	156	16	55.8	1.85	2.13	1.20
June	27	8.0	14.5	.480	.53	.310
July	17	3.9	8.21	.272	.31	.176
August	30	3.0	6.22	.206	.24	.133
September	6.3	2.2	3.16	.105	.12	.68
The year	289	2.2	23.4	.775	10.56	.501

Monthly discharge of Evitts Creek near Centerville, Pa.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1948–49						
October	71	2.7	10.8	0.358	0.41	0.231
November	55	5.0	16.4	.543	.61	.351
December	219	20	56.4	1.87	2.15	1.21
January	236	22	72.1	2.39	2.75	1.54
February	118	46	65.8	2.18	2.27	1.41
March	53	19	30.5	1.01	1.17	.653
April	62	18	32.3	1.07	1.19	.692
May	29	11	14.5	.480	.55	.310
June	131	5.4	21.7	.719	.80	.465
July	85	10	22.6	.748	.86	.483
August	76	5.4	11.1	.368	.42	.238
September	8.3	3.7	5.05	.167	.19	.108
The year	236	2.7	29.8	.987	13.37	.638
1949–50						
October	15	3.7	5.05	0.167	0.19	0.108
November	21	4.3	6.20	.205	.23	.132
December	74	6.3	15.3	.507	.58	.328
January	73	13	23.6	.781	.90	.505
February	144	23	69.7	2.31	2.40	1.49
March	164	16	52.5	1.74	2.00	1.12
April	85	17	32.3	1.07	1.19	.692
May	92	23	47.3	1.57	1.81	1.01
June	41	7.2	15.2	.503	.56	.325
July	20	3.8	7.10	.235	.27	.152
August	13	2.9	4.58	.152	.17	.098
September	140	3.3	18.8	.623	.69	.403
The year	164	2.9	24.5	.811	10.99	.524
1950–51						
October	140	5.6	25.8	0.854	0.98	0.552
November	109	13	27.4	.907	1.01	.586
December	480	15	94.7	3.14	3.61	2.03
January	158	21	76.9	2.55	2.94	1.65
February	239	55	95.0	3.15	3.28	2.04
March	240	38	70.2	2.32	2.68	1.50
April	130	36	65.8	2.18	2.43	1.41
May	76	17	37.6	1.25	1.43	.808
June	407	13	64.9	2.15	2.40	1.39
July	56	7.0	14.6	.483	.56	.312
August	92	4.0	9.16	.303	.35	.196
September	6.7	3.0	3.77	.125	.14	.081
The year	480	3.0	48.5	1.61	21.81	1.04

Monthly discharge of Evitts Creek near Centerville, Pa.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1951–52						
October	5.5	3.2	3.65	0.121	0.14	0.078
November	15	3.8	6.05	.200	.22	.129
December	60	4.0	14.3	.474	.55	.306
January	267	18	59.5	1.97	2.27	1.27
February	118	16	34.9	1.16	1.25	.750
March	804	15	89.6	2.97	3.42	1.92
April	230	37	92.2	3.05	3.41	1.97
May	129	37	58.9	1.95	2.25	1.26
June	100	9.9	21.9	.725	.81	.469
July	37	4.5	9.14	.303	.35	.196
August	10	3.4	5.10	.169	.19	.109
September	10	3.2	4.67	.155	.17	.100
The year	804	3.2	33.3	1.10	15.03	.711
1952–53						
October	7.3	3.4	3.86	0.128	0.15	0.083
November	310	3.4	28.9	.957	1.07	.619
December	180	9.0	23.3	.772	.89	.499
January	225	10	60.7	2.01	2.32	1.30
February	89	28	46.7	1.55	1.61	1.00
March	440	30	110	3.64	4.20	2.35
April	83	31	50.6	1.68	1.87	1.09
May	830	18	70.2	2.32	2.68	1.50
June	480	8.4	45.5	1.51	1.68	.976
July	56	5.3	9.62	.319	.37	.206
August	12	3.1	4.79	.159	.18	.103
September	4.9	2.9	3.38	.112	.12	.072
The year	830	2.9	38.1	1.26	17.14	.814
1953–54						
October	3.7	2.8	3.22	0.107	0.12	0.069
November	12	3.1	3.72	.123	.14	.080
December	12	3.0	4.32	.143	.17	.092
January	14	3.1	5.21	.173	.20	.112
February	11	3.0	5.42	.179	.19	.116
March	640	22	63.1	2.09	2.41	1.35
April	55	13	22.1	.732	.82	.473
May	48	13	21.9	.725	.84	.469
June	230	7.3	30.2	1.00	1.12	.646
July	17	2.8	5.52	.183	.21	.118
August	16	2.6	4.76	.158	.18	.102
September	8.3	2.5	3.56	.118	.13	.076
The year	640	2.5	14.5	.480	6.53	.310

Monthly discharge of Evitts Creek near Centerville, Pa.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1954–55						
October	740	3.0	55.3	1.83	2.11	1.18
November	175	12	41.9	1.39	1.55	.898
December	230	21	56.2	1.86	2.15	1.20
January	105	10	33.7	1.12	1.29	.724
February	106	11	36.1	1.20	1.24	.776
March	540	41	123	4.07	4.69	2.63
April	156	22	48.9	1.62	1.81	1.05
May	51	8.8	21.2	.702	.81	.454
June	320	6.6	49.4	1.64	1.82	1.06
July	14	3.9	7.28	.241	.28	.156
August	200	3.3	24.8	.821	.95	.531
September	20	3.6	5.83	.193	.22	.125
The year	740	3.0	42.0	1.39	18.92	.898
1955–56						
October	7.9	3.3	4.52	0.150	0.17	0.097
November	11	3.9	5.68	.188	.21	.122
December	6.3	2.5	3.67	.122	.14	.079
January	110	2.5	7.72	.256	.29	.165
February	158	15	60.4	2.00	2.16	1.29
March	144	29	60.1	1.99	2.29	1.29
April	356	29	76.9	2.55	2.84	1.65
May	99	19	41.9	1.39	1.60	.898
June	87	11	33.3	1.10	1.23	.711
July	211	9.2	42.7	1.41	1.63	.911
August	127	12	29.8	.987	1.14	.638
September	45	8.5	16.9	.560	.63	.362
The year	356	2.5	31.8	1.05	14.33	.679
1956–57						
October	21	6.6	9.21	0.305	0.35	0.197
November	42	8.1	11.8	.391	.44	.253
December	356	7.8	55.2	1.83	2.11	1.18
January	203	22	40.8	1.35	1.56	.873
February	183	29	57.5	1.90	1.98	1.23
March	64	26	41.9	1.39	1.60	.898
April	324	28	81.1	2.69	3.00	1.74
May	56	11	24.6	.815	.94	.527
June	52	7.8	13.2	.437	.49	.282
July	8.4	3.1	4.88	.162	.19	.105
August	3.4	2.4	2.73	.090	.10	.058
September	5.3	2.3	2.86	.095	.11	.061
The year	356	2.3	28.6	.947	12.87	.612

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of Evitts Creek near Centerville, Pa.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1957–58						
October	23	2.4	5.01	0.166	0.19	0.107
November	20	3.4	5.99	.198	.22	.128
December	277	4.3	32.4	1.07	1.24	.692
January	131	9.6	32.3	1.07	1.23	.692
February	134	14	34.9	1.16	1.20	.750
March	213	37	86.6	2.87	3.31	1.85
April	134	25	69.9	2.31	2.58	1.49
May	446	20	105	3.48	4.00	2.25
June	77	9.2	20.6	.682	.76	.441
July	15	4.7	8.11	.269	.31	.174
August	33	3.6	7.37	.244	.28	.158
September	13	2.9	4.19	.139	.15	.090
The year	446	2.4	34.5	1.14	15.47	.737
1958–59						
October	5.3	3.0	3.53	0.117	0.13	0.076
November	15	3.1	4.39	.145	.16	.094
December	8.8	1.7	3.68	.122	.14	.079
January	48	2.2	10.2	.338	.39	.218
February	162	6.0	26.8	.887	.92	.573
March	218	12	39.8	1.32	1.52	.853
April	159	22	54.0	1.79	1.99	1.16
May	149	15	50.7	1.68	1.94	1.09
June	48	3.9	11.6	.384	.43	.248
July	18	3.0	4.92	.163	.19	.105
August	14	2.4	4.34	.144	.17	.093
September	4.3	2.0	2.44	.081	.09	.052
The year	218	1.7	18.0	.596	8.07	.385

‡ Not previously published.

POTOMAC RIVER BASIN—*Continued*

Yearly discharge of Evitts Creek near Centerville, Pa.

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in milion gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1933	36.3	1.20	16.27	0.776	33.9	1.12	15.18	0.724
1934	13.9	.460	6.26	.297	15.8	.523	7.13	.338
1935	29.9	.990	13.43	.640	25.6	.848	13.07	.548
1936	44.2	1.46	19.95	.944	48.2	1.60	21.76	1.03
1937	41.7	1.38	18.72	.892	43.9	1.45	19.72	.937
1938	27.0	.894	12.12	.578	19.6	.649	8.79	.419
1939	31.4	1.04	14.12	.672	31.6	1.05	14.21	.679
1940	27.5	.911	12.38	.589	29.5	.977	13.27	.631
1941	21.7	.719	9.76	.465	19.2	.636	8.64	.411
1942	25.9	.858	11.64	.555	42.2	1.40	18.96	.905
1943	46.3	1.53	20.79	.989	29.6	.980	13.31	.633
1944	27.4	.907	12.35	.586	28.9	.957	13.02	.619
1945	31.2	1.03	14.01	.666	34.6	1.15	15.53	.743
1946	27.5	.911	12.34	.589	23.6	.781	10.61	.505
1947	16.9	.560	7.59	.362	16.1	.533	7.25	.344
1948	23.4	.775	10.56	.501	29.1	.964	13.11	.623
1949	29.8	.987	13.37	.638	24.9	.825	11.20	.533
1950	24.5	.811	10.99	.524	34.7	1.15	15.59	.743
1951	48.5	1.61	21.81	1.04	38.1	1.26	17.12	.814
1952	33.3	1.10	15.03	.711	36.0	1.19	16.23	.769
1953	38.1	1.26	17.14	.814	34.4	1.14	15.46	.737
1954	14.5	.480	6.53	.310	26.5	.877	11.91	.567
1955	42.0	1.39	18.92	.898	30.3	1.00	13.63	.646
1956	31.8	1.05	14.33	.679	37.1	1.23	16.71	.795
1957	28.6	.947	12.87	.612	25.8	.854	11.62	.552
1958	34.5	1.14	15.47	.737	31.8	1.05	14.25	.679
1959	18.0	.596	8.07	.385				
Highest	48.5	1.61	21.81	1.04	48.2	1.60	21.76	1.03
Average	30.2	1.00	13.58	.646	30.4	1.01	13.74	.651
Lowest	13.9	.460	6.26	.297	15.8	.523	7.13	.338

POTOMAC RIVER BASIN

12. Evitts Creek near Cumberland

Location.—Lat. 39°39′50″, long 78°43′51″, at Cumberland Country Club, 2.5 miles northeast of Cumberland, Allegany County, and 3.3 miles upstream from mouth.

Drainage area.—89.0 sq mi.

Records available.—August 1929 to November 1932. Monthly records August 1929 to November 1932 published in Bulletin 1 (August 1929 completed herein).

Gage.—Water-stage recorder. Datum of gage 626.15 ft above mean sea level (city of Cumberland bench mark). Prior to Oct. 18, 1929, chain gage at same site and datum.

Extremes.—Maximum discharge, 1,290 cfs Oct. 22, 1929, (gage height, 6.26 ft); minimum, 0.7 cfs July 15, 1932 (gage height, 1.10 ft).

Flood in July 1928 reached a stage of 11.1 ft from floodmarks (discharge about 19,000 cfs from rating curve extended above 1,100 cfs on basis of slope-area measurement at gage height, 10.6 ft), and exceeded the flood in 1924.

Flood of Mar. 17 or 18, 1936, reached a stage of 10.6 ft from floodmarks (discharge, about 15,000 cfs, from rating curve extended above 1,100 cfs as noted above).

Remarks.—Flow partly regulated by Gordon Lake (usable capacity, 1,841 acre-ft) for period of record, and by Thomas W. Koon reservoir (capacity, 7,044 acre-ft) since March 1932. Occasional regulation by swimming pool a quarter of a mile above gage. About 6 cfs diverted from reservoirs for water supply for city of Cumberland is discharged by sewers into Willis Creek, Chesapeake and Ohio Canal, and North Branch Potomac River above mouth of Evitts Creek.

Monthly discharge of Evitts Creek near Cumberland

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1929						
August‡	12	4	6.84			

‡ Not previously published.

Yearly discharge of Evitts Creek near Cumberland

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1930	42.5	—	—	—	22.6	—	—	—
1931	39.3	—	—	—	41.0	—	—	—
1932	46.4							

POTOMAC RIVER BASIN

13. Town Creek near Oldtown

Location.—Lat 39°33′12″, long 78°33′19″, on upstream side of highway bridge, 2.2 miles upstream from Sawpit Run, 3 miles northeast of Oldtown, Allegany County, and 4 miles upstream from mouth.

Drainage area.—148 sq mi.

Records available.—July 1928 to September 1935. Monthly records July 1928 to September 1935 published in Bulletin 1 (July 1928 completed, 1929 revised herein).

Gage.—Chain gage. Altitude of gage is 550 ft (from topographic map).

Average discharge.—7 years (1928–35), 123 cfs.

Extremes.—Maximum discharge, 9,700 cfs Oct. 23, 1929 (gage height, 14.0 ft from graph based on gage readings), from rating curve extended above 1,100 cfs on basis of contracted-opening measurement at gage height, 19.0 ft; minimum, 0.9 cfs Aug. 2, 3, 7–14, 1930 (gage height, 1.41 ft).

Flood of Mar. 17 or 18, 1936, reached a stage of 19.0 ft, from floodmarks (discharge, 27,000 cfs, from rating curve extended above 1,100 cfs as explained above).

Monthly discharge of Town Creek near Oldtown

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1928						
July‡	3,270	25	280	1.89	2.18	1.22
1928–29						
October	64	10	23.5	0.159	0.18	0.103
November	96	3	26.2	.177	.20	.114
December	142	—	48.0	.324	.37	.209
January	—	—	17.4	.118	.14	.076
February	2,310	—	180	1.22	1.27	.789
March	1,860	81	366	2.47	2.85	1.60
April*	4,210	54	628	4.24	4.73	2.74
May	1,250	67	226	1.53	1.76	.989
June	191	12	63.8	.431	.48	.279
July	99	3	20.2	.136	.16	.088
August	16	2	7.7	.052	.06	.034
September	38	2	10.2	.069	.08	.045
The year	4,210	2	134	.905	12.28	.585

‡ Not previously published.

* Revised.

POTOMAC RIVER BASIN—*Continued*

Yearly discharge of Town Creek near Oldtown

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1929	134	0.905	12.28	0.585	173	1.17	15.91	0.756
1930	91.2	.616	8.38	.398	45.2	.305	4.15	.197
1931	107	.723	9.80	.467	112	.757	10.24	.489
1932	127	.858	11.72	.555	145	.980	13.30	.633
1933	186	1.26	17.04	.814	170	1.15	15.55	.743
1934	74.5	.503	6.85	.325	89.4	.604	8.21	.390
1935	142	.959	12.98	.620				
Highest	186	1.26	17.04	.814	173	1.17	15.91	.756
Average	123	.832	11.29	.538	122	.828	11.23	.535
Lowest	74.5	.503	6.85	.325	45.2	.305	4.15	.197

POTOMAC RIVER BASIN

14. Sawpit Run near Oldtown

Location.—Lat 39°32′50″, long 78°33′20″, on left bank 900 ft upstream from bridge on State Highway 51, 1.0 mile upstream from mouth, and 3.0 miles east of Oldtown, Allegany County.

Drainage area.—5.0 sq mi, approximately.

Records available.—October 1947 to December 1958 (discontinued).

Gage.—Water-stage recorder and concrete control. Datum of gage is 574.06 ft above mean sea level, datum of 1929.

Average discharge.—11 years, 4.11 cfs.

Extremes.—Maximum discharge, 770 cfs Oct. 15, 1954 (gage height, 4.72 ft), from rating curve extended above 110 cfs on basis of slope-area measurement of peak flow; no flow at times each year.

Monthly discharge of Sawpit Run near Oldtown

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1947–48						
October	0.5	0	0.029	0.0058	0.007	0.0038
November	7.6	.04	1.81	.362	.40	.234
December	.85	.15	.454	.091	.10	.059
January	36	.2	3.35	.670	.77	.433
February	28	.15	6.48	1.30	1.40	.840
March	28	2.0	8.39	1.68	1.94	.109
April	68	1.3	11.4	2.28	2.54	.147
May	50	.20	7.48	1.50	1.72	.969
June	3.9	.03	.553	.111	.12	.072
July	.04	0	.011	.0022	.003	.0014
August	.35	0	.026	.0052	.006	.0034
September	1.6	0	.260	.052	.06	.034
The year	68	0	3.33	.666	9.07	.430
1948–49						
October	17	0.30	2.41	0.482	0.56	0.312
November	22	.49	4.28	.856	.96	.553
December	68	1.9	12.3	2.46	2.83	1.59
January	45	1.7	11.0	2.20	2.54	1.42
February	21	3.0	8.55	1.71	1.78	1.11
March	5.0	1.4	2.42	.484	.56	.313
April	9.3	.65	2.79	.558	.62	.361
May	15	.13	1.45	.290	.33	.187
June	3.3	.01	.376	.075	.08	.048
July	119	.07	9.90	1.98	2.28	1.28
August	16	0	.931	.186	.21	.120
September	.44	.01	.078	.016	.02	.010
The year	119	0	4.71	.942	12.77	.609

Monthly discharge of Sawpit Run near Oldtown—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1949–50						
October	2.8	0.03	0.454	0.091	0.10	0.059
November	5.9	.16	.711	.142	.16	.092
December	22	.40	2.85	.570	.66	.368
January	27	.71	2.83	.566	.65	.366
February	49	.90	12.2	2.44	2.53	1.58
March	48	.54	8.56	1.71	1.97	1.11
April	13	.59	2.15	.430	.48	.278
May	54	1.4	1.14	.228	.26	.147
June	21	0	2.22	.444	.50	.287
July	.54	0	.065	.013	.01	.008
August	.05	0	.007	.0014	.002	.0009
September	23	.01	1.59	.318	.36	.206
The year	54	0	2.83	.566	7.68	.366
1950–51						
October	14	0.05	1.56	0.312	0.36	0.202
November	14	.27	1.87	.374	.42	.242
December	86	1.3	10.5	2.10	2.42	1.36
January	50	1.0	8.93	1.79	2.06	1.16
February	60	3.0	15.1	3.02	3.15	1.95
March	98	2.6	11.7	2.34	2.70	1.51
April	29	1.7	8.38	1.68	1.87	1.09
May	22	.30	4.52	.904	1.04	.584
June	108	.05	7.83	1.57	1.75	1.01
July	.13	0	.020	.0040	.005	.0026
August	.01	0	0	0	0	0
September	.19	0	.011	.0022	.002	.0014
The year	108	0	5.81	1.16	15.78	.750
1951–52						
October	0.01	0	0.002	0.00040	0.0004	0.00026
November	.45	.01	.101	.020	.02	.013
December	20	.12	2.63	.526	.61	.340
January	79	1.5	14.5	2.90	3.34	1.87
February	16	1.1	4.72	.944	1.02	.610
March	88	1.2	10.8	2.16	2.49	1.40
April	60	1.6	11.8	2.36	2.64	1.53
May	65	1.7	11.8	2.36	2.71	1.53
June	4.8	.02	.631	.126	.14	.081
July	2.8	0	.224	.045	.05	.029
August	.01	0	.004	.00080	.0009	.00052
September	.25	0	.024	.0048	.005	.0031
The year	88	0	4.78	.956	13.03	.618

Monthly discharge of Sawpit Run near Oldtown—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1952–53						
October	0.03	0.01	0.013	0.0026	0.003	0.0017
November	52	.01	3.47	.694	.77	.449
December	47	.49	3.32	.664	.77	.429
January	57	1.6	13.1	2.62	3.02	1.69
February	31	1.2	7.80	1.56	1.62	1.01
March	78	1.7	17.9	3.58	4.13	2.31
April	35	1.4	7.35	1.47	1.64	.950
May	126	.22	7.36	1.47	1.70	.950
June	44	.01	2.43	.486	.54	.314
July	.07	0	.007	.0014	.002	.0009
August	.06	0	.006	.0012	.001	.0008
September	.01	0	.0003	.000060	.00007	.000039
The year	126	0	5.23	1.05	14.20	.679
1953–54						
October	0.02	0	0.004	0.00080	0.0008	0.00052
November	.40	0	.025	.0050	.006	.0032
December	3.6	.01	.318	.064	.07	.041
January	5.7	.03	.799	.160	.18	.103
February	1.6	.05	.545	.109	.11	.070
March	152	1.6	10.7	2.14	2.48	1.38
April	7.0	.60	1.72	.344	.38	.222
May	7.3	.35	1.32	.264	.30	.171
June	16	0	2.00	.400	.45	.259
July	.57	0	.026	.0052	.006	.0034
August	16	0	.726	.145	.17	.094
September	.05	0	.009	.0018	.002	.0012
The year	152	0	1.53	.306	4.15	.198
1954–55						
October	146	0.01	7.25	1.45	1.67	0.937
November	71	.85	7.77	1.55	1.73	1.00
December	49	1.1	8.66	1.73	2.00	1.12
January	9.8	.07	2.25	.450	.52	.291
February	45	.1	10.3	2.06	2.15	1.33
March	142	3.1	18.8	3.76	4.33	2.43
April	140	1.4	9.74	1.95	2.17	1.26
May	3.9	.05	.988	.198	.23	.128
June	164	.01	12.1	2.42	2.71	1.56
July	.24	0	.021	.0042	.005	.0027
August	34	0	3.11	.622	.72	.402
September	.52	.02	.060	.012	.01	.0078
The year	164	0	6.72	1.34	18.24	.866

Monthly discharge of Sawpit Run near Oldtown—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1955–56						
October	0.09	0.03	0.042	0.0084	0.01	0.0054
November	.66	.04	.256	.051	.06	.033
December	.32	.02	.084	.017	.02	.011
January	9.0	.01	.562	.112	.13	.072
February	50	2.3	12.5	2.50	2.69	1.62
March	72	1.7	10.1	2.02	2.33	1.31
April	77	1.1	7.24	1.45	1.62	.937
May	18	.72	2.67	.534	.62	.345
June	41	.60	5.19	1.04	1.16	.672
July	5.1	.09	.959	.192	.22	.124
August	8.1	.04	1.15	.230	.27	.149
September	.78	.02	.095	.019	.02	.012
The year	77	.01	3.36	.672	9.15	.434
1956–57						
October	5.2	0.12	0.675	0.135	0.16	0.087
November	.55	.08	.260	.052	.06	.034
December	26	.12	4.85	.970	1.12	.627
January	58	.84	5.04	1.01	1.16	.653
February	74	1.5	10.7	2.14	2.23	1.38
March	14	1.2	3.70	.740	.85	.478
April	44	1.3	6.87	1.37	1.53	.885
May	2.8	.05	.612	.122	.14	.079
June	9.3	.04	.689	.138	.15	.089
July	.26	0	.029	.0058	.007	.0038
August	.06	0	.005	.0010	.001	.0006
September	.02	0	.008	.0016	.002	.0010
The year	74	0	2.73	.546	7.41	.353
1957–58						
October	3.9	0	0.553	0.111	0.13	0.072
November	2.0	.17	.599	.120	.13	.078
December	61	.27	4.72	.944	1.09	.610
January	18	.20	3.80	.760	.88	.491
February	26	.63	6.14	1.23	1.28	.795
March	66	1.7	14.9	2.98	3.43	1.93
April	42	1.1	7.10	1.42	1.58	.918
May	84	.24	10.5	2.10	2.42	1.36
June	3.0	.01	.461	.092	.10	.060
July	.41	.01	.069	.014	.02	.0090
August	8.8	.01	.906	.181	.21	.117
September	.16	0	.020	.0040	.004	.0026
The year	84	0	4.15	.830	11.27	.536

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of Sawpit Run near Oldtown—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1958–59						
October	0.06	0	0.009	0.0018	0.002	0.0012
November	.37	.02	.078	.016	.02	.010
December	.53	0	.084	.017	.02	.011

Yearly discharge of Sawpit Run near Oldtown

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1948	3.33	0.666	9.07	0.430	4.74	0.948	12.91	0.613
1949	4.71	.942	12.77	.609	3.45	.690	9.34	.446
1950	2.83	.566	7.68	.366	3.67	.734	9.96	.474
1951	5.81	1.16	15.78	.750	4.87	.974	13.21	.630
1952	4.78	.956	13.03	.618	5.12	1.02	13.94	.659
1953	5.23	1.05	14.20	.679	4.69	.938	12.73	.606
1954	1.53	.306	4.15	.198	3.50	.700	9.48	.452
1955	6.72	1.34	18.24	.866	4.76	.952	12.94	.615
1956	3.36	.672	9.15	.434	3.81	.762	10.40	.492
1957	2.73	.546	7.41	.353	2.74	.548	7.42	.354
1958	4.15	.830	11.27	.536	3.67	.734	9.97	.474
Highest	6.72	1.34	18.24	.866	5.12	1.02	31.94	.659
Average	4.11	.821	11.16	.531	4.09	.818	11.12	.529
Lowest	1.53	.306	4.15	.198	2.74	.548	7.42	.354

POTOMAC RIVER BASIN

15. Potomac River at Paw Paw, W. Va.

Location.—Lat 39°32′13″, long 78°27′28″, on left bank 250 ft upstream from bridge on Maryland State Highway 51 at Paw Paw, Morgan County, and 3.3 miles downstream from Little Cacapon River.

Drainage area.—3,109 sq. mi.

Records available.—October 1938 to September 1959. Monthly records October 1938 to September 1943 published in Bulletin 1.

Gage.—Water-stage recorder. Datum of gage is 487.88 ft above mean sea level (Corps of Engineers bench mark). Prior to Mar. 25, 1939, wire-weight gage at bridge 250 ft downstream at same datum.

Average discharge.—21 years, 3,077 cfs.

Extremes.—Maximum discharge, 111,000 cfs Oct. 16, 1942 (gage height, 38.36 ft); minimum, 193 cfs Sept. 7–9, 1957.

Maximum stage known, 54.0 ft Mar. 18, 1936 (discharge, 240,000 cfs, from rating curve extended above 85,000 cfs on basis of slope-area measurement of peak flow at site 5 miles upstream at Okonoko, W. Va.).

Remarks.—Low flow affected by Stony River Reservoir and since December 1950, by Savage River Reservoir. Unadjusted figures are published as the affect on the annual figures is insignificant (see North Branch Potomac River at Luke for change in contents).

Monthly discharge of Potomac River at Paw Paw, W. Va.

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1943–44						
October	643	219	321	0.103	0.12	0.067
November	936	370	526	.169	.19	.109
December	1,180	220	394	.127	.15	.082
January	18,000	500	2,083	.670	.77	.433
February	17,000	894	3,914	1.26	1.36	.814
March	26,400	5,040	10,290	3.31	3.82	2.14
April	16,100	3,130	6,220	2.00	2.23	1.29
May	27,800	2,090	5,897	1.90	2.19	1.23
June	5,020	838	1,425	.458	.51	.296
July	745	270	444	.143	.16	.092
August	306	253	278	.089	.10	.058
September	1,380	228	478	.154	.17	.100
The year	27,800	219	2,688	.865	11.77	.559

Monthly discharge of Potomac River at Paw Paw, W. Va.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1944–45						
October	15,800	502	2,141	0.689	0.79	0.445
November	2,890	550	842	.271	.30	.175
December	16,000	1,180	3,190	1.03	1.18	.666
January	11,700	1,650	3,149	1.01	1.17	.653
February	27,500	1,100	7,826	2.52	2.62	1.63
March	23,800	2,620	7,990	2.57	2.96	1.66
April	5,750	1,900	3,212	1.03	1.15	.666
May	7,000	1,720	3,673	1.18	1.36	.763
June	1,590	706	1,198	.385	.43	.249
July	6,420	379	1,056	.340	.39	.220
August	6,640	379	1,574	.506	.58	.327
September	38,600	545	5,012	1.61	1.80	1.04
The year	38,600	379	3,378	1.09	14.73	.704
1945–46						
October	2,400	545	1,051	0.338	0.39	0.218
November	10,200	534	2,963	.953	1.06	.616
December	7,160	1,340	3,011	.968	1.12	.626
January	17,700	1,500	5,130	1.65	1.90	1.07
February	11,600	1,680	3,943	1.27	1.32	.821
March	9,470	3,730	5,596	1.80	2.08	1.16
April	6,600	1,260	2,379	.765	.85	.494
May	11,800	1,720	5,245	1.69	1.95	1.09
June	14,800	1,460	3,747	1.20	1.34	.776
July	1,820	375	901	.290	.33	.187
August	3,160	298	692	.223	.26	.144
September	660	231	280	.090	.10	.058
The year	17,700	231	2,909	.936	12.70	.605
1946–47						
October	2,980	273	655	0.211	0.24	0.136
November	726	350	429	.138	.15	.089
December	4,500	317	765	.246	.28	.159
January	8,000	1,380	3,392	1.09	1.26	.704
February	4,110	686	1,485	.478	.50	.309
March	15,200	712	4,046	1.30	1.50	.840
April	5,400	1,500	2,619	.842	.94	.544
May	6,360	1,680	3,031	.975	1.12	.630
June	3,370	613	1,471	.473	.53	.306
July	3,010	415	1,282	.412	.48	.266
August	3,450	366	1,108	.356	.41	.230
September	894	302	518	.167	.19	.108
The year	15,200	273	1,741	.560	7.60	.362

Monthly discharge of Potomac River at Paw Paw, W. Va.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1947–48						
October	392	250	276	0.089	0.10	0.058
November	3,160	401	1,439	.463	.52	.299
December	1,420	560	950	.306	.35	.198
January	16,700	640	2,575	.828	.96	.535
February	25,600	660	4,995	1.61	1.73	1.04
March	21,000	2,800	6,788	2.18	2.52	1.41
April	42,800	2,560	8,426	2.71	3.02	1.75
May	12,800	1,260	4,946	1.59	1.83	1.03
June	5,040	1,060	2,002	.644	.72	.416
July	3,400	650	1,415	.455	.52	.294
August	1,680	529	1,005	.323	.37	.209
September	1,720	397	771	.248	.28	.160
The year	42,800	250	2,953	.950	12.92	.614
1948–49						
October	7,640	764	2,194	0.706	0.81	0.456
November	10,100	752	2,623	.844	.94	.545
December	37,900	2,780	8,538	2.75	3.17	1.78
January	24,700	3,250	8,256	2.66	3.06	1.72
February	9,830	4,900	6,963	2.24	2.33	1.45
March	5,460	2,560	3,583	1.15	1.33	.743
April	13,900	1,900	4,487	1.44	1.61	.931
May	7,720	1,300	2,131	.685	.79	.443
June	65,200	596	6,533	2.10	2.34	1.36
July	20,400	1,300	5,071	1.63	1.88	1.05
August	6,840	693	1,987	.639	.74	.413
September	2,720	487	890	.286	.32	.185
The year	65,200	487	4,426	1.42	19.32	.918
1949–50						
October	2,040	434	621	0.200	0.23	0.129
November	6,560	894	1,731	.557	.62	.360
December	9,080	1,380	3,136	1.01	1.16	.653
January	5,140	1,500	2,819	.907	1.05	.586
February	29,400	2,290	8,628	2.78	2.89	1.80
March	14,800	1,820	6,215	2.00	2.30	1.29
April	6,440	1,460	2,895	.931	1.04	.602
May	11,400	2,720	5,192	1.67	1.93	1.08
June	6,360	943	2,268	.729	.81	.471
July	1,060	561	724	.233	.27	.151
August	567	306	400	.129	.15	.083
September	15,200	452	3,243	1.04	1.16	.672
The year	29,400	306	3,118	1.00	13.61	.646

Monthly discharge of Potomac River at Paw Paw, W. Va.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1950–51						
October	3,000	745	1,471	0.473	0.55	0.306
November	10,200	1,100	2,513	.808	.90	.522
December	35,600	1,260	7,428	2.39	2.75	1.54
January	15,100	2,040	6,091	1.96	2.26	1.27
February	31,900	4,630	9,199	2.96	3.08	1.91
March	24,700	3,980	6,772	2.18	2.51	1.41
April	19,000	3,250	7,503	2.41	2.69	1.56
May	10,000	1,540	4,311	1.39	1.60	.898
June	46,200	1,100	5,783	1.86	2.08	1.20
July	2,400	578	1,014	.326	.38	.211
August	726	329	470	.151	.17	.098
September	596	241	377	.121	.14	.078
The year	46,200	241	4,376	1.41	19.11	.911
1951–52						
October	329	238	261			
November	1,460	346	643			
December	7,160	584	2,082			
January	26,100	3,610	8,619			
February	13,100	1,680	4,109			
March	32,800	1,500	7,726			
April	34,700	3,130	8,711			
May	16,400	3,090	6,407			
June	2,870	845	1,508			
July	1,240	331	618			
August	590	323	453			
September	740	340	465			
The year	34,700	238	3,470	1.12	15.22	0.724
1952–53						
October	410	280	326			
November	15,700	280	1,513			
December	12,300	726	2,364			
January	24,400	1,510	7,159			
February	17,000	2,490	5,576			
March	25,600	2,860	9,407			
April	16,500	2,550	5,764			
May	10,100	1,710	4,283			
June	11,100	634	1,837			
July	1,030	336	534			
August	873	239	385			
September	327	233	272			
The year	25,600	233	3,276	1.05	14.25	0.679

Monthly discharge of Potomac River at Paw Paw, W. Va.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1953–54						
October	381	233	262			
November	572	284	338			
December	1,460	310	560			
January	4,620	327	1,295			
February	2,190	520	1,116			
March	39,800	2,490	6,315			
April	4,880	1,530	2,415			
May	4,600	1,390	2,032			
June	8,070	785	2,372			
July	2,980	334	773			
August	3,800	312	1,183			
September	1,530	395	644			
The year	39,800	233	1,614	0.519	7.05	0.335
1954–55						
October	62,000	375	4,959			
November	12,600	1,190	3,439			
December	29,700	1,750	5,227			
January	15,600	800	3,465			
February	13,000	1,100	4,995			
March	35,500	3,820	11,200			
April	12,500	1,750	3,707			
May	5,000	1,420	2,248			
June	19,700	700	4,446			
July	1,930	410	814			
August	76,700	347	6,458			
September	1,460	504	815			
The year	76,700	347	4,322	1.39	18.87	0.898
1955–56						
October	530	380	457			
November	1,100	385	618			
December	999	500	653			
January	9,190	340	793			
February	18,800	3,640	8,606			
March	23,900	2,830	6,901			
April	27,200	2,130	6,123			
May	10,900	1,910	3,404			
June	7,520	1,190	2,711			
July	4,060	748	1,486			
August	18,800	820	2,953			
September	1,460	624	886			
The year	27,200	340	2,939	0.945	12.83	0.611

Monthly discharge of Potomac River at Paw Paw, W. Va.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1956–57						
October	1,800	605	971			
November	3,440	694	1,333			
December	13,100	648	4,176			
January	13,300	1,510	4,540			
February	32,300	3,190	8,234			
March	7,580	2,400	4,268			
April	23,100	2,240	6,554			
May	4,400	1,060	2,074			
June	4,930	830	1,779			
July	1,590	338	556			
August	440	229	285			
September	465	193	286			
The year	32,300	193	2,882	0.927	12.58	0.599
1957–58						
October	2,370	258	881			
November	1,260	476	794			
December	16,700	749	3,675			
January	4,090	1,020	2,435			
February	8,040	1,250	3,366			
March	16,600	2,650	7,075			
April	21,800	4,060	9,286			
May	33,100	1,370	7,452			
June	2,480	717	1,132			
July	2,950	456	1,204			
August	8,340	766	2,079			
September	724	370	542			
The year	33,100	258	3,331	1.07	14.54	0.692
1958–59						
October	468	325	390			
November	640	390	494			
December	899	420	554			
January	7,430	600	1,789			
February	6,600	1,180	2,624			
March	7,800	1,260	3,323			
April	12,500	2,110	4,610			
May	8,910	1,390	3,229			
June	11,600	480	1,955			
July	941	295	466			
August	1,260	290	465			
September	439	192	252			
The year	12,500	192	1,670	0.537	7.29	0.347

POTOMAC RIVER BASIN—*Continued*

Yearly discharge of Potomac River at Paw Paw, W. Va.

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1939	3,221	1.04	14.06	0.672	3,223	1.04	14.07	0.672
1940	3,120	1.00	13.64	.646	3,404	1.09	14.89	.704
1941	2,386	.767	10.43	.496	2,049	.659	8.95	.426
1942	2,433	.783	10.62	.506	3,834	1.23	16.74	.795
1943	4,358	1.40	19.04	.905	2,909	.936	12.72	.605
1944	2,688	.865	11.77	.559	3,105	.999	13.58	.646
1945	3,378	1.09	14.73	.704	3,445	1.11	15.03	.717
1946	2,909	.936	12.70	.605	2,477	.797	10.80	.515
1947	1,741	.560	7.60	.362	1,807	.581	7.90	.376
1948	2,953	.950	12.92	.614	3,855	1.24	16.87	.801
1949	4,426	1.42	19.32	.918	3,760	1.21	16.41	.782
1950	3,118	1.00	13.61	.646	3,619	1.16	15.80	.750
1951	4,376	1.41	19.11	.911	3,665	1.18	16.01	.763
1952	3,470	1.12	15.22	.724	3,571	1.15	15.65	.743
1953	3,276	1.05	14.25	.679	3,021	.972	13.19	.628
1954	1,614	.519	7.05	.335	2,665	.857	11.63	.554
1955	4,322	1.39	18.87	.898	3,319	1.07	14.52	.692
1956	2,939	.945	12.83	.611	3,340	1.07	14.62	.692
1957	2,882	.927	12.58	.599	2,788	.897	12.17	.580
1958	3,331	1.07	14.54	.692	2,999	.965	13.10	.624
1959	1,670	.537	7.29	.347				
Highest	4,426	1.42	19.32	.918	3,855	1.24	16.87	.801
Average	3,077	.989	13.44	.639	3,143	1.01	13.73	.653
Lowest	1,614	.519	7.05	.335	1,807	.581	7.90	.376

16. Little Tonoloway Creek near Hancock

Location.—Lat 39°42′45″, long 78°13′55″, on right bank at downstream side of highway bridge, 100 ft downstream from unnamed tributary and 2.8 miles northwest of Hancock, Washington County.

Drainage area.—16.9 sq mi.

Records available.—August 1947 to September 1959. Prior to October 1951, published as Tonoloway Creek near Hancock. Monthly records August 1947 to September 1949 published in the report "The Physical Features of Washington County" 1951.

Gage.—Water-stage recorder and concrete control. Datum of gage is 457.51 ft above mean sea level, datum of 1929.

Average discharge.—12 years, 15.8 cfs.

Extremes.—Maximum discharge, 1,470 cfs Oct. 15, 1954 (gage height, 7.10 ft), from rating curve extended above 440 cfs on basis of slope-area measurement of peak flow; no flow at times.

Monthly discharge of Little Tonoloway Creek near Hancock

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1949–50						
October	21	0.4	3.13	0.185	0.21	0.120
November	24	1.6	4.49	.266	.30	.172
December	79	2.1	12.8	.757	.88	.489
January	27	3.4	9.88	.585	.67	.378
February	170	5.2	48.1	2.85	2.97	1.84
March	170	3.2	24.0	1.42	1.64	.918
April	26	3.4	7.94	.470	.52	.304
May	260	6.6	49.5	2.93	3.38	1.89
June	102	.6	13.4	.793	.88	.513
July	4.7	.1	.95	.056	.06	.036
August	1.7	0	.12	.0071	.008	.0046
September	101	0	16.6	.982	1.10	.635
The year	260	0	15.7	.929	12.62	.600
1950–51						
October	108	2.1	13.9	0.822	0.95	0.531
November	350	4.6	32.0	1.89	2.11	1.22
December	471	9.0	50.4	2.98	3.44	1.93
January	142	9.0	32.2	1.91	2.20	1.23
February	277	18	61.5	3.64	3.79	2.35
March	350	13	52.1	3.08	3.56	1.99
April	130	11	34.4	2.04	2.27	1.32
May	53	3.4	12.6	.746	.86	.482
June	602	2.1	63.1	3.73	4.16	2.41
July	8.6	.6	2.26	.134	.15	.087
August	14	.2	.87	.051	.06	.033
September	.6	.1	.16	.0095	.01	.0061
The year	602	.1	29.3	1.73	23.56	1.12

Monthly discharge of Little Tonoloway Creek near Hancock—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1951–52						
October	0.2	0.1	0.10	0.0059	0.007	0.0038
November	9.5	.5	1.44	.085	.09	.055
December	149	.8	13.3	.787	.91	.509
January	316	4.6	77.9	4.61	5.31	2.98
February	146	2.6	25.2	1.49	1.61	.963
March	332	1.4	41.7	2.47	2.84	1.60
April	239	4.4	48.3	2.86	3.19	1.85
May	113	7.8	23.5	1.39	1.60	.898
June	96	.6	8.08	.478	.53	.309
July	51	.2	7.64	.452	.52	.292
August	8.1	.2	.64	.038	.04	.025
September	85	1.3	8.10	.479	.53	.310
The year	332	.1	21.4	1.27	17.18	.821
1952–53						
October	2.7	0.9	1.27	0.075	0.09	0.048
November	538	.8	45.7	2.70	3.02	1.75
December	265	9.6	30.5	1.80	2.08	1.16
January	187	16	57.2	3.38	3.90	2.18
February	56	12	27.9	1.65	1.72	1.07
March	231	14	57.1	3.38	3.90	2.18
April	70	9.6	24.9	1.47	1.64	.950
May	390	5.1	27.9	1.65	1.90	1.07
June	258	1.0	17.9	1.06	1.18	.685
July	10	.2	.95	.056	.07	.036
August	4.3	.1	.51	.030	.03	.019
September	.2	.1	.13	.0077	.008	.0050
The year	538	.1	24.3	1.44	19.54	.931
1953–54						
October	0.3	0.1	0.11	0.0065	0.008	0.0042
November	24	.2	1.54	.091	.10	.059
December	40	.7	5.55	.328	.38	.212
January	22	1.1	4.97	.294	.34	.190
February	9.9	1.4	4.35	.257	.27	.166
March	408	8.0	37.3	2.21	2.54	1.43
April	15	4.1	6.90	.408	.46	.264
May	12	1.8	4.36	.258	.30	.167
June	13	.2	1.76	.104	.12	.067
July	.8	.1	.20	.012	.01	.008
August	41	.1	2.56	.151	.17	.098
September	.9	.1	.24	.014	.02	.009
The year	408	.1	5.87	3.47	4.72	.224

Monthly discharge of Little Tonoloway Creek near Hancock—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1954–55						
October	308	0.2	18.2	1.08	1.24	0.698
November	113	2.5	17.5	1.04	1.16	.672
December	106	7.0	31.2	1.85	2.13	1.20
January	46	3.5	11.2	.663	.76	.429
February	62	3.8	17.9	1.06	1.10	.685
March	454	13	65.7	3.89	4.48	2.51
April	107	6.7	21.2	1.25	1.40	.808
May	20	1.8	6.89	.408	.47	.264
June	31	.7	5.67	.336	.37	.217
July	3.2	0	.45	.027	.03	.018
August	45	0	4.12	.244	.28	.158
September	3.0	.1	.47	.028	.03	.018
The year	454	0	16.8	.994	13.45	.642
1955–56						
October	4.7	0.2	1.04	0.062	0.07	0.040
November	2.8	.6	1.35	.080	.09	.052
December	1.5	.2	.68	.040	.05	.026
January	23	.2	2.04	.121	.14	.078
February	136	9.4	36.4	2.15	2.32	1.39
March	138	8.7	35.6	2.11	2.43	1.36
April	133	6.8	26.1	1.54	1.72	.995
May	14	2.9	7.83	.463	.53	.299
June	17	.8	4.07	.241	.27	.156
July	78	.8	15.4	.911	1.05	.589
August	113	1.2	12.3	.728	.84	.471
September	5.9	.6	1.71	.101	.11	.065
The year	138	.2	12.0	.710	9.62	.459
1956–57						
October	14	1.2	3.82	0.226	0.26	0.146
November	11	1.3	4.57	.270	.30	.175
December	121	1.2	25.3	1.50	1.72	.969
January	107	7.5	22.1	1.31	1.51	.847
February	178	10	33.6	1.99	2.07	1.29
March	37	7.1	18.9	1.12	1.29	.724
April	115	7.5	35.2	2.08	2.32	1.34
May	16	.9	5.28	.312	.36	.202
June	14	.4	2.68	.159	.18	.103
July	1.9	.1	.31	.018	.02	.012
August	.1	0	.05	.0030	.004	.0019
September	.1	0	.003	.00018	.0002	.00012
The year	178	0	12.5	.740	10.03	.478

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of Little Tonoloway Creek near Hancock—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1957–58						
October	6.2	0	0.67	0.040	0.05	0.026
November	6.2	.4	1.69	.100	.11	.065
December	196	.5	16.2	.959	1.11	.620
January	60	1.9	19.0	1.12	1.30	.724
February	86	4.7	19.8	1.17	1.22	.756
March	181	10	50.3	2.98	3.43	1.93
April	115	8.8	35.1	2.08	2.32	1.34
May	229	3.0	44.9	2.66	3.06	1.72
June	26	.3	4.77	.282	.31	.182
July	3.8	.2	1.48	.088	.10	.057
August	10	.2	2.18	.129	.15	.083
September	3.0	.1	.72	.043	.05	.028
The year	299	0	16.4	.970	13.21	.627
1958–59						
October	6.2	0.2	1.54	0.091	0.10	0.059
November	5.0	.4	1.16	.069	.08	.045
December	3.2	.1	.87	.051	.06	.033
January	30	.5	5.12	.303	.35	.196
February	28	2.1	9.01	.533	.56	.344
March	94	3.0	18.7	1.11	1.28	.717
April	95	9.6	23.2	1.37	1.53	.885
May	49	3.2	18.0	1.07	1.23	.692
June	13	.2	2.11	.125	.14	.081
July	12	.2	1.79	.106	.12	.068
August	50	0	3.26	.193	.22	.125
September	6.7	.2	1.90	.112	.13	.072
The year	95	0	7.21	.427	5.80	.276

POTOMAC RIVER BASIN—*Continued*

Yearly discharge of Little Tonoloway Creek near Hancock

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1948	11.1	0.657	8.91	0.425	15.4	0.911	12.45	0.589
1949	17.1	1.01	13.70	.653	14.1	.834	11.32	.539
1950	15.7	.929	12.62	.600	22.1	1.31	17.73	.847
1951	29.3	1.73	23.56	1.12	22.5	1.33	18.07	.860
1952	21.4	1.27	17.18	.821	26.5	1.57	21.36	1.01
1953	24.3	1.44	19.54	.931	18.5	1.09	14.84	.704
1954	5.87	.347	4.72	.224	10.9	.645	8.76	.417
1955	16.8	.994	13.45	.642	11.4	.675	9.13	.436
1956	12.0	.710	9.62	.459	14.5	.858	11.69	.555
1957	12.5	.740	10.03	.478	11.2	.663	9.02	.429
1958	16.4	.970	13.21	.627	15.2	.899	12.18	.581
1959	7.21	.427	5.80	.276				
Highest	29.3	1.73	23.56	1.12	26.5	1.57	21.36	1.01
Average	15.8	.935	12.70	.605	16.6	.980	13.32	.633
Lowest	5.87	.347	4.72	.224	10.9	.645	8.76	.417

POTOMAC RIVER BASIN

17. Potomac River at Hancock

Location.—Lat 39°41′49″, long 78°10′39″, on left bank 0.2 mile downstream from Little Tonoloway Creek, half a mile downstream from bridge on U. S. Highway 522 at Hancock, Washington County, and 1.1 miles upstream from Tonoloway Creek (formerly called Great or Big Tonoloway Creek).

Drainage area.—4,073 sq mi.

Records available.—October 1932 to September 1959. Monthly records October 1932 to September 1943 published in Bulletin 1, October 1943 to September 1949 in "The Physical Features of Washington County", 1951 (1948, 1949 revised herein).

Supplemental records available.—Records of water temperatures for July 1952 to September 1959 published in reports of U. S. Geological Survey. Gage-height records collected at same site since June 1925 are contained in reports of U. S. Weather Bureau.

Gage.—Water-stage recorder. Datum of gage is 383.46 ft above mean sea level, adjustment of 1912. Oct. 1, 1932, to Aug. 27, 1934, chain gage, and Aug. 28, 1934 to Jan. 5, 1935, Mar. 18, 1936, to Jan. 20, 1937, wire-weight gage, on former highway bridge just upstream at same datum. Jan. 6, 1935 to Mar. 18, 1936, water-stage recorder at present site and datum.

Average discharge.—27 years, 3,993 cfs.

Extremes.—Maximum discharge, 340,000 cfs Mar. 18, 1936 (gage height, 47.6 ft), from rating curve extended above 120,000 cfs on basis of slope-area measurement of peak flow; minimum observed, 180 cfs Oct. 4, 1932 (gage height, 2.01 ft).

Maximum stage known prior to 1932, about 40 ft in May 1889 (discharge, about 220,000 cfs).

Remarks.—Slight regulation at low flow from power plants upstream. Low flow affected slightly by Stony River Reservoir and since December 1950 by Savage River Reservoir. Unadjusted figures published as the affect on the annual figures is insignificant (see North Branch Potomac River at Luke for change in contents).

Monthly discharge of Potomac River at Hancock

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1947–48						
October	408	303	328	0.081	0.09	0.052
November	3,980	447	1,661	.408	.45	.264
December	1,490	678	1,054	.259	.30	.167
January	18,000	800	3,031	.744	.86	.481
February*	24,000	840	5,626	1.38	1.49	.892
March	24,800	3,500	7,992	1.96	2.26	1.27
April	58,300	3,430	10,310	2.53	2.82	1.64
May	16,500	1,480	6,313	1.55	1.79	1.00
June	5,930	1,260	2,330	.572	.64	.370
July	3,280	750	1,566	.384	.44	.248
August*	2,400	662	1,224	.301	.35	.195
September	1,860	477	842	.207	.23	.134
The year	58,300	303	3,508	.861	11.72	.556

Monthly discharge of Potomac River at Hancock—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1948–49						
October	10,600	734	2,762	0.678	0.78	0.438
November	10,400	898	3,153	.774	.86	.500
December	49,700	3,500	10,730	2.63	3.04	1.70
January*	29,300	4,050	10,600	2.60	3.00	1.68
February*	14,500	6,200	8,761	2.15	2.24	1.39
March*	6,200	3,200	4,372	1.07	1.24	.692
April*	18,100	2,470	5,367	1.32	1.47	.853
May	8,430	1,800	2,936	.721	.83	.466
June	77,600	710	7,285	1.79	2.00	1.16
July*	29,900	1,650	6,677	1.64	1.89	1.06
August*	9,070	1,100	2,678	.658	.76	.425
September	3,890	588	1,115	.274	.31	.177
The year	77,600	588	5,524	1.36	18.42	.879
1949–50						
October	2,260	508	705	0.173	0.20	0.112
November	5,120	980	1,953	.479	.54	.310
December	11,400	1,600	3,855	.946	1.09	.611
January	5,030	1,800	3,351	.823	.95	.532
February	37,900	2,980	11,090	2.72	2.83	1.76
March	20,400	2,260	7,765	1.91	2.20	1.23
April	7,550	1,860	3,553	.872	.97	.564
May	13,400	3,360	6,750	1.66	1.91	1.07
June	7,970	1,130	2,968	.729	.81	.471
July	1,210	710	890	.219	.25	.142
August	702	375	471	.116	.13	.075
September	17,400	630	3,894	.956	1.07	.618
The year	37,900	375	3,887	.954	12.95	.617
1950–51						
October	4,430	946	2,021	0.496	0.57	0.321
November	15,300	1,500	3,441	.845	.94	.546
December	54,100	2,010	10,500	2.58	2.97	1.67
January	19,100	3,000	7,741	1.90	2.19	1.23
February	33,800	6,290	12,070	2.96	3.09	1.91
March	31,900	4,960	8,765	2.15	2.48	1.39
April	26,800	4,130	9,827	2.41	2.69	1.56
May	12,400	2,180	5,736	1.41	1.62	.911
June	59,200	1,530	7,806	1.92	2.14	1.24
July	3,190	935	1,446	.355	.41	.229
August	1,040	384	613	.151	.17	.098
September	740	296	488	.120	.13	.078
The year	59,200	296	5,825	1.43	19.40	.924

Monthly discharge of Potomac River at Hancock—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1951–52						
October	427	288	321	0.079	0.09	0.051
November	1,710	418	788	.193	.22	.125
December	10,600	800	2,461	.604	.70	.390
January	30,400	4,650	10,750	2.64	3.04	1.71
February	17,500	2,290	5,486	1.35	1.45	.873
March	43,300	2,080	9,940	2.44	2.81	1.58
April	48,200	4,290	11,560	2.84	3.17	1.84
May	21,400	4,020	8,574	2.11	2.43	1.36
June	3,600	1,100	1,998	.491	.55	.317
July	1,780	409	912	.224	.26	.145
August	860	392	587	.144	.17	.093
September	1,780	409	755	.185	.21	.120
The year	48,200	288	4,513	1.11	15.10	.717
1952–53						
October	600	328	426			
November	34,300	352	3,081			
December	18,900	1,210	3,306			
January	28,300	1,920	9,408			
February	18,100	3,280	6,922			
March	34,400	3,660	12,202			
April	19,700	3,440	7,474			
May	11,500	2,390	5,771			
June	19,200	850	2,787			
July	1,130	425	683			
August	1,000	305	468			
September	419	290	351			
The year	34,400	290	4,397	1.08	14.65	0.698
1953–54						
October	469	300	337			
November	900	362	488			
December	2,170	449	807			
January	5,400	455	1,524			
February	2,870	704	1,386			
March	58,700	2,980	8,371			
April	6,570	1,870	2,961			
May	7,310	1,660	2,628			
June	9,140	970	2,801			
July	3,330	390	868			
August	4,180	373	1,279			
September	2,050	455	761			
The year	58,700	300	2,026	0.497	6.75	0.321

Monthly discharge of Potomac River at Hancock—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1954–55						
October	66,500	419	6,502			
November	17,200	1,480	4,294			
December	42,500	2,100	6,387			
January	22,500	860	4,520			
February	15,800	1,200	5,862			
March	49,700	5,140	14,300			
April	16,700	2,180	4,955			
May	6,140	1,800	2,913			
June	37,900	930	6,161			
July	2,360	497	1,004			
August	107,000	431	9,479			
September	1,820	714	1,114			
The year	107,000	419	5,638	1.38	18.79	0.892
1955–56						
October	714	462	603			
November	1,350	483	793			
December	1,190	560	765			
January	6,400	420	751			
February	21,600	4,530	10,620			
March	27,500	3,490	8,605			
April	37,800	2,670	7,896			
May	12,900	2,440	3,890			
June	7,610	1,640	3,228			
July	5,520	930	1,887			
August	24,300	980	3,356			
September	1,700	724	1,098			
The year	37,800	420	3,591	0.882	12.00	0.570
1956–57						
October	2,020	771	1,189			
November	3,620	840	1,562			
December	14,600	790	4,931			
January	16,400	1,850	5,266			
February	38,100	3,790	10,140			
March	9,370	2,880	5,334			
April	26,900	2,950	8,526			
May	5,970	1,370	2,603			
June	6,770	1,000	2,179			
July	1,650	407	681			
August	549	254	350			
September	565	233	350			
The year	38,100	233	3,544	0.870	11.81	0.562

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of Potomac River at Hancock—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1957–58						
October	2,880	315	1,020			
November	1,540	605	1,000			
December	18,700	920	4,224			
January	6,000	1,350	3,231			
February	11,500	1,600	4,295			
March	26,500	3,310	9,603			
April	27,800	5,290	11,350			
May	37,700	1,730	9,756			
June	3,380	820	1,478			
July	5,110	597	1,650			
August	10,200	980	2,608			
September	890	431	628			
The year	37,700	315	4,243	1.04	14.14	0.672
1958–59						
October	589	390	470			
November	752	431	571			
December	1,030	520	662			
January	8,500	650	2,144			
February	7,190	1,350	2,913			
March	9,140	1,440	3,715			
April	16,400	2,460	5,292			
May	12,400	1,700	4,316			
June	18,000	565	2,740			
July	1,060	373	597			
August	1,640	351	594			
September	557	245	331			
The year	18,000	245	2,019	0.496	6.73	0.321

* Revised.

POTOMAC RIVER BASIN—*Continued*

Yearly discharge of Potomac River at Hancock

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1933	5,130	1.26	17.12	0.814	4,678	1.15	15.60	0.743
1934	2,070	.508	6.91	.328	2,378	.584	7.92	.377
1935	4,388	1.08	14.61	.698	4,281	1.05	14.26	.679
1936	5,813	1.43	19.43	.924	5,964	1.46	19.93	.944
1937	5,202	1.28	17.35	.827	6,055	1.49	20.19	.963
1938	3,623	.890	12.08	.575	2,422	.595	8.08	.385
1939	3,940	.967	13.13	.625	3,955	.971	13.18	.628
1940	3,982	.978	13.31	.632	4,331	1.06	14.48	.685
1941	2,986	.733	9.95	.474	2,524	.620	8.40	.401
1942	2,985	.733	9.96	.474	4,902	1.20	16.34	.776
1943	5,652	1.39	18.83	.898	3,688	.905	12.29	.585
1944	3,381	.830	11.29	.536	3,838	.942	12.82	.609
1945	4,124	1.01	13.74	.653	4,298	1.06	14.32	.685
1946	3,655	.897	12.18	.580	3,089	.758	10.29	.490
1947	2,152	.528	7.16	.341	2,210	.543	7.35	.351
1948	3,508	.861	11.72	.556	4,656	1.14	15.56	.737
1949	5,524	1.36	18.42	.879	4,667	1.15	15.57	.743
1950	3,887	.954	12.95	.617	4,685	1.15	15.60	.743
1951	5,825	1.43	19.40	.924	4,780	1.17	15.93	.756
1952	4,513	1.11	15.10	.717	4,782	1.17	15.98	.756
1953	4,397	1.08	14.65	.698	3,964	.973	13.21	.629
1954	2,026	.497	6.75	.321	3,336	.819	11.12	.529
1955	5,638	1.38	18.79	.892	4,372	1.07	14.57	.692
1956	3,591	.882	12.00	.570	4,056	.996	13.56	.644
1957	3,544	.870	11.81	.562	3,423	.840	11.41	.543
1958	4,243	1.04	14.14	.672	3,859	.947	12.86	.612
1959	2,019	.496	6.73	.321				
Highest	5,825	1.43	19.43	.924	6,055	1.49	20.19	.963
Average	3,993	.981	13.32	.634	4,046	.993	13.49	.642
Lowest	2,019	.496	6.73	.321	2,210	.543	7.35	.351

POTOMAC RIVER BASIN

18. Licking Creek near Sylvan, Pa.

Location.—Lat 39°43′20″, long 78°03′35″, at highway bridge 200 ft upstream from Pennsylvania-Maryland State line, 3 miles southwest of Sylvan, Franklin County, and 10 miles upstream from mouth.

Drainage area.—158 sq mi.

Records available.—June 1930 to January 1942. Monthly records June 1930 to January 1942 published in Bulletin 1 (June 1930 completed, 1935 revised herein).

Gage.—Chain gage. Datum of gage is 434.16 ft above mean sea level, adjustment of 1907.

Average discharge.—11 years (1930–41), 166 cfs.

Extremes.—Maximum discharge, 20,700 cfs Mar. 18, 1936 (gage height 17.4 ft, from floodmark), from rating curve extended above 5,500 cfs on basis of contracted-opening measurement of peak flow, minimum observed 3.0 cfs Aug. 8, 1930 (gage height, 0.64 ft).

Monthly discharge of Licking Creek near Sylvan, Pa.

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1930						
June‡	38	12	24.5	0.155	0.17	0.100
1934–35						
October	462	30	78.9	0.499	0.58	0.323
November	600	25	71.4	.452	.50	.292
December*	4,800	87	420	2.66	3.07	1.72
January	430	103	204	1.29	1.49	.834
February	1,230	117	357	2.26	2.35	1.46
March	564	170	295	1.87	2.16	1.21
April	960	90	278	1.76	1.96	1.14
May	600	54	222	1.41	1.63	1.43
June	102	26	43.3	.274	.31	.177
July	69	16	29.2	.185	.21	.120
August	42	11	21.0	.133	.15	.086
September	564	12	50.0	.316	.35	.204
The year	4,800	11	172	1.09	14.76	.704

‡ Not previously published.

* Revised.

POTOMAC RIVER BASIN—*Continued*

Yearly discharge of Licking Creek near Sylvan, Pa.

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1931	114	0.722	9.75	0.467	116	0.734	10.00	0.474
1932	119	.753	10.26	.487	165	1.04	14.20	.672
1933	240	1.52	20.60	.982	201	1.27	17.20	.821
1934	94.8	.600	8.13	.388	132	.835	11.32	.540
1935	172	1.09	14.76	.704	142	.899	12.18	.581
1936	230	1.46	19.79	.944	234	1.48	20.20	.957
1937	237	1.50	20.38	.969	271	1.72	23.24	1.11
1938	137	.867	11.78	.560	104	.658	8.97	.425
1939	161	1.02	13.85	.659	164	1.04	14.09	.672
1940	184	1.16	15.85	.750	195	1.23	16.76	.795
1941	139	.880	11.95	.569				
Highest	240	1.52	20.60	.982	271	1.72	23.24	1.11
Average	166	1.05	14.28	.680	172	1.09	14.82	.705
Lowest	94.8	.600	8.13	.388	104	.658	8.97	.425

19. Conococheague Creek at Fairview

Location.—Lat 39°42′57″, long 77°49′28″, on right bank 0.7 mile upstream from highway bridge in Fairview, Washington County, 2 miles upstream from Rockdale Run, and 6½ miles northwest of Hagerstown.

Drainage area.—494 sq mi.

Records available.—June 1928 to September 1959. Monthly records June 1928 to September 1943 published in Bulletin 1 (1928, 1930 revised herein); October 1943 to September 1949 in "The Physical Features of Washington County" 1951.

Supplemental records available.—Records of chemical analyses and water temperature for the period April 1948 to September 1950, and suspended-sediment loads for the period August 1948 to September 1950, are published in reports of U. S. Geological Survey.

Gage.—Water-stage recorder. Datum of gage is 391.77 ft above mean sea level, adjustment of 1912. Prior to Dec. 6, 1932, chain gage at highway bridge 0.7 mile downstream at datum 2.85 ft lower. Dec. 6, 1932, to Oct. 7, 1933, staff gage at site 200 ft downstream from former site at datum 4.84 ft lower than present datum.

Average discharge.—31 years, 570 cfs.

Extremes.—Maximum discharge, 17,100 cfs Nov. 22, 1952 (gage height, 15.16 ft, from high-water mark in well); minimum, 22 cfs Dec. 16, 1930; minimum daily, 25 cfs Nov. 28, 1930.

Maximum stage known, about 16.5 ft sometime in 1889, from information by local residents (discharge, about 22,000 cfs).

Remarks.—Low flow partly regulated by small power plants near Mercersburg, Pa.

Monthly discharge of Conococheague Creek at Fairview

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1928						
June‡	6,480	440	2,045	4.14	4.62	2.68
July	5,310	512	1,360	2.75	3.17	1.78
August	1,260	280	433	.877	1.01	.567
September	457	210	276	.559	.62	.361
1929–30						
October	6,500	155	1,230	2.49	2.88	1.61
November*	2,970	370	814	1.65	1.84	1.07
December	783	—	460	.931	1.07	.602
January	846	—	469	.949	1.09	.613
February	1,600	325	636	1.29	1.34	.834
March	3,960	454	881	1.78	2.06	1.15
April	1,170	359	481	.974	1.09	.630
May	398	196	266	.538	.62	.348
June	359	95	156	.316	.35	.204
July	112	50	75.7	.153	.18	.099
August	69	38	55.0	.111	.13	.072
September	79	42	54.6	.111	.12	.072
The year	6,500	38	465	.941	12.77	.608

Monthly discharge of Conococheague Creek at Fairview—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1949–50						
October	376	99	146	0.296	0.34	0.191
November	456	110	170	.344	.38	.222
December	2,920	128	500	1.01	1.17	.653
January	782	280	496	1.00	1.16	.646
February	3,740	523	1,348	2.73	2.84	1.76
March	4,150	402	1,009	2.04	2.36	1.32
April	1,040	373	568	1.15	1.28	.743
May	4,850	402	1,180	2.39	2.75	1.54
June	1,730	270	612	1.24	1.38	.801
July	402	136	221	.447	.52	.289
August	1,860	108	201	.407	.47	.263
September	2,830	134	537	1.09	1.21	.704
The year	4,850	99	577	1.17	15.86	.756
1950–51						
October	2,860	198	632	1.28	1.47	0.827
November	7,880	344	1,249	2.53	2.82	1.64
December	5,590	480	1,481	3.00	3.46	1.94
January	3,070	436	1,105	2.24	2.58	1.45
February	5,250	755	1,851	3.75	3.90	2.42
March	5,290	675	1,157	2.34	2.70	1.51
April	5,100	700	1,370	2.77	3.09	1.79
May	920	270	492	.996	1.15	.644
June	6,780	229	934	1.89	2.11	1.22
July	968	217	383	.775	.89	.501
August	484	126	184	.372	.43	.240
September	153	93	118	.239	.27	.154
The year	7,880	93	905	1.83	24.87	1.18
1951–52						
October	116	88	97.7	0.198	0.23	0.128
November	487	126	210	.425	.47	.275
December	2,730	151	663	1.34	1.55	.866
January	4,880	568	1,544	3.13	3.60	2.02
February	2,990	420	922	1.87	2.01	1.21
March	11,600	408	1,900	3.85	4.44	2.49
April	4,540	664	1,486	3.01	3.36	1.95
May	2,910	640	1,137	2.30	2.65	1.49
June	994	268	432	.874	.98	.565
July	3,890	211	540	1.09	1.26	.704
August	325	135	196	.397	.46	.257
September	5,110	158	638	1.29	1.44	.834
The year	11,600	88	815	1.65	22.45	1.07

Monthly discharge of Conococheague Creek at Fairview—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1952–53						
October	199	112	142	0.287	0.33	0.185
November	13,000	110	1,399	2.83	3.16	1.83
December	3,300	450	1,070	2.17	2.50	1.40
January	5,720	416	1,584	3.21	3.70	2.07
February	1,760	756	1,024	2.07	2.16	1.34
March	5,290	684	1,709	3.46	3.99	2.24
April	1,510	578	963	1.95	2.17	1.26
May	3,140	491	1,056	2.14	2.47	1.38
June	1,840	254	616	1.25	1.39	.808
July	929	160	243	.492	.57	.318
August	652	100	183	.370	.43	.239
September	151	88	103	.209	.23	.135
The year	13,000	88	840	1.70	23.10	1.10
1953–54						
October	148	76	90.9	0.184	0.21	0.119
November	756	84	140	.283	.32	.183
December	1,460	102	347	.702	.81	.454
January	400	85	181	.366	.42	.237
February	2,010	115	363	.735	.77	.475
March	3,500	400	814	1.65	1.90	1.07
April	982	267	428	.866	.97	.560
May	1,440	240	637	1.29	1.49	.834
June	395	99	194	.393	.44	.254
July	166	59	90.1	.182	.21	.118
August	803	60	174	.352	.41	.228
September	469	76	154	.312	.35	.202
The year	3,500	59	301	.609	8.30	.394
1954–55						
October	5,890	86	501	1.01	1.17	0.653
November	685	175	308	.623	.70	.403
December	2,670	242	779	1.58	1.82	1.02
January	1,230	200	472	.955	1.10	.617
February	2,250	195	595	1.20	1.25	.776
March	5,840	645	1,738	3.52	4.06	2.28
April	1,510	469	801	1.62	1.81	1.05
May	766	204	382	.773	.89	.500
June	1,780	165	521	1.05	1.18	.679
July	366	99	161	.326	.38	.211
August	4,190	92	523	1.06	1.22	.685
September	447	121	191	.387	.43	.250
The year	5,890	86	582	1.18	16.01	.763

Monthly discharge of Conococheague Creek at Fairview—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in millions gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1955–56						
October	3,950	125	504	1.02	1.18	0.659
November	361	191	267	.540	.60	.349
December	230	150	186	.377	.43	.244
January	1,210	120	213	.431	.50	.279
February	3,760	532	1,184	2.40	2.58	1.55
March	2,480	480	1,125	2.28	2.63	1.47
April	3,430	469	1,065	2.16	2.41	1.40
May	659	257	392	.794	.91	.513
June	421	162	233	.472	.53	.305
July	2,430	142	417	.844	.97	.545
August	509	123	208	.421	.49	.272
September	198	97	130	.263	.29	.170
The year	3,950	97	491	.994	13.52	.642
1956–57						
October	2,050	102	322	0.652	0.75	0.421
November	5,530	244	837	1.69	1.89	1.09
December	4,320	199	1,045	2.12	2.44	1.37
January	1,420	400	664	1.34	1.55	.866
February	2,250	541	976	1.98	2.06	1.28
March	1,320	460	824	1.67	1.92	1.08
April	3,260	442	1,048	2.12	2.37	1.37
May	447	175	287	.581	.67	.376
June	568	160	281	.569	.63	.368
July	225	93	129	.261	.30	.169
August	95	54	71.7	.145	.17	.094
September	186	54	75.7	.153	.17	.099
The year	5,530	54	543	1.10	14.92	.711
1957–58						
October	250	64	105	0.213	0.25	0.138
November	482	86	162	.328	.37	.212
December	3,910	109	693	1.40	1.62	.905
January	3,720	270	983	1.99	2.30	1.29
February	4,280	330	719	1.46	1.52	.944
March	3,680	611	1,417	2.87	3.31	1.85
April	2,030	654	1,239	2.51	2.80	1.62
May	6,500	416	1,657	3.35	3.87	2.17
June	2,270	240	555	1.12	1.25	.724
July	425	175	263	.532	.61	.344
August	684	140	229	.464	.53	.300
September	455	113	162	.328	.37	.212
The year	6,500	64	683	1.38	18.80	.892

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of Conococheague Creek at Fairview—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1958-59						
October	204	100	124	0.251	0.29	0.162
November	500	102	150	.304	.34	.196
December	300	100	147	.298	.34	.193
January	4,250	110	413	.836	.96	.540
February	2,020	216	497	1.01	1.05	.653
March	1,630	236	571	1.16	1.33	.750
April	1,290	351	642	1.30	1.45	.840
May	964	218	475	.962	1.11	.622
June	1,020	133	254	.514	.57	.332
July	1,430	108	224	.453	.52	.293
August	797	93	174	.352	.41	.228
September	254	58	106	.215	.24	.139
The year	4,250	58	314	.636	8.61	.411

‡ Not previously published.
* Revised.

POTOMAC RIVER BASIN—*Continued*

Yearly discharge of Conococheague Creek at Fairview

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1929	533	1.08	14.64	0.698	687	1.39	18.88	0.898
1930	465	.941	12.77	.608	267	.540	7.32	.349
1931	320	.648	8.80	.419	328	.664	9.03	.429
1932	342	.692	9.42	.447	520	1.05	14.33	.679
1933	842	1.70	23.13	1.10	694	1.40	19.07	.905
1934	418	.846	11.47	.547	573	1.16	15.71	.750
1935	579	1.17	15.91	.756	468	.947	12.86	.612
1936	737	1.49	20.31	.963	740	1.50	20.40	.969
1937	787	1.59	21.62	1.03	873	1.77	23.97	1.14
1938	430	.870	11.81	.562	316	.640	8.69	.414
1939	497	1.01	13.66	.653	503	1.02	13.83	.659
1940	559	1.13	15.40	.730	628	1.27	17.30	.821
1941	463	.937	12.73	.606	385	.779	10.56	.503
1942	662	1.34	18.19	.866	855	1.73	23.49	1.12
1943	782	1.58	21.47	1.02	577	1.17	15.85	.756
1944	482	.976	13.29	.631	490	.992	13.51	.641
1945	512	1.04	14.07	.672	622	1.26	17.11	.814
1946	653	1.32	17.93	.853	552	1.12	15.16	.724
1947	480	.972	13.19	.628	474	.960	13.02	.620
1948	474	.960	13.07	.620	542	1.10	14.92	.711
1949	587	1.19	16.15	.769	523	1.06	14.36	.685
1950	577	1.17	15.86	.756	791	1.60	21.72	1.03
1951	905	1.83	24.87	1.18	705	1.43	19.37	.924
1952	815	1.65	22.45	1.07	950	1.92	26.19	1.24
1953	840	1.70	23.10	1.10	671	1.36	18.45	.879
1954	301	.609	8.30	.394	387	.783	10.65	.506
1955	582	1.18	16.01	.763	529	1.07	14.53	.692
1956	491	.994	13.52	.642	595	1.20	16.39	.776
1957	543	1.10	14.92	.711	439	.889	12.08	.575
1958	683	1.38	18.80	.892	637	1.29	17.53	.834
1959	314	.636	8.61	.411				
Highest	905	1.83	24.87	1.18	950	1.92	26.19	1.24
Average	570	1.15	15.66	.745	577	1.17	15.88	.755
Lowest	301	.609	8.30	.394	267	.540	7.32	.349

POTOMAC RIVER BASIN

20. Potomac River at Shepherdstown W. Va.

Location.—Lat 39°26′04″, long 77°48′07″, on right bank 0.1 mile downstream from Rumsey Bridge at Shepherdstown, Jefferson County, and 3.3 miles upstream from Antietam Creek.

Drainage area.—5,936 sq mi.

Records available.—August 1928 to September 1953 (discontinued). Monthly records August 1928 to September 1943 published in Bulletin 1, October 1943 to September 1949 in "The Physical Features of Washington County" (1928, 1936, 1947–49 revised herein).

Gage.—Water-stage recorder. Datum of gage is 281.00 ft above mean sea level, adjustment of 1912.

Average discharge.—25 years 5,804 cfs.

Extremes.—Maximum discharge, 335,000 cfs Mar. 19, 1936 (gage height 42.1 ft, from floodmarks), from rating curve extended above 200,000 cfs on basis of slope-area measurements of gage heights 32.68 and 42.1 ft; minimum, 231 cfs Aug. 17, 19, 1930; minimum daily, 252 cfs Oct. 2, 1932.

Floods of June 1889 and May 1924 reached stages of 39.2 and 29.8 ft, respectively, from floodmarks (discharges about 290,000 and 168,000 cfs, respectively, from rating curve extended above).

Remarks.—Some regulation at low flow by power plants above station, Stony River Reservoir, and since December 1950 by Savage River Reservoir. Change in contents for Stony River and Savage River Reservoirs included with record for North Branch Potomac River at Luke.

Monthly discharge of Potomac River at Shepherdstown W. Va.

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1928						
August‡	5,900	800	2,960	0.500	0.57	0.323
September	6,760	1,540	2,590	.434	.49	.281
1935–36						
October	2,260	474	913	0.154	0.18	0.100
November	10,900	965	3,276	.552	.62	.357
December	11,600	1,750	4,016	.677	.78	.438
January	33,200	2,400	11,740	1.98	2.28	1.28
February*	81,600	3,100	12,950	2.18	2.35	1.41
March	287,000	16,000	45,990	7.75	8.94	5.01
April	40,000	4,260	13,490	2.27	2.53	1.47
May	4,020	1,770	2,923	.492	.57	.318
June	5,300	1,240	2,035	.343	.38	.222
July	2,980	778	1,441	.243	.28	.157
August	2,220	778	1,111	.187	.22	.121
September	945	298	624	.105	.12	.068
The year	287,000	298	8,389	1.41	19.25	.911

Monthly discharge of Potomac River at Shepherdstown W. Va.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in millions gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1946–47						
October	6,700	765	1,858	0.313	0.36	0.202
November	2,420	778	1,188	.200	.22	.129
December	6,850	678	1,373	.231	.27	.149
January*	14,900	2,980	6,069	1.02	1.18	.659
February	9,960	1,400	3,180	.536	.56	.346
March	25,200	1,500	6,881	1.16	1.34	.750
April	7,140	2,980	4,072	.686	.77	.443
May	10,100	3,430	5,699	.960	1.11	.620
June	7,870	1,620	3,480	.586	.65	.379
July	8,990	1,330	3,402	.573	.66	.370
August	5,330	900	2,359	.397	.46	.257
September	1,940	652	1,099	.185	.21	.120
The year	25,200	652	3,400	.573	7.79	.370
1947–48						
October*	806	473	573	0.097	0.11	0.063
November*	4,640	702	2,589	.436	.49	.282
December	2,590	880	1,592	.268	.31	.173
January	25,500	1,190	4,443	.748	.86	.483
February	29,800	1,200	7,006	1.18	1.27	.763
March	23,100	5,300	10,720	1.81	2.08	1.17
April	67,600	5,160	13,690	2.31	2.57	1.49
May	23,300	2,630	9,608	1.62	1.87	1.05
June	7,900	2,320	3,719	.627	.70	.405
July	4,520	1,380	2,402	.405	.47	.262
August*	3,090	1,150	1,904	.321	.37	.207
September*	1,900	860	1,215	.205	.23	.132
The year	67,600	473	4,940	.832	11.33	.538
1948–49						
October*	11,000	1,120	3,697	0.623	0.72	0.403
November	11,600	1,220	4,410	.743	.83	.480
December*	55,700	5,040	14,730	2.48	2.86	1.60
January	44,100	6,160	15,930	2.68	3.09	1.73
February*	18,800	8,990	12,780	2.15	2.24	1.39
March	9,310	4,490	6,056	1.02	1.18	.659
April	18,800	3,710	7,284	1.23	1.37	.795
May	11,000	2,960	4,477	.754	.87	.487
June	63,100	1,110	7,905	1.33	1.49	.860
July*	38,000	2,900	9,529	1.61	1.85	1.04
August*	11,000	1,690	3,490	.588	.68	.380
September*	6,160	755	1,784	.301	.34	.195
The year	63,100	755	7,656	1.29	17.52	.834

Monthly discharge of Potomac River at Shepherdstown W. Va.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1949–50						
October	2,480	586	1,008	0.170	0.20	0.110
November	6,160	1,220	2,406	.405	.45	.262
December	16,400	2,050	5,345	.900	1.04	.582
January	7,740	2,620	4,802	.809	.93	.523
February	47,300	4,760	15,420	2.60	2.70	1.68
March	32,800	3,460	10,720	1.81	2.08	1.17
April	11,000	2,860	5,217	.879	.98	.568
May	22,600	4,900	10,220	1.72	1.98	1.11
June	12,700	1,920	4,792	.807	.90	.522
July	2,180	1,300	1,615	.272	.31	.176
August	2,470	415	1,014	.171	.20	.111
September	18,700	1,300	5,780	.974	1.09	.630
The year	47,300	415	5,627	.948	12.86	.613
1950–51						
October	12,000	1,600	3,673	0.619	0.71	0.400
November	39,700	2,340	7,074	1.19	1.33	.769
December	65,400	4,490	15,140	2.55	2.94	1.65
January	24,200	4,230	10,900	1.84	2.12	1.19
February	42,100	9,960	17,800	3.00	3.12	1.94
March	41,300	7,290	12,390	2.09	2.41	1.35
April	45,200	6,440	14,810	2.49	2.78	1.61
May	14,900	3,100	7,862	1.32	1.53	.853
June	66,500	2,360	10,570	1.78	1.99	1.15
July	4,490	1,750	2,586	.436	.50	.282
August	2.090	785	1,309	.221	.25	.143
September	1,300	452	877	.148	.16	.096
The year	66,500	452	8,679	1.46	19.84	.944
1951–52						
October	817	306	553	0.093	0.11	0.060
November	2,030	644	1,105	.186	.21	.120
December	11,500	840	3,387	.571	.66	.369
January	42,600	7,000	15,330	2.58	2.98	1.67
February	24,200	3,580	8,666	1.46	1.57	.944
March	60,000	3,340	15,110	2.55	2.93	1.65
April	73,800	6,580	17,090	2.88	3.21	1.86
May	35,100	6,990	13,240	2.23	2.57	1.44
June	6,400	2,080	3,372	.568	.63	.367
July	4,900	1,040	2,190	.369	.43	.238
August	1,750	1,040	1,405	.237	.27	.153
September	13,800	1,050	2,532	.427	.48	.276
The year	73,800	306	7,001	1.18	16.05	.763

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of Potomac River at Shepherdstown W. Va.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1952–53						
October	1,070	520	874	0.147	0.17	0.095
November	60,000	563	7,006	1.18	1.32	.763
December	24,500	2,900	6,275	1.06	1.22	.685
January	37,700	3,300	14,380	2.42	2.79	1.56
February	23,600	5,510	9,780	1.65	1.72	1.07
March	46,500	5,670	17,530	2.95	3.40	1.91
April	24,600	5,400	10,620	1.79	2.00	1.16
May	19,800	4,140	8,818	1.49	1.71	.963
June	28,900	1,690	5,170	.871	.97	.563
July	3,780	819	1,453	.245	.28	.158
August	1,960	640	1,063	.179	.21	.116
September	900	552	660	.111	.12	.072
The year	60,000	520	6,958	1.17	15.91	.756

‡ Not previously published.

* Revised.

POTOMAC RIVER BASIN—*Continued*

Yearly discharge of Potomac River at Shepherdstown, W. Va.

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1929	5,210	0.878	11.92	0.567	6,750	1.14	15.43	0.737
1930	4,200	.708	9.59	.458	2,310	.389	5.28	.251
1931	3,440	.580	7.89	.375	3,600	.606	8.23	.392
1932	4,710	.793	10.79	.513	5,710	.962	13.07	.622
1933	7,670	1.29	17.53	.834	6,840	1.15	15.63	.743
1934	3,130	.527	7.18	.341	3,778	.636	8.65	.411
1935	6,166	1.04	14.08	.672	5,780	.974	13.21	.630
1936	8,389	1.41	19.25	.911	8,610	1.45	19.76	.937
1937	7,678	1.29	17.56	.834	8,865	1.49	20.26	.963
1938	5,078	.855	11.61	.553	3,477	.586	7.95	.379
1939	5,574	.939	12.75	.607	5,651	.952	12.93	.615
1940	5,677	.956	13.01	.618	6,273	1.06	14.37	.685
1941	4,583	.772	10.47	.499	3,755	.633	8.58	.409
1942	4,696	.791	10.74	.511	7,431	1.25	16.99	.808
1943	8,338	1.40	19.05	.905	5,515	.929	12.60	.600
1944	4,849	.817	11.13	.528	5,341	.900	12.26	.582
1945	5,871	.989	13.42	.639	6,394	1.08	14.62	.698
1946	5,580	.940	12.77	.608	4,682	.789	10.71	.510
1947	3,400	.573	7.79	.370	3,425	.577	7.85	.373
1948	4,940	.832	11.33	.538	6,467	1.09	14.83	.704
1949	7,656	1.29	17.52	.834	6,466	1.09	14.80	.704
1950	5,627	.948	12.86	.613	7,069	1.19	16.15	.769
1951	8,679	1.46	19.84	.944	6,926	1.17	15.84	.756
1952	7,001	1.18	16.05	.763	7,756	1.31	17.78	.847
1953	6,958	1.17	15.91	.756				
Highest	8,679	1.46	19.84	.944	8,865	1.49	20.26	.963
Average	5,804	.977	13.29	.632	5,786	.975	13.24	.630
Lowest	3,130	.527	7.18	.341	2,310	.389	5.28	.251

POTOMAC RIVER BASIN

21. Antietam Creek near Waynesboro, Pa.

Location.—Lat 39°43′00″, long 77°36′25″, on upstream side of highway bridge at Rock Forge, 0.5 mile downstream from Maryland-Pennsylvania state line, 0.9 mile downstream from confluence of West and East Branches of Antietam Creek, 1.85 miles northeast of Leitersburg, and 2.5 miles southwest of Waynesboro, Pa.

Drainage area.—93.5 sq mi.

Records available.—May 1948 to September 1951 (discontinued). Monthly records May 1948 to September 1949 published in "The Physical Features of Washington County" (May 1948 completed herein).

Supplemental records available.—Records of chemical analyses and water temperatures for the period April 1948 (suspended-sediment loads from August 1948) to June 1951, are published in reports of U. S. Geological Survey.

Gage.—Wire-weight gage and crest-stage indicator. Datum of gage is 536.27 ft above mean sea level, datum of 1929 (Corps of Engineers bench mark).

Extremes.—Maximum discharge, 1,490 cfs Nov. 25, 1950 (gage height, 8.55 ft), from rating curve extended above 400 cfs by logarithmic plotting; minimum observed, 33 cfs Aug. 29, 30, 1950.

Remarks.—Gage read twice daily. Some regulation by grist mills above station.

Monthly discharge of Antietam Creek near Waynesboro, Pa.

Month	Discharge in cfs				Runoff in inches	Discharge in millions gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1948						
May‡	350	111	170	1.82	2.09	1.18
1949–50						
October	158	56	71.6	0.766	0.88	0.495
November	105	58	68.6	.734	.82	.474
December	331	57	103	1.10	1.27	.711
January	167	83	112	1.20	1.39	.776
February	258	122	176	1.88	1.96	1.22
March	364	98	168	1.80	2.07	1.16
April	219	106	137	1.47	1.64	.950
May	276	110	168	1.80	2.07	1.16
June	264	78	129	1.38	1.54	.892
July	110	52	68.5	.733	.84	.474
August	61	34	43.5	.465	.54	.301
September	98	35	45.7	.489	.55	.316
The year	364	34	107	1.14	15.57	.737

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of Antietam Creek near Waynesboro, Pa.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1950–51						
October	201	36	56.4	0.603	0.70	0.390
November	936	46	120	1.28	1.43	.827
December	788	117	245	2.62	3.02	1.69
January	266	111	161	1.72	1.98	1.11
February	431	164	249	2.66	2.78	1.72
March	340	151	210	2.25	2.59	1.45
April	265	151	202	2.16	2.41	1.40
May	197	91	135	1.44	1.67	.931
June	492	83	205	2.19	2.45	1.42
July	221	71	101	1.08	1.24	.698
August	118	48	62.0	.663	.76	.429
September	70	38	46.6	.498	.56	.322
The year	936	36	149	1.59	21.59	1.03

‡ Not previously published.

Yearly discharge of Antietam Creek near Waynesboro, Pa.

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1949	133	1.42	19.41	0.918	128	1.37	18.57	0.885
1950	107	1.14	15.57	.737	122	1.30	17.75	.840
1951	149	1.59	21.59	1.03				

POTOMAC RIVER BASIN

22. Antietam Creek near Sharpsburg

Location.—Lat 39°27′01″, long 77° 43′ 52″, on left bank 400 ft downstream from Burnside Bridge, 1 mile southeast of Sharpsburg, Washington County ,and 4 miles upstream from mouth.

Drainage area.—281 sq mi. At site used prior to 1928, 279 sq mi.

Records available.—June 1897 to August 1905. August 1928 to September 1959. Monthly records July 1897 to August 1905, August 1928 to September 1943 published in Bulletin 1, October 1943 to September 1949 in "The Physical Features of Washington County" (1898–1905, 1928 revised, 1930–1949 adjusted figures published herein).

Gage.—Water-stage recorder, concrete control since Mar. 29, 1934. Datum of gage is 311.00 ft above mean sea level, adjustment of 1912. June 24, 1897, to Aug. 25, 1905, staff gage a few hundred feet downstream from Middle Bridge, 1.2 miles upstream at datum about 12 ft higher. Aug. 21, 1928, to July 13, 1933, staff gage at Burnside Bridge at same datum.

Average discharge.—38 years (1897–1903, 1904–05, 1928–59) 269 cfs (adjusted for inflow since 1930).

Extremes.—Maximum discharge, 12,600 cfs. July 20, 1956 (gage height, 16.73 ft), from rating curve extended above 4,300 cfs on basis of contracted-opening measurement of peak flow; minimum, 9.4 cfs Nov. 22, 1957; result of regulation caused by construction work above station; minimum daily, 50 cfs Sept. 29, 1930, Feb. 1, Oct. 4, 1931.

Remarks.—Flow slightly regulated by powerplant above station. Regulation greater prior to 1936. Since 1928, records include pumpage from Potomac River for municipal supply of Hagerstown. This water later enters Antietam Creek above station as sewage.

Monthly discharge of Antietam Creek near Sharpsburg

(No adjustments prior to 1928)

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1897–98						
October	153	74	109	0.391	0.45	0.253
November	437	74	140	.502	.56	.324
December	362	110	210	.753	.87	.487
January	628	91	303	1.09	1.25	.704
February*	517	203	260	.932	.97	.602
March	676	203	312	1.12	1.29	.724
April	476	231	316	1.13	1.26	.730
May	676	203	375	1.34	1.55	.866
June	327	153	226	.810	.90	.524
July	261	131	155	.556	.64	.359
August	1,799	153	322	1.15	1.33	.743
September	231	131	167	.599	.67	.387
The year	1,799	74	242	.867	11.74	.560

Monthly discharge of Antietam Creek near Sharpsburg—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1898–99						
October	456	91	200	0.717	0.83	0.463
November	399	131	249	.892	.99	.577
December	4,015	203	598	2.14	2.47	1.38
January	832	399	529	1.90	2.19	1.23
February*	2,030	327	560	2.01	2.09	1.30
March	1,610	560	897	3.22	3.71	2.08
April	752	327	483	1.73	1.93	1.12
May	517	261	358	1.28	1.48	.827
June	945	203	317	1.14	1.27	.737
July	246	110	169	.606	.70	.392
August	778	110	200	.717	.82	.463
September	293	110	160	.573	.64	.370
The year	4,015	91	393	1.41	19.12	.911
1899–1900						
October	153	74	109	0.391	0.45	0.253
November	327	91	144	.516	.58	.333
December	418	91	133	.477	.55	.308
January*	362	—	135	.484	.56	.313
February*	1,185	—	315	1.13	1.18	.730
March	975	277	432	1.55	1.79	1.00
April	362	203	291	1.04	1.16	.672
May	605	153	222	.796	.92	.514
June	380	131	181	.649	.72	.419
July	203	74	115	.412	.47	.266
August	203	74	112	.401	.46	.259
September	153	59	91.7	.329	.37	.213
The year	1,185	59	189	.677	9.21	.438
1900–01						
October	217	59	99.1	0.355	0.41	0.229
November	362	74	114	.409	.45	.264
December	327	59	110	.394	.45	.255
January	131	74	90.5	.324	.37	.209
February*	153	—	80.0	.287	.30	.185
March	1,995	74	285	1.02	1.18	.659
April	1,925	362	632	2.27	2.53	1.47
May	2,715	231	523	1.87	2.16	1.21
June	476	261	341	1.22	1.36	.789
July	362	153	238	.853	.98	.551
August	1,035	131	218	.781	.90	.505
September	399	110	171	.613	.68	.396
The year	2,715	—	242	.867	11.77	.560

Monthly discharge of Antietam Creek near Sharpsburg—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1901–02						
October	261	91	130	0.466	0.54	0.301
November‡	—	—	175	.627	.70	.405
December‡	—	—	510	1.83	2.11	1.18
January	1,248	231	410	1.47	1.69	.950
February	6,835	177	871	3.12	3.25	2.02
March	3,295	517	1,068	3.83	4.41	2.48
April	2,835	399	662	2.37	2.65	1.53
May	517	261	313	1.12	1.29	.724
June	327	177	249	.892	1.00	.577
July	805	131	232	.832	.96	.538
August	399	74	141	.505	.58	.326
September	293	74	113	.405	.45	.262
The year	6,835	74	404	1.45	19.63	.937
1902–03						
October	293	110	150	0.538	0.62	0.348
November	293	91	131	.470	.52	.304
December*	1,155	153	530	1.90	2.19	1.23
January*	1,610	—	810	2.90	3.35	1.87
February	2,292	293	849	3.04	3.17	1.96
March	1,280	437	750	2.69	3.10	1.74
April	3,040	517	926	3.32	3.70	2.15
May	701	293	398	1.43	1.64	.924
June	860	293	350	1.25	1.40	.808
July	4,110	362	738	2.65	3.05	1.71
August	860	203	354	1.27	1.46	.821
September	560	177	242	.867	.97	.560
The year	4,110	91	517	1.85	25.17	1.20
1903–04						
October	560	165	226	0.810	0.93	0.524
November	203	153	172	.616	.69	.398
December	399	153	195	.699	.80	.452
January‡	2,480	—	320	1.15	1.32	.743
February	—	—	—	—	—	
March	—	—	—	—	—	
April	—	—	—	—	—	
May	—	—	—	—	—	
June	—	—	—	—	—	
July‡	—	110	155	.556	.64	.359
August	560	82	126	.452	.52	.292
September	165	74	101	.362	.41	.234
The year	—	—	—	—	—	—

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of Antietam Creek near Sharpsburg—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1904–05						
October	190	74	96.7	0.347	0.40	0.224
November	120	66	92.8	.333	.37	.215
December*	246	74	100	.358	.41	.231
January*	805	—	205	.735	.85	.475
February*	—	—	105	.376	.39	.243
March	1,065	131	508	1.82	2.10	1.18
April	476	231	332	1.19	1.33	.769
May	231	153	196	.703	.81	.454
June	399	131	190	.681	.76	.440
July	1,750	142	311	1.11	1.28	.717
August‡	—	177	470	1.68	1.94	1.09
September‡	—	—	280	1.00	1.12	.646
The year	—	66	242	.867	11.76	.560

Month	Discharge in cfs					Adjusted	
	Observed			Adjusted		Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Mean	Per square mile		
1928							
August‡	480	231	296	a	—	—	—
September	435	184	245	a	—	—	—
1929–30							
October	1,590	96	300	a	—	—	—
November	565	213	296	a	—	—	—
December	319	—	227	a	—	—	—
January	278	—	217	213	0.758	0.87	0.490
February	437	—	326	324	1.15	1.20	.743
March	1,160	291	430	428	1.52	1.75	.982
April	598	238	317	315	1.12	1.25	.724
May	251	156	189	187	.665	.77	.430
June	333	103	157	151	.537	.60	.347
July	166	93	110	103	.367	.42	.237
August	106	61	90.3	83.7	.298	.34	.193
September	123	50	91.0	84.8	.302	.34	.195
The year	1,590	50	229	a	—	—	

Monthly discharge of Antietam Creek near Sharpsburg—*Continued*

Month	Discharge in cfs					Adjusted	
	Observed			Adjusted		Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Mean	Per square mile		
1930–31							
October	119	52	86.5	80.3	0.286	0.33	0.185
November	112	72	97.3	91.1	.324	.36	.209
December	406	68	92.5	86.0	.306	.35	.198
January	134	53	78.4	72.1	.257	.30	.166
February	101	50	72.5	68.1	.242	.25	.156
March	319	65	101	96.0	.342	.39	.221
April	775	70	167	164	.584	.65	.377
May	369	77	139	137	.488	.56	.315
June	699	82	154	151	.537	.60	.347
July	1,240	96	259	254	.904	1.04	.584
August	553	90	132	125	.445	.51	.288
September	306	70	112	106	.377	.42	.244
The year	1,240	50	125	120	.427	5.76	.276
1931–32							
October	93	50	74.1	69.7	0.248	0.29	0.160
November	90	65	77.5	71.3	.254	.28	.164
December	109	56	69.6	63.5	.226	.26	.146
January	183	71	99.3	95.9	.341	.39	.220
February	233	79	115	112	.399	.43	.258
March	661	90	222	219	.779	.90	.503
April	545	176	297	295	1.05	1.17	.679
May	1,940	224	520	518	1.84	2.12	1.19
June	261	143	202	200	.712	.79	.460
July	163	101	126	121	.431	.50	.279
August	143	82	97.2	91.0	.324	.37	.209
September	457	76	109	102	.363	.40	.235
The year	1,940	50	168	164	.584	7.90	.377
1932–33							
October	725	75	170	165	0.587	0.68	0.379
November	2,140	153	419	417	1.48	1.65	.957
December	379	150	222	220	.783	.90	.506
January	480	197	264	262	.932	1.07	.602
February	445	222	294	292	1.04	1.08	.672
March	1,260	234	543	541	1.93	2.22	1.25
April	1,040	445	647	646	2.30	2.57	1.49
May	690	318	472	471	1.68	1.94	1.09
June	515	174	248	246	.875	.98	.566
July*	1,340	151	250	245	.872	1.01	.564
August	3,230	136	334	329	1.17	1.35	.756
September	1,000	186	267	264	.940	1.05	.608
The year	3,230	75	344	341	1.21	16.50	.782

Monthly discharge of Antietam Creek near Sharpsburg—*Continued*

Month	Discharge in cfs					Adjusted	
	Observed			Adjusted		Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Mean	Per square mile		
1933–34							
October	560	180	234	231	0.822	0.95	0.531
November	198	141	162	157	.559	.62	.361
December	176	120	139	134	.477	.55	.308
January	380	110	203	200	.712	.82	.460
February	152	90	120	117	.416	.43	.269
March	336	110	193	191	.680	.78	.439
April	398	226	294	292	1.04	1.16	.672
May	340	174	229	227	.808	.93	.522
June	300	115	158	155	.552	.62	.357
July	145	86	103	97.4	.347	.40	.224
August	178	76	96.9	91.4	.325	.37	.210
September	1,020	66	140	136	.484	.54	.313
The year	1,020	66	140	136	.484	.54	.313
1934–35							
October	358	95	128	125	0.445	0.51	0.288
November	196	81	105	102	.363	.40	.235
December	1,870	184	363	359	1.28	1.48	.827
January	338	170	217	214	.762	.88	.492
February	681	202	366	363	1.29	1.34	.834
March	570	307	410	407	1.45	1.67	.937
April	744	325	459	457	1.63	1.82	1.05
May	507	228	336	333	1.19	1.37	.769
June	263	156	191	188	.669	.75	.432
July	1,820	117	205	200	.712	.82	.460
August	158	95	122	115	.409	.47	.264
September	267	87	114	110	.391	.44	.253
The year	1,870	81	251	247	.879	11.95	.568
1935–36							
October	283	74	97.8	91.7	0.326	0.38	0.211
November	188	89	120	115	.409	.46	.264
December	292	111	171	169	.601	.69	.388
January	606	158	378	376	1.34	1.54	.866
February	1,190	212	362	359	1.28	1.38	.827
March	3,230	755	1,290	1,289	4.59	5.29	2.97
April	1,190	422	692	690	2.46	2.74	1.59
May	427	219	311	309	1.10	1.27	.711
June	386	166	212	207	.737	.82	.476
July	238	131	163	156	.555	.64	.359
August	430	118	157	150	.534	.62	.345
September	173	95	116	109	.388	.43	.251
The year	3,230	74	340	336	1.20	16.26	.776

Monthly discharge of Antietam Creek near Sharpsburg—*Continued*

Month	Discharge in cfs					Adjusted	
	Observed			Adjusted			
	Maximum	Minimum	Mean	Mean	Per square mile	Runoff in inches	Discharge in million gallons per day per square mile
1936–37							
October	271	93	118	112	0.399	0.46	0.258
November	107	85	93.5	87.8	.312	.35	.202
December	427	85	207	203	.722	.83	.467
January	1,000	229	481	479	1.70	1.96	1.10
February	1,910	423	615	612	2.18	2.27	1.41
March	550	307	395	392	1.40	1.61	.905
April	5,180	261	718	715	2.54	2.83	1.64
May	975	299	496	493	1.75	2.02	1.13
June	725	257	347	345	1.23	1.37	.795
July	569	181	243	240	.854	.98	.552
August	866	140	207	202	.719	.83	.465
September	212	114	140	133	.473	.53	.306
The year	5,180	85	336	332	1.18	16.04	.763
1937–38							
October	1,700	107	301	296	1.05	1.21	0.679
November	654	240	330	328	1.17	1.30	.756
December	500	190	260	258	.918	1.06	.593
January	400	160	223	221	.786	.91	.508
February	226	159	179	177	.630	.66	.407
March	355	164	234	232	.826	.95	.534
April	266	175	210	208	.740	.83	.478
May	642	140	225	223	.794	.92	.513
June	300	130	172	170	.605	.68	.391
July	238	111	136	132	.470	.54	.304
August	240	83	113	106	.377	.43	.244
September	424	92	122	118	.420	.47	.271
The year	1,700	83	209	206	.733	9.96	.474
1938–39							
October	100	79	88.1	82.5	0.294	0.34	0.190
November	124	79	97.2	92.5	.329	.37	.213
December	696	110	265	262	.932	1.07	.602
January	568	133	200	198	.705	.81	.456
February	1,420	332	532	529	1.88	1.96	1.22
March	916	334	455	453	1.61	1.86	1.04
April	769	321	453	451	1.60	1.78	1.03
May	515	218	332	330	1.17	1.35	.756
June	451	167	217	213	.758	.85	.490
July	319	130	171	164	.584	.67	.377
August	231	97	121	113	.402	.46	.260
September	165	84	103	95	.338	.38	.218
The year	1,420	79	251	247	.879	11.90	.568

Monthly discharge of Antietam Creek near Sharpsburg—*Continued*

Month	Discharge in cfs					Adjusted	
	Observed			Adjusted		Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Mean	Per square mile		
1939–40							
October	370	94	128	120	0.427	0.49	0.276
November	340	113	154	148	.527	.59	.341
December	161	99	111	105	.374	.43	.242
January	312	92	120	114	.406	.47	.262
February	700	95	253	248	.883	.95	.571
March	804	310	462	459	1.63	1.88	1.05
April	1,570	438	766	763	2.72	3.04	1.76
May	1,010	336	461	458	1.63	1.88	1.05
June	596	228	339	336	1.20	1.34	.776
July	538	159	206	201	.715	.82	.462
August	400	126	168	160	.569	.66	.368
September	1,060	118	202	196	.698	.78	.451
The year	1,570	92	280	275	.979	13.33	.633
1940–41							
October	410	154	204	201	0.715	0.82	0.462
November	1,050	186	443	440	1.57	1.75	1.01
December	656	306	402	399	1.42	1.64	.918
January	539	306	384	381	1.36	1.57	.879
February	375	258	298	295	1.05	1.09	.679
March	511	236	337	334	1.19	1.37	.769
April	900	266	385	382	1.36	1.52	.879
May	259	169	215	210	.747	.86	.483
June	392	150	205	199	.708	.79	.458
July	249	115	147	140	.498	.57	.322
August	238	104	120	112	.399	.46	.258
September	160	86	100	91.5	.326	.36	.211
The year	1,050	86	270	265	.943	12.80	.609
1941–42							
October	100	75	84.9	76.1	0.271	0.31	0.175
November	139	75	93.2	84.7	.301	.34	.195
December	229	81	121	112	.399	.46	.258
January	137	90	109	100	.356	.41	.230
February	344	98	158	153	.544	.57	.352
March	461	129	274	270	.961	1.11	.621
April	1,080	288	519	514	1.83	2.04	1.18
May	1,630	214	390	385	1.37	1.58	.885
June	406	208	274	268	.954	1.06	.617
July	288	169	222	215	.765	.88	.494
August	1,150	178	410	403	1.43	1.65	.924
September	375	187	241	234	.833	.93	.538
The year	1,630	75	242	235	.836	11.34	.540

Monthly discharge of Antietam Creek near Sharpsburg—*Continued*

Month	Discharge in cfs					Adjusted	
	Observed			Adjusted			
	Maximum	Minimum	Mean	Mean	Per square mile	Runoff in inches	Discharge in million gallons per day per square mile
1942–43							
October	1,390	166	410	404	1.44	1.66	0.931
November	502	299	377	373	1.33	1.48	.860
December	1,590	270	451	446	1.59	1.83	1.03
January	975	348	481	476	1.69	1.95	1.09
February	950	357	572	567	2.02	2.10	1.31
March	945	355	543	538	1.91	2.20	1.23
April	720	330	419	414	1.47	1.64	.950
May	1,110	290	413	408	1.45	1.67	.937
June	363	186	247	242	.861	.96	.556
July	222	134	164	156	.555	.64	.359
August	137	110	121	112	.399	.46	.258
September	112	90	99.0	89.0	.317	.35	.205
The year	1,590	90	357	351	1.25	16.94	.808
1943–44							
October	188	84	104	94.8	0.337	0.39	0.218
November	298	95	118	111	.395	.44	.255
December	200	63	88.1	79.9	.284	.33	.184
January	2,700	80	247	241	.858	.99	.555
February	137	97	116	111	.395	.43	.255
March	1,050	119	337	332	1.18	1.36	.763
April	502	286	355	351	1.25	1.40	.808
May	625	189	314	309	1.10	1.27	.711
June	606	139	183	176	.626	.70	.405
July	137	99	119	110	.391	.45	.253
August	153	75	93.5	83.0	.295	.34	.191
September	148	71	92.6	83.4	.297	.33	.192
The year	2,700	63	181	174	.619	8.43	.400
1944–45							
October	235	75	106	96.6	0.344	0.40	0.222
November	150	73	87.0	78.2	.278	.31	.180
December	840	92	192	186	.662	.76	.428
January	450	130	186	180	.641	.74	.414
February	845	125	308	303	1.08	1.12	.698
March	720	282	439	434	1.54	1.78	.995
April	658	271	381	376	1.34	1.50	.866
May	745	253	355	350	1.25	1.44	.808
June	260	146	200	193	.687	.77	.444
July	178	123	142	132	.470	.54	.304
August	332	110	147	137	.488	.56	.315
September	862	119	233	225	.801	.89	.518
The year	862	73	231	224	.797	10.81	.515

Monthly discharge of Antietam Creek near Sharpsburg—*Continued*

Month	Discharge in cfs					Adjusted	
	Observed			Adjusted		Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Mean	Per square mile		
1945–46							
October	203	132	156	150	0.534	0.62	0.345
November	1,010	123	205	196	.698	.78	.451
December	828	260	396	390	1.39	1.60	.898
January	492	267	361	358	1.27	1.46	.821
February	426	242	265	262	.932	.97	.602
March	399	294	340	337	1.20	1.38	.776
April	301	186	228	225	.801	.89	.518
May	749	172	249	242	.861	.99	.556
June	1,560	219	405	400	1.42	1.58	.918
July	226	141	177	169	.601	.69	.388
August	271	130	165	156	.555	.64	.359
September	309	99	136	126	.448	.50	.290
The year	1,560	99	257	251	.893	12.10	.577
1946–47							
October	200	128	148	137	0.488	0.56	0.315
November	148	114	130	122	.434	.48	.281
December	155	103	119	111	.395	.46	.255
January	340	139	186	181	.644	.74	.416
February	330	150	201	196	.698	.73	.451
March	540	160	251	246	.875	1.01	.566
April	229	170	195	190	.676	.75	.437
May	334	186	257	251	.893	1.03	.577
June	567	197	289	284	1.01	1.13	.653
July	309	189	230	224	.797	.92	.515
August	321	146	175	166	.591	.68	.382
September	155	106	129	120	.427	.48	.276
The year	567	103	192	185	.658	8.97	.425
1947–48							
October	132	88	98.8	88.7	0.316	0.36	0.204
November	278	97	136	128	.456	.51	.295
December	123	94	109	103	.367	.42	.237
January	656	115	191	184	.655	.76	.423
February	635	123	219	212	.754	.81	.487
March	412	246	324	319	1.14	1.31	.737
April	940	309	462	457	1.63	1.82	1.05
May	795	301	431	425	1.51	1.74	.976
June	399	219	270	263	.936	1.04	.605
July	305	162	203	195	.694	.80	.449
August	401	132	175	166	.591	.68	.382
September	148	106	118	109	.388	.43	.251
The year	940	88	228	221	.786	10.68	.508

Monthly discharge of Antietam Creek near Sharpsburg—*Continued*

Month	Discharge in cfs					Adjusted	
	Observed			Adjusted		Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Mean	Per square mile		
1918–19							
October	301	99	168	159	0.566	0.65	0.366
November	420	144	239	233	.829	.92	.536
December*	1,480	280	453	447	1.59	1.83	1.03
January*	2,300	459	799	792	2.82	3.25	1.82
February	820	570	656	651	2.32	2.42	1.50
March	565	294	394	389	1.38	1.59	.892
April	670	286	357	352	1.25	1.40	.808
May	359	194	255	249	.886	1.02	.573
June	242	146	171	164	.584	.65	.377
July	3,490	123	586	579	2.06	2.38	1.33
August	363	194	263	257	.915	1.05	.591
September	582	160	207	201	.715	.80	.462
The year	3,490	99	378	372	1.32	17.96	.853
1949–50							
October	246	139	166	161	0.573	0.66	0.370
November	267	140	171	166	.591	.66	.382
December	845	140	242	237	.843	.97	.545
January	368	206	271	266	.947	1.09	.612
February	600	334	459	455	1.62	1.69	1.05
March	995	264	449	444	1.58	1.82	1.02
April	570	298	378	373	1.33	1.48	.860
May	695	286	400	395	1.41	1.63	.911
June	473	212	313	307	1.09	1.22	.704
July	253	160	194	188	.669	.77	.432
August	200	125	143	135	.480	.55	.310
September	298	128	165	156	.555	.62	.359
The year	995	125	278	272	.968	13.16	.626
1950–51							
October	330	117	158	151	0.537	0.62	0.347
November	2,570	137	355	349	1.24	1.38	.801
December	2,810	363	776	770	2.74	3.16	1.77
January	658	350	448	443	1.58	1.82	1.02
February	1,380	478	741	736	2.62	2.73	1.69
March	921	478	609	604	2.15	2.48	1.39
April	751	417	522	517	1.84	2.05	1.19
May	492	246	352	346	1.23	1.42	.795
June	1,420	235	534	528	1.88	2.10	1.22
July	464	209	276	270	.961	1.11	.621
August	350	140	191	183	.651	.75	.421
September	180	117	140	133	.473	.53	.306
The year	2,810	117	423	417	1.48	20.15	.957

Monthly discharge of Antietam Creek near Sharpsburg—*Continued*

Month	Discharge in cfs					Adjusted	
	Observed			Adjusted			
	Maximum	Minimum	Mean	Mean	Per square mile	Runoff in inches	Discharge in million gallons per day per square mile
1951–52							
October	134	110	116	108	0.384	0.44	0.248
November	267	114	143	136	.484	.54	.313
December	352	114	166	160	.569	.66	.368
January	970	317	484	478	1.70	1.96	1.10
February	820	305	439	433	1.54	1.66	.995
March	920	286	503	497	1.77	2.04	1.14
April	2,120	426	721	715	2.54	2.83	1.64
May	2,330	435	779	773	2.75	3.17	1.78
June	635	309	422	416	1.48	1.65	.957
July	511	192	268	261	.929	1.07	.600
August	232	155	189	181	.644	.74	.416
September	1,690	162	326	319	1.14	1.27	.737
The year	2,330	110	379	372	1.32	18.03	.853
1952–53							
October	212	130	152	145	0.516	0.60	0.333
November	3,720	124	422	415	1.48	1.65	.957
December	1,060	320	451	445	1.58	1.82	1.02
January	1,140	300	601	595	2.12	2.44	1.37
February	640	425	499	493	1.75	1.82	1.13
March	1,040	400	600	594	2.11	2.43	1.36
April	700	415	546	540	1.92	2.14	1.24
May	855	366	479	473	1.68	1.94	1.09
June	805	243	366	359	1.28	1.43	.827
July	435	170	209	201	.715	.82	.462
August	366	124	161	153	.544	.63	.352
September	176	106	125	116	.413	.46	.267
The year	3,720	106	383	376	1.34	18.18	.866
1953–54							
October	131	92	102	92.8	0.330	0.38	0.213
November	124	97	103	93.6	.333	.37	.215
December	312	92	130	122	.434	.50	.281
January	138	75	99.7	91.5	.326	.38	.211
February	150	82	105	97.5	.347	.36	.224
March	655	176	231	225	.801	.92	.518
April	218	140	165	159	.566	.63	.366
May	505	135	215	209	.744	.86	.481
June	145	88	115	108	.384	.43	.248
July	133	67	86.7	77.8	.277	.32	.179
August	182	63	91.3	82.3	.293	.34	.189
September	115	69	81.4	72.2	.257	.29	.166
The year	655	63	127	119	.423	5.78	.273

Monthly discharge of Antietam Creek near Sharpsburg—*Continued*

Month	Discharge in cfs					Adjusted	
	Observed			Adjusted		Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Mean	Per square mile		
1954–55							
October	750	67	138	128	0.456	0.53	0.295
November	128	92	105	97.6	.347	.39	.224
December	390	92	168	161	.573	.66	.370
January	222	120	161	155	.552	.64	.357
February	1,330	112	242	235	.836	.87	.540
March	1,410	246	556	550	1.96	2.26	1.27
April	460	299	356	350	1.25	1.40	.808
May	304	165	219	212	.754	.87	.487
June	475	147	208	201	.715	.80	.462
July	299	106	142	133	.473	.55	.306
August	1,540	99	410	402	1.43	1.65	.924
September	335	152	198	191	.680	.76	.439
The year	1,540	67	242	235	.836	11.38	.540
1955–56							
October	885	135	224	217	0.772	0.89	0.499
November	229	140	164	157	.559	.62	.361
December	147	110	130	123	.438	.50	.283
January	553	106	148	141	.502	.58	.324
February	1,110	212	499	492	1.75	1.89	1.13
March	885	290	486	479	1.70	1.96	1.10
April	765	326	452	445	1.58	1.76	1.02
May	362	196	263	256	.911	1.05	.589
June	262	143	184	177	.630	.70	.407
July	3,760	131	357	350	1.25	1.44	.808
August	236	131	169	163	.580	.67	.375
September	281	122	148	140	.498	.56	.322
The year	3,760	106	268	261	.929	12.62	.600
1956–57							
October	596	119	186	178	0.633	0.73	0.409
November	1,310	201	347	341	1.21	1.35	.782
December	900	170	379	374	1.33	1.53	.860
January	435	250	313	307	1.09	1.26	.704
February	794	352	448	442	1.57	1.64	1.01
March	476	295	385	380	1.35	1.56	.873
April	772	288	421	416	1.48	1.65	.957
May	310	185	246	240	.854	.98	.552
June	299	151	194	187	.665	.74	.430
July	162	106	126	117	.416	.48	.269
August	123	78	92.6	82.0	.292	.34	.189
September	120	71	93.3	83.9	.299	.33	.193
The year	1,310	71	268	261	.929	12.59	.600

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of Antietam Creek near Sharpsburg—*Continued*

Month	Discharge in cfs					Adjusted	
	Observed			Adjusted		Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Mean	Per square mile		
1957–58							
October	115	71	82.2	73.5	0.262	0.30	0.169
November	171	70	88.7	81.5	.290	.32	.187
December	686	71	173	167	.594	.68	.384
January	930	118	330	324	1.15	1.33	.743
February	1,200	150	291	285	1.01	1.05	.653
March	1,140	286	525	520	1.85	2.13	1.20
April	1,080	425	632	627	2.23	2.49	1.44
May	1,860	358	692	686	2.44	2.81	1.58
June	510	243	324	317	1.13	1.26	.730
July	595	173	246	239	.851	.98	.550
August	285	140	178	171	.609	.70	.394
September	200	117	138	131	.466	.52	.301
The year	1,860	70	309	302	1.07	14.57	.692
1958–59							
October	200	100	118	110	0.391	0.45	0.253
November	220	95	114	107	.381	.43	.246
December	160	90	112	106	.377	.43	.244
January	901	70	172	166	.591	.68	.382
February	476	143	221	215	.765	.80	.494
March	385	173	213	208	.740	.85	.478
April	353	200	262	256	.911	1.02	.589
May	304	152	219	213	.758	.87	.490
June	385	119	169	162	.577	.64	.373
July	236	99	125	117	.416	.48	.269
August	183	86	109	100	.356	.41	.230
September	99	61	75.0	65.9	.235	.26	.152
The year	901	61	158	151	.537	7.32	.347

* Revised.

‡ Not previously published.

ª Pumpage figures not available

POTOMAC RIVER BASIN—*Continued*

Yearly discharge of Antietam Creek near Sharpsburg

(Adjusted for inflow since 1930)

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1898	242	0.867	11.74	0.560	291	1.04	14.15	0.672
1899	393	1.41	19.12	.911	337	1.21	16.41	.782
1900	189	.677	9.21	.438	184	.659	8.94	.426
1901	242	.867	11.77	.560	284	1.02	13.81	.659
1902	404	1.45	19.63	.937	403	1.44	19.61	.931
1903	517	1.85	25.17	1.20	499	1.79	24.26	1.16
1905	242	.867	11.76	.560				
1929	267				293			
1930	229				178	.633	8.58	.409
1931	120	.427	5.76	.276	115	.409	5.55	.264
1932	164	.584	7.90	.377	214	.762	10.30	.492
1933	341	1.21	16.50	.782	318	1.13	15.39	.730
1934	169	.601	8.17	.388	174	.619	8.44	.400
1935	247	.879	11.95	.568	229	.815	11.09	.527
1936	336	1.20	16.26	.776	338	1.20	16.37	.776
1937	332	1.18	16.04	.763	373	1.33	17.97	.860
1938	206	.733	9.96	.474	169	.601	8.17	.388
1939	247	.879	11.90	.568	241	.858	11.63	.555
1940	275	.979	13.33	.633	331	1.18	16.03	.763
1941	265	.943	12.80	.609	201	.715	9.70	.462
1942	235	.836	11.34	.540	315	1.12	15.20	.724
1943	351	1.25	16.94	.808	272	.968	13.13	.626
1944	174	.619	8.43	.400	180	.641	8.74	.414
1945	224	.797	10.81	.515	255	.907	12.34	.586
1946	251	.893	12.10	.577	220	.783	10.60	.506
1947	185	.658	8.97	.425	181	.644	8.76	.416
1948	221	.786	10.68	.508	264	.940	12.79	.608
1949	372	1.32	17.96	.853	349	1.24	16.85	.801
1950	272	.968	13.16	.626	332	1.18	16.03	.763
1951	417	1.48	20.15	.957	344	1.22	16.63	.789
1952	372	1.32	18.03	.853	423	1.51	20.46	.976
1953	376	1.34	18.18	.866	319	1.14	15.36	.737
1954	119	.423	5.78	.273	126	.448	6.11	.290
1955	235	.836	11.38	.540	244	.868	11.81	.561
1956	261	.929	12.62	.600	294	1.05	14.22	.679
1957	261	.929	12.59	.600	213	.758	10.28	.490
1958	302	1.07	14.57	.692	302	1.07	14.58	.692
1959	151	.537	7.32	.347				
Highest	517	1.85	25.17	1.20	499	1.79	24.26	1.16
Average	269	.961	13.06	.621	272	.969	13.15	.626
Lowest	119	.423	5.76	.273	115	.409	5.55	.264

POTOMAC RIVER BASIN

23. Shenandoah River at Millville, W. Va.

Location.—Lat 39°16′55″, long 77°47′22″, on left bank 0.4 mile downstream from Cattail Run, 1 mile upstream from Millville, Jefferson County, and 5 miles upstream from Harpers Ferry and mouth.

Drainage area.—3,040 sq mi. At site used April 1895 to March 1909, 3,042 sq mi.

Records available.—April 1895 to March 1909, August 1928 to September 1959. Monthly records April 1895 to March 1909, August 1928 to September 1943 published in Bulletin 1 (1895–1899, 1901, 1902, 1904, 1905, 1907, 1908, 1928 revised herein).

Gage.—Water-stage recorder. Datum of gage is 293.00 ft above mean sea level, adjustment of 1912. April 15, 1895, to Mar. 31, 1909, staff gage at site three-quarters of a mile downstream at datum 0.32 ft higher.

Average discharge.—44 years (1895–1908, 1928–59), 2,694 cfs.

Extremes.—Maximum discharge, 230,000 cfs Oct. 16, 1942 (gage height, 32.4 ft, from floodmarks); minimum, about 59 cfs Oct. 4, 1930 (gage height, 0.39 ft); minimum daily, 194 cfs July 24, 1930.

Flood of 1870 reached practically same stage as flood of Mar. 18, 1936, 26.4 ft (discharge, 151,000 cfs).

Remarks.—Regulation by hydroelectric plants, particularly that of Potomac Edison Co. half a mile above station.

Monthly discharge of Shenandoah River at Millville, W. Va.

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1895						
April‡	25,000	1,870	5,040	1.66	1.85	1.07
May	20,780	2,560	5,570	1.83	2.11	1.18
June	3,130	980	1,613	.530	.59	.343
July	7,260	980	1,880	.618	.71	.399
August*	1,090	540	772	.254	.29	.164
September	1,320	610	722	.237	.26	.153
1895–96						
October	610	480	537	0.177	0.20	0.114
November	690	540	621	.204	.23	.132
December	1,450	610	754	.248	.29	.160
January	11,400	880	2,434	.800	.92	.517
February	12,580	1,450	3,817	1.25	1.35	.808
March	12,180	1,450	3,842	1.26	1.46	.814
April	8,860	1,450	2,807	.923	1.03	.597
May	4,370	1,090	2,127	.699	.81	.452
June	3,940	780	2,056	.676	.75	.437
July	9,030	1,320	2,858	.940	1.08	.608
August	1,870	780	1,150	.378	.44	.244
September*	29,800	540	1,596	.525	.59	.339
The year	29,800	480	2,043	.672	9.15	.434

Monthly discharge of Shenandoah River at Millville, W. Va.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1896–97						
October*	84,400	880	5,983	1.97	2.27	1.27
November	4,840	880	1,835	.603	.67	.390
December	6,380	1,450	2,296	.755	.87	.488
January*	1,720	900	1,070	.352	.41	.228
February‡	40,000	1,090	13,100	4.31	4.48	2.79
March	6,760	2,590	4,946	1.63	1.87	1.05
April	3,350	1,620	2,671	.878	.98	.567
May	30,620	1,760	6,243	2.05	2.37	1.32
June	2,410	1,010	1,632	.536	.60	.346
July*	3,770	910	1,427	.469	.54	.303
August	1,760	730	987	.324	.37	.209
September	1,350	580	664	.218	.24	.141
The year	84,400	580	3,513	1.15	15.67	.743
1897–98						
October	1,010	550	692	0.227	0.26	0.147
November	1,620	650	859	.282	.32	.182
December	3,990	820	1,619	.532	.61	.344
January	6,180	1,010	2,435	.800	.92	.517
February*	1,700	1,010	1,390	.457	.48	.295
March	5,650	1,010	2,227	.732	.84	.473
April	13,120	2,070	4,353	1.43	1.60	.924
May	29,150	2,070	5,711	1.88	2.16	1.22
June	2,410	1,120	1,647	.541	.60	.350
July	3,770	820	1,249	.411	.47	.266
August	50,900	1,350	8,164	2.68	3.09	1.73
September	1,835	1,120	1,360	.447	.50	.289
The year	50,900	550	2,659	.874	11.85	.565
1898–99						
October	30,500	1,010	5,684	1.87	2.15	1.21
November	4,210	2,070	2,827	.929	1.04	.600
December	14,780	2,410	4,498	1.48	1.70	.957
January	17,840	2,770	5,116	1.68	1.94	1.09
February‡	30,000	2,050	7,330	2.41	2.51	1.56
March‡	33,000	4,440	10,400	3.42	3.94	2.21
April	4,910	2,070	3,289	1.08	1.21	.698
May	4,910	1,480	2,533	.833	.96	.538
June	4,670	1,010	1,607	.528	.59	.341
July	1,760	730	906	.298	.34	.193
August	1,910	650	992	.326	.38	.211
September	1,760	730	989	.325	.36	.210
The year	33,000	650	3,837	1.26	17.12	.814

Monthly discharge of Shenandoah River at Millville, W. Va.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1900–01						
October	2,770	650	947	0.311	0.36	0.201
November	9,020	730	1,453	.478	.53	.309
December	10,060	1,010	2,232	.734	.85	.474
January	5,910	820	1,812	.596	.69	.385
February*	1,910	730	1,120	.368	.38	.238
March	20,620	820	3,376	1.11	1.28	.717
April	50,000	2,500	12,840	4.22	4.71	2.73
May	45,920	2,590	8,704	2.86	3.30	1.85
June	38,240	3,770	8,225	2.70	3.02	1.75
July	13,940	1,290	4,437	1.46	1.68	.944
August	11,180	1,620	3,528	1.16	1.34	.750
September	11,940	1,230	2,496	.821	.92	.531
The year	50,000	650	4,268	1.40	19.06	.905
1901–02						
October	6,460	1,120	1,769	0.582	0.67	0.376
November	3,990	910	1,341	.441	.49	.285
December	50,000	1,350	8,124	2.67	3.08	1.73
January	21,100	2,240	5,176	1.70	1.96	1.10
February*	70,000	1,120	9,861	3.24	3.38	2.09
March	77,900	4,100	13,880	4.56	5.26	2.95
April	20,140	2,960	6,785	2.23	2.49	1.44
May	7,380	1,760	2,606	.857	.99	.554
June	1,910	1,120	1,402	.461	.51	.298
July	1,620	865	1,097	.361	.42	.233
August	2,410	775	1,062	.349	.40	.226
September	1,120	650	724	.238	.27	.154
The year	77,900	650	4,463	1.47	19.92	.950
1903–04						
October	2,770	1,065	1,454	0.478	0.55	0.309
November	1,120	730	961	.316	.35	.204
December	1,620	650	927	.305	.35	.197
January‡	9,000	910	1,740	.572	.66	.370
February‡	12,000	940	2,570	.845	.91	.546
March‡	9,900	1,515	2,490	.819	.94	.529
April	7,880	1,090	2,191	.720	.80	.465
May	5,570	1,650	2,862	.941	1.08	.608
June	6,960	1,090	2,430	.799	.89	.516
July	12,580	1,090	1,930	.634	.73	.410
August	2,030	575	1,096	.360	.42	.233
September	880	510	620	.204	.23	.132
The year	12,580	510	1,771	.582	7.91	.376

Monthly discharge of Shenandoah River at Millville, W. Va.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1904–05						
October	610	480	521	0.171	0.20	0.111
November	610	480	528	.174	.19	.112
December	2,845	510	780	.256	.30	.165
January	4,150	830	2,065	.679	.78	.439
February*	1,900	1,200	1,483	.488	.51	.315
March*	9,370	1,900	4,063	1.34	1.54	.866
April	3,230	1,200	1,945	.639	.71	.413
May	2,940	880	1,382	.454	.52	.293
June	13,820	690	2,552	.839	.94	.542
July	11,400	1,450	2,994	.984	1.13	.636
August	4,840	930	1,557	.512	.59	.331
September	1,145	575	810	.266	.30	.172
The year	13,820	480	1,728	.568	7.71	.367
1906–07						
October*	44,800	1,450	7,419	2.44	2.81	1.58
November	7,880	1,720	3,020	.993	1.11	.642
December	8,520	1,450	3,052	1.00	1.16	.646
January	11,400	2,940	4,710	1.55	1.79	1.00
February	3,940	2,120	2,990	.983	1.02	.635
March	6,960	2,380	3,840	1.26	1.45	.814
April	—	—	4,600	1.51	1.69	.976
May	—	—	3,400	1.12	1.29	.724
June	—	—	7,200	2.37	2.64	1.53
July	2,750	1,260	1,700	.559	.65	.361
August	2,750	980	1,300	.427	.49	.276
September	17,800	980	2,610	.858	.96	.555
The year	—	980	3,820	1.26	17.06	.814
1907–08						
October	2,660	980	1,300	0.427	0.49	0.276
November	8,860	980	2,100	.690	.77	.446
December	17,800	1,800	4,880	1.60	1.85	1.03
January*	42,800	2,750	7,210	2.37	2.73	1.53
February	37,500	2,380	6,640	2.18	2.35	1.41
March	8,520	2,840	4,890	1.61	1.85	1.04
April	3,230	1,580	2,290	.753	.84	.487
May	33,200	1,520	7,070	2.32	2.68	1.50
June	6,960	1,580	3,240	1.07	1.19	.692
July	4,150	980	1,740	.572	.66	.370
August	8,200	930	2,120	.697	.80	.450
September	3,330	830	1,330	.437	.49	.282
The year	42,800	830	3,730	1.23	16.70	.795

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of Shenandoah River at Millville, W. Va.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1928						
August‡	11,000	700	3,190	1.05	1.21	0.679
September	9,200	1,430	2,990	.983	1.10	.635
1943–44						
October	729	422	570	0.188	0.22	0.122
November	852	503	674	.222	.25	.143
December	1,020	369	594	.195	.23	.126
January	2,080	617	1,051	.346	.40	.224
February	2,560	614	1,141	.375	.40	.242
March	9,400	2,580	4,518	1.49	1.71	.963
April	5,640	2,060	2,860	.941	1.05	.608
May	16,600	1,700	3,995	1.31	1.52	.847
June	2,300	852	1,289	.424	.47	.274
July	900	538	676	.222	.26	.143
August	1,310	377	567	.187	.21	.121
September	10,700	394	1,544	.508	.57	.328
The year	16,600	369	1,626	.535	7.29	.346
1944–45						
October	14,800	820	2,379	0.783	0.90	0.506
November	1,580	837	1,083	.356	.40	.230
December	4,500	992	1,963	.646	.74	.418
January	6,200	1,820	2,725	.896	1.03	.579
February	6,220	1,300	2,775	.913	.95	.590
March	6,220	1,590	3,087	1.02	1.17	.659
April	2,310	1,240	1,596	.525	.59	.339
May	3,200	1,260	1,865	.613	.71	.396
June	2,380	791	1,400	.461	.51	.298
July	6,620	555	1,169	.385	.44	.249
August	10,100	692	2,015	.663	.76	.429
September	47,100	814	6,701	2.20	2.46	1.42
The year	47,100	555	2,390	.786	10.66	.508

Monthly discharge of Shenandoah River at Millville, W. Va.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1945–46						
October	3,840	922	1,590	0.523	0.60	0.338
November	4,610	904	1,295	.426	.48	.275
December	4,920	1,600	3,020	.993	1.15	.642
January	8,340	2,030	4,250	1.40	1.61	.905
February	6,000	2,640	3,800	1.25	1.30	.808
March	5,560	2,420	3,767	1.24	1.43	.801
April	7,080	1,650	2,759	.908	1.01	.587
May	12,200	2,090	3,581	1.18	1.36	.763
June	8,800	966	2,345	.771	.86	.498
July	2,040	796	1,181	.388	.45	.251
August	1,300	650	866	.285	.33	.184
September	1,030	396	614	.202	.23	.131
The year	12,200	396	2,418	.795	10.81	.514
1946–47						
October	1,020	416	704	0.232	0.27	0.150
November	746	594	656	.216	.24	.140
December	958	542	662	.218	.25	.141
January	4,770	902	2,105	.692	.80	.447
February	1,660	825	1,189	.391	.41	.253
March	14,700	850	2,867	.943	1.09	.609
April	1,980	1,340	1,571	.517	.58	.334
May	3,190	1,160	1,858	.611	.70	.395
June	4,710	796	1,421	.467	.52	.302
July	1,980	644	1,052	.346	.40	.224
August	1,550	517	760	.250	.29	.162
September	830	410	584	.192	.21	.124
The year	14,700	410	1,289	.424	5.76	.274
1947–48						
October	1,140	320	644	0.212	0.24	0.137
November	6,350	675	1,888	.621	.69	.401
December	1,210	759	918	.302	.35	.195
January	1,660	800	1,125	.370	.43	.239
February	18,800	840	3,321	1.09	1.18	.704
March	7,600	2,080	3,675	1.21	1.39	.782
April	11,500	2,260	4,976	1.64	1.83	1.06
May	8,870	1,750	4,066	1.34	1.54	.866
June	5,950	1,020	2,038	.671	.75	.434
July	1,890	748	1,162	.382	.44	.247
August	6,780	951	2,674	.879	1.01	.568
September	2,290	710	1,230	.405	.45	.262
The year	18,800	320	2,302	.757	10.30	.489

Potomac River Basin—*Continued*

Monthly discharge of Shenandoah River at Millville, W. Va.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1948–49						
October	18,400	950	3,939	1.30	1.49	0.840
November	14,200	1,500	4,140	1.36	1.52	.879
December	23,700	3,080	7,539	2.48	2.86	1.60
January	15,700	3,600	6,873	2.26	2.61	1.46
February	8,200	3,600	5,221	1.72	1.79	1.11
March	5,660	2,000	2,984	.982	1.13	.635
April	16,100	2,140	4,220	1.39	1.55	.898
May	9,540	2,150	3,976	1.31	1.51	.847
June	36,600	1,030	4,754	1.56	1.74	1.01
July	10,700	1,720	4,263	1.40	1.62	.905
August	9,830	1,260	3,229	1.06	1.22	.685
September	5,680	1,040	1,950	.641	.72	.414
The year	36,600	950	4,425	1.46	19.76	.944
1949–50						
October	1,820	774	987	0.325	0.37	0.210
November	5,780	1,050	1,964	.646	.72	.418
December	3,640	952	1,557	.512	.59	.331
January	2,700	1,200	1,574	.518	.60	.335
February	15,400	2,050	4,611	1.52	1.58	.982
March	9,080	1,510	3,182	1.05	1.21	.679
April	3,850	1,410	1,969	.648	.72	.419
May	6,250	1,560	3,223	1.06	1.22	.685
June	10,600	1,070	2,981	.981	1.09	.634
July	1,710	861	1,094	.360	.41	.233
August	954	620	743	.244	.28	.158
September	10,800	660	2,548	.838	.94	.542
The year	15,400	620	2,181	.717	9.73	.463
1950–51						
October	2,220	909	1,236	0.407	0.47	0.263
November	11,200	945	1,992	.655	.73	.423
December	37,000	1,860	7,613	2.50	2.89	1.62
January	3,150	1,900	2,290	.753	.87	.487
February	13,400	3,000	6,371	2.10	2.18	1.36
March	11,000	2,700	4,898	1.61	1.86	1.04
April	14,300	3,000	6,454	2.12	2.37	1.37
May	5,910	1,640	2,673	.879	1.01	.568
June	15,000	1,360	3,323	1.09	1.22	.704
July	2,310	880	1,332	.438	.51	.283
August	1,140	558	879	.289	.33	.187
September	873	552	667	.219	.24	.142
The year	37,000	552	3,288	1.08	14.68	.698

Monthly discharge of Shenandoah River at Millville, W. Va.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1951–52						
October	653	483	552	0.182	0.21	0.118
November	1,090	583	742	.244	.27	.158
December	7,400	619	2,067	.680	.78	.439
January	9,420	2,250	3,992	1.31	1.51	.847
February	17,600	2,200	4,849	1.60	1.72	1.03
March	22,200	2,040	5,364	1.76	2.03	1.14
April	40,800	3,250	8,305	2.73	3.05	1.76
May	16,000	2,580	5,777	1.90	2.19	1.23
June	2,770	1,350	1,840	.605	.68	.391
July	3,630	828	1,429	.470	.54	.304
August	2,110	770	1,244	.409	.47	.264
September	5,710	746	1,585	.521	.58	.337
The year	40,800	483	3,137	1.03	14.03	.666
1952–53						
October	1,120	615	856	0.282	0.32	0.182
November	23,900	629	3,122	1.03	1.15	.666
December	12,300	1,830	3,252	1.07	1.23	.692
January	13,100	2,090	5,538	1.82	2.10	1.18
February	11,000	2,350	3,606	1.19	1.24	.769
March	30,700	2,860	7,503	2.47	2.85	1.60
April	6,240	2,660	4,094	1.35	1.50	.873
May	8,520	2,050	4,239	1.39	1.61	.898
June	3,120	1,020	1,714	.564	.63	.365
July	1,340	615	903	.297	.34	.192
August	981	503	718	.236	.27	.153
September	1,520	509	681	.224	.25	.145
The year	30,700	503	3,021	.994	13.49	.642
1953–54						
October	981	497	566	0.186	0.21	0.120
November	990	522	652	.214	.24	.138
December	2,180	540	991	.326	.38	.211
January	2,560	497	1,151	.379	.44	.245
February	4,880	845	1,520	.500	.52	.323
March	27,700	2,210	5,180	1.70	1.96	1.10
April	3,990	1,720	2,359	.776	.87	.502
May	5,810	1,280	2,192	.721	.83	.466
June	3,460	899	1,790	.589	.66	.381
July	1,160	500	738	.243	.28	.157
August	926	435	575	.189	.22	.122
September	601	415	467	.154	.17	.100
The year	27,700	415	1,517	.499	6.78	.323

Monthly discharge of Shenandoah River at Millville, W. Va.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1954–55						
October	28,700	390	2,599	0.855	0.99	0.553
November	11,000	700	2,458	.809	.90	.523
December	8,870	1,140	2,597	.854	.98	.552
January	12,300	979	2,595	.854	.98	.552
February	7,230	1,020	2,638	.868	.90	.561
March	21,900	2,310	6,191	2.04	2.35	1.32
April	4,500	1,770	2,890	.951	1.06	.615
May	2,650	1,270	1,797	.591	.68	.382
June	8,000	867	2,657	.874	.98	.565
July	1,760	632	940	.309	.36	.200
August	94,900	632	10,390	3.42	3.94	2.21
September	3,120	1,040	1,756	.587	.64	.374
The year	94,900	390	3,307	1.09	14.76	.704
1955–56						
October	1,220	746	976	0.321	0.37	0.207
November	1,100	714	840	.276	.31	.178
December	786	520	691	.227	.26	.147
January	1,120	548	701	.231	.27	.149
February	5,600	1,420	2,690	.885	.95	.572
March	8,870	1,440	3,264	1.07	1.24	.692
April	7,620	1,520	2,893	.952	1.06	.615
May	1,430	828	1,092	.359	.41	.232
June	1,020	548	772	.254	.28	.164
July	3,890	503	1,311	.431	.50	.279
August	4,350	582	1,258	.414	.48	.268
September	3,070	461	736	.242	.27	.156
The year	8,870	461	1,430	.470	6.40	.304
1956–57						
October	2,960	534	1,157	0.381	0.44	0.246
November	7,180	1,130	2,189	.720	.80	.465
December	2,290	950	1,321	.435	.50	.281
January	2,030	855	1,393	.458	.53	.296
February	6,750	2,280	3,498	1.15	1.20	.743
March	8,820	1,930	3,639	1.20	1.40	.776
April	22,200	1,770	4,894	1.61	1.80	1.04
May	4,390	1,400	2,293	.754	.87	.487
June	4,980	1,080	2,012	.662	.74	.428
July	1,150	548	686	.226	.26	.146
August	587	330	435	.143	.17	.092
September	837	315	538	.177	.20	.114
The year	22,200	315	1,988	.654	8.91	.423

POTOMAC RIVER BASIN—*Continued*

Monthly discharge of Shenandoah River at Millville, W. Va.—*Continued*

Month	Discharge in cfs				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1957–58						
October	2,450	422	903	0.297	0.34	0.192
November	1,680	567	884	.291	.32	.188
December	7,070	999	2,175	.715	.83	.462
January	5,940	1,170	2,988	.983	1.13	.635
February	6,790	1,400	3,020	.993	1.03	.642
March	12,200	3,250	5,935	1.95	2.25	1.26
April	14,600	3,350	7,791	2.56	2.86	1.65
May	12,300	2,200	5,459	1.80	2.07	1.16
June	2,020	1,240	1,592	.524	.58	.339
July	6,470	851	2,069	.681	.78	.440
August	3,640	1,170	2,171	.714	.82	.461
September	1,360	644	870	.286	.32	.185
The year	14,600	422	2,990	.984	13.33	.636
1958–59						
October	1,040	571	678	0.223	0.26	0.144
November	899	435	642	.211	.24	.136
December	3,180	500	689	.227	.26	.147
January	3,020	571	1,190	.391	.45	.253
February	983	732	849	.279	.29	.180
March	2,340	690	1,278	.420	.48	.271
April	8,300	1,040	3,261	1.07	1.20	.692
May	5,210	1,090	2,143	.705	.81	.456
June	25,000	891	3,350	1.10	1.23	.711
July	1,080	601	779	.256	.30	.165
August	1,300	494	756	.249	.29	.161
September	1,010	435	594	.195	.22	.126
The year	25,000	435	1,348	.443	6.03	.286

‡ Not previously published; estimated or partly estimated.

* Revised.

Yearly discharge of Shenandoah River at Millville, W. Va.

Year	Year ending Sept. 30				Calendar year			
	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in cfs		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1896	2,043	0.672	9.15	0.434	2,735	0.899	12.24	0.581
1897	3,513	1.15	15.67	.743	2,926	.962	13.05	.622
1898	2,659	.874	11.85	.565	3,489	1.15	15.55	.743
1899	3,837	1.26	17.12	.814	3,049	1.00	13.61	.646
1900	2,156	.709	9.62	.458	2,237	.735	9.98	.475
1901	4,268	1.40	19.06	.905	4,829	1.59	21.56	1.03
1902	4,463	1.47	19.92	.950	4,102	1.35	18.32	.873
1903	4,327	1.42	19.31	.918	4,018	1.32	17.92	.853
1904	1,771	.582	7.91	.376	1,644	.540	7.35	.349
1905	1,728	.568	7.71	.367	1,878	.617	8.38	.399
1906	2,574	.846	11.49	.547	3,408	1.12	15.21	.724
1907	3,820	1.26	17.06	.814	3,382	1.11	15.09	.717
1908	3,730	1.23	16.07	.795	3,390	1.11	15.51	.717
1929	2,540	.836	11.36	.540	3,040	1.00	13.58	.646
1930	1,810	.595	8.11	.385	1,130	.372	5.06	.240
1931	1,200	.395	5.34	.255	1,200	.395	5.34	.255
1932	1,660	.546	7.44	.353	2,380	.783	10.64	.506
1933	3,640	1.20	16.27	.776	3,010	.990	13.46	.640
1934	1,300	.428	5.81	.277	1,830	.602	8.17	.389
1935	3,584	1.18	15.99	.763	3,342	1.10	14.91	.711
1936	4,003	1.32	17.92	.853	3,937	1.30	17.62	.840
1937	3,551	1.17	15.84	.756	4,325	1.42	19.30	.918
1938	2,573	.846	11.49	.547	1,707	.562	7.62	.363
1939	2,437	.802	10.90	.518	2,346	.772	10.49	.499
1940	2,498	.822	11.13	.531	2,817	.927	12.61	.599
1941	2,024	.666	9.03	.430	1,613	.531	7.21	.343
1942	1,813	.596	8.09	.385	3,532	1.16	15.76	.750
1943	4,344	1.43	19.40	.924	2,631	.865	11.76	.559
1944	1,626	.535	7.29	.346	1,929	.635	8.63	.410
1945	2,390	.786	10.66	.508	2,430	.799	10.85	.516
1946	2,418	.795	10.81	.514	2,090	.687	9.34	.444
1947	1,289	.424	5.76	.274	1,407	.463	6.28	.299
1948	2,302	.757	10.30	.489	3,326	1.09	14.89	.704
1949	4,425	1.46	19.76	.944	3,487	1.15	15.57	.743
1950	2,181	.717	9.73	.463	2,719	.894	12.14	.578
1951	3,288	1.08	14.68	.698	2,656	.874	11.85	.565
1952	3,137	1.03	14.03	.666	3,458	1.14	15.47	.737
1953	3,021	.994	13.49	.642	2,601	.856	11.62	.553
1954	1,517	.499	6.78	.323	1,975	.650	8.82	.420
1955	3,307	1.09	14.76	.704	2,875	.946	12.83	.611
1956	1,430	.470	6.40	.304	1,609	.529	7.20	.342
1957	1,988	.654	8.91	.423	1,932	.636	8.66	.411
1958	2,990	.984	13.33	.636	2,825	.929	12.60	.600
1959	1,348	.443	6.03	.286				
Highest	4,463	1.47	19.92	.950	4,829	1.59	21.56	1.03
Average	2,694	.886	12.02	.573	2,727	.897	12.18	.580
Lowest	1,200	.395	5.34	.255	1,130	.372	5.06	.240

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PLATE 8

FIGURE 1. Gaging Station on Little Tonoloway Creek near Hancock

FIGURE 2. Highway Bridge Equipment Used to Measure Discharge at Stages Higher than Wading

FIGURE 1. Engineer Making Discharge Measurements by Wading

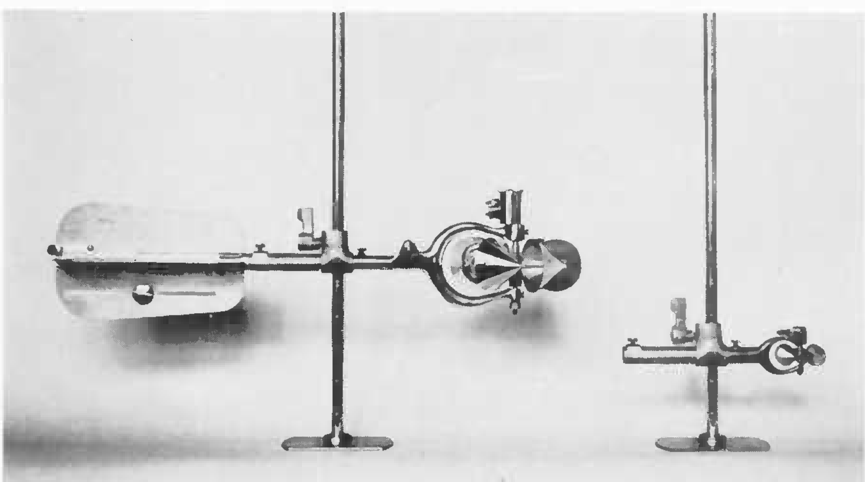


FIGURE 2. Price Standard Current Meter and Pygmy Meter Suspended on Wading Rods Used to Measure Discharge

INDEX


MAP
OF
ALLEGANY COUNTY
SHOWING
THE LOCATION OF
WELLS AND SPRINGS
AND
GEOLOGIC FORMATIONS
Well
Spring (direction of flow)
1962
Scale 1:62500
1 1/2 0 1 2 3 4 Miles
1 1/2 0 1 2 3 4 5 Kilometers
Numbered ticks indicate the 10,000 foot Maryland State Grid
The last three digits of the grid numbers are omitted
INDEX OF MARYLAND COUNTIES
As the map is a cooperative product of the U. S. Geological Survey and the Maryland Department of Geology, Mines and Water Resources, the classification and nomenclature of the rock units differs somewhat from that of the U. S. Geological Survey.
EXPLANATION
PERMIAN
P
Permian undifferentiated
Rocks of probable Permian age underlie several isolated hills in the vicinity of Frostburg and Lonaconing. The poorly exposed rocks appear to be mainly shale, siltstone, and sandstone. Argillaceous lenticular limestone and several thin beds of impure coal are present. Between Koontz Run and Squirrel Neck Run on the east side of Savage Mountain north of Lonaconing, the basal part of the Permian is a massive white conglomeratic sandstone. Minimum thickness 250 feet.
PENNSYLVANIAN
Pm
Monongahela formation
Includes the rocks between the base of the Pittsburgh coal (P) and the top of the Waynesburg coal (W). Composed of argillaceous limestone, claystone, shale, siltstone, sandstone, and coal. The Monongahela contains three extensively mined coals. The Pittsburgh (Big Vein) at the base, Sewickley (Tyson) 120 to 140 feet above the base, and the Uniontown (Koontz) 240 to 250 feet above the base. The coal that was correlated with the Waynesburg coal of Pennsylvania in the Maryland Geological Survey Coal Report of 1922 is now believed to be the correlative of the Uniontown coal. (H. L. Berryhill and Wallace deWitt, Jr.: Revised correlation of Koontz Coal and Pennsylvania-Permian boundary in Georges Creek basin. Bull. Amer. Asso. Petrol. Geol., vol. 39, p. 2087). Thickness 370 to 375 feet.
Pc
Conemaugh formation
Includes the rocks between the top of the Upper Freeport coal (UF) and the base of the Pittsburgh coal (P). Composed of interbedded argillaceous limestone, clay, claystone, shale, siltstone, sandstone, and coal. Two marine fossiliferous shales—the Brush Creek, which overlies the Brush Creek coal, and the Ames, which overlies the Harlem coal—occur 117 and 325 feet respectively above the base. Minable coals in the Conemaugh are, in ascending order, Piedmont, Lower Bakerstown, Upper Bakerstown, Harlem, Barton, Franklin, and Little Pittsburgh. Thickness 900 feet.
Pap
Allegheny formation
Pottsville formation
Allegheny and Pottsville formations undifferentiated. Includes the rocks between the top of the Mauch Chunk shale and the top of the Upper Freeport coal (UF). Predominantly shale, siltstone, and sandstone but also some claystone, clay, and coal. Conglomeratic sandstone is present in the middle and lower parts of the unit. The most extensive coals are the Middle Kittanning, Upper Kittanning, Lower Freeport, and Upper Freeport. Thickness 300 to 600 feet.
MISSISSIPPIAN
Mmc
Mauch Chunk shale
Red shale, reddish-purple mudstone, and red, brown, and gray, crossbedded, slabby-weathering sandstones. Thin light-green beds in some of the shale and mudstone. Thickness 650 to 700 feet.
Mgb
Greenbrier limestone
Lower part gray to purplish-red, crossbedded, arenaceous limestone (Loyalhanna member). Upper part reddish shale, mudstone, and sandstone and some interbedded fossiliferous grayish limestone. Thickness 240 to 250 feet.
Mp
Pocono formation
Medium-gray, white, tan, and brown crossbedded, platy to massive sandstone, locally conglomeratic. Much interbedded gray and reddish-brown shale, mudstone, and siltstone. On Town Hill a few thin impure lenses of bituminous shale and shaly coal occur in the lower and middle parts. Fossils consist entirely of plant remains. Thickness 250 to 1700 feet.
DEVONIAN
Dh
Hampshire formation
Interbedded red shale, red mudstone, and red to brown crossbedded siltstone and sandstone. Fossils consist of plant remains and fragments of fish skeletons. Contact with Pocono and Jennings formations gradational. Thickness 1630 to 2400 feet.
Dj
Jennings formation
Includes dark-gray to black platy shale (Geneseo member) in base; olive-gray, platy, siliceous shales and interbedded siltstones (Woodmont member) in middle; and shale, siliceous shale, interbedded siltstones and conglomeratic sandstones (Chemung member) at top. The uppermost conglomeratic sandstone in the Chemung member forms Green Ridge and Polish-Ragged Mountain. Thickness 3000 to 4800 feet.
Dr
Romney shale
Olive-gray and black shale with interbedded fossiliferous argillaceous limestone in lower part (Onondaga member); black shale (Marcellus member) in middle; and fossiliferous silty mudstone and interbedded siltstone (Hamilton member) at top. Thickness 350 to 1660 feet.
Do
Oriskany formation
Highly calcareous, fossiliferous cherty siltstone (Shriver member) in lower part; calcareous, fossiliferous, coarse-grained, locally conglomeratic sandstone (Ridgely member) in upper part. Thickness 300 to 350 feet.
Dhg
Helderberg limestone
Fossiliferous massive gray cobbly-weathering limestone (Keyser member) in lower part; slabby fossiliferous limestone containing much massive white chert (New Scotland member) in upper part. Thickness 350 feet.
SILURIAN
Stl
Tonoloway limestone
Platy-weathering, laminated gray limestone. Bedding planes often show desiccation cracks. Contains abundance of ostracods. Thickness 660 feet.
Swc
Wills Creek shale
Interbedded olive to yellowish-gray shale and limestone which weathers yellowish gray. Some thin-bedded olive-gray sandstone in upper part. Cedar Cliff limestone embedded in Bloomsburg red and green sandstone and shale in basal part. Bedding planes show desiccation cracks. Ostracods are abundant. Thickness 450 feet.
Smc
McKenzie formation
Calcareous shale and interbedded, lenticular, argillaceous, fossiliferous limestone. Upper part primarily shale containing some thin lenses of sandstone. Gradational contact with Wills Creek and Rose Hill formations. Thickness 240 feet.
Srh
Rose Hill formation
Olive-gray to pink shale containing interbedded thin sandstones. Has Cresaptown iron sandstone 175 feet above the base and Keefer (Roberts ore) sandstone 25 to 40 feet below the top. Upper 40 feet is interbedded with highly fossiliferous lenticular limestone (Rochester member). Gradational contact with McKenzie formation. Thickness 550 feet.
St
Tuscarora sandstone
Massive white sandstone containing a few thin layers of shale in the upper part. Appears to be gradational with the Juniata formation. Forms rim of "The Narrows" of Wills Mountain west of Cumberland. Thickness 380 feet.
ORDOVICIAN
Oj
Juniata formation
Interbedded red shale and sandstone; base concealed. Exposed only in "The Narrows" of Wills Mountain west of Cumberland. Thickness 530 feet.
Contact of geologic formations; dashed where approximately located
60
Strike and dip of beds

MAP OF WASHINGTON COUNTY SHOWING THE LOCATION OF WELLS AND SPRINGS AND GEOLOGIC FORMATIONS

○ Well

● Spring (direction of flow)

1962

Scale 1/62500

1 1/2 0 1 2 3 4 Miles

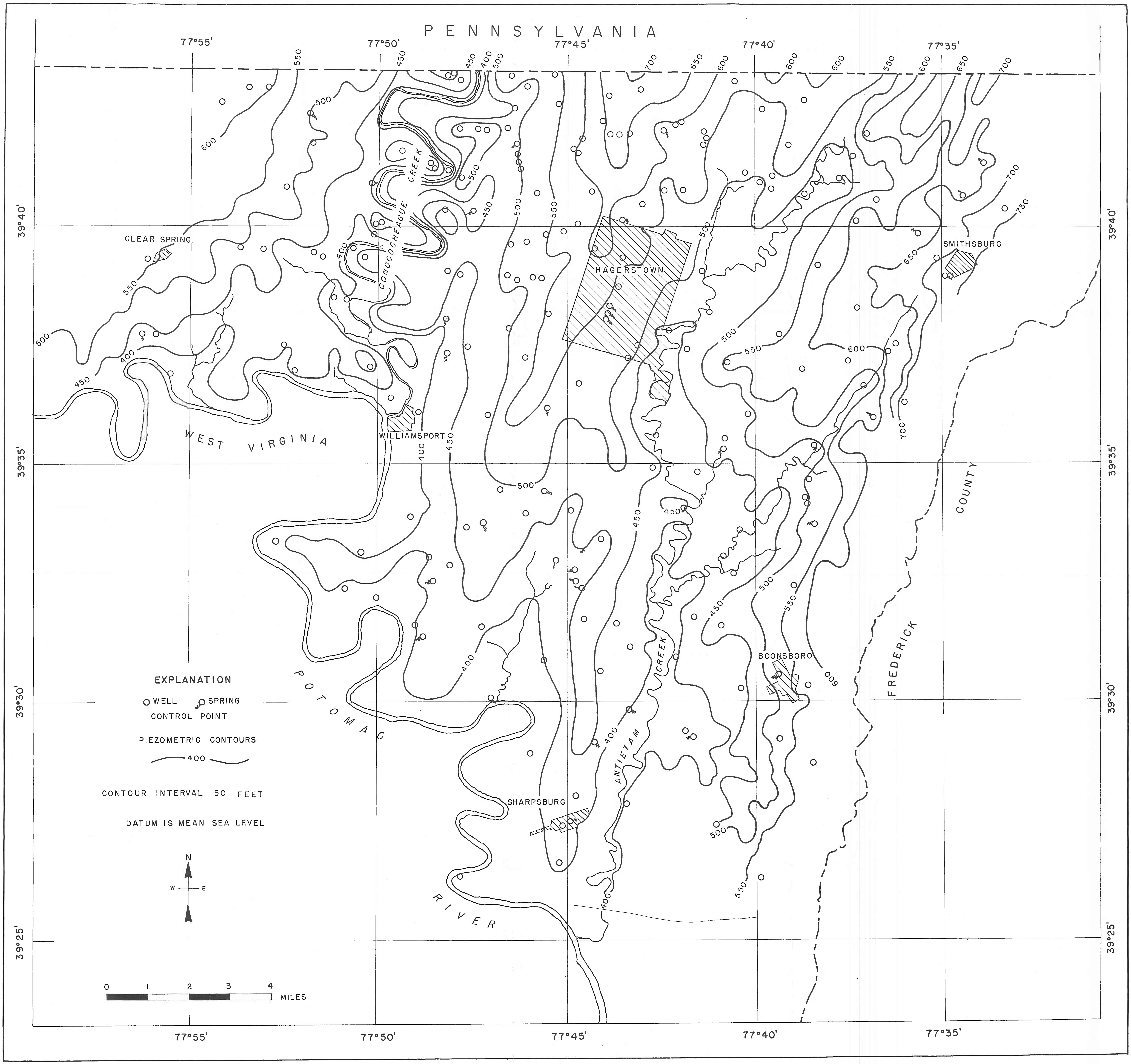
1 1/2 0 1 2 3 4 5 Kilometers

EXPLANATION

Fault, dashed where inferred

Symbol	Formation	Group	System
Qmw	Mountain wash		Quaternary
Qal	River alluvium		
Mp	Pocono		Mississippian
Dh	Hampshire		Devonian
Dj	Jennings		
Dr	Romney shale		
Do	Oriskany sandstone		
Dhg	Helderberg limestone		
Stl	Tonoloway limestone		Silurian
Swc	Wills Creek shale		
Smc	Mc Kenzie		
Srh	Rose Hill		
St	Tuscarora sandstone		
Oj	Juniata		Ordovician
Om	Martinsburg shale		
Oc	Chambersburg limestone		
Osp	St. Paul group	St. Paul	
Ops	Pinesburg Station dolomite	Beekmantown	
Orr	Rockdale Run		
Os	Stonehenge limestone		
Ꞓc	Conococheague limestone		Cambrian
Ꞓe	Elbrook limestone		
Ꞓwb	Waynesboro		
Ꞓt	Tomstown dolomite		
Ꞓa	Antietam quartzite		
Ꞓh	Harpers		Cambrian (?)
Ꞓw	Weverton quartzite		
Ꞓl	Loudoun		
cmb	Catoctin metabasalt		Precambrian
ggn	Granitic gneisses		

Williams & Heintz Map Corporation, Washington 27, D.C.



Piezometric Map of the Aquifers in Hagerstown Valley

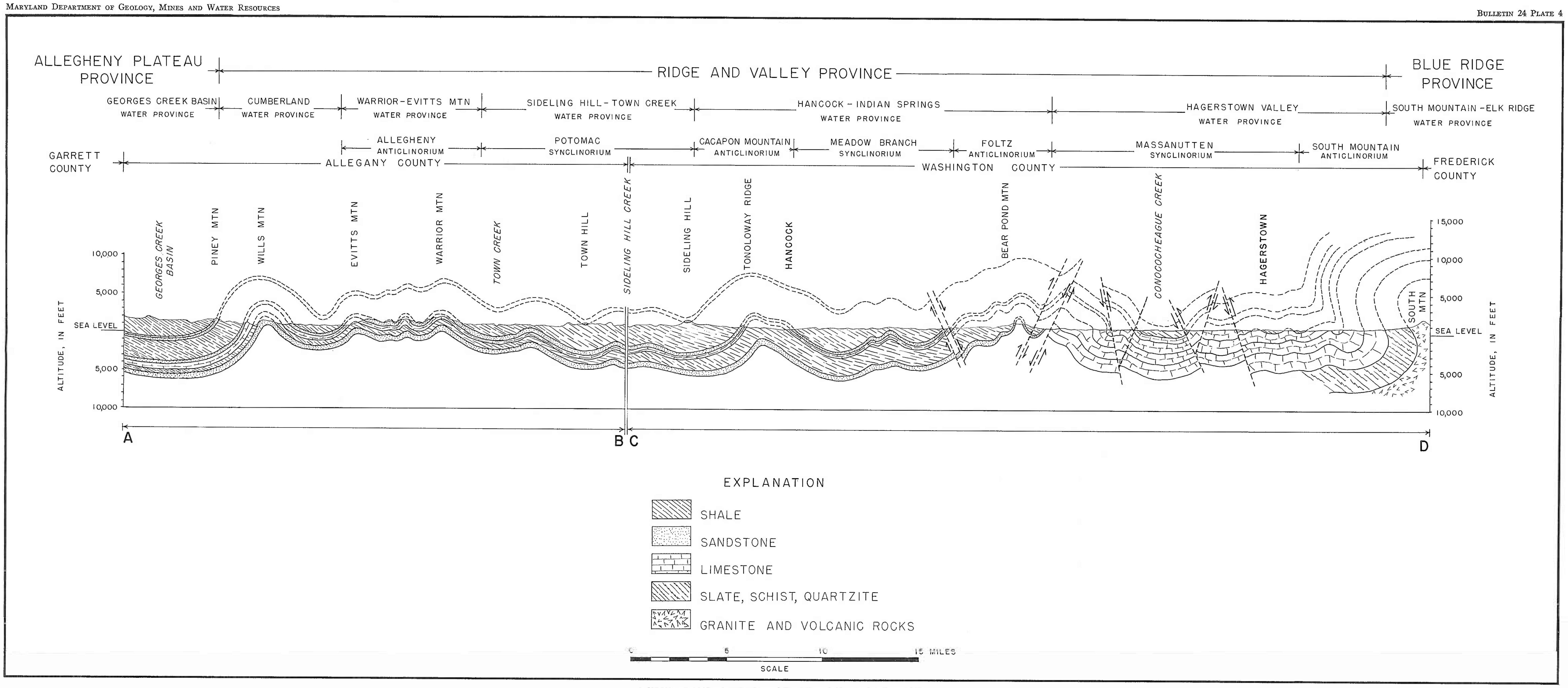


Figure 1. Geologic Sections Across Allegany and Washington Counties

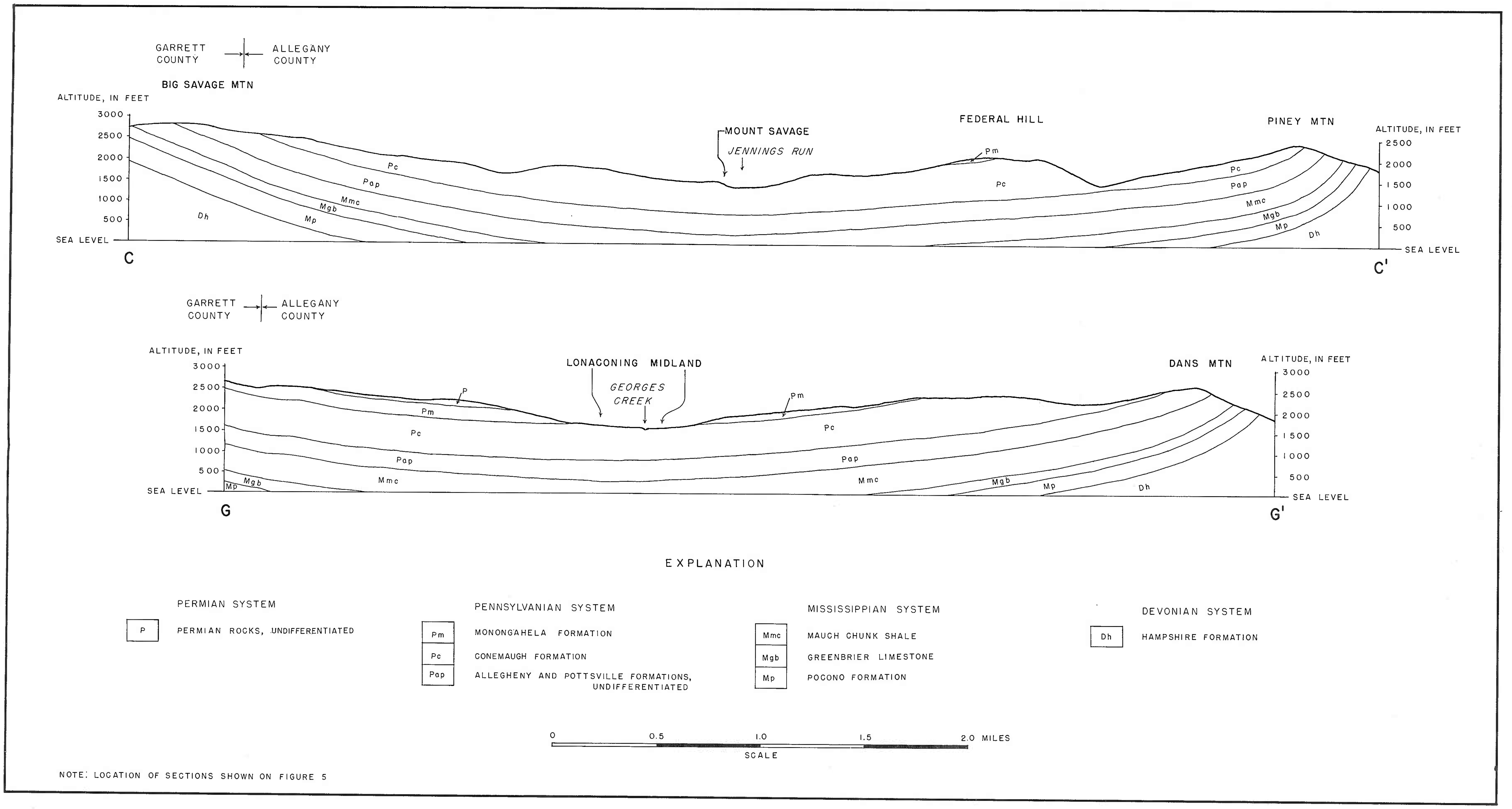


Figure 2. Geologic Section Across Georges Creek Basin

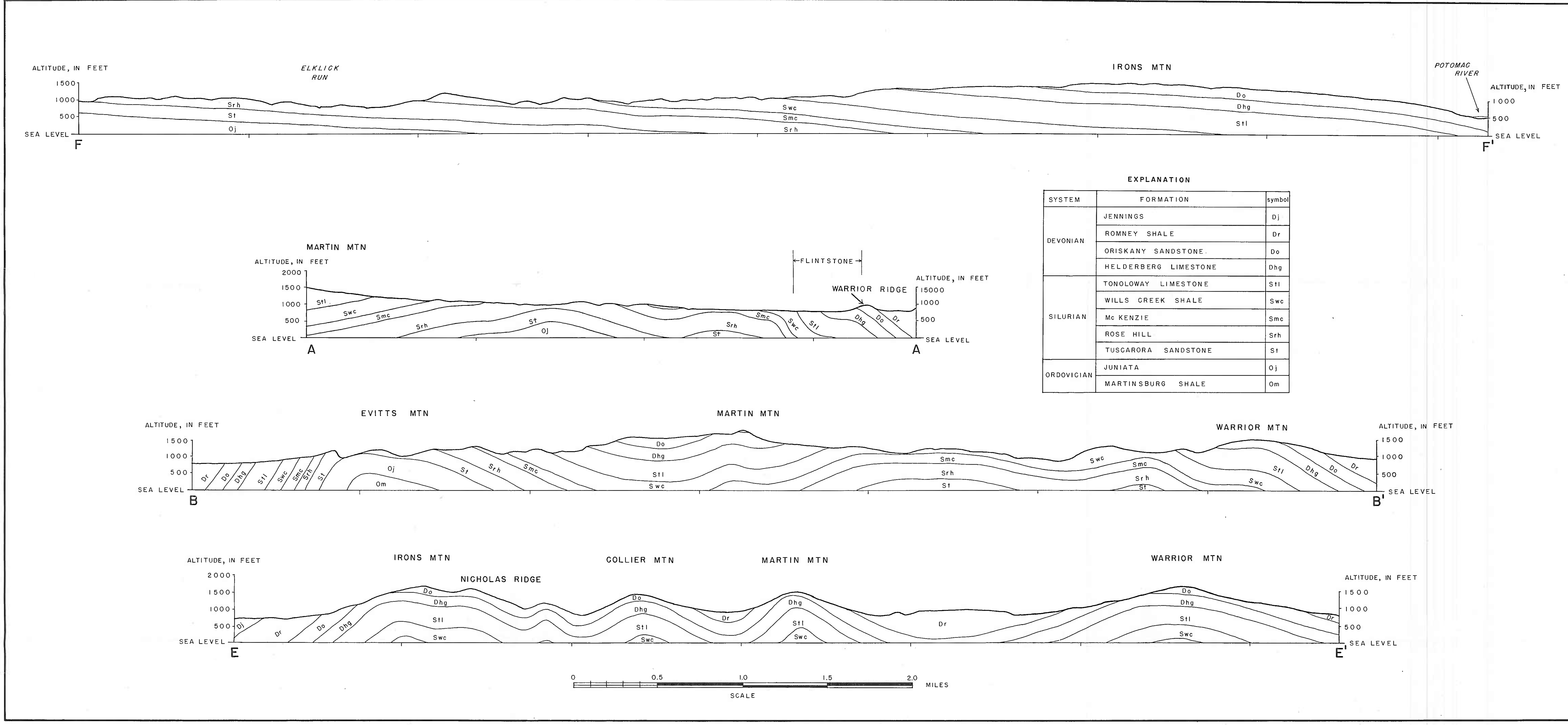


Figure 1. Geologic Sections in Warrior-Evitts Mountains Water Province

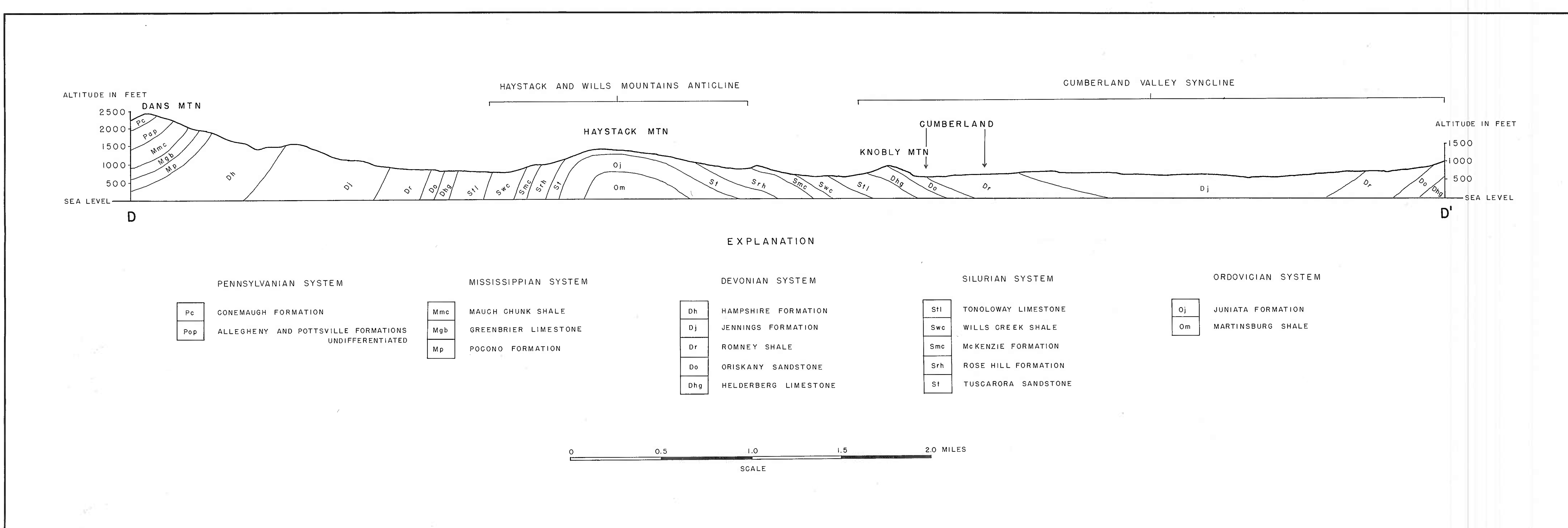


Figure 2. Geologic Section Across Cumberland Water Province

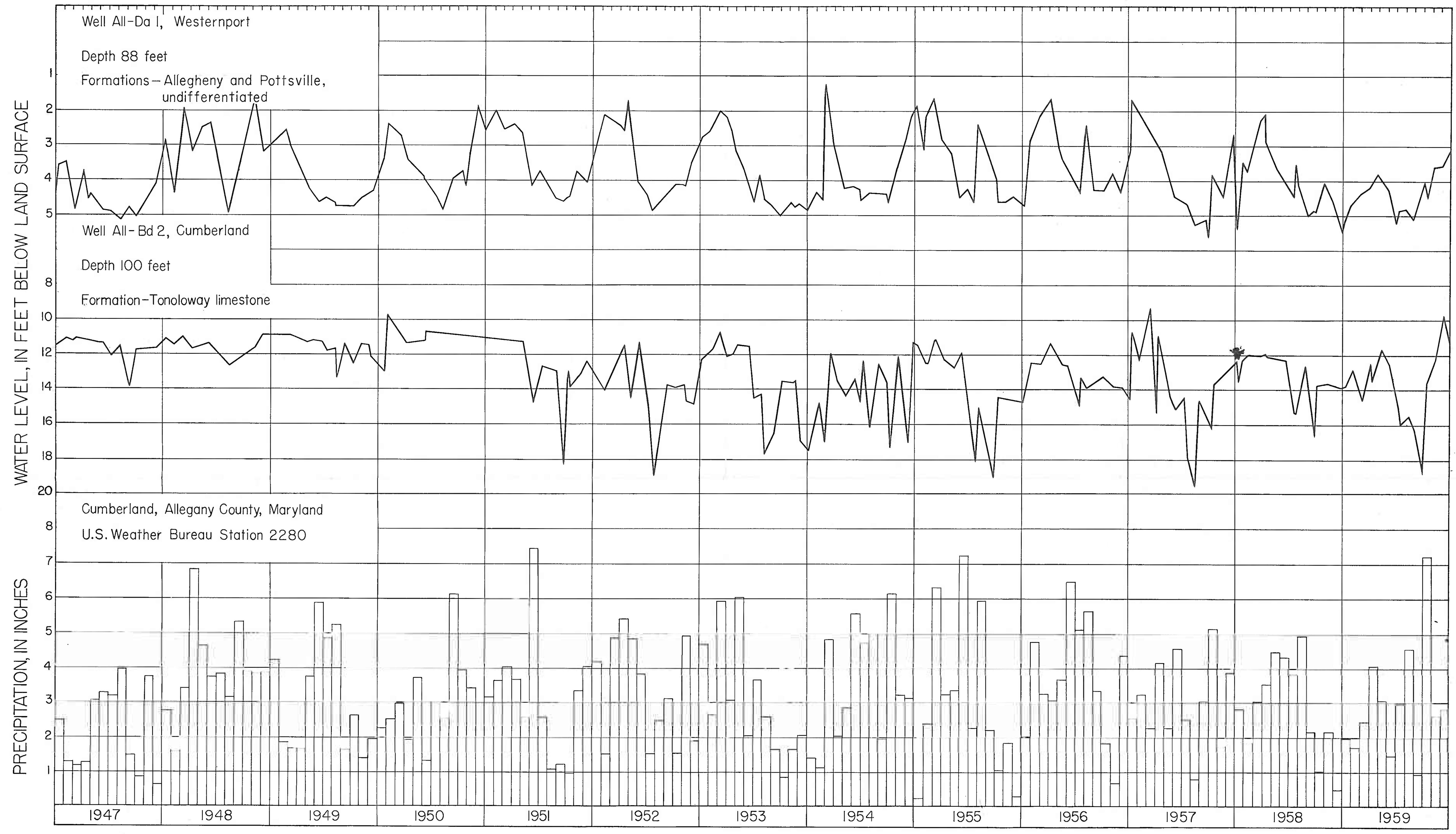


Figure 1. Hydrographs of Two Observation Wells in Allegany County and Monthly Precipitation at Cumberland

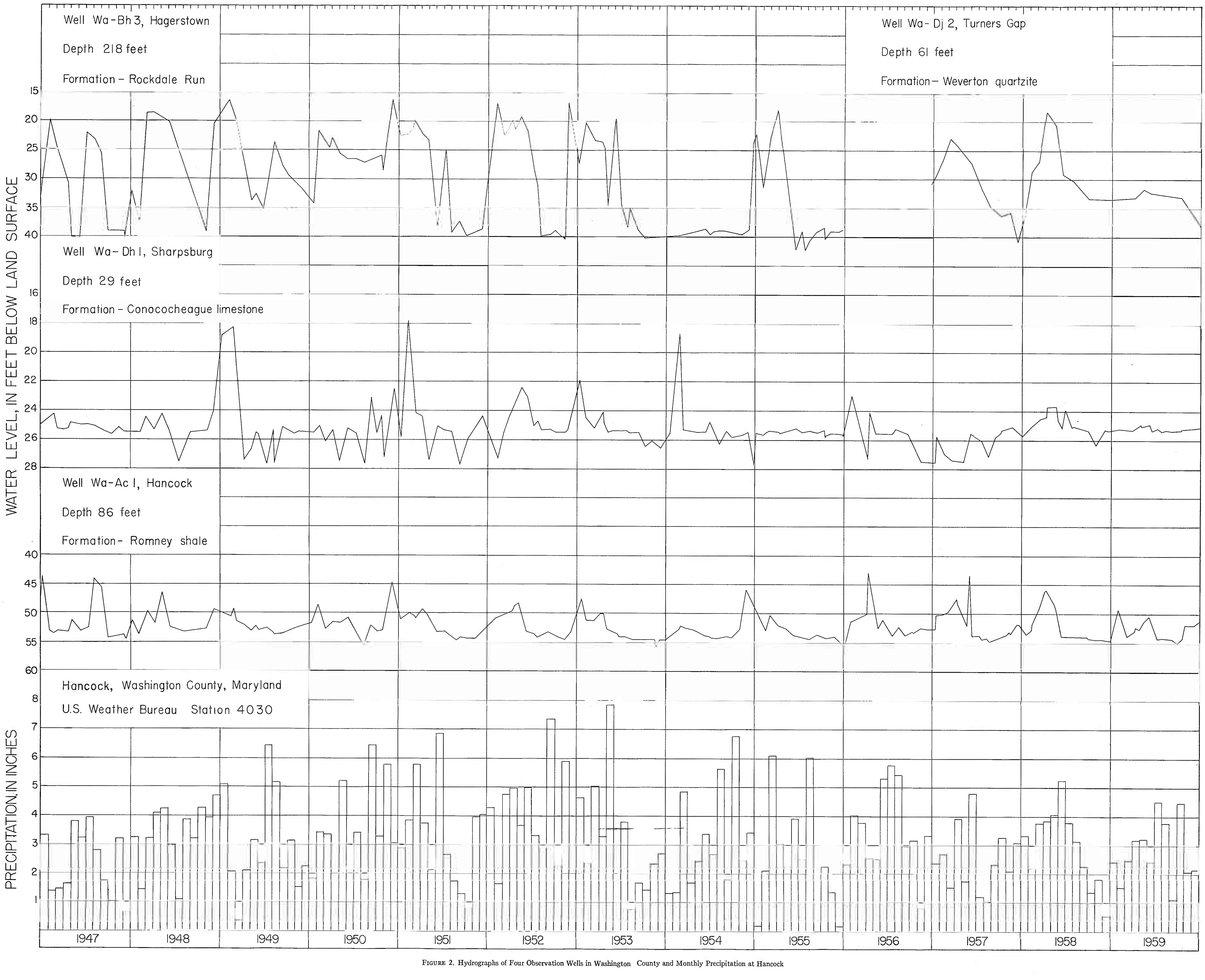
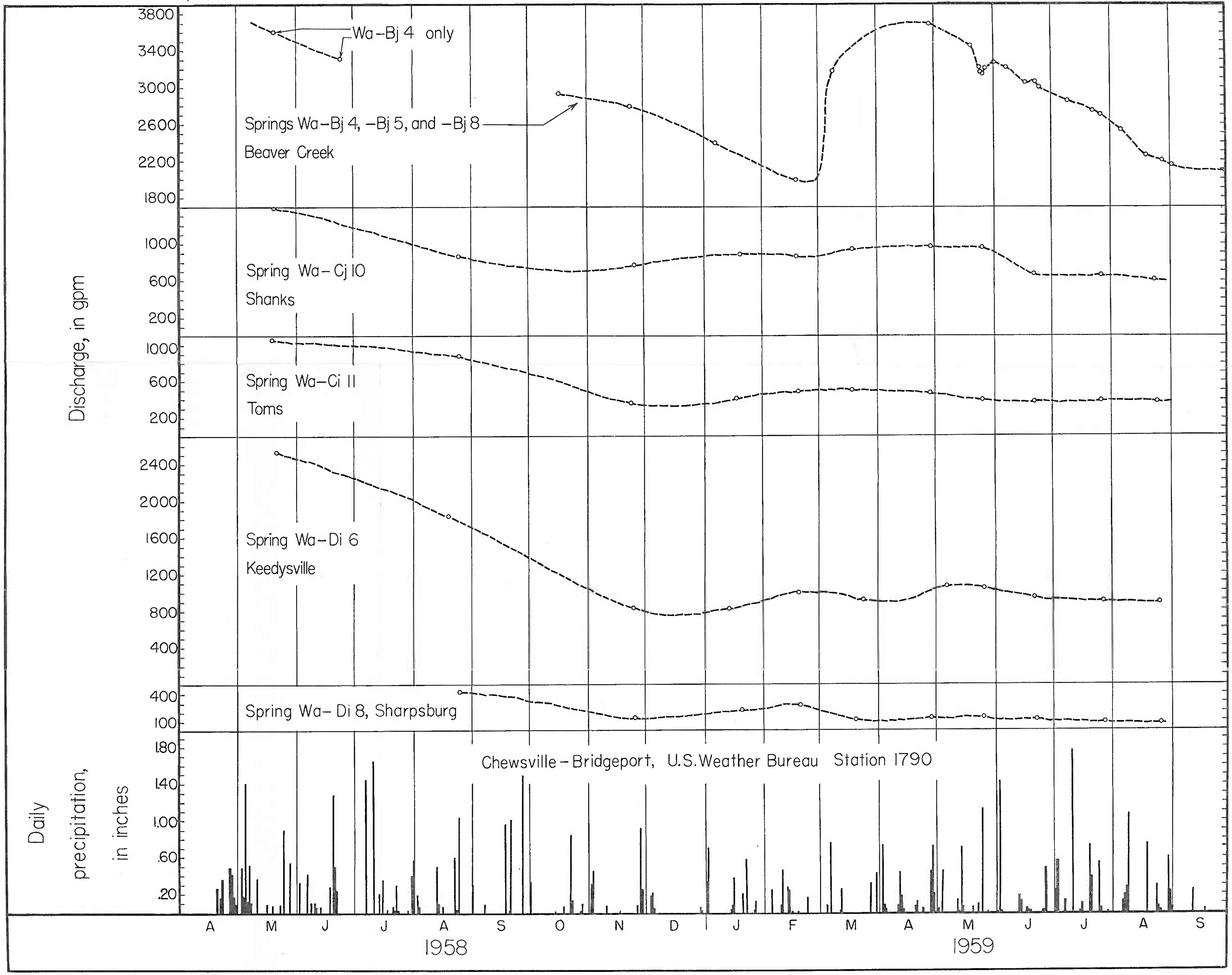


Figure 2. Hydrographs of Four Observation Wells in Washington County and Monthly Precipitation at Hancock



Graphs of Discharge of Seven Springs in Eastern Part of Hagerstown Valley