STATE OF MARYLAND
BOARD OF NATURAL RESOURCES
DEPARTMENT OF GEOLOGY, MINES AND WATER RESOURCES
JOSEPH T. SINGEWALD, JR. *Director*

BULLETIN 10

GEOLOGY AND WATER RESOURCES OF PRINCE GEORGES COUNTY

SEDIMENTARY DEPOSITS

by C. Wythe Cooke

SURFACE-WATER RESOURCES

by Robert O. R. Martin

GROUND-WATER RESOURCES

by Gerald Meyer

BALTIMORE, MARYLAND
1952

COMPOSED AND PRINTED AT THE
WAVERLY PRESS, INC.
BALTIMORE, MD., U.S.A.

COMMISSION ON
GEOLOGY, MINES AND WATER RESOURCES

PREFACE

One of the projects of the Maryland Geological Survey was a series of county reports dealing primarily with the geology and mineral resources but including brief descriptions of other natural resources supplemented by an atlas of a topographic map, and geologic, soils, and forestry maps printed on the topographic base. The county report and the geologic map of Prince Georges County were published in 1911, the forestry map in 1912, and the soils map in 1913.

A completely revised topographic map of Prince Georges County was published in 1946. The 1911 edition of the geologic map was exhausted in 1947, and the preparation of a new geologic map on the revised topographic base started in 1948. The United States Geological Survey very generously assigned to Dr. C. Wythe Cooke, one of the foremost authorities on the geology of the Atlantic Coastal Plain, the remapping of the geology of Prince Georges County. The revised geologic map was completed in 1950 and published by this Department in 1951.

Since the publication of the 1911 report and geologic map, much additional information on the stratigraphy of the Coastal Plain formations had become available. A two-volume Systematic Report on the Upper Cretaceous formations had been published in 1916 by the Maryland Geological Survey. Additional information on the Eocene formations had been published by this Department in 1948 in Bulletin 3, Eocene Stratigraphy and Aquia Foraminifera. A study of the sub-surface geology of Southern Maryland was started in 1945 with the inauguration of a systematic investigation of the ground-water resources of Southern Maryland under the cooperative program of ground-water studies with the United States Geological Survey. An areal investigation of the ground-water resources of Prince Georges County was begun late in 1948. In view of the more comprehensive understanding of the stratigraphy of the sedimentary deposits in Prince Georges County, it was desirable to supplement the 1911 Prince Georges County report with a further account of the sedimentary deposits. Through the generous cooperation of the United States Geological Survey, Dr. Cooke prepared the portion of Bulletin 10 dealing with the geology of those deposits to accompany his new geologic map of Prince Georges County. The publication of this report was postponed waiting for the completion of the report on the ground-water resources of the County.

The report on the ground-water resources, prepared by Mr. Gerald Meyer of the cooperative ground-water staff in Maryland, was completed the latter part of 1950 and released for publication to this Department by the United States Geological Survey early in 1952. This report lists with their locations and basic geologic and hydrologic data 502 wells in the County. Additional information is given in drillers' logs of 179 of these wells and in detailed logs of 32 wells from which cuttings samples were obtained and described by the cooperative ground-water staff. The geologic descriptions of the formations in Dr. Cooke's report are augmented by further descriptions of the hydrologic properties of the formations. The report includes a contour map of the surface of the underlying crystalline rock floor on which the Coastal Plain sediments were deposited and structure contour maps showing the depths of the top of the Magothy and Aquia formations, the two most important water-bearing formations in the County. Water level fluctuation trends as disclosed by the records of measurements in observation wells and other sources of information are discussed. The quality of the water in the various water-bearing sands is shown in 55 water analyses. This report enables well drillers and prospective well owners to determine the depths at which ground-water may be obtained, the quantity of water obtainable from the various aquifers, and the probable quality of the water. However, the Department of Geology, Mines and Water Resources can be called upon at any time for such information and for additional data that will be accumulated by the continued inventorying of wells through the operation of the 1945 Well Control Act.

The report on the surface-water resources of Prince Georges County was prepared by Mr. Robert O. R. Martin of the United States Geological Survey on the cooperative stream-gaging staff in Maryland. The first stream flow measurements in Prince Georges County were made on the Patuxent River at Laurel. A gaging station was operated there for two years during 1896 to 1898. Three additional stations in the County were operated for a full year in 1911 to 1912. There are now five stations at which measurements are being made. Two were installed in 1938, and the other three in 1944, 1948, and 1949. The flow measurements prior to 1943 were published by this Department in Bulletin 1, 1944. The records since 1943 are included in this report.

JOSEPH T. SINGEWALD, JR., *Director.*

CONTENTS

TABLES

FIGURES

PLATES

SEDIMENTARY DEPOSITS OF PRINCE GEORGES COUNTY AND THE DISTRICT OF COLUMBIA

BY

C. WYTHE COOKE

Introduction

COMPOSITION

The sedimentary deposits of Prince Georges County, Maryland, and the District of Columbia include material of various types and textures ranging from large, angular blocks of hard rock evidently derived from the adjacent Piedmont region to fine-grained silt and clay of less obvious origin. Some of the deposits must have accumulated in the ocean, for they include sea shells and the green mineral glauconite, which is known to originate only in the sea. Other deposits, though evidently transported by water, appear never to have reached the open ocean.

AGE

Though the deposits range in age from Cretaceous to Recent, there are many gaps in the sedimentary record. The oldest sediments in this region are nonmarine, and probably of Lower Cretaceous age. The Upper Cretaceous includes both marine and nonmarine deposits. The Paleocene epoch is represented by one formation. The early Eocene is believed to be represented by two marine formations, but late Eocene and Oligocene deposits are not recognized. Early (?) and Middle Miocene marine deposits are present, but Late Miocene deposits have not certainly been recognized. The Miocene is partly covered by an alluvial fan probably of Pliocene age, and the valleys contain fluvial and estuarine deposits of Pleistocene and Recent ages.

PREVIOUS REPORTS

The geology of part of this area was mapped and described in the Washington Folio (Darton and Keith, 1901) and another part in the Patuxent Folio (Shattuck, Miller, and Bibbins, 1907), and the entire area was covered by a report on Prince Georges County (B. L. Miller, 1911) published by the Maryland Geological Survey. More recently part of the area was included in a geologic map of the sedimentary formations of Washington and vicinity by Darton (1947) published by the U. S. Geological Survey. All these maps and reports have been helpful, though some of the geologic formations mapped in them were not recognized.

General publications covering this area are the systematic reports published by the Maryland Geological Survey entitled "Lower Cretaceous" (1911), "Upper Cretaceous" (two volumes, 1916), "Eocene" (1901), "Miocene" (text and plates, 1904), and "Pliocene and Pleistocene" (1906). These include descriptions and excellent illustrations of nearly all the species of fossils known from this region. The generic assignments of some of the species referred to in this report have been revised, but most of the new names can be readily identified.

FIELD WORK

Field work for this report was done intermittently during the summer of 1948 with the assistance of Harold Kelly Brooks, who collected most of the fossils, prepared them for study, and made preliminary identifications. Supplementary field studies were made alone during the summer of 1949.

CRETACEOUS SYSTEM

LOWER CRETACEOUS SERIES

McGee (1886) applied the name Potomac formation to clay, sand, and gravel deposits of supposed Cretaceous age in the vicinity of Washington. Later Clark and Bibbins (1897) raised the Potomac to the rank of group and divided it into four formations, the Patuxent, Arundel, Patapsco, and Raritan. The Patuxent and Arundel were provisionally assigned by Clark and Bibbins to the Late Jurassic because of Marsh's identification (1888) of supposed Jurassic Reptilia from Muirkirk (Arundel clay), and the Patapsco and Raritan were placed in the Lower Cretaceous because of the supposed affinities of their plants as determined by L. F. Ward. The Raritan was removed from the Potomac group when its flora was proved to be Upper Cretaceous (Berry, 1910). Later, Clark, Bibbins, and Berry (1911) transferred the Patuxent and Arundel formations to the Lower Cretaceous on the evidence of the plants (Berry, 1911) and of the Reptilia as restudied by Lull (1911). The Reptilia of the Arundel were later reexamined by Gilmore (1921), who concluded that they are of Upper Cretaceous age. The Upper Cretaceous age of the Arundel and Patapsco has since been substantiated by Anderson (1948) and Spangler and Peterson (1950). This leaves only the Patuxent formation in the Lower Cretaceous series.

Patuxent Formation

Name.—William Bullock Clark (1897a, p. 190) proposed the name Patuxent formation for the basal formation of the Coastal Plain in the upper valleys of the Little and Big Patuxent Rivers. He had traced it as a narrow, broken band along the landward margin of the Coastal Plain from Cecil County, Maryland, to the District of Columbia. The name is used here in its original sense. Part of the typical area of the Patuxent formation lies within Prince Georges County.

Description.—The main constituent of the Patuxent is sand, but the formation includes large, well-rounded, polished pebbles as well as lenses of white or varicolored massive clay. The sand commonly is mixed with more or less kaolin and mica. Clark described the beds as arkosic, but the feldspar crystals, an essential component of arkose, are at many places so thoroughly decomposed that the term hardly seems applicable. Part of the area formerly mapped as Patuxent appears to be occupied by disintegrated crystalline rocks.

According to Little (1917, p. 60) the Patuxent averages about 80 feet in thickness in Anne Arundel County, where it does not exceed 100 feet. The thickness in adjoining Prince Georges County may be somewhat greater. The formation thickens toward the east, for a deep well near Ocean City passed through 2310 feet of sediments referred to this formation without reaching the bottom (Anderson, 1948, p. 93).

Stratigraphic relations.—The Patuxent is the oldest formation of the Coastal Plain in this region and lies directly on crystalline rocks, on which it may have been deposited as outwash from the Piedmont. The formation contains many unconformities, probably the result of shifting currents and channels, and there is presumably one at the top separating it from the overlying Patapsco formation.

Paleogeography.—At the beginning of Patuxent time there appears to have been a wide base-leveled plain that extended eastward from the present Piedmont to or beyond the present shore of the Atlantic Ocean. Debris from the Piedmont washed out upon this plain and was distributed by meandering streams. This condition probably persisted throughout Patuxent time.

Fauna and flora.—According to Little (1917, p. 60) the known fauna of the Patuxent consists only of a *Unio* (a fresh-water mussel) and a fish. The flora includes ferns, horsetails, cycads, and conifers, but no angiosperms have been found unless three genera of doubtful relationships represent that order. Berry (Clark, Bibbins, and Berry, 1911, pp. 90–94) lists 23 species from Maryland and the District of Columbia, all but five of which are listed also from the Arundel clay or the Patapsco formation, and these five species are referred to genera represented also in those formations.

Age.—The Patuxent formation is older than the Arundel clay, which contains Reptilia that are now regarded as of Upper Cretaceous age, and which must occupy a position very low in that series. The only fossils in the Patuxent itself that are valuable for correlation are the plants. These include several primitive species referred by Berry (Clark, Bibbins, and Berry, 1911, p. 94) to *Ficophyllum*, *Proteaephyllum*, and *Rogersia* that have not certainly been identified from either the Arundel clay or the Patapsco formation. Moreover, the complete lack of advanced angiosperms in Berry's list contrasts with the abundance of such angiosperms in the Patapsco. Both these factors suggest that the Patuxent is older than Upper Cretaceous. Presumably it is Lower Cretaceous, to which series it is commonly referred.

Distribution.—The Patuxent formation crops out as a band averaging 3 miles in width and extending from Laurel to Georgetown. The band is partly cut through by the valleys of Northwest Branch and Sligo Branch. An outlier in Tenleytown and Cleveland Heights is separated from the main body of the formation by the valley of Rock Creek.

The most extensive exposures of the Patuxent are in the pits of the Contee Sand and Gravel Company. These lie on both sides of the Contee road near the head of Indian Creek, 2½ miles west of Contee and 4 miles west-southwest of Laurel. Sand and gravel dredged from Indian Creek at Branchville probably also are Patuxent, though some of the material may be Pleistocene. McMillan Reservoir at Washington was dug in it, and road cuts at Howard University exposed it. There once were good exposures of the Patuxent at Meridian Hill Park in Washington, but they are now covered by a retaining wall. Coarse round gravel faulted against crystalline rock is still exposed on Adams Mill road near the entrance to the National Zoological Park.

Coarse gravel, sand, and clay of the Patuxent rest directly on weathered crystalline rocks on the east side of New Mexico Avenue at Macomb Street in Washington. Red gravel above the Patuxent at this place is probably the Bryn Mawr (Pliocene?).

The excavation for the Mayflower Hotel at Connecticut Avenue and DeSales Street in Washington passed through a Pleistocene swamp deposit into 7 to 12 feet of clay, sand, and gravel identified by Wentworth (1924, p. 3) as basal Patuxent. The gravel at the base contained angular blocks of fragile schist like that on which it rested as well as many pebbles and boulders of distant origin. The top of the bed consisted of micaceous clay silt into which roots of Pleistocene cypress trees penetrated for 3 or 4 feet below the swamp clay in which their stumps still stood. The altitude of the Patuxent there was 20 to 30 feet above present sea level.

UPPER CRETACEOUS SERIES

The Upper Cretaceous deposits of Prince Georges County and the District of Columbia fall naturally into two divisions—a lower part, which is dominantly nonmarine; and an upper part, which is completely marine. The nonmarine division was included in the Potomac formation of McGee (1886), which later became a group of four formations. Of these the lowest, the Patuxent formation, is classified as Lower Cretaceous. The next two, the Arundel clay and the Patapsco formation, have been variously assigned to the Jurassic (Clark and Bibbins, 1897) and the Lower Cretaceous (Clark, Bibbins, and Berry, 1911). They are here raised to the Upper Cretaceous on the evidence of the Reptilia of the Arundel as interpreted by Gilmore (1921; Vokes, 1948). The topmost formation of the old Potomac group, the Raritan formation of New Jersey, though mapped in this area by Miller (1911) and Darton (1947), was not recognized. If it is not completely overlapped by the Monmouth formation, it is probably here included in the Patapsco.

The upper division consists of the Monmouth formation, which lies near the top of the Upper Cretaceous series and overlaps the Matawan, Magothy, and Raritan formations onto the Patapsco. Both the Magothy and the Matawan were mapped in Prince Georges County by Miller (1911), and the Magothy but not the Matawan by Darton (1947). The only supposed faunal evidence of the Magothy in the Washington area was a few molds of marine mollusks found at Goodhope Hill (Clark, 1916, p. 63), which later proved to be Miocene. No Matawan fossils have been reported from Prince Georges County by Gardner (1916).

The sequence of Upper Cretaceous formations in this region is, therefore, not as complete as farther northeast. The only formations here recognized are the Arundel clay, the Patapsco formation, and the Monmouth formation. The first two appear to be of early Upper Cretaceous age. The Monmouth is separated from them by a gap; it is of late Upper Cretaceous age.

Arundel Clay

Name.—The Arundel formation, so called from Anne Arundel County, Maryland, was first named and described by Clark (1897a, pp. 190–191). The more specific name Arundel clay is preferred because the formation consists almost entirely of clay.

Description.—According to Clark the formation "consists of a series of large and small lenses of iron-ore bearing clays which occupy ancient depressions in the surface of the Patuxent formation. . . . The clays are highly carbonaceous, lignitized trunks of trees being often encountered in an upright position with their larger roots still intact. Scattered through the tough, dark clays are vast quantities of nodules of iron carbonate, at times reaching many tons in weight, and known to the miners under the name of 'white ore.' In the upper portion of the formation the carbonate ores have changed to hydrous oxides of iron, which the miners call 'brown ore.' The largest clay lenses have been found to reach a thickness of nearly 125 feet."

Stratigraphic relations.—The Arundel clay lies unconformably on the Patuxent formation and is said to be unconformable also with the overlying Patapsco formation (Clark, 1897a, p. 192). This unconformity at the top, however, may be the result of shifting currents and may not record a long stratigraphic break.

Paleogeography.—During Arundel time the eroded surface of the Patuxent formation was dotted with swamps. Drainage at that time must have been very imperfect, and the streams must have been very sluggish.

Fauna and flora.—The swamps of Arundel time were inhabited by several species of carnivorous and herbivorous dinosaurs, crocodiles, turtles, and garfishes. The imperfectly known flora included ferns, a few cycads, and conifers.

Stumps of trees, still upright, have been found in these swamp deposits, and carbonized wood is of common occurrence.

Age.—The best evidence as to the age of the Arundel clay is afforded by the reptilian bones, even though most of them are very fragmentary. The reptiles were first studied by Marsh (1888), who compared them with species of the Morrison formation of the West and concluded that they are of Late Jurassic age. The same collections were later studied by Lull (1911), who agreed with Marsh that they are comparable with species from the Morrison, but Lull assigned that formation to the Lower Cretaceous. More recently these vertebrates were restudied by Gilmore (1921), who found that "the evidence appears to show—first, that the vertebrate fauna as a whole is not to be closely correlated with that of the Morrison formation of the West; second, that it contains forms having undoubted Upper Cretaceous affinities; third, that it consists of a combination of dinosaurian forms hitherto unknown in any fauna of this continent—that is, the intermingling of sauropodous dinosaurs with those having Upper Cretaceous affinities."

If the Arundel is Upper Cretaceous, as the available evidence seems to indicate, it must lie well down in that series, for it is the oldest of several formations of Upper Cretaceous age. Vokes (1948, p. 133), who has reviewed the evidence, is of the opinion that it is probably Cenomanian (earliest Upper Cretaceous).

Distribution.—On the geologic map of Prince Georges County published in 1951 by the Department of Geology, Mines and Water Resources, the Arundel clay is combined with the Patapsco formation under one pattern. The Arundel occupies only a small part of the area so colored. It lies along the western edge of the area and occurs chiefly in the northern half, centering around Muirkirk.

The Arundel is exposed at the bottom of the pits of the Washington Brick Company. The clay is gray and contains lumps of iron ore and lignitized wood.

In the vicinity of Contee and Muirkirk there are many old iron-ore pits in the Arundel clay. Most of them are thoroughly overgrown and show few exposures, and many of them are filled with water. The largest is Blue Pond, 1 mile east of Muirkirk; there are several smaller ponds in or near Swampoodle, a settlement half a mile south of Blue Pond and $2\frac{1}{2}$ miles northeast of Beltsville. These old pits and the ore in them have been described by Singewald (1911, pp. 253–259, 285–291). The ore consists of iron carbonate partly altered to limonite. According to Hatcher (1903, p. 11), the dinosaur bones studied by Marsh came from Swampoodle. Most of those that have been found since came from the same locality.

A thick lens of dark-gray lignitic clay resembling the Arundel, though presumably within the Patapsco formation, was cut by the new Baltimore-Washington Expressway at the Good Luck Road 0.8 mile east of the Edmonston Road.

Patapsco Formation

Name.—The Patapsco formation was named by Clark (1897a, p. 191) from the Patapsco River, near Baltimore.

Description.—The basal part of the Patapsco formation is clayey; the upper part also contains clay but is more sandy and contains many lateral transitions from clay into sand, some of which contains disseminated kaolin. The lower clay is commonly maroon. The colors of the upper part are prevailingly lighter, especially the sand, much of which is white. Most of the beds are lenticular, but a few near the top are more even and appear to have been deposited in quiet water. Possibly the basal maroon clay properly belongs with the Arundel rather than the Patapsco, and some of the upper beds may represent the Raritan. There are no reliable estimates of the thickness of the Patapsco in this region. Perhaps 200 or 300 feet may be somewhere near the actual thickness, which is presumably variable.

Stratigraphic relations.—According to Clark, Bibbins, and Berry (1911, p. 70) the Patapsco formation lies unconformably on the Arundel clay and locally transgresses across it and the Patuxent onto the crystalline rocks. In this region the Patapsco, as here interpreted, is directly overlain by the Monmouth formation, which has overlapped the Matawan, Magothy, and Raritan formations, which intervene between the Patapsco and the Monmouth farther north.

Paleogeography.—During Patapsco time the swamps of the preceding Arundel time seem to have expanded into lakes, which became filled with outwash from the Piedmont. The shore line apparently lay east of this region during most of the time but may have shifted westward near the close. Marine mollusks have been reported (Vokes, 1948) from beds tentatively correlated with the Patapsco in the Maryland Esso well 4½ miles north of Ocean City, Maryland, an indication that the shore line did not lie that far east.

Flora and fauna.—The flora of the Patapsco formation, as reported by Berry (1911), includes ferns, horsetails, cycads, conifers, and the first extensive development of advanced angiosperms, which are represented by 25 listed species. The presence of these angiosperms distinguishes the Patapsco flora from the Patuxent flora. No comparison can be made with the very imperfectly known Arundel flora.

A bone collected in 1943 by Mr. A. P. Bennison, 1 mile southwest of Brightseat, was identified by C. W. Gilmore as *Ornithomimus affinis*. The presence of this Arundel carnivorous dinosaur in beds presumably high in the Patapsco suggests that there is little difference in age between the Patapsco and the Arundel.

Age.—The Patapsco formation is manifestly of Upper Cretaceous age, for it lies between the Arundel clay, which contains reptiles having Upper Cretaceous affinities, and the Monmouth formation, which carries a large marine fauna of late Upper Cretaceous age. It presumably occupies a location well down in the series, for it seems much more closely related to the Arundel, which is likewise nonmarine, than to the Monmouth, from which it is separated by a gap representing several marine and nonmarine formations.

Distribution.—The Patapsco formation occupies a band about 6 miles wide that extends southwestward across the county from the Patuxent River to the Potomac River. The lower part of the formation is best exposed in the large pits of the Washington Brick Company. These pits lie east of the Baltimore and Ohio Railroad and west of the Old Baltimore Pike a quarter to half a mile northeast of the overpass at Muirkirk, 3 miles southwest of Laurel. They expose about 50 feet of massive maroon clay overlying gray Arundel clay containing lumps of iron ore and lignitized wood.

The grade for the new Baltimore-Washington Expressway, between the Defense Highway 1.5 miles east of the Peace Cross at Bladensburg and the Good Luck Road, 2.4 miles farther north, cuts deep into the Patapsco formation. At the Good Luck Road 0.8 mile east of the Edmonston Road the cut exposes thick lenses of dark-gray lignitic clay, red clay, and yellow sand.

Beds higher in the Patapsco are exposed in sand pits north of the Good Luck Road 1.5 miles north of the Defense Highway at Lanham, where banded gray clay containing the fern *Onychiopsis goepperti* (Schenk)[1] is overlain by yellow and white sand interbedded with gray clay. Other notable exposures of the upper part of the Patapsco are in road cuts and sand pits at Dodge Park, 3.8 miles east-southeast of the Peace Cross at Bladensburg.

Monmouth Formation

Name.—The name Monmouth was proposed by Clark (1897b) for greensands and other marine deposits extending from New Jersey, where they are typically developed in Monmouth County, to the Patuxent Valley in Maryland. The formation was extended across the Patuxent into Prince Georges County by Miller (1911), who mapped it as far west as Collington, 2 miles south of Bowie.

Description.—In Prince Georges County the Monmouth formation consists chiefly of very fine sand commonly including more or less glauconite and mica. The base of the formation consists of a gravel bed about 2 feet thick containing well-rounded pebbles and coarse pink quartz sand. This bed merges upward into fine micaceous sand that weathers rusty brown. Fresher exposures are colored gray-green to nearly black by the unaltered glauconite. In this condition the Monmouth closely resembles the Eocene Aquia greensand, which overlies it, but from which it can be distinguished by its characteristic fossils. Moreover the basal Aquia is commonly coarser and contains more and coarser grains of glauconite than the Monmouth.

[1] Identified by R. W. Brown.

Though no complete sections have been found, the total thickness of the outcropping Monmouth probably does not exceed 100 feet and may be as little as 40 or 50 feet. The formation presumably is thicker in Prince Georges County than farther seaward because of the greater proportion of quartz sand deposited near shore. Only 33 feet of argillaceous glauconitic sand was assigned to the Monmouth in a well on the Eastern Shore 6 miles east of Salisbury, 75 miles seaward from the outcrop (Anderson, 1948, p. 17).

The regional strike of the Monmouth is approximately N. 45° E. The formation dips toward the southeast at a rate estimated at 25 feet to the mile.

Stratigraphic relations.—The Monmouth formation rests on the Patapsco formation. That the relations are not conformable is shown by the abrupt change from nonmarine to marine deposits, by the bed of rounded pebbles at the base of the Monmouth, and by the absence of the Matawan, Magothy and Raritan formations, which farther north intervene between the Potomac group and the Monmouth formation.

The Monmouth is overlain unconformably by beds of Paleocene age or, more commonly, by the Eocene Aquia greensand or by the Miocene Chesapeake group, both of which nearly everywhere overlap the Paleocene.

Paleogeography.—During Monmouth time the Atlantic Ocean extended westward across the Eastern Shore of Maryland, the Chesapeake Bay region, Calvert County, and most of Prince Georges County. The shore line presumably lay not far west of the present outcrop.

The absence of the Matawan, Magothy and Raritan formations indicates that the Monmouth sea advanced across a land surface. The pebble bed at the base of the Monmouth yields further evidence of this advance. The advance of the sea resulted either from a down-warp of the land or from a rise of sea level. That it may have been the latter is suggested by the widespread prevalence of an unconformity at this horizon throughout the Coastal Plain.

Fauna.—The Monmouth formation contains a large and diversified marine fauna, including fishes, crabs, and all classes of shellfish. Pelecypods are the most abundant, but there are also many gastropods and a few cephalopods. Among the distinctive species are *Exogyra costata*, *Eutrephoceras dekayi*, and *Sphenodiscus lobatus*, all widely distributed and of narrow stratigraphic range.

Age.—The presence of *Exogyra costata* locates the Monmouth formation within the *Exogyra costata* zone, or upper part of the Upper Cretaceous series, and *Sphenodiscus lobatus* restricts it to the upper part of that zone, or very near the top of the Upper Cretaceous. On this evidence, the fossiliferous part of the Monmouth of Prince Georges County correlates very closely with the Tinton sand member of the Red Bank sand of New Jersey; with the Prairie Bluff chalk of Mississippi and Alabama; and with the Corsicana marl of Texas.

The Monmouth of Prince Georges County may also include the equivalent of the typical Red Bank sand of New Jersey, which carries *Exogyra costata* and

Eutrephoceras dekayi but apparently not *Sphenodiscus*. The absence of *Exogyra ponderosa* and *Belemnitella americana* suggests that no part of the Monmouth of this county is as old as the Navesink marl of New Jersey, which, with the Red Bank sand, is included in the Monmouth group.

Distribution.—The outcrop of the Monmouth formation extends south-southwestward across Prince Georges County from the vicinity of Priest Bridge on the Patuxent River to Fort Washington on the Potomac River. Between Priest Bridge and Brightseat the outcrop forms a band 2 to 3 miles wide in some places; beyond Brightseat it is narrower, very crooked, and discontinuous because of the greater topographic relief and the partial overlap of Miocene and Pleistocene beds.

The area mapped as Monmouth on the 1951 geologic map of Prince Georges County includes some outcrops of Paleocene beds, which had not been recognized when the map was made and which are difficult to distinguish from the Monmouth except where they contain identifiable fossils. An area underlain by sparingly glauconitic micaceous sand extending northward from Collington may represent an overlap of a younger formation rather than the Monmouth, or it may be the Matawan, as it was previously mapped.

The lower part of the Monmouth is exposed in a steep bluff overlooking the mouth of Piscataway Creek at the south end of Fort Washington. The lower 19 feet of the bluff consists of mottled pink clay of the Potomac group. This is overlain unconformably by a 2-foot conglomerate containing partly rounded quartz pebbles as much as 2 inches in length, the bottom of the Monmouth. The conglomerate merges upward into fine dark-brown micaceous sandy clay containing impressions of marine mollusks. About 20 feet of this bed is exposed. Coarse rusty glauconitic sand, basal Aquia, crops out on the path up the hill not far above this exposure.

Old collections of Monmouth fossils from Fort Washington identified by Gardner (Clark, 1916, pp. 90–101) include the following species:

Pelecypods from the Monmouth formation at Fort Washington

Leda rostratruncata Gardner
Cucullaea vulgaris Morton
Cucullaea carolinensis (Gabb)
Trigonia eufalensis Gabb
Crassatella vadosa Morton
Crassatella lintea Conrad
Tenea parilis (Conrad)
Cyprimeria depressa (Conrad)
Cyprimeria alta (Conrad)
Cymbophora berryi (Gardner)

The bed of a small stream heading near Friendly carries float of broken shells where it crosses the Indian Head road about 1 mile west by north of Friendly. From somewhere in this vicinity came the old collections of Monmouth fossils listed by Gardner (Clark, 1916, pp. 90–101) as from Friendly and 1 mile west of Friendly as follows:

Fossils from the Monmouth formation near Friendly

Sphenodiscus lobatus (Tuomey)
Ringicula clarki Gardner
Paladmete cancellaria (Conrad)
Surcula amica Gardner
Liopeplum cretaceum (Conrad)
Liopeplum monmouthensis Gardner
Pyropsis whitfieldi Weller
Pyrifusus marylandicus Gardner
Pyrifusus? elevatus Whitfield
Turritella trilira Conrad?
Gyrodes petrosus (Morton)
Nucula slackiana Gabb
Nucula amica Gardner
Leda whitfieldi Gardner
Leda rostratruncata Gardner
Glycymeris wordeni Gardner
Pteria rhombica Gardner
Ostrea larva falcata Morton
Ostrea larva nasuta Morton
Ostrea larva mesenterica Morton
Ostrea monmouthensis Weller
Ostrea tecticosta Gabb
Exogyra costata Say
Gryphaea vomer Morton
Trigonia eufalensis Gabb
Pecten argillensis Conrad
Pecten simplicius Conrad
Anomia argentaria Morton
Anomia forteplicata Gardner
Lithophaga ripleyana Gabb
Crenella serica Conrad
Dreissena tippana Conrad
Veniella conradi (Morton)
Crassatella lintea Conrad
Crassatella pteropsis Conrad
Myrtaea stephensoni Gardner
Tenea parilis Conrad
Cardium eufaulense Conrad
Cardium kummeli Weller
Cyclina parva Gardner
Legumen planulatum (Conrad)
Cyprimeria depressa (Conrad)
Tellina gabbi Gardner
Tellinimera eborea (Conrad)
Aenona eufalensis (Conrad)
Linearia metastriata Conrad

Leptosolen biplicata (Conrad)
Cymbophora berryi (Gardner)
Cymbophora wordeni (Gardner)
Corbula terramaria Gardner
Corbula subradiata Gardner
Hamulus onyx Morton
Micrabacia rotatilis Stephenson
Micrabacia marylandica Stephenson

Schmidt (1948, p. 399) reports dark-green glauconitic, micaceous marl containing fragments of shells, foraminifers, and ostracodes in this stream where it begins to approach the road to Friendly about a quarter of a mile above the Indian Head Road. From two collections made in this vicinity she lists the following species of ostracodes:

Monmouth ostracodes from stream west of Friendly

Brachycythere rhomboidalis (Berry)
Brachycythere arachoides (Berry)
Paracypris monmouthensis Schmidt
Haplocytheridea? plummeri (Alexander)
Haplocytheridea? fabaformis (Berry)
Haplocytheridea? fabaformis multilira Schmidt
Haplocytheridea? macropora (Alexander)
Haplocytheridea? amygdaloides brevis (Cornuel)
Haplocytheridea? ulrichi (Berry)
"Archycythereis" cf. Cythereis pidgeoni (Berry)
Cytherella sp.

The contact of the Monmouth and the Aquia lies about 5 feet above the Indian Head road in the cut south of the road to Friendly. The Monmouth is light-gray, sparingly glauconitic, fine micaceous sand. The Aquia is coarser. It contains more and larger grains of glauconite and little if any mica. There appear to be borings filled with Aquia in the top of the Monmouth.

The excavation for the new Oxon Hill High School on the Indian Head road about 2.6 miles south of the District line cuts through about 40 feet of Monmouth formation into white sand of the Potomac group. Only the upper part of the pit was visible when visited, but black sand containing angular quartz pebbles and many large, full-grown shells of *Ostrea tecticosta* Gabb? apparently came from the lower part of the Monmouth.[2] A higher bed in the Monmouth consists of black micaceous clay containing concretions of hard gray marlstone enclosing *Rostellites marylandicus* Gardner, *Turritella vertebroides* Morton?, *Exogyra costata* Say, *Crassatella vadosa* Morton, and *Cyprimeria alta* (Conrad). The elevation of the top of this black bed is about 110 feet above sea level. The

[2] This oyster-bearing black sand may be of Paleocene age. The oyster appears to be related to *Ostrea crenulimarginata* Gabb, a Midway (Paleocene) species. The sand and shells were not seen in place. They came from the water-filled excavation.

bed is overlain by fine gray glauconitic sand. The top of the Monmouth lies 2 or 3 feet lower than the south door of the school. Above the Monmouth is about 10 feet of coarser rusty, glauconitic sand referred to the Aquia greensand. The Aquia is overlain by coarse Pleistocene gravel.

A ditch extending northward along the east side of the Indian Head road from a point about half a mile north of the new Oxon Hill High School to Carey Branch cuts into dark-gray micaceous sand containing *Exogyra costata* Say and fragments of other mollusks. Several star-shaped concretion-like objects probably of organic origin were also found.

Another fossiliferous outcrop of the Monmouth formation is in a gully leading into a tributary of Henson Creek on the land of Lucius Latham, a quarter of a mile east of the old Oxon Hill High School and 1.55 miles south-southwest of Phelps Corner. The gully cuts through coarse poorly-sorted cobbly Pleistocene sand (Sunderland formation) into dark-gray, nearly black, fine micaceous sand containing a shell bed about 10 feet below the top. The following species were collected there:

USGS 21066. Tributary of Henson Creek 1.5 miles south-southwest of Phelps Corner. C. Wythe Cooke and H. K. Brooks, collectors.

Nautiloid fragments
Liopeplum cretaceum (Conrad)?
Nucula slackinana (Gabb)
Leda rostratruncata Gardner
Leda whitfieldi Gardner
Arca (Barbatia) saffordi Gabb
Ostrea tecticosta Gabb? (juv.)
Exogyra costata Say
Pecten argillensis Conrad
Pecten simplicius Conrad
Anomia argentaria Morton
Crenella serica Conrad
Pholadomya sp.
Cardium eufalense Conrad?
Legumen sp.
Lithophaga conchifodentis Gardner
Cyprimeria alta (Conrad)
Tellina (Acropagia) gabbi Gardner
Aenona eufalensis (Conrad)
Spisula berryi Gardner
Corbula crassiplica Gabb
Corbula terramaria Gardner
Micrabacia marylandica Stephenson

Black micaceous, finely glauconitic sand containing prints of mollusks is exposed to a thickness of 30 or 40 feet on Branch Avenue between Military Road (Suitland Parkway) and Naylor Road a quarter of a mile south of the District line. The Monmouth is overlain by a foot or two of coarser green glauconitic sand, presumably Aquia, above which is Miocene clay containing fossil bones. Micaceous, sparingly glauconitic sand cut in graves in Cedar Hill Cemetery, south of Oxon Run and 0.3 mile northeast of the Suitland Road, presumably represents the Monmouth formation.

Schmidt (1948, p. 398) obtained the following species of ostracodes from the bank of Cabin Branch west of the Addison Road, 0.7 mile south of Central Avenue:

Monmouth ostracodes from Cabin Branch west of Addison Road

Brachycythere rhomboidalis (Berry)
Brachycytheridea arachoides (Berry)
Haplocytheridea? fabaformis (Berry)
Haplocytheridea? plummeri (Alexander)
Haplocytheridea? macropora (Alexander)
Haplocytheridea? amygdaloides brevis (Cornuel)
Cythereis pidgeoni (Berry)

Paleocene fossils were obtained farther up Cabin Branch and on Addison Road near this exposure of Monmouth.

Both Aquia and Monmouth fossils have been reported from the Brooks Estate, which is 0.4 mile south of Central Avenue at a point 0.65 mile east of the Addison Road and 1.6 miles southeast of the eastern corner of the District of Columbia. The Eocene exposures are in a small stream southwest of the barn; presumably the Cretaceous crops out farther down the same stream. The following Cretaceous species have been listed (Clark, 1916, pp. 90–101) from the Brooks Estate:

Monmouth fossils from the Brooks Estate

Fishes (identified by E. W. Berry)

Lamna elegans Agassiz
Lamna cuspidata Agassiz
Corax pristodontus Agassiz
Enchodus dirus (Leidy)
Myliobatis obesus Leidy?

Crabs (identified by H. A. Pilsbry)

Callianassa mortoni Pilsbry
Callianassa mortoni marylandica Pilsbry
Callianassa conradi Pilsbry
Callianassa conradi punctimanus Pilsbry

Mollusks (identified by Julia Gardner)

Eutrephoceras dekayi (Morton)
Sphenodiscus lobatus (Tuomey)
Ringicula clarki Gardner
Haminea cylindrica Gardner

Acteocina forbesiana (Whitfield)
Surcula amica Gardner
Liopeplum leiodermum (Conrad)
Liopeplum cretaceum (Conrad)
Vulpecula reileyi (Whitfield)
Pyropsis perlata (Conrad)
Pyropsis whitfieldi Weller
Serrifusus nodocarinatus Whitfield
Odontofusus medians Whitfield
Anchura pergracilis Johnson
Anchura monmouthensis Gardner
Turritella paravertebroides Gardner
Turritella trilira Conrad
Turritella tippana Conrad
Gyrodes petrosus (Morton)
Polynices altispira (Gabb)
Discohelix lapidosus (Morton)
Nucula slackinana (Gabb)
Nucula microstriata Gardner?
Leda whitfieldi Gardner
Leda rostratruncata Gardner
Perrisonota protexta Conrad
Nemodon eufalensis (Gabb)
Cucullaea vulgaris Morton
Arca (Barbatia) saffordi Gabb
Glycymeris (Postligata) wordeni Gardner
Ostrea larva falcata Morton
Ostrea larva nasuta Morton
Ostrea larva mesenterica Morton
Ostrea monmouthensis Weller?
Ostrea faba Gardner
Ostrea tecticosta Gabb
Ostrea subspatulata Forbes
Exogyra costata Say
Gryphaea (Gryphostrea) vomer Morton
Trigonia eufalensis Gabb
Trigonia cerulea Whitfield
Pecten argillensis Conrad
Pecten whitfieldi Weller
Pecten simplicius Conrad
Lima obliqua Gardner
Anomia argentaria Morton
Modiolus trigonus Gardner
Lithophaga ripleyana Gabb
Lithophaga juliae (Lea)
Crenella serica Conrad
Dreissena tippana Conrad
Periplomya elliptica (Gabb)
Liopistha protexta (Conrad)
Veniella conradi (Morton)

Crassatella vadosa Morton
Crassatella lintea Conrad
Crassatella pteropsis Conrad
Myrtaea stephensoni Gardner
Tenea parilis (Conrad)
Cardium eufalense Conrad
Cardium dumosum Conrad
Cardium kummeli Weller
Dosinia obliquata Conrad
Cyclina parva Gardner
Legumen planulatum (Conrad)
Cyprimeria depressa (Conrad)
Cyprimeria major Gardner = C. alta (Conrad)
Tellina (Arcopagia) gabbi Gardner
Tellinimeria eborea (Conrad)
Aenona eufalensis (Conrad)
Linearia metastriata Conrad
Leptosolen biplicata (Conrad)
Spisula (Cymbophora) berryi Gardner
Spisula (Cymbophora) wordeni Gardner
Corbula crassiplica Gabb
Corbula monmouthensis Gardner
Corbula percompressa Gardner?
Corbula subradiata Gardner
Panope monmouthensis Gardner

Worms (identified by Julia Gardner)

Serpula whitfieldi (Weller)
Hamulus onyx Morton
Ornatoporta marylandica Gardner

Coral (identified by L. W. Stephenson)

Micrabacia rotatilis Stephenson

The Maryland Geological Survey's report on the Upper Cretaceous lists Monmouth fossils from a "R. R. cut west of Seat Pleasant." Presumably this cut is the one crossed by Central Avenue just west of the Addison Road, 0.7 mile southeast of the eastern corner of the District of Columbia, though the direction specified is different. This cut is now abandoned and badly overgrown, but the Monmouth formation, resting unconformably on the Potomac group, is exposed on a bare slope south of Central Avenue and east of the cut. The species listed in the report (Clark, 1916, pp. 90–101) are as follows:

Monmouth fossils from railway cut east of Seat Pleasant

Crocodile (identified by E. W. Berry)

Thoracosaurus sp.

Crab (identified by H. A. Pilsbry)

Callianassa conradi Pilsbry

Mollusks (identified by Julia Gardner)

Pugnellus densatus (Conrad)
Gyrodes petrosus (Morton)

Polynices (Euspira) halli (Gabb)
Nucula slackiana (Gabb)
Leda rostratruncata Gardner
Ostrea larva nasuta Morton
Exogyra costata Say
Trigonia eufalensis Gabb
Anomia argentaria Morton
Lithophaga twitchelli Gardner
Liopistha protexta (Conrad)
Veniella conradi (Morton)
Crassatella vadosa Morton
Crassatella pteropsis Conrad
Cyprimeria major Gardner = C. alta (Conrad)

The headwaters of a stream 0.8 mile S. 60° E. of Brightseat and 2.6 miles N. 62° E. of the eastern corner of the District of Columbia cuts through the fine dark-gray silty, micaceous glauconitic sand of the Monmouth formation. This place is reached from Brightseat by following the Sheriff Road westward 0.66 mile to a private road leading southward, then southwestward about a quarter of a mile, paralleling the left (northwest) side of the stream. The following species of mollusks were collected there:

USGS 21068. Monmouth mollusks 0.8 mile southwest of Brightseat.
C. Wythe Cooke and Harold K. Brooks, collectors

Discoscaphites sp.
Sphenodiscus sp.
Gyrodes sp.
Liopeplum sp.
Nucula slackiana Gabb
Nucula stantoni Stephenson?
Nucula whitfieldi Weller?
Leda rostratruncata Gardner
Glycymeris wordeni Gardner
Arca saffordi Gabb
Nemodon eufalensis (Gabb)
Ostrea larva mesenterica Morton
Exogyra costata Say
Trigonia eufalensis Gabb
Pecten simplicius Conrad
Anomia argentaria Morton
Crassatella vadosa Morton
Cardium sp.
Tellina? sp.
Aenona eufalensis (Conrad)
Lithophaga juliae (Lea)
Crenella serica Conrad
Cyprimeria alta (Conrad)
Legumen sp.
Corbula crassiplica Gabb
Corbula monmouthensis Gardner

A much longer list of fossils from this or a neighboring locality near Brightseat is contained in the Upper Cretaceous volumes of the Maryland Geological Survey (Clark, 1916, pp. 90–101).

Schmidt (1948, p. 398) lists the following species of ostracodes from an old collection from Brightseat:

Monmouth ostracodes from near Brightseat

Brachycythere rhomboidalis (Berry)
Brachycythere arachoides (Berry)
Cytheropteron (C.) coryelli Schmidt
Loxoconcha cretacea Alexander
Haplocytheridea? fabaformis (Berry)
Haplocytheridea? macropora (Alexander)
Haplocytheridea? amygdaloides brevis (Cornuel)
Haplocytheridea? ulrichi (Berry)
Cythereis pidgeoni (Berry)
Cytherella cf. C. beyrichi (Reuss)
Cytherella sp.

Ledges of ironstone cap a hill 0.75 mile east of the railroad crossing at Glenn Dale at an altitude of about 235 feet. They are underlain by gray micaceous, glauconitic, argillaceous sand, which crops out along the road leading southward to a thickness of perhaps 20 feet. This exposure probably represents the Monmouth, though no recognizable fossils were found. It may, however, be Matawan.

About 6 feet of fine light-gray micaceous sand containing small round green grains, probably glauconite, unconformably overlies about 20 feet of white clay and yellow sand of the Patapsco formation in a cut on the abandoned Washington, Baltimore, and Annapolis Electric Railway about 0.4 mile northeast of High Bridge. There are quartz pebbles in the base of the upper bed, which is probably Monmouth, though it may be Miocene or Matawan. The altitude of the contact is about 150 feet above sea level.

Three or 4 feet of fine dark-gray micaceous, sparingly glauconitic sand containing impressions of shells is exposed in a cut on the Defense Highway at the gate of Belair Lodge, 0.5 mile northeast of the Bowie Road at Collington. It is overlain by the Aquia greensand, coarser sand containing large grains of glauconite.

Rusty micaceous, sparingly glauconitic fine sand, probably representing the Monmouth formation, possibly Matawan, crops out at intervals along the road from the Defense Highway 1.5 miles west of Priest Bridge to Bowie Race Track. The contact with the underlying Patapsco formation was noted about 0.2 mile south of the race track at an altitude of about 110 feet.

Streams crossing the Crain Highway 1.3 and 2.0 miles south of Priest Bridge cut through the Aquia greensand into dark-gray sand of the Monmouth.

Across the Patuxent River in Anne Arundel County 23 feet of gray-brown clayey sand with vertical cleavage cracks and impressions of fossils is overlain by 21 feet of fine dark-gray micaceous, argillaceous sand containing shark teeth and impressions of mollusks and with glauconite at the top. The exposure is on a road 0.6 mile south of the junction of the Defense Highway and the Crain Highway near Priest Bridge.

Black micaceous sand is exposed along a small tributary of Western Branch near the Lottsford Road 0.3 mile west of the Enterprise Road at Woodmoor. Black clay and very fine blue-black glauconitic sand crop out in another tributary crossing the entrance to Northampton 0.2 mile north of Central Avenue 0.7 mile east of Largo. These beds may be of Paleocene age.

TERTIARY SYSTEM

PALEOCENE SERIES

The Paleocene series was first officially accepted by the U. S. Geological Survey about 1940. The beds then included in it had been referred to the Eocene series as its lower part. The justification for classifying the Paleocene as a series lies in its fauna, which is, perhaps, as individual as that of any other series in the Cenozoic era. In the Southern States the Paleocene series comprises the Midway group. The Midway fauna, though dominantly Cenozoic, shows closer relationships to Upper Cretaceous faunas than does that of the Wilcox group, which is now classified as basal Eocene.

In Maryland, foraminifera elsewhere indicative of Paleocene age were first noted by Cushman (1948, p. 226) in the Hammond well on the Eastern Shore. Later, they were found also in the Buchheister well east of Upper Marlboro and in the Southern Maryland Electric Cooperative well at Hughesville in Charles County, where they include large specimens of *Nodosaria affinis* Reuss and *Robulus* sp. cf. *R. piluliferus* Cushman (Shifflett, 1948, p. 32). On the basis of these two wells, Shifflett (1948, p. 36) indicates that the Paleocene sea extended into the eastern part of Prince Georges County.

In connection with the cooperative ground-water investigations by the U. S. Geological Survey and the Maryland Department of Geology, Mines and Water Resources, the supposed Paleocene bed was traced in the subsurface to exposures 1 mile and 3½ miles southwest of Brightseat. Fossil mollusks from the first exposure were cursorily examined by H. E. Vokes, who detected Paleocene affinities, and they were later more critically studied by Julia Gardner, who confirmed their Paleocene age under date of May 5, 1951. This information came too late to be included on the 1951 geologic map of Prince Georges County.

Brightseat Formation

Name.—The name Brightseat formation has been proposed by Bennett and Collins (1952) for the Paleocene deposits underlying part of Prince Georges

County and exposed in two small areas about 1 mile and $3\frac{1}{2}$ miles southwest of Brightseat.

Description.—The Brightseat consists prevailingly of fine dark-gray micaceous sandy clay. It contains local ledges or nodules of hard gray marlstone. The formation may be as much as 20 or 30 feet thick at the outcrop, and it is probably thicker underground, where the surface is less eroded.

Stratigraphic relations.—The Brightseat formation lies unconformably on the Upper Cretaceous Monmouth formation. The contact is marked by a bed of pebbles. The upper surface was much eroded before the Aquia greensand was deposited on it—so much so that the formation has been completely removed at many places, causing the Eocene Aquia greensand to lie directly on the Upper Cretaceous Monmouth formation. The contact of the Aquia with the Brightseat is a sharp line. It can be recognized by a change from the fine micaceous sand of the Brightseat to the coarse glauconitic sand of the Aquia, with the inclusion of small black phosphatic nodules or pebbles and reworked phosphatized moulds of fossils in the overlying Aquia.

Paleogeography.—During Paleocene time, or at least the part represented by the Brightseat formation, the open ocean extended westward across Maryland as far as the eastern corner of the District of Columbia and possibly farther. That the water in which the Brightseat accumulated was marine is indicated not only by the character of the sediments but also by the fossils, which represent genera characteristic of the sea. This sea withdrew at the end of Brightseat time, probably because of a world-wide lowering of sea level brought on by crustal movements elsewhere, for there seems to be no evidence of local warping in the interval between the times of deposition of the Brightseat and the Aquia.

Fauna.—The fauna of the Brightseat formation is still very incompletely known. Among mollusks collected south of the Sheriff Road near Brightseat Julia Gardner identified *Ledina* sp. cf. *L. smirna* Dall, a species characteristic of the Midway group. Other species that she regards as definitely older than the Aquia fauna are venericards with laterally terraced ribs, *Miltha* (*Plastomiltha claytonia* Harris?, and *Gilbertina texana* Gardner, a species characteristic of the Midway group of Texas. Associated with these species and supposed to have come from the same bed are *Cucullaea gigantea* Conrad, *Venericardia regia* Conrad, "*Cytherea pyga* Conrad", *Turritella humerosa* Conrad, and immature specimens related to *Turritella mortoni* Conrad. All these associated species occur also in the Aquia greensand.

Age.—The Paleocene era did not last long enough, or physical conditions were too uniform, to produce a great variety of sediments. In general not more than two successive formations are recognized in the Southern States, where the series is best developed. Too little is yet known about the Brightseat formation to establish a definite correlation with either of these parts. Presumably, deposition of the Brightseat began with the first invasion of the Paleocene sea and continued uninterruptedly until the sea withdrew at the end of that era. Erosion prior to the invasion of the Aquia (Eocene) sea stripped off an unknown thickness of Paleocene beds, leaving only remnants of the early deposits of the era.

Distribution.—The Brightseat formation underlies a large part of the area now covered by the Aquia greensand, but only two outcrops of the formation have been discovered. Both are mapped as Monmouth on the 1951 Prince Georges County geologic map. Some of the other outcrops mapped as Monmouth formation likewise may really represent the Brightseat. Among these may be mentioned the fine black sand exposed in a tributary of Western Branch at the entrance to Northampton, 0.75 mile east-northeast of Largo. However, along the line of outcrop the formation seems to occur only as isolated patches or outliers, for in another ravine only a quarter of a mile from the fossiliferous exposure near Brightseat, the fossiliferous Aquia greensand seems to rest directly on fossiliferous Monmouth, the Brightseat formation being absent.

The more characteristic exposure of the Brightseat formation, although it is the farther from the crossroads bearing that name, is on the Addison Road 0.75 mile south of Central Avenue and 3.5 miles southwest of Brightseat. A cut on the east side of the road exposes about 5 feet of fine dark-gray or brown sand enclosing a few lumps of hard fossiliferous marlstone. The Brightseat formation is overlain with sharp contact by coarse glauconitic Aquia greensand containing at the base a zone of round phosphatic nodules and reworked phosphatized moulds of shells. The contact of the Brightseat with the Monmouth is marked by a zone of pebbles in the bank of Cabin Branch 10 or 15 feet below the level of the road and a short distance down stream from the cut. The contact with the Aquia is exposed also in the bank of Cabin Branch back of a pigpen about 100 yards upstream from the exposure on the road.

The other locality, containing recognizable fossil mollusks, is in a narrow ravine near the head of a stream that crosses the Sheriff Road 0.85 mile west of Route 202 at Brightseat. Fossils collected about a quarter of a mile south of the road were submitted by R. R. Bennett. The list of species follows.

Paleocene mollusks from 1 mile west by south of Brightseat

(Identified by Julia Gardner)

Nuculanids, 2 genera, not recognized
Ledina sp. cf. L. smirna Dall
Cucullaea gigantea Conrad
Glycymeris sp.
Exogyra costata Say (reworked and juvenile)
Crenella sp.
Venericardia (Venicor) sp. cf. V. regia Conrad
Venericardia (Venicor) sp. cf. V. hijuana Gardner and Bowles
Crassatellites n. sp. aff. C. alaeformis Conrad
Miltha (Plastomiltha) claytonia Harris?

Lucinoma n. sp? (The group is generally indicative of cool water)
"Lucina" sp. cf. "L." uhleri Clark
Cavilucina sp.?
Leptonid?
Dosiniopsis sp. cf. D. lenticularis (Rogers and Rogers)
"Cytherea pyga Conrad"
Venerids, probably new, aff. Callocardia aequorea (Conrad)
Tellina n. sp.?
Corbula sp. aff. C. subengonata Dall
Turritella humerosa Conrad
Turritella sp. cf. T. mortoni Conrad (immature)
Calyptraea? sp.
Naticoids, possibly near Polynices harrisii Gardner
Aporrhais n. sp. (an ancient type with a very sparse representation in the lower Eocene.)
Strepsidura sp. aff. S. subscalarina Heilprin
Tornatellaea sp. cf. T. bella Conrad
Gilbertina texana Gardner

Besides the mollusks the collection from near Brightseat includes foraminifera, a solitary coral, otoliths, fish teeth, and bones.

EOCENE SERIES

PAMUNKEY GROUP

The Eocene epoch is divisible into three parts. During some of early Eocene time the Atlantic Ocean covered most of Prince Georges County and deposited sand and clay comprising the Pamunkey group. During middle and late Eocene time this region may have been above sea level, for no deposits of those ages have been recognized here.

The Pamunkey was considered a single formation by Darton (1891), who named it from the Pamunkey River in Virginia. Clark and Martin (1901) called it a group, which they divided into the Aquia and Nanjemoy formations.

Aquia Greensand

Name.—The name Aquia greensand is applied to the Eocene deposits, chiefly glauconitic sand or greensand, that intervene between the Paleocene Brightseat formation and the Eocene Nanjemoy formation. As thus used, the term is equivalent to the Aquia formation of Clark and Martin (1901), which is an expansion of the Aquia Creek stage proposed by Clark (1895, 1896) several years earlier. The more specific term greensand is preferred to formation in this region because glauconite is the dominant mineral and occurs throughout the formation.

Description.—The glauconite of the Aquia is commonly in rather large grains, particularly in the lower part of the formation. It is nearly everywhere mixed with somewhat finer sand, which is less conspicuous because of its neutral color, though it may exceed the glauconite in actual volume. The Aquia includes several local ledges of marlstone in which the glauconitic sand is cemented by lime.

Fresh exposures of the Aquia are generally very dark green, but this color alters to rusty-brown in time because of the oxidation of the iron in the glauconite.

Clark and Martin (1901, p. 59) estimated the thickness of the Aquia as 100 feet. This estimate may be excessive at the outcrop, though the thickness exposed doubtless varies from place to place according to the amount of erosion that the top of the formation has undergone. The Aquia strikes approximately N. 55° E. It dips southeastward about 15 feet to the mile.

Stratigraphic relations.—The Aquia lies unconformably on the eroded surface of the Paleocene Brightseat formation or overlaps on older formations.

The Aquia is overlain by the Nanjemoy formation. The relations are probably unconformable, for there is an abrupt change at the contact from coarse glauconitic sand to plastic pink clay, and the contact is somewhat uneven. This unconformity, if it is one, represents a much shorter time than that at the base of the Aquia, for both formations are comprised within the interval represented by the Wilcox group of Alabama.

Paleogeography.—A widespread advance of the sea at the beginning of Eocene time brought the open ocean into this region. This invasion was probably caused by a rise in sea level rather than by a local downwarp, for it extended at least from Alabama to New Jersey. That there was no rejuvenation of the streams near at hand is indicated by the absence of basal conglomerate. Some fine sand is incorporated in the basal Aquia, but there are few if any pebbles other than phosphatic nodules and phosphatized reworked fossils. The abundance of glauconite and the occurrence of marine fossils indicate that the invading water was marine, not brackish.

Fauna.—Fossils occur at several horizons within the Aquia. The lowest zone, lying only a foot or two above the base, includes several large, heavy mollusks that indicate shallow water, such as *Venericardia planicosta regia*, *Callocardia ovata*, *Cucullaea gigantea*, *Ostrea compressirostra*, *Crassatella* sp., and *Turritella humerosa*. The fauna of this zone, which has not been thoroughly explored, includes several undescribed species. *Turritella mortoni*, *Ostrea compressirostra*, *Cucullaea gigantea*, and *Crassatella alaeformis* are the most conspicuous species at higher zones. Most of the shells are very soft and fragile.

Age.—*Ostrea compressirostra* and several other species correlate the Aquia closely with the basal Eocene Nanafalia formation of Alabama. This correlation is more precise than that of Clark (1896), who said that "the general aspect of this assemblage is Lignitic" (Wilcox group).

Distribution.—The Aquia greensand underlies the southeastern two-thirds of Prince Georges County. The line of outcrop extends from the Potomac River at the southwestern boundary of Prince Georges County to the Patuxent River near Priest Bridge, but it is broken by an overlap of Pliocene and Pleistocene beds near the southern part of the District of Columbia.

The Aquia greensand containing *Turritella mortoni* crops out in a gully a quarter of a mile from the Charles County boundary, 1 mile from the Potomac River. It occurs also near the Bryan Point road 1.2 miles west of the county line. Other small exposures are at the foot of the bluff back of the terrace bordering the estuary of Piscataway Creek.

A ravine half a mile south of the entrance to Fort Washington reservation exposes about 30 feet of Aquia greensand containing large casts of *Cucullaea gigantea*, *Ostrea compressirostra*, and other fossils. Farther downstream is a small outcrop of brown micaceous sand of the Monmouth formation.

A ravine running southwestward through the reservation to the mouth of Piscataway Creek exposes about 40 feet of Aquia greensand containing *Ostrea compressirostra* and other fossils. The Aquia is overlain by terrace gravel. The contact is exposed on the west side, below the parade ground. The Aquia is overlain by Miocene sand.

The Aquia is exposed in a gully north of the road and outside of the entrance to Fort Washington reservation. The fossils noted are *Turritella mortoni*, *Turritella humerosa*, *Cucullaea gigantea*, *Ostrea compressirostra*, and *Crassatella alaeformis*. There are ledges of marlstone near the top of the exposure.

Clark and Martin (1901, pp. 74–78) list the following species from Fort Washington:

Aquia fossils from Fort Washington[3]

Fishes

Odontaspis elegans (Agassiz)
Odontaspis macrota (Agassiz)
Odontaspis cuspidata (Agassiz)

Mollusks

Tudicla sp.
Turritella mortoni Conrad
Turritella humerosa Conrad
Lunatia marylandica Conrad
Calyptraea aperta (Solander)
Phenacomya petrosa (Conrad)
Panope elongata (Conrad)
Tellina virginiana Clark
Tellina papyria Conrad?
Callocardia ovata pyga (Conrad)
Dosiniopsis lenticularis (Rogers)
Venericardia planicosta regia Conrad
Crassatella alaeformis Conrad

[3] Some of the names of genera are revised in this and other lists.

Pholadomya marylandica Conrad
Modiolus alabamensis Aldrich
Ostrea compressirostra Say
Ostrea compressirostra alepidota Dall
Cucullaea gigantea Conrad

Turritella mortoni was noted in the Aquia greensand in a ravine 1 mile east-southeast of the entrance to Fort Washington.

The most nearly complete section of the Aquia greensand and the Nanjemoy formation in Prince Georges County is exposed on the new Indian Head Road north of Piscataway Creek. It extends from just above water level in the creek to the top of the road cut, a vertical distance of 105 feet. The Aquia is noteworthy for the great numbers of *Turritella mortoni* and *Ostrea compressirostra*. The section is as follows:

Section on Indian Head Road at Piscataway Creek

	Feet
4. Covered to top of hill, about	10
Nanjemoy formation	
3. Gray glauconitic sand; some lumps contain obscure fossils	16
2. Pink plastic clay containing small round ferruginous concretions	27
Aquia greensand.	
1. Gray-green glauconitic sand, some mica. Two principal shell beds; the lower, about 6 feet thick, has many *Turritella mortoni* and *Ostrea compressirostra*; the upper contains *T. mortoni* and *Crassatella alaeformis*. Greensand is said to extend 40 feet below water level at the bridge, but the Monmouth may be included in that interval. To water level, about	62

The species in the following list were collected at this place:

USGS 17104. Aquia fossils on Indian Head Road at Piscataway Creek.
C. Wythe Cooke and Harold K. Brooks, collectors
Odontaspis (Odontaspis) rutoti (Winkler) (Identified by D. H. Dunkle)
Odontaspis (Synodontaspis) macrota (Agassiz) (Identified by D. H. Dunkle)
Myliobatis or Rhinoptera sp. (Identified by D. H. Dunkle)
Turritella mortoni Conrad
Turritella praecincta Conrad
Cucullaea gigantea Conrad
Ostrea compressirostra Say
Venericardia planicosta regia Conrad
Dosiniopsis lenticularis (Rogers)
Crassatella alaeformis Conrad
Corbula subengonata Dall

Aquia greensand containing *Turritella mortoni* crops out below the forks of a small tributary of Tinkers Creek and west of a road 1.2 miles north-northwest of St. Mary's Church at Piscataway.

Shifflett (1948, p. 7) records a very detailed section of the Aquia greensand extending along a small stream that heads near Friendly and flows westward. The exposures are about 0.5 mile west of Friendly. She lists (Shifflett, 1948, fig. 2) 64 species of foraminifera from the Aquia, which is there in contact with the Monmouth formation.

About 18 feet of greenish-brown Aquia greensand crops out near the road 0.2 mile southeast of Henson Creek and 1 mile northwest of Palmers Corner. The altitude of the exposure is about 100 feet above sea level. *Ostrea compressirostra* and a few other fossils occur there (USGS 17148).

A tributary of Henson Creek three-quarters of a mile east of Phelps Corner exposes coarse green Aquia greensand about 140 feet above sea level. The outcrop is in the bed of the creek below the Crenshaw Road. *Turritella humerosa*, *Ostrea compressirostra*, *Cucullaea gigantea*, *Crassatella alaeformis*, and *Dosiniopsis lenticularis* were collected here (USGS 17127).

A branch of Henson Creek a quarter of a mile east of the Temple Hills Road and a mile and a quarter west-northwest of Camp Springs yielded *Turritella humerosa*, *T. mortoni*, *Dosiniopsis lenticularis*, *Ostrea compressirostra*, and *Crassatella alaeformis*.

From a small branch southwest of the barn on the Brooks Estate, 0.4 mile south of Central Avenue and 0.7 mile west of the Addison Road, the following Aquia fossils were obtained from coarse green glauconitic sand: *Turritella humerosa*, *Ostrea compressirostra*, *Cucullaea gigantea*, *Dosiniopsis lenticularis*, *Crassatella alaeformis*, and *Modiolus alabamiensis* (USGS 17126). Clark and Martin (1901, pp. 74–78) list also *Cythere marylandica*, *Turritella mortoni*, *Callocardia ovata pyga*, *Crassatella aquiana*, and *Astarte marylandica*. The Cretaceous fossils found on the Brooks Estate are listed under the Monmouth formation.

From the head of the same branch southwest of Brightseat from which Monmouth fossils were collected, the following Aquia species were obtained. They were collected very near the bottom of the formation, for the Cretaceous outcrop is only a few feet lower.

USGS 17147. Aquia fossils from head of branch 1 mile southwest of Brightseat.
C. Wythe Cooke and Harold K. Brooks, collectors

Lunatia marylandica Conrad
Turritella humerosa Conrad
Cucullaea gigantea Conrad
Ostrea compressirostra Say
Dosiniopsis lenticularis (Rogers)
Callocardia pyga (Rogers)
Lucina sp.
Macoma? sp.
Crassatella sp.
Corbula subengonata Dall
Venericardia planicosta regia Conrad

The Aquia crops out also near the head of a branch that crosses the Sheriff Road 0.85 mile west of the Marlboro Road at Brightseat. This place is less than a quarter of a mile northwest of USGS 17147.

Ostrea compressirostra and internal molds of *Cucullaea gigantea* and *Dosiniopsis lenticularis* (USGS 17128) were found in the Aquia greensand on the Largo-Marlboro Pike east of Western Branch, 5 miles north-northwest of Upper Marlboro. This is doubtless the locality "3 miles west of Leeland" from which Clark and Martin (1901, pp. 77–80) list *Crassatella aquiana* Clark, *Ostrea compressirostra alepidota* Dall, *Cucullaea gigantea* Conrad, and *Terebratula harlani* Morton. The section there is reported thus by Cooke (1932b, p. 15):

Section east of Western Branch 0.7 mile west of Oak Grove

Eocene (Aquia formation)	Feet
Much oxidized glauconitic sand containing casts of mollusks	15
Irregularly indurated glauconitic marl containing many shells. *Ostrea compressirostra* is the most conspicuous species	7
Rusty glauconitic sand	3
Covered to water level in Western Branch	16

Schmidt (1948, p. 400) lists the following species of ostracodes from this locality:

Aquia ostracodes from 0.65 mile west of Oak Grove

Haplocitheridea veatchi aquia Schmidt
Haplocitheridea leei (Howe and Garrett)
Brachycythere marylandica (Ulrich)
Bythocypris parilis Ulrich
"Archicythereis" retiplana Schmidt
Cytherelloidea truncata Schmidt
Paracythereis potomaca Schmidt
Eucythere triordinis Schmidt
Cythereis bassleri reticulolira Schmidt
Cythereis siegristae Schmidt
Cythereis pauca Schmidt
Cythereis plusculmenis Schmidt
Xestoleberis longissima Schmidt
Loxoconcha? sp.
Cytherella cf. beyrichi (Reuss)
Cytherella sp.

Turritella sp. and other fossils were noted in the Aquia on the road to Upper Marlboro, three-quarters of a mile east of Ritchie, and fossil oysters were found south of Turkey Branch at Brown, 3.8 miles northwest of Upper Marlboro. There are also exposures of Aquia near the foot of the bluff east of Western Branch three-quarters of a mile above Upper Marlboro.

The unconformable contact of the Aquia greensand with pink clay of the

Nanjemoy formation is visible in the bank of a small stream east of the Back Road about half a mile southwest of the triangle at Upper Marlboro. The contact is about 10 feet above water level, about 80 feet above sea level.

The contact is also exposed on the Largo-Marlboro Pike, 0.15 mile north of the highway at Upper Marlboro. This place is probably that from which Clark and Martin (1901, p. 72, pl. 7, fig. 2) report the following section:

Section east of bridge at Upper Marlboro, Prince Georges County

	Feet
Nanjemoy formation.	
Glauconitic clay	22
Pink clay, without glauconite or fossils	22
Aquia formation (Paspotansa member)	
Coarse glauconitic sand	32
Shell marl with *Gibbula glandula, Fissuridea marlboroensis, Lucina aquiana, Diplodonta marlboroensis, Venericardia planicosta regia, Pteria limula, Cucullaea gigantea, Leda parilis, Nucula ovula*	2
Indurated ledge with *Turritella humerosa, T. mortoni, Mesalia obruta, Calyptraphorus jacksoni, Panope elongata, Callocardia ovata pyga, Dosiniopsis lenticularis, Venericardia planicosta regia, Crassatella alaeformis, Astarte marylandica, Glycymeris idoneus, Cucuttaea gigantea, Leda parilis, Nucula ovula*	5
Glauconitic sand full of fine fragments of shells accompanied by bryozoa, echinoid spines, and foraminifera; and with *Ostrea compressirostra, Gryphaeostrea vomer,* and *Platidia marylandica.* (Known as bryozoan sand.)	5
Total	88

Schmidt (1948, p. 400) lists the following species of ostracodes from this locality:

Aquia ostracodes from Upper Marlboro

Haplocytheridea leei (Howe and Garrett)
Brachycythere marylandica (Ulrich)
Bythocypris parilis Ulrich
Xestoleberis mayeri (Howe and Garrett)
Xestoleberis longissima Schmidt
Cythereis siegristae Schmidt
Cythereis plusculmenis Schmidt
Clithrocytheridea virginica Schmidt
Clithrocytheridea malkinae Schmidt
Loxoconcha? sp.
Cytherella sp.

Glauconitic sand, probably Aquia, is exposed in a ravine and deep cut on the abandoned Chesapeake Beach Railway 0.4 mile due south of the triangle at Upper Marlboro. An unconformity indicated by round quartz pebbles and rolled fragments of glauconitic marl probably marks the contact of the Aquia with overlying Miocene sand at an altitude of 80 or 90 feet above sea level. Clark and

Martin (1901, pp. 77–79) refer fossils listed from this cut to the Nanjemoy formation, but their location in the cut is unknown. Among the species listed is *Ostrea sellaeformis* Conrad, which may be a mistaken identification of *O. compressirostra* (Clark and Martin, 1901, p. 192). No pink clay, elsewhere forming the base of the Nanjemoy, was seen in the cut.

The probably unconformable contact of the Aquia greensand with the pink clay of the Nanjemoy formation is exposed on the Queen Anne Road, 100 yards east of the Crain Highway, 1.4 miles north of Central Avenue. The Aquia consists of 12 feet of fine greenish-gray glauconitic sand.

Aquia shells were noted on the Collington Road, 0.4 mile northwest of the Crain Highway.

Green Branch, which crosses the Crain Highway 3.6 miles north of Central Avenue and 0.5 mile north of the Collington Road, has cut a narrow gorge through the fine gray-green Aquia greensand. The gorge extends from the highway almost to the Patuxent River.

Fossil shells were noted in the Aquia greensand on the Crain Highway 0.9 mile north of Green Branch and 1.8 miles south of the Defense Highway. These evidently lie near the base of the Aquia, for the Monmouth formation crops out in a small stream crossing the Crain Highway about 0.2 mile farther north.

The probable contact of the Aquia on the Monmouth is marked by a waterfall west of the Crain Highway 1 mile south of its junction with the Defense Highway. Green glauconitic sand above the level of the road is succeeded by coarse ferruginous sandstone, probably basal Aquia, at the waterfall, about 20 feet in all. The Monmouth, black sand containing impressions of shells, is exposed below the waterfall.

The upper part of the Aquia greensand is exposed in the bluff on the Patuxent River at Hills Bridge, 2 miles east of Upper Marlboro, where it is overlain by pink clay of the Nanjemoy formation 5 feet above water level.

Nanjemoy Formation

Name.—The Nanjemoy formation, named by Clark and Martin (1901, p. 64) from Nanjemoy Creek, Charles County, includes the upper part (zones 10–16) of what Clark (1896) had previously called the Aquia Creek stage and also Clark's (1896) Woodstock stage (zone 17). They retained the name Woodstock for the upper member of the Nanjemoy and called the lower part Potapaco member from the original Indian name of Port Tobacco.

Description.—The most distinctive part of the Nanjemoy formation in Prince Georges County is a bed of pink plastic clay, called the Marlboro clay member of the Nanjemoy (Clark and Martin, 1901, p. 65; Darton, 1948), that lies directly on the Aquia greensand. This is overlain by gray to green glauconitic sand very like the Aquia in appearance but commonly somewhat finer.

The pink clay is 27 feet thick on the Indian Head Road at Piscataway Creek.

The full thickness of the overlying glauconitic sand is not known. Clark and Martin (1901, p. 64) report the total thickness of the formation as 125 feet. The Nanjemoy strikes about N. 60° E. and dips about 15 feet to the mile southeastward.

Stratigraphic relations.—The contact of the pink clay with the underlying Aquia greensand is very sharp, with no sign of transition between the beds nor any indication of erosion between them except a slight unevenness of the contact. If the contact marks an unconformity, the hiatus between the beds probably was of short duration.

The contact of the clay with the overlying glauconitic sand is likewise sharp, but there is some evidence of wave action, for lumps of clay are incorporated in the bed above. If this indicates an unconformity, it, too, probably does not record a long period of time. Perhaps the clay bed properly belongs with the Aquia rather than the Nanjemoy.

In Prince Georges County the Nanjemoy is overlain directly by overlapping Miocene beds. The interval represented by this unconformity includes perhaps all of middle and late Eocene time as well as all of the Oligocene.

Paleogeography.—Whether or not the sea withdrew between Aquia and Nanjemoy time is not evident, but there must have been a sudden change in the source of the sediments. The clay bed at the base of the Nanjemoy probably is of marine origin although no fossils have been found in it. At the close of this clay deposition, open marine conditions like those prevalent in Aquia time were restored, for the succeeding bed contains marine fossils and glauconite.

Fauna.—The pink clay of the Nanjemoy contains few if any mollusks. The glauconitic sand above it is more fossiliferous, though identifiable shells are rare. The most common and best-preserved species is *Venericardia potapacoensis* Clark and Martin, which seems to be restricted to the Nanjemoy formation. A much rarer species but more diagnostic for correlation is *Turritella gilberti* Bowles, which occurs also in the Bashi formation at Woods Bluff, Alabama. Other species are *Cadulus abruptus* Meyer and Aldrich, *Tuba marylandica* Clark and Martin, *Tornatellaea bella* Conrad, *Nuculana parva* (Rogers), *Calorhadia pharcida* (Dall), *Callocardia ovata* (Rogers), and *Calyptraphorus trinodiferous* Conrad.

Age.—The fauna of the Nanjemoy correlates it with the upper part of the Wilcox group of Alabama, probably with the Bashi formation. *Ostrea sellaeformis* Conrad, a typical Lisbon (Claiborne group) species, has been reported from several localities in Maryland, but according to Clark and Martin (1901, p. 192) it is represented only by "small specimens, almost indistinguishable from the young of *O. compressirostra*." In all probability these specimens were wrongly identified. The ones figured by Clark and Martin (1901, pls. 47, 48) came from James River, Virginia. *Ostrea sellaeformis* is reported by Clark and

Miller (1912, p. 114) at Newcastle, Pamunkey River, Virginia, in coarse, sandy, pebbly, calcareous marl referred to the Nanjemoy but almost certainly younger.

If the Aquia represents the Nanafalia formation and if the upper part of the Nanjemoy is of Bashi age, the pink clay between them comes somewhere in the interval occupied in Alabama by the Tuscahoma sand.

Distribution.—The Nanjemoy is exposed in sinuous, narrow, disconnected bands along the streams flowing into the Potomac River and the Patuxent River in the southern half of Prince Georges County. The continuity of the outcrop is broken by an overlap of Miocene sand.

The Aquia greensand on the Indian Head Road at Piscataway Creek is overlain by 27 feet of pink plastic clay and 16 feet of fine gray glauconitic sand. The clay contains round, nutlike ferruginous concretions, and the glauconitic sand contains unidentifiable soft fragments of shells. Neither the upper nor the lower surface of the clay is well exposed, for the road cut has been scraped by a bulldozer, which obscured the contacts. The bottom of the clay member of the Nanjemoy is about 62 feet above water level in Piscataway Creek.

About 5 feet of gray-green micaceous glauconitic sand of the Nanjemoy is exposed near the bottom of a cut 0.5 mile north of Piscataway Creek on the Indian Head Road. It is overlain unconformably by about 25 feet of gray to yellow sand containing bones of Miocene cetaceans near the bottom. The Nanjemoy at this locality (USGS 17099) contains *Turritella gilberti* Bowles, *Callocardia ovata* (Rogers), *Venericardia potapacoensis* Clark and Martin, two species of *Corbula*, *Nucula* sp., *Dentalium* sp., and fish teeth.

A short lateral gully east of a farm trail 0.3 mile north of Piscataway Creek, about 0.2 mile east of the Indian Head Road, and 1 mile due west of St. Mary's Church at Piscataway, cuts into gray-green micaceous, glauconitic sand of the Nanjemoy. Well-preserved shells (USGS 17107) were found 40 feet below the trail approximately 130 feet above sea level. The following species were found:

USGS 17107. Nanjemoy mollusks 1 mile west of Piscataway.
H. K. Brooks, collector.

Calyptraphorus sp.
Turritella gilberti Bowles
Lunatia sp.
Tuba marylandica Clark and Martin
Cadulus abruptus Meyer and Aldrich
Dentalium sp.
Tornatellaea bella Conrad
Cylichna sp.
Calorhadia pharcida (Dall)
Corbula 2 sp.
Lucina whitei Clark
Callocardia ovata (Rogers)
Venericardia potapacoensis Clark and Martin

The Nanjemoy is exposed about a quarter of a mile south of Thrift in a gully leading southward into Piscataway Creek. *Venericardia potapacoensis* was found there (USGS 17103).

A ravine leading westward to Burch Branch, 2½ miles east of Piscataway and south of the Flora Park Road cuts into the Nanjemoy formation. The following species were found there in gray-green glauconitic sand:

USGS 17101, 17102. Nanjemoy mollusks 2½ miles east of Piscataway.
H. K. Brooks, collector

- Neverita sp.
- Dentalium sp.
- Nuculana parva (Rogers)
- Nuculana improcera (Conrad)
- Callocardia ovata (Rogers)
- Venericardia potapacoensis Clark and Martin
- Corbula sp.
- Tellina williamsi Clark?

Burch Branch, 1 mile north-northeast of Danville and 2¾ miles east of Piscataway, cuts through gray-green glauconitic sand containing (USGS 17114) *Turritella gilberti* Bowles, *Cypraea* sp., *Nuculana parva* (Rogers), *Calorhadia pharcida* (Dall), *Callocardia ovata* (Rogers), *Venericardia potapacoensis* Clark and Martin, and *Corbula aldrichi* Meyer.

A gully south of the Flora Park Road 1 mile east of Piscataway yielded (USGS 17125) *Turritella gilberti* Bowles, *Cadulus abruptus* Meyer and Aldrich, *Callocardia* sp., *Lucina dartoni* Clark, *Venericardia potapacoensis* Clark and Martin, and *Corbula aldrichi* Meyer.

A collection of shells from the Nanjemoy formation in Charles County about 100 yards west of the Prince Georges County line was made on a small tributary of Mattawoman Creek 1 mile east of Bryans Road, the junction of the road to Marshall Hall with the Indian Head Road. The collection (USGS 17113) includes *Calorhadia pharcida* (Dall), *Nuculana parva* (Rogers), *Callocardia ovata* Rogers, *Venericardia potapacoensis* Clark and Martin, *Tellina williamsi* Clark, and *Corbula aldrichi* Meyer.

Tornatellaea sp., *Venericardia potapacoensis*, and *Callocardia ovata* were noted above pink clay of the Nanjemoy in a gully 1 mile east of the Crain Highway and 2.7 miles north of Hills Bridge.

Pink clay of the Nanjemoy rises 6 feet above the road at the intersection of the Crain Highway with Central Avenue. It is overlain by about 10 feet of fine yellow sand of the Miocene Chesapeake group. A mile and three-eighths farther north a cut on the Queen Anne Road, 100 yards east of the Crain Highway, exposes 12 feet of pale pink clay of the Nanjemoy underlain with probable unconformity by about 12 feet of fine greenish-gray Aquia greensand and overlain unconformably by about 20 feet of sand of the Miocene Chesapeake group.

At Hills Bridge the base of the pink clay stands 5 feet above water level in the Patuxent River, resting on Aquia greensand. There are other exposures of the clay in a ravine north of the highway and west of the river.

A cut on the Largo-Marlboro Pike, 100 yards north of the bridge over Western Branch at Upper Marlboro, exposes 31 feet of pink clay of the Nanjemoy formation. The contact with the underlying loose Aquia greensand is sharp, but there are inclusions of greensand in the basal inch of the clay. The bed above the clay and separated from it probably by an unconformity is fine gray glauconitic sand, which is of Miocene age if not Nanjemoy.

About 10 feet of pink clay of the Nanjemoy is exposed in bluffs of a small stream east of the Back Road about half a mile southwest of the triangle at Upper Marlboro. The contact with the underlying Aquia greensand appears to be unconformable. Its altitude is about 70 or 80 feet above sea level.

The highway bypass south of Upper Marlboro, under construction in 1949, cuts through the pink clay and the overlying glauconitic sand of the Nanjemoy formation. The glauconitic sand contains soft shells too poorly preserved for identification. The principal exposures are west of the Popes Creek Branch of the Pennsylvania Railroad.

Pink clay overlain by glauconitic sand is exposed also on the Crain Highway south of Charles Branch, 3.4 miles southwest of the triangle at Upper Marlboro.

At the old diatomaceous earth mines on the east bank of the Patuxent River at Lyons Creek Wharf in Calvert County highly glauconitic sand of the Nanjemoy is overlain by very similar reworked sand forming the base of the Chesapeake group. The contact lies approximately 26 feet above water level in the river. Similar glauconitic sand on Tanyard Branch three-quarters of a mile west of Nottingham has been mapped as Miocene.

MIOCENE SERIES

CHESAPEAKE GROUP

Name.—For the Miocene deposits of eastern Maryland and Virginia, which attain their greatest development in the vicinity of Chesapeake Bay, Darton (1891) proposed the name Chesapeake formation. Dall (Dall and Harris, 1892) extended the name Chesapeake to all the Miocene deposits from Delaware to Florida and called it a group. As currently used the Chesapeake group is generally restricted to the Miocene deposits north of Cape Hatteras.

Divisions.—In Maryland the Chesapeake group has been divided (Shattuck, 1902) into the Calvert, Choptank, and St. Marys formations. A fourth formation, the Yorktown, lies at the top of the group in Virginia but has not been definitely recognized in Maryland, though it may be represented there by unfossiliferous sand. The Chesapeake group has not been divided on the 1951 geologic map of Prince Georges County because of uncertainty as to the location of the boundary between the formations represented, which are the Calvert and possibly also the Choptank.

Description.—In the famous Calvert Cliffs along Chesapeake Bay, 8 or 9 miles east of Prince Georges County, are almost continuous clean exposures of the Calvert and Choptank formations. The St. Marys formation crops out farther south. The beds referred to the Calvert formation are, for the most part, whitish siliceous diatomaceous earth and compact calcareous blue-gray clay. The Choptank formation consists chiefly of yellow fine micaceous quartz sand. Both formations contain a great profusion of fossil shells. In Prince Georges County the Miocene consists chiefly of dark-gray to light-gray clay, which weathers readily into fine fluffy sand or silt. Some of this material is known to contain diatoms, but most of it has not been examined under a microscope. At some places the basal Miocene deposits are carbonaceous. Elsewhere they contain enough glauconite to impart a green or gray color. These glauconitic basal beds appear to consist almost entirely of materials reworked from the underlying Aquia greensand or the Nanjemoy formation, though small quartz pebbles near the contact must have had a different source.

Many exposures in Prince Georges County show only a few feet of Miocene sand, but the total thickness there may be as much as 80 feet. About 1000 feet is referred to the Miocene in the deep well near Salisbury (Anderson, 1948). In Prince Georges County the Miocene strikes about N. 55° E. and dips about 6 feet per mile southeastward.

Stratigraphic relations.—The Chesapeake group overlaps unconformably across the Eocene Nanjemoy formation and Aquia greensand and the Upper Cretaceous Monmouth formation onto the Patapsco formation of the Potomac group. The Chesapeake is overlain unconformably by the Brandywine formation, of presumed Pliocene age, or by Pleistocene sand and gravel.

According to Shattuck (1902) there is an unconformity between the Calvert and the overlapping Choptank formation. Though this may be a fact, Shattuck (Clark, Shattuck, and Dall, 1904, pl. 5) appears to have mislocated the contact in several of his sections in the Calvert Cliffs, which need reexamination. The unconformity, if there is one, presumably lies at the bottom of zone 17 rather than zone 16, which is shown as pinching out, whereas it is probably overlapped. Moreover, there appears to be a reversal of dip from Plum Point northward, which, if verified, would invalidate Shattuck's zonal correlation.

Paleogeography.—The Chesapeake group was deposited in the ocean, which advanced across a former land surface. The neighboring land probably had slight relief, for the streams flowing from it brought little coarse sediment. A few small quartz pebbles at the base of the group are the only materials that must have been brought from a distance. The basal beds commonly resemble the underlying formation so closely that they are difficult to distinguish from it.

They appear to be composed of materials reworked from the neighboring region.

Fauna and flora.—The Miocene sea, particularly during the early part of that epoch, swarmed with microscopic plants, diatoms, whose siliceous framework contributed much to the sediments deposited then. Though the temperature of the water seems to have been fairly cool, it was not too cool to favor the growth of a great profusion of mollusks, whose shells at times covered the bottom in great abundance. Conditions for the preservation of shells were less favorable in Prince Georges County than near Chesapeake Bay, because much of the Miocene deposits stand above the zone of permanent saturation and are subject to leaching by percolating rainwater. Consequently, Miocene shells are rarely found in the county though impressions of them are fairly abundant. The shells themselves have been dissolved.

Among the more common or distinctive mollusks in the Calvert Cliffs may be mentioned *Pecten madisonius* Say, *Isocardia fraterna* Say, *Panope americana* (Conrad), *Turritella plebeia* Say, and *Ecphora tricostata* Martin. Two species of echinoids are known, *Scutella aberti* Conrad and *Echinocardium orthonotum* (Conrad). Bones of whales and porpoises are fairly common in the Calvert Cliffs and several have been found in Prince Georges County. Fish teeth are locally very abundant.

Age.—Correlation of the Chesapeake group with Miocene formations in other parts of the world has been hampered by differences in faunal facies caused, at least in part, by differences in the temperature of the sea water. For a long time the Tampa limestone and the Alum Bluff group of Florida, which are now classified as lower and middle Miocene, were supposed to be older than any part of the Maryland Miocene. Latterly, however, there has been a tendency to telescope the geologic sections until the section south of Cape Hatteras has been tentatively correlated with the Chesapeake group, the Tampa limestone being presumably equivalent to the Calvert formation, the Chipola to the Choptank, the Shoal River to the St. Marys, and the Duplin to the Yorktown (Cooke, 1945, p. 110). It was recognized long ago that the Duplin marl is the equivalent of at least part of the Yorktown; the correlation of the remainder of the section awaits verification.

Distribution.—Nearly all of the southern part of Prince Georges County is underlain by the Chesapeake group. The northern boundary of the group extends from Anacostia, D. C., northeasterly not far southeast of the abandoned line of the Washington, Baltimore and Annapolis Electric Railway, which it crosses between Bell and Hillmeade. In the highlands the Chesapeake is covered by the Brandywine formation. Where it lies at the surface it may be recognized by its peculiar hummocky topography. In much of the northern part of its occurrence it remains only as outliers on the Eocene and Upper Cretaceous formations.

Darton (1947) mapped outliers of the Chesapeake group, which he identified as Calvert formation, under gravel deposits at the Soldiers Home and Tenleytown, D. C., and near Freedom Hill and Tysons Crossroads in Fairfax County, Virginia. At the localities in Virginia the supposed Miocene appears to be fine yellow sand residual from sericite schist. In the Tenleytown area at least part of it is probably Patuxent formation. The supposed occurrence at the Soldiers Home could not be verified because of the present lack of exposures.

At Good Hope Hill, on Good Hope Road at 24th Street, S. E. in Washington, the Chesapeake group appears to lie directly on the Patapsco formation; the Nanjemoy, Aquia, and Monmouth formations are overlapped. The section there has been interpreted in several ways. Darton (Darton and Keith, 1901) in the old Washington Folio mapped the sequence as Potomac, Matawan, and Chesapeake, apparently interpreting as Matawan black carbonaceous sand here considered as basal Chesapeake. Miller (1911) mapped the sequence as Patapsco, Raritan, Magothy, Matawan, Monmouth, and Calvert. Darton (1947) later mapped it as Potomac, Raritan, Magothy, Monmouth, and Calvert. The section as now exposed is as follows:

Section at Good Hope Hill

	Feet
Miocene, Chesapeake group (undifferentiated).	
2. Coarse black carbonaceous pebbly sand at base, passing upward into light-gray and brownish clayey sand, silty clay at top. Impressions of mollusks in lower-middle part. Upper part mantled with gravel derived from the Brandywine formation. Bottom approximately 210 feet above sea level....	40±
Upper Cretaceous, Patapsco formation.	
1. Tough dark-gray to brown massive clay changing eastward into fine white sand. A thin ledge of ferruginous sandstone, locally conglomeratic, separates it from the overlying Miocene..................................	5

Fossil mollusks from Good Hope Hill were listed (Clark, 1916, pp. 94–100) as from the Magothy formation, and these were the only supposed Magothy fossils listed in the Cretaceous volumes of the Maryland Geological Survey. Two molds, which did not resemble any known Cretaceous forms, were described as new. These are the type specimens of *Turritella bonaspes* Gardner, which probably is a synonym of *Turritella plebeia* Say, and *Panope bonaspes* Gardner, which may be the young of *Panope americana* (Conrad). Both *T. plebeia* and *P. americana* are common Miocene species. The silty clay of which the molds are composed is similar to the Miocene at Good Hope Hill.

The Miocene also lies directly on the Patapsco formation in an old sand pit used as a pistol range by the Eleventh Precinct Pistol Club. This pit lies northeast of the Morris Road, half a mile southeast of Nicols Avenue, in Anacostia. The Miocene consists chiefly of light-gray silt containing coarse pebbles at the base. The altitude of the contact with the Cretaceous is estimated at 230 feet above sea level.

The Chesapeake group is separated from the Monmouth formation by only a thin wedge of coarse glauconitic sand, presumably Aquia greensand, on Branch Avenue south of the Military Highway (Suitland Parkway) 0.4 mile southeast of the District line. The best exposure of the Miocene is in a vertical bank back of a group of stores on the east side of the road, where the unweathered material is massive light-gray to dark-gray clay. Large bones, probably either whale or porpoise, were reported from this bank. The weathered Miocene in the road cut is fine yellow sand. The Aquia greensand is exposed only at the south end of the road cut approximately 200 feet above sea level. Black micaceous, sparingly glauconitic sand of the Monmouth is exposed continuously in ditches on both sides of Branch Avenue to the foot of the hill.

A cut on the Indian Head Road 0.5 mile north of Piscataway Creek shows the Miocene resting on the Eocene Nanjemoy formation and overlain by Pleistocene gravel. The section is as follows (thicknesses estimated):

Cut on Indian Head Road 0.5 mile north of Piscataway Creek

	Feet
Pleistocene, Sunderland formation.	
6. Brownish-yellow clay to top of hill	4
5. Blue-gray or pinkish silt	6
4. Poorly sorted gravel, some cobbles 1 foot in diameter, passing upward into fine yellow and white cross-bedded sand	20
Miocene, Chesapeake group (undifferentiated)	
3. Fine yellow silt	5
2. Dark-gray to light-gray sand containing fragments of carbonized wood, large phosphatic lumps, fish teeth, and porpoise bones near bottom. The contact with the overlying bed is sharp, possibly unconformable	20
Eocene, Nanjemoy formation	
1. Greenish-gray glauconitic sand loaded with *Venericardia potapacoensis* and other shells. Exposed at the south end of the cut, top about level with the road at entrance to cut, about 145 feet above sea level	5

About 40 feet of fine yellow and gray sand and clay (Miocene) overlies about 5 feet of light grayish-green glauconitic sand (Nanjemoy) in a cut on the Indian Head Road 1.5 miles south of Piscataway Creek. The Miocene is partly mantled with gravel derived from an overlying Pleistocene bed, but the contact was not seen in this cut.

PLIOCENE (?) SERIES

Bryn Mawr Gravel

Name.—The term Bryn Mawr gravel was provisionally applied by Lewis (1880) to high-level deposits of gravel on the Piedmont rocks in the vicinity of Philadelphia. The name was later revived and redefined by Bascom (1924) to include the high-level (390–480 feet) gravel deposits of Pennsylvania, Delaware, and Cecil County, Maryland. The extension of the name to deposits in the vicinity of Washington and Burtonsville appears to be justified although the patches of gravel are separated by wide gaps.

Description.—In this area the Bryn Mawr consists of coarse, poorly sorted pebbles in red sand and silt. The bright-red color distinguishes it from the pink or yellow Brandywine formation, with which it is nowhere in contact. It is further distinguished by its altitude, being everywhere higher. In the District of Columbia it ranges in altitude from approximately 350 to 410 feet above sea level; and near Tysons Crossroads in Fairfax County, Virginia, red gravel presumably Bryn Mawr stands as high as 518 feet. In Montgomery County near Burtonsville the altitude ranges from 450 to 500 feet.

Stratigraphic relations.—The higher, farther inland parts of the Bryn Mawr gravel lie unconformably on the crystalline rocks of the Piedmont, but the formation extends eastward onto the eroded surface of the Patuxent formation. No younger formations lie on it; it forms the surface of the ground wherever it occurs.

Paleogeography.—Wherever the Bryn Mawr has been recognized it lies near the debouchure of a river from the Piedmont onto the Coastal Plain. The formation seems to have been deposited as a series of disconnected alluvial fans, one at each river, where the current slackened at the Fall Line. The typical occurrence at Bryn Mawr, Pennsylvania, presumably forms part of the fan of the Schuylkill River or perhaps of the larger Delaware. The remnants at Burtonsville are not far from the Patuxent River, and those near Washington were evidently deposited by the Potomac.

Whether or not these fans terminated at the seashore, which then may have stood near by, or whether they merged into river terraces on the Coastal Plain is not now apparent. The neighboring land has been denuded so much since their deposition that they now stand as remnants high above their surroundings and separated by wide gaps from late Tertiary formations with which they may be contemporaneous.

Age.—No animal or plant fossils that might give a clue to the age of the Bryn Mawr gravel have been found in it. Considerable antiquity is indicated by the great erosion to which it has been subjected. The Bryn Mawr must have been deposited in the lowest places, and these, protected by the cover of gravel, have now become high hills, producing a complete inversion of the topography. The customary age assignment has been Pliocene (?), and this is continued here. The formation may be of Miocene age or older.

Distribution.—The Potomac fan of the Bryn Mawr gravel is preserved as remnants on both sides of the river. A V-shaped area wholly within the District of Columbia extends from Tenleytown southeastward along Wisconsin Avenue past the Washington Cathedral and southwestward along Nebraska Avenue to

Cathedral Avenue, where it terminates less than a mile from the Potomac River. The highest parts of this area stand slightly higher than 410 feet above sea level; and the bottom of the gravel, as mapped by Darton (1947), ranges from about 340 to about 400 feet in altitude. Darton's map shows the gravel resting on the Miocene Calvert formation. The present writer's interpretation is that it lies partly on the Cretaceous Patuxent formation and partly on crystalline rocks, the Miocene not occurring there.

A larger area in Fairfax County, Virginia, 3 to 5 miles south of the Potomac, is crossed by the Leesburg Turnpike near Tysons Crossroads. The surface of this area slopes from 518 feet above sea level near Tysons Crossroads to 464 feet at Idlewood, 2 miles southeastward. This gravel overlies crystalline rocks, including a sericite schist that disintegrates into yellow sand resembling that of the Miocene Chesapeake group. There are several smaller areas of Bryn Mawr gravel in Virginia, including one at the John Marshall School in Arlington County.

A remnant of the Patuxent fan of the Bryn Mawr gravel extends from Burtonsville in Montgomery County nearly to the Prince Georges County line on the road to Laurel and nearly to Fairland on the south. The Bryn Mawr in this region straddles the contact of the Patuxent formation and the crystalline rocks. The gravel is about 50 feet thick.

Brandywine Gravel

Name.—The name Brandywine formation was proposed by Clark (1915) for gravel, sand, and loam previously included in the Appomattox or Lafayette formations (now abandoned by U. S. Geological Survey) and typically developed near the village of Brandywine in Prince Georges County. As originally used, the Brandywine included high-level gravel later identified as Bryn Mawr by Bascom (1924), who restricted the Brandywine to deposits 300 feet above sea level or lower. The name is here used in its restricted sense, except that some of the gravel stands higher than 300 feet. The term Brandywine gravel rather than formation is preferred because gravel is the dominant component of the formation within this area.

The name Brandywine terrace was applied by Clark (1915) to the plain surrounding Brandywine (altitude 233 feet), which he regarded as of marine origin and probably of early Pleistocene age. Later, the landward limit of the terrace was set at 265 feet (Cooke, 1930a, p. 582) or 270 feet (Cooke, 1931, p. 505) above sea level, which is the approximate altitude at which the Brandywine plain abuts against the Piedmont upland in Fairfax County, Virginia. It now seems doubtful that the Brandywine terrace is a marine feature. It may be merely the gently sloping surface of the Brandywine gravel, which appears to be an alluvial fan built above tide level, not a marine deposit as Clark supposed.

Description.—The Brandywine gravel is composed predominantly of well-rounded, polished pebbles of quartzite, sandstone, and chert mingled with fairly clean quartz sand. The pebbles are not well sorted as to size, but the size decreases towards the southeast and the gravel becomes progressively somewhat better sorted. The gravel is commonly overlain by silt.

The maximum thickness of the Brandywine gravel is probably about 40 feet. The gravel slopes south-southeastward about 5 feet per mile.

Stratigraphic relations.—The main body of the Brandywine lies unconformably on the Chesapeake group. Outliers at the U. S. Soldiers Home and on northern Sixteenth Street, in the District of Columbia, overlap the Miocene and lie on the Patuxent formation and crystalline rocks.

Paleogeography.—The distribution, composition, and irregular bedding of the Brandywine gravel indicate that the formation is an abandoned alluvial fan of the Potomac River (Campbell, 1931). The river emerged from the Piedmont Plateau at Washington and spread out southward over the Coastal Plain in a widening wedge, whose western side lay along the edge of the Piedmont. Campbell recognized two prongs of the fan in Maryland, and there appears to be a third in Virginia adjacent to the Piedmont.

The land over which the river flowed probably was very flat, being the slightly eroded surface of the Miocene Chesapeake group. Flow of the river toward the east and northeast may have been prevented by higher land composed of sand, clay, and gravel of the Potomac group. Since the end of this epoch, all the land adjoining the fan on the north and east has been deeply eroded, leaving the more resistant Brandywine gravel perched on a high plateau. The river has since cut its valley between two prongs of the alluvial fan and now flows at sea level, 300 feet below the plateau.

Campbell (1931, pp. 847–848) was quite sure that the seashore at the time of deposition of the Brandywine gravel lay along the "Surry beach," which extends from "near the present mouth of Potomac River to the North Carolina line in the vicinity of Branchville . . . at an altitude of 90 to 100 feet above present sea level."

Age.—As the Brandywine gravel lies on the Chesapeake group, it must be younger than Miocene unless, possibly, it was deposited during the concluding part of that epoch. As it is the highest extensive sheet of river gravel in which the present Potomac Valley has been cut, it presumably antedates the Pleistocene era, which was ushered in by a lowering of sea level, during which trenches were cut by all streams not too far from the seashore. Such trenching would have stopped the growth of the alluvial fan by draining the river into lower channels. By this reasoning, the age of the Brandywine would be Pliocene. The absence of large, striated boulders, which are rather common in the Pleistocene terrace deposits is also suggestive that the Brandywine is older than Pleistocene. No fossils have been found to verify the age assignment. The Brandywine is therefore referred here to the Pliocene (?).

Distribution.—In this region the Brandywine gravel occupies a roughly triangular area extending from an apex at Good Hope Hill in the District of Columbia to the southern boundary of Prince Georges County, which forms the base of the triangle. The area is cut almost through by Piscataway Creek and Henson Creek. Other smaller streams have dissected the sides of the triangle to such an extent that its boundaries are very crooked.

Some of these indentations may lie between original lobes of the old alluvial fan of the Potomac River, but others are manifestly erosional features that have come into existence since the river drained away from its original course.

Two small areas in the District of Columbia have been mapped as Brandywine gravel. One underlies the U. S. Soldiers Home and part of Rock Creek Cemetery. The other crosses Sixteenth Street, N.W., between Upshur and Nicholson Streets. The correlation of these patches with the Brandywine has not been definitely established. It seems likely that they were formed by Rock Creek, for they contain no chert.

Several patches of gravel west of Laurel have also been mapped as Brandywine. These do not form part of the old alluvial fan of the Potomac River but evidently are remnants of a smaller fan built by the Patuxent and presumably contemporaneous with the typical Brandywine.

Exposures of the Brandywine gravel are most numerous along the edges of the plateau south of Washington and in the ravines that dissect it. In the pits of the Washington Sand and Gravel Company, southwest of the Marlboro Road at Oakland, 20 feet or more of pinkish gravel is exposed. The pebbles consist chiefly of quartz and chert, obviously derived from the Paleozoic rocks of the upper Potomac Valley. They are most abundant and largest in the lower part of the exposure, where many are $1\frac{1}{2}$ inches or more in diameter. The upper part of the Brandywine is more sandy. The surface of the land there stands about 290 feet above sea level.

Pits of the Davis Sand and Gravel Company northeast of Clinton expose about 25 feet of Brandywine gravel at an altitude of 250 feet. Many pebbles of quartz and chert are $1\frac{1}{2}$ inches in diameter, and some are larger.

On U Street at Branch Avenue, in Anacostia, the Brandywine is still coarser and includes little chert. The altitude at the top is about 280 feet above sea level. The gravel lies unconformably on clay of the Patapsco formation.

A gravel pit west of U. S. Highway 301, a mile southwest of Cheltenham and about 220 feet above sea level, contains quartz and chert pebbles, some of which are 3 inches long. The surface in the neighborhood is 240 feet above sea level.

On the Woodyard Road, south of the Dower House Pond, fine Miocene sand is overlain by chert and quartz gravel with pebbles $1\frac{1}{2}$ inches long. The gravel is overlain by brown silt, which extends to the top of the hill at an altitude greater than 240 feet.

On Route 381, 1.3 miles south of Aquasco, in the southeastern extension of the county, about 20 feet of fine white Miocene sand laminated with clay in the upper part is overlain unconformably by about 15 feet of rather coarse gravel. Most of the pebbles consist of chert or quartz. Many are $1\frac{1}{2}$ inches long, but there are a few cobbles as much as 6 inches in diameter. The altitude of the base of the gravel is about 150 feet above sea level. The highest land in the vicinity stands about 180 feet above sea level. Similar gravel is exposed on the road to Waldorf 1 mile west of Aquasco.

There are exposures of the alluvial fan referred to ancient Rock Creek at Sixteenth and Nicholson Streets, N.W., in Washington. Ten feet of coarse red gravel and well-rounded cobbles evidently lie not far above the crystalline rock, for there are also large blocks of vein quartz. The pebbles consist chiefly of quartz or quartzite, and many are deeply corroded. The apparent complete absence of chert distinguishes these exposures from the typical Brandywine gravel, which everywhere contains a large proportion of chert pebbles. The altitude at the surface is 270 feet above sea level.

Red gravel containing smaller corroded pebbles was noted at Thirteenth and Madison Streets, N.W., about 280 or 290 feet above sea level.

QUATERNARY SYSTEM

PLEISTOCENE SERIES

Oscillations of sea level.—The Pleistocene is notable as an epoch during which the polar ice caps alternately advanced into much lower latitudes than they now occupy and then retreated poleward by the melting away of their extended parts. Four such major ice ages have been recognized, and they were separated by three interglacial stages of much longer duration. During each ice age a great quantity of water that otherwise would have run into the ocean remained on the land as snow and ice, and consequently sea level was that much lower than normal. This landlocked water was restored to the sea during each interglacial stage, and sea level rose accordingly.

The polar ice caps may have been smaller during the three interglacial stages than they are today and sea level then may have been higher. It is also possible that there was a progressive lowering of sea level during the Pleistocene because of the gradual foundering of a continental land mass such as that which probably connected Canada with northern Europe during the Pliocene epoch, of which land mass Greenland and Iceland are remnants. Whatever the cause, it seems likely that sea level is lower now than during most of the Pleistocene epoch, for marine deposits of Pleistocene age now stand well above sea level in regions that show no evidence of deformation.

On the basis of a critical study of the topography and stratigraphy of the Pleistocene deposits of the Southeastern States the writer recognizes the following sequence of oscillations of sea level (Cooke, 1930a, b, 1931, 1932a, 1935, 1945):

1. Sea level undetermined (first glacial epoch?).
2. Rise of sea level to approximately 215 feet above the present sea level (Coharie level, first interglacial epoch?).
3. Fall to approximately 170 feet (Sunderland level, first interglacial epoch?).
4. Sea level lower, location undetermined (second glacial epoch?).
5. Rise of sea level to approximately 140 feet (Okefenokee level, second interglacial epoch?).
6. Fall to approximately 100 feet (Wicomico level, second interglacial epoch?).
7. Fall to approximately 70 feet (Penholoway level, second interglacial epoch?).
8. Fall to approximately 42 feet (Talbot level, second interglacial epoch?).
9. Sea level lower, location undetermined (third glacial epoch?).
10. Rise of sea level to approximately 25 feet (Pamlico level, third interglacial epoch?).
11. Fall to approximately 6 feet (Silver Bluff level, third interglacial epoch?).
12. Sea level at least 25 feet lower than now (fourth glacial epoch).
13. Rise of sea level to present location (Recent epoch).

This sequence should be applicable along all undeformed seaboards throughout the world, though allowance should be made for differences in tidal range caused by differences in latitude and by the configuration of the shore.

These oscillations of sea level caused the coast line to migrate back and forth. At each resting stage shore-line features of varying size and conspicuousness were built by wave, wind, and current. Some of these have survived the vicissitudes of time and can still be recognized. Such features are best preserved in regions of slight relief, such as the coastal parts of Georgia, Florida, and the Carolinas, where erosion is slow.

River terracing.—The effects of oscillation of sea level are conspicuous in river valleys, especially in regions such as the Coastal Plain, where the bedrock consists of soft, easily eroded sediments. A lowering of sea level gives the stream an opportunity to entrench itself deeper in its valley provided that the newly exposed sea bottom slopes more steeply than the graded profile of the river, and this rejuvenation works rapidly up the valley until it meets a resistant stratum, such as the hard rocks of the Piedmont. A rise in sea level ponds the stream, converts it into an estuary, slackens its current, and causes it to deposit silt on its gravel-strewn channel and flood plain. A delta will begin to fill up the head of the estuary, and waves may cut a shelf at tide level at exposed places along its shore. Another fall in sea level will reveal the old valley floor lightly mantled with silt except at the head of the former estuary, where drained tidal flats will indicate the former location of sea level. A trench will be cut through the old delta and a new delta will begin to form at the new tide level unless the gradient is steep enough to start another cycle of rejuvenation. Emerged bayhead deltas and other tidal flats are especially helpful in determining the former height of sea level.

Terraces along the Potomac River.—Since the deposition of the alluvial fan of Brandywine gravel in Pliocene (?) time, the Potomac River, along with all other large rivers entering the sea, has experienced four epochs of valley cutting. During the first epoch the river sank its valley about 100 feet below the surface of the fan; the second carried it about 100 feet lower; the third deepened the valley about 75 feet more; and the fourth cut a channel perhaps 50 feet below the third, sinking it below the present sea level.

These four epochs of valley cutting presumably correspond to the four ice ages. Though the continental ice caps did not extend as far south as Maryland, an indication of colder climate is seen in many large blocks of stone, apparently ice-rafted down the river during spring freshets, which are mingled with the much finer gravel and sand of the river-terrace deposits. Wentworth (1927; 1930, p. 46) has pointed out that some of these boulders and cobbles are scratched as though they had been dragged by water-borne ice.

A large part of the sheets of gravel that floored the Potomac Valley at different stages of its down-cutting escaped destruction because the river, whenever rejuvenated, deepened its channel where the gravel cover was thinnest or absent, because the softer sand and clay of the bedrock offered less resistance to erosion.

Definite evidence for the altitudes of the high stages of sea level that caused the successive drownings of the Potomac Valley was obtained, as noted on pages 42 to 43, chiefly in southern Virginia, the Carolinas, Georgia, and Florida, where there has been much less subsequent erosion than in Maryland and where the emerged shore lines are consequently more easily traced. A change of sea level necessarily affects the oceans and estuaries of the entire world, though its vertical extent is locally obscured by warpings of the earth's crust, which raise or lower the abandoned shore line. Maryland and the southern Atlantic seaboard appear not to have been subjected to crustal warpings during the Pleistocene epoch; the emerged shore lines retain their original attitude, which was approximately horizontal.

During the high-sea-level (interglacial) stages the drowned valley of the Potomac River was modified by the building of deltas and tidal flats and by wave-cutting. After the first epoch of down-cutting the valley was drowned by a rise of the sea to a height approximately 215 feet above the present sea level, and a delta was built there. Then the water partly receded and another delta was built near 170 feet. These two deltas presumably date from the first interglacial epoch.

After the second epoch of valley cutting (second glacial epoch), water level in the newly drowned valley stood successively at 140, 100, 70, and 42 feet, and there was some sedimentation and shore cutting at each of those levels. These four deltas presumably date from the second interglacial epoch.

After the third (glacial) epoch of entrenchment the valley was drowned to a height of 25 feet above the present sea level, and a delta was built there; then the water receded to about 6 feet, both stages presumably during the third interglacial epoch.

After the fourth (glacial) epoch of entrenchment the valley was drowned to its present extent, and a delta is now forming at sea level.

Geologic formations.—Along much of the southeastern Atlantic seaboard, where the marine terraces are wide and well developed, a separate formation name is given to the deposits corresponding to each of the emerged shore lines. In the Potomac Valley, however, it is not practicable to map each deposit separately, and only three successive Pleistocene formations are recognized, one corresponding to each cycle of erosion and sedimentation. Each formation is compound in that it includes the fluvial deposits, chiefly gravel, that floored the valley while it was being deepened during one ice age, and the estuarine sediments, chiefly silt, that were laid down conformably on the fluvial deposits when the valley was drowned by the rise of sea level during the succeeding interglacial epoch. The formations of the three cycles are further complicated by the successive lowerings of sea level during their respective epochs, which shifted the location of bayhead-delta building farther down the valley and lowered the shorelines on the sides of the valley.

These three Pleistocene formations in the Potomac Valley are essentially the same as the three described by Shattuck (1901, 1906). Their interpretation differs from Shattuck's, however, in attributing the shifting shore lines to oscillations of sea level rather than to oscillations of the land. Moreover, it regards as intermediate shore lines what Shattuck (1906) supposed were parts of his primary shore lines warped down to lower levels. Like Shattuck's, it recognizes only four epochs of valley cutting, but between these were eight instead of three emerged shore lines.

Sunderland Formation

Name.—The Sunderland formation, named for a village in Calvert County, was briefly described by Shattuck in 1901 and more fully in later reports (Shattuck, 1902, 1906).

Description.—The Sunderland consists of coarse gravel, including cobbles a foot or more in diameter, cross-bedded sand, silt, and clay. The color ranges from orange-red to pink, yellow, and blue-gray. The maximum thickness of the Sunderland formation is probably about 40 or 50 feet. Variations in altitude of the Sunderland seem to be caused by inequalities in the valley floor on which it was deposited rather than by deformation.

Stratigraphic relations.—As the Sunderland in this region consists almost entirely of valley fill, it lies unconformably on deposits ranging in age from the ancient crystalline rocks to the Pliocene. At the northern end of the Potomac estuary it lies much lower than the Brandywine gravel, but at the southern end of the county it lies nearly as high.

Paleogeography.—Accumulation of the Sunderland formation in the District of Columbia and Prince Georges County began while the Potomac River was cutting a valley through its Pliocene alluvial fan of Brandywine gravel. At that time the seashore lay an unknown distance east of this region, perhaps beyond the present coast. The river flowed rapidly, for it rolled along its channel cobbles too large to be moved by a weak current. Spring floods brought ice floes carrying still larger blocks of stone. Later a rise of sea level to 215 feet (Coharie level) shifted the coast inland about to the county line and backed tidewater up the valley to Washington, forming an estuary not unlike that of the present Potomac River though perhaps wider. After a long pause during which a delta was built in the upper reaches of the estuary, the sea withdrew to a level about 45 feet lower (170 feet, Sunderland level), and the river carried gravel across its delta and began to build a new delta at the lower level. Finally, tidewater withdrew beyond the limits of the county, and the river began anew to incise a lower channel.

Age.—The Sunderland formation, as here interpreted, spans the interval between the first low-water stage of the Pleistocene and the beginning of the next. It therefore presumably accumulated in early Pleistocene during the first (Nebraskan) glacial stage and the first (Aftonian) interglacial stage. Outside of the estuaries, where the sea expanded across the open land and there are no fluvial or glacial deposits, the entire formation can be referred to the Aftonian. The Sunderland formation of this region as here defined, appears to be equivalent to the combined Sunderland and Coharie formations of North Carolina.

Distribution.—The Sunderland formation extends interruptedly from the Mt. Pleasant neighborhood in Washington to the southern end of Prince Georges County, forming a broken band 5 miles or less wide east of the Potomac River. The estuary in which this extension of the Sunderland was deposited probably opened into the ocean near the southwest corner of the county. The seashore ran eastward through Charles County not far south of Waldorf, crossed the southeastern part of Prince Georges County south of Cedarville, and extended northward through the eastern part of the county.

Few, if any, recognizable deposits of the Sunderland sea are to be expected along this part of the seashore, for there were no running streams to bring in sand, and most of the silt and mud carried in suspension was dropped in the estuaries before reaching the ocean. Moreover, the land in this region, being an old alluvial fan that sloped gently out beneath the sea, offered no banks from which sand and gravel could be readily mined by the waves.

In the Potomac estuary, however, there were ample deposits. An excavation at Columbia Road and Wyoming Avenue in Washington showed about 5 feet of coarse orange-red gravel on decayed crystalline rock. The surface there is about 170 feet above sea level.

At Thirteenth and Lamont Streets, N.W., fine orange gravel forms the surface at an altitude of 190 feet. Coarser gravel crops out at Fourteenth and Clifton Streets at an altitude of 170 feet. The top of the upland near by is 200 feet above sea level. At Ontario Road and Lanier Place there is gravel at 190 feet.

At Nichols Avenue and Portland Street, S. E., in Congress Heights (altitude 170 feet), the Sunderland consists of dirty light-colored gravel. The pebbles are poorly sorted. Many are 1½ inches in diameter. Blue-gray chert pebbles were probably derived from the Brandywine, which stands 230 feet higher not far away.

At Chesapeake and Second Streets, S.W., the Sunderland contains coarse cherty gravel, including boulders 1 foot in diameter, overlain by yellow silt. The top of the exposure is 165 feet above sea level.

In the vicinity of Fort Greble at Darrington Street and Nichols Avenue, S.E., the Sunderland formation, resting on the Potomac group, is about 20 feet thick. The lower half consists of poorly sorted gravel; the upper half is yellow silt. The surface is about 160 feet above sea level.

Where the Indian Head Road crosses the Oxon Hill Road (altitude 180+), coarse poorly sorted gravel is overlain by yellow silt. The Brandywine ½ mile farther east stands at 260 feet.

A cut on the Indian Head Road half a mile north of Piscataway Creek (see section, p. 37,) shows about 30 feet of Sunderland formation overlying the Miocene Chesapeake group. Poorly-sorted gravel including cobbles a foot in diameter merges upward into fine yellow and white cross-bedded sand. This is overlain by blue-gray or pinkish silt and brownish-yellow clay. Another gravel bed a little higher than this exposure is cut at the crossroads about a quarter of a mile farther north. The altitude at this crossroads is near 200 feet above sea level.

About 10 feet of coarse yellow gravel is cut by the Indian Head Road 2.3 miles northeast of the Charles County line. It contains much sandstone and some chert. Some of the boulders are as much as 18 inches in diameter. The altitude is about 160 or 170 feet above sea level.

About 6 feet of yellow silty sand is exposed on the Indian Head Road near the Charles County line. The altitude is over 180 feet above sea level.

Wicomico Formation

Name.—The Wicomico formation was named by Shattuck (1901) from the Wicomico River in Charles and St. Marys Counties in Maryland, but it is much more extensively developed on the Eastern Shore of Maryland (Shattuck, 1906, p. 92). As used in this report, the Wicomico includes materials ranging in elevation from 25 to 140 feet.

Description.—In this area the Wicomico consists of a coarse gravel bed at the base and finer sand and silt above. The color of the silt ranges from yellow to drab to dirty-white. There are also local basal deposits of carbonaceous clay containing tree stumps and other woody débris. The Wicomico formation rarely exceeds 30 feet in thickness.

Stratigraphic relations.—The Wicomico lies unconformably on older formations. In the Potomac Valley it follows a meandering course cut in crystalline bedrock and the Potomac group. Along the Patuxent it lies on Cretaceous, Eocene, and Miocene beds. It is sunk below the base of the Sunderland formation, and is separated from it by a slope exposing older rocks.

Paleogeography.—The beginning of Wicomico time found the sea withdrawn somewhere east of Prince Georges County. The Potomac River was deepening its valley to an elevation of 30 feet or less above the present sea level. A cypress swamp at that level became filled with muck to a depth of 9 feet in Washington before a rise in sea level backed tidewater up the valley to an altitude of 140 feet. Storm waves eroded a 60-foot cliff along the shore of this estuary near Florida Avenue from Rock Creek to Eleventh Street in Northwest Washington.

Later, as the sea withdrew successively to 100, 70, and 42 feet above its present level, the Potomac entrenched meanders in the tidal flats of its estuary.

The Patuxent River had a quite different history. At the beginning of Wicomico time it probably was flowing eastward into the Magothy River, as is suggested by the distribution of terrace deposits in Anne Arundel County (Little, 1917, geol. map). While sea level was still low, a small vigorous stream cut its head northward and captured the headwaters of the Patuxent somewhere not far below Laurel. The succeeding rise of sea level flooded the Patuxent up to Laurel and flooded Western Branch as far as Central Avenue.

The Anacostia River and its headwaters appear to have been flooded first during Wicomico time.

During the high-level stages of Wicomico time the entire Eastern Shore of Maryland and Virginia was under water, and the seashore lay near the western side of Chesapeake Bay. At the 100-foot stage, the shore extended south-southeastward across Tidewater Virginia from the mouth of the Potomac to the North Carolina line near Boykins, following the "Surry scarp" (Wentworth, 1930, p. 57). At the 70-foot and 42-foot stages, part of the Eastern Shore was emerged, and more of the mainland stood above water.

Flora.—Fossil plants have been found at only one place in this area—the excavation for the Mayflower Hotel (then called Walker Hotel) on Connecticut Avenue at DeSales Street in Washington. A carbonaceous clay at the base of the Wicomico contained large erect stumps of the bald cypress, *Taxodium distichum*, which was the most abundant and conspicuous species. Grapes, elderberries, blackberries, and sedges were also present (Berry, 1924). The most significant element of the flora is the diatoms, which are represented by 78 species or varieties (Mann, 1924). Most of these are not denizens of the region today, but have been found also in Pleistocene bog deposits at Crane Pond, Massachusetts, and at Montgomery, Alabama.

Age.—The flora yields little evidence as to the age of the Wicomico formation other than that it is Pleistocene. The Wicomico was deposited during the second of three cycles of down-cutting and subsequent fill of the Potomac Valley and therefore it presumably was laid down during the middle Pleistocene. Deposition is believed to have begun during the second (Kansan) glacial stage and was completed during the second (Yarmouth) interglacial stage. This conclusion differs from that of Leverett (1928), who traced a gravel train supposed to be derived from Illinoian (third glacial) drift into the Wicomico formation at the mouth of the Susquehanna River.

The Wicomico formation as interpreted in this region is more comprehensive than farther south, where the Wicomico formation is restricted (Cooke, 1931) to deposits formed when the seashore stood 100 feet above the present sea level. Its marine equivalents elsewhere are the Talbot formation as restricted by the writer (1931, p. 510) (shore line 42 feet), the Penholoway formation (shore line 70 feet), the restricted Wicomico formation, and the Okefenokee formation (shore line 140 feet, as here restricted).

Distribution.—The largest area of the Wicomico formation in this region is in Washington, where it extends from Florida Avenue southward to the White House and from the mouth of Rock Creek eastward past the Capitol to the Anacostia River. A narrow strip along the right bank of the Anacostia River broadens up the Northwest Branch and the Northeast Branch. There is a circular area including Hedge Neck north of Fort Washington, with an extension up Henson Creek. Strips of Wicomico extend up Piscataway Creek, Tinker Creek, and Mattawoman Creek. The Wicomico extends up the Patuxent River to Laurel and up Western Branch to Central Avenue.

At DuPont Circle in Washington the Wicomico formation rests directly on crystalline schist. The bottom bed consists of 2 or 3 feet of coarse gravel and large boulders, presumably a river deposit formed during the second ice age. This is overlain by about 15 feet of yellow to drab silt. The silt has been eroded off south of the circle, for at Connecticut Avenue and N Street the gravel lies near the surface.

The excavation for the Mayflower Hotel at Connecticut Avenue and DeSales Street cut through the Wicomico and 7 to 12 feet of the Patuxent formation into the schist (Wentworth, 1924, p. 8). The base of the Wicomico, at an altitude of 30 feet above sea level, consists of 6 to 9 feet of light-brown to black highly carbonaceous silt or swamp muck containing cypress stumps (Berry, 1924) and fresh-water diatoms (Mann, 1924). The swamp deposit is overlain by 15 feet of light-gray loam, sandy clay, sand, and gravel. This bed is poorly sorted and includes bands and lenses of pebbly sand. The eroded upper surface of this bed was covered by artificial fill, to the level of the street, at an altitude of 57 feet, about 25 feet lower than DuPont Circle.

The vicinity of Pennsylvania Avenue and Seventeenth Street, N.W., is underlain by dirty-white or cream-colored silt of the Wicomico formation. The altitude there is about 60 feet above sea level.

The highest shore line (Okefenokee level) of the Wicomico is marked by a sudden steepening of the ground on Connecticut Avenue below LeRoy Place at an altitude of approximately 140 feet. Here the Wicomico abuts against a bank of crystalline rock capped by gravel of the Sunderland formation. A gentle slope leads down to 100 feet at S Street, from which the main Wicomico plain extends southward. The 70-foot shore line (Penholoway level) is conspicuous north of H Street on a parking lot between Seventeenth and Eighteenth Streets, N.W. It extends eastward across Lafayette Park and Franklin Park and runs parallel to New York Avenue as far as New Jersey Avenue. The 42-foot shore line (Talbot level) extends from Twenty-third and C Streets, N.W., to the Municipal Center. It is crossed by Eighteenth Street at E and passes behind the White House.

Pamlico Formation

Name.—The Pamlico formation, named from Pamlico Sound in North Carolina, was first described by Stephenson (1912, p. 286). The formation is bounded by a marine shore line, with estuarine reentrants, now standing 25 feet above sea level. What is now called Pamlico was included in the Talbot formation of Shattuck (1901, p. 104), which by original definition has a shore line about 45 (42) feet above sea level. The Talbot was restricted to this older part, corresponding to a shore line at 42 feet, by the writer (1931, p. 510).

Description.—In this region the Pamlico is entirely fluvial and estuarine. It consists chiefly of gravel, sand, and silt. The deposits probably do not exceed 30 feet in thickness.

Stratigraphic relations.—The Pamlico formation lies on valley floors cut in the ancient crystalline rocks and in sedimentary deposits ranging in age from the Cretaceous Potomac group to the Miocene Chesapeake group. It may locally lie unconformably on the Pleistocene Wicomico formation. Where it does not form the surface, it is overlain unconformably by Recent sediments or by artificial fill.

Paleogeography.—Pamlico time began with the accumulation of gravel in the beds of streams running swiftly as the result of a lowering of sea level. The seashore lay somewhere east of Prince Georges County, probably beyond the present coast. Then followed a rise of sea level that backed tidewater up to a height of 25 feet but later dropped to 6 feet (Silver Bluff level, Cooke, 1945, p. 248). All of the streams below those levels were changed into estuaries. The head of tide in the Potomac probably stood at Little Falls, as it does now. Tides extended beyond the head of the Anacostia nearly to Riverdale on the Northeast Branch and to Queens Chapel Airport on the Northwest Branch. In Washington the old Naval Hospital, the White House, the Courthouse, and the Capitol stand above the Pamlico shore of the Potomac estuary. In the Patuxent River, tides then reached Governor Bridge, midway between Central Avenue and the Defense Highway. Except for the possibly wider estuaries, conditions in Prince Georges County and the District of Columbia were not much different from those of the present.

Age.—The Pamlico formation accumulated during the third cycle of downcutting and subsequent drowning of the Potomac River. Presumably this epoch is in the later Pleistocene. It began during the third glacial stage (Illinoian) and continued and was completed during the third interglacial stage (Sangamon).

Distribution.—The Pamlico formation occupies the valley floors of all streams except the very smallest below an altitude of 25 feet above sea level. The area mapped as Pamlico includes also tidal marsh and other alluvial deposits of Recent age as well as artificial fill, or "made land."

LATE PLEISTOCENE AND RECENT DEPOSITS

Description.—The late Pleistocene deposits are for the most part buried beneath Recent accumulations or submerged under water. They doubtless consist chiefly of gravel, sand, and silt. As all except swamp deposits were transported by running water, the coarser materials occur in streams heading in the Piedmont region or crossing it, though some coarse gravel was reworked from formations in the Coastal Plain. The marine Cretaceous, the Eocene, and the Miocene formations yielded chiefly fine sand.

The Recent deposits consist chiefly of mud, silt, and fine sand deposited in tidal marshes, though coarser sand and gravel are rolled along the channels in the upper reaches of the estuaries during floods and freshets. There are also extensive areas of "made land" and artificial fill in the vicinity of Washington and along the highways.

Stratigraphic relations.—The late Pleistocene deposits occupy channels cut in older beds on which they lie unconformably. They are covered without stratigraphic break by Recent sediments, which overlap them onto former valley slopes.

Paleogeography and geography.—Late Pleistocene time was begun by a recession of sea level from 6 feet above to at least 25 feet below the present level. At this lowest stage the seashore lay on the Continental Shelf somewhere beyond the present coast, the Susquehanna River flowed through wide plains that are now flooded by Chesapeake Bay, and the Potomac and Patuxent Rivers were flowing streams to their mouths.

During the Recent epoch the sea rose to its present level and flooded all the lowlands, forming estuaries whose shore lines followed the contour of the flooded lands. The shallower places were changed into tidal marshes by the accumulation of silt and the growth of water plants. In recent years large areas of marsh and shallow water have been filled with materials dredged from the channels and converted into land.

Age.—The lowering of sea level that preceded the Recent drowning of the watercourses caused the last of a series of four emergences. Presumably it took place during the latest of four ice ages, that is, in the Wisconsin glacial epoch.

Distribution.—The drowned valleys of the Potomac and the Patuxent Rivers form catchment basins that retain most of the débris washed into them. The principal areas of sedimentation are at the heads of the tributary estuaries, where each little stream drops its load when the current slackens. The deltas so built soon become tidal marshes. In the Potomac, however, little sediment is dropped above Georgetown because the flow of the river, though subject to a tidal variation of 5 feet, is strong enough to keep the channel swept clean. The current through the gorge is reversed by the flood tide only at times of exceptionally low water in the upper river.

Though tides extend up the Potomac to Little Falls, the channel is deep,[4] narrow, and rocky as far down as Fletchers Cove, $1\frac{1}{2}$ miles farther downstream. The Hen and Chickens rocks narrow the channel below the cove. The rocks called the Three Sisters from time to time form the nucleus of an alluvial island, which is repeatedly washed away by floods or scoured out by ice. Extensive tidal marshes at the south end of Analostan Island (now officially named Theodore Roosevelt Island) were modified by the cutting of a channel to form the mouth of Little River and by the construction of Columbia Island, which separates Boundary Channel from Georgetown Channel. Potomac Park is based on tidal marshes that have been covered by artificial fill dredged from Georgetown and Washington Channels. Much of Anacostia Park, also, is reclaimed marshland. There has been much silting and some artificial fill in the upper part of Anocostia River since colonial days, when Bladensburg was a port.

A large part of the National Airport was built of dredgings from the river. Tiber Creek, which formerly flowed past the site of the City Post Office and

[4] The channel of the Potomac is scoured to a depth of 60 feet below sea level at Chain Bridge.

along Constitution Avenue to a wide mouth near the Lincoln Memorial, has been completely filled in.

STRUCTURE

The structure of the sedimentary formations is very simple. The Patuxent and Patapsco formations, an agglomeration of lenses of gravel, sand, and clay, apparently deposited as outwash on a sloping plain, give little evidence of deformation, for their regional dip of 50 to 90 feet to the mile (Miller, 1911, p. 87) is little more than the normal depositional slope of such an accumulation. That there has been some faulting, however, is proved by a small overthrust of crystalline rocks on coarse gravel (Patuxent) in the National Zoological Park at Adams Mill Road.

All the marine Cretaceous, Eocene, and Miocene formations slope gently southeastward at rates becoming progressively less with decreasing age, and ranging from an estimated 25 feet to the mile for the Late Cretaceous Monmouth formation to 6 feet or less for the Miocene strata. Even the steepest of these dips would not be an excessive depositional slope for a near-shore marine formation, for the sea bottom is rarely horizontal. If there has been any deformation, it has been very slight. It is not intended to imply that the tops and bottoms of these formations are plane surfaces. They undoubtedly have minor irregularities, some of which may be the result of warping. Most of them, however, may be interpreted as caused by variations in the thickness of a formation, by unevennesses in the surface on which it was deposited, or by a combination of these two factors.[5]

The Bryn Mawr and the Brandywine gravels, being alluvial fans, must have had an original slope sufficiently steep to permit water flowing down it to carry the pebbles of which they are composed. The present slope of about 6 feet to the mile has probably not been steepened by deformation.

The Pleistocene formations are estuarine deposits superimposed on fluvial gravel. The bottom beds slope gently downstream; the upper beds can be referred to horizontal shore lines. There appears to be no evidence that they have been deformed.

[5] Dryden (1935) thinks differently. See also Cooke (1936) and Monroe (1936).

SURFACE WATER RESOURCES

BY

ROBERT O. R. MARTIN

Introduction

Human life and progress are closely dependent upon water, and man can exist but a few days without it. The conservation and control of water, therefore, have become one of his vital problems. The demands of an advancing civilization have placed limitations on the use of water, especially after man abandoned his nomadic way of life and established a permanent home rather than moving continually from water hole to water hole. In densely populated areas, the demand for water very often approaches the limit of supply. Areas lacking in water are most often sparsely settled because the expense of transporting water is a burden to the homemaker. An adequate water supply is a prerequisite to the growth of our cities.

With increased demand for water many complex problems arise, such as pollution and contamination from known or unknown sources within the watershed. Water as precipitated on the earth is originally pure, but man has a trying task to maintain this quality. Numerous outbreaks of sickness and epidemics have been traced to impure drinking water. Clean, pure streams and lakes are important assets to a community for recreational purposes aside from their value as possible sources of public water supplies.

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 manifold industrial uses of surface waters in our 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 commonly 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 stream flow.

Although stream flow is indispensable to man, excessive amounts can cause tremendous damage and even loss of life. It has been the inclination of man to establish his home on or near a stream in order to have a readily accessible supply of water or means of transportation. As river settlements grow, the usual trend is for the flood plains of the stream to be encroached upon, and even for the normal stream channel to be crowded and its carrying capacity reduced by structures of all kinds. Thus, the tendency toward flooding is aggravated, and the actual or potential flood damages are vastly 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, it is necessary that records of stream flow be available for a sufficient number of years to establish the flood-flow characteristics of the stream.

STREAM-FLOW MEASUREMENT STATIONS

In order to study systematically the range of stream flow so as to derive maximum benefits from it, the U. S. Geological Survey has installed numerous stream-gaging stations throughout the country. In cooperation with the Maryland Department of Geology, Mines and Water Resources, and other State, Federal, and municipal agencies, many such gages are in operation in Maryland. Most of these are equipped with automatic water-stage recorders, which collect a continuous record of the stage of the stream (fig. 1). In conjunction with the stage record, flow determinations must be made periodically by means of a precise instrument known as a current meter in order to correlate stage with discharge (Pl. 2, fig. 1). With an established stage-discharge relationship, the discharge corresponding to a given stage can be determined by interpolation provided the channel conditions of the stream remain unchanged.

The selection of a site for a gaging station requires a careful appraisal of the stream channel to be assured that hydraulic conditions are stable and that a fixed relation between stage and discharge will be maintained. Consideration must be given also to the accessibility of the gage under adverse conditions of storm and high water and to the requirement that the measurement of discharge of the stream be possible at all stages. In order to avoid building expensive structures it is economical to benefit by the proximity of a bridge suitable for discharge measurements. In some cases there is no alternative except to erect a cableway across a stream. This cableway is generally suspended from high A-frames on each bank and is used to support a cable car. The elevation of the cableway must be sufficient to support an engineer and his measuring equipment with sufficient clearance above the stages of anticipated floods.

Present-day construction practice favors a permanent-type recording-gage structure. The usual gage well and house in Maryland is constructed of concrete block or reinforced concrete and has inside dimensions of about 4 feet square. The structure is provided with steel doors for house and well and is connected to the stream by one or more horizontal pipes or intakes to permit the water in the well to fluctuate simultaneously with the stream. The height of the structure is governed by the height of the maximum anticipated flood (Pl. 1, figs. 1 and 2).

A continuous graphic record of stage with respect to time is obtained by means of a water-stage recorder installed in the gage house to record the fluctuations of the water level in the gage well (fig. 1). The modern water-stage recorder requires very little attention. Inspections to change the continuous recorder charts can be made once a month or even less frequently. In silt-laden streams it is necessary to clean the intake pipes by forcing water through them by means of a flushing device. In Prince Georges County most of the streams contain enough silt to require an intake-pipe flushing system.

The rate of flow of a stream, or the discharge, is the quantity of water passing any point in a given time. This quantity is expressed in terms of cubic feet per second, commonly called second-feet. Discharge varies with precipitation and with basin characteristics, such as depth and texture of the soils and steepness of the terrain. The discharge at any point on a stream can readily be determined by multiplying the cross-sectional area of the water by its velocity. Stream-flow measurements are made periodically by means of a Price current meter which determines the velocity of the water. Plate 2, figure 1, shows a standard Price current meter mounted on a rod for use in making a discharge measurement by wading a stream and the smaller Pygmy meter designed for shallow streams. Plate 2, figure 2, shows the heavier crane and reel equipment used to measure deep swift streams. The purpose of a discharge measurement is to define the stage-discharge relation existing at that time (fig. 2).

Daily discharge records for the gaging-stations are published in annual water-supply papers of the United States Geological Survey, in Part 1 of the series called "Surface-Water Supply of the United States".

DEFINITIONS OF TERMS

Several technical terms are used in stream-flow records. Brief explanations of them are:

Second-feet.—An abbreviation for "cubic feet per second." A 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.

Discharge.—A rate of flow of water, usually expressed in second-feet. One second-foot flowing for one day equals 86,400 cubic feet, equals 646,317 gallons, equals about 2.0 acre-feet.

Second-feet per square mile.—An average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the runoff is distributed uniformly as regards both time and area.

Runoff in inches.—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.

Drainage basin.—The area drained by a stream or stream system, usually expressed in square miles.

Water year.—A special annual period selected to facilitate water studies, commencing October 1 and ending September 30.

Plate 1, Fig. 1. Gage House at Stream Flow Measurement Station on Western Branch near Largo (facing upstream).

Plate 1, Fig. 2. Gage House at Stream Flow Measurement Station on Northeast Branch Anacostia River at Riverdale (facing upstream).

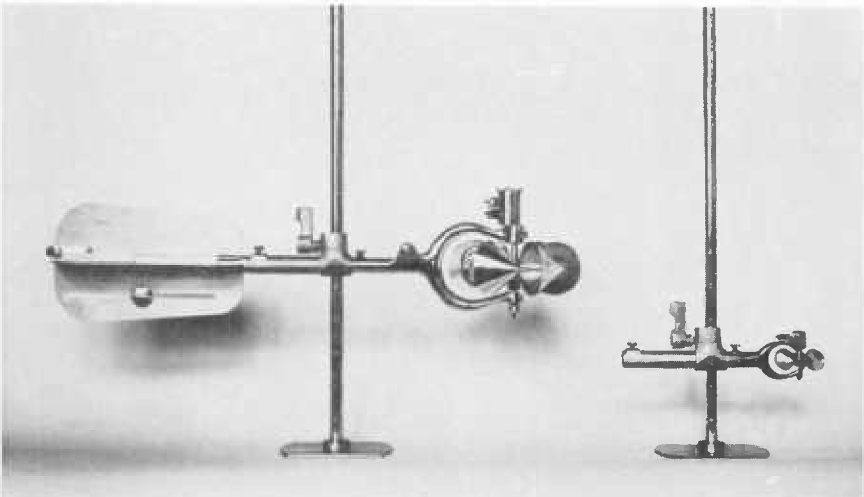


PLATE 2, FIG. 1. Standard Price Current Meter and Pygmy Meter, Suspended on Wading Rods, Used to Measure Discharge.

PLATE 2, FIG. 2. Equipment Used in Making Discharge Measurements from Bridge.

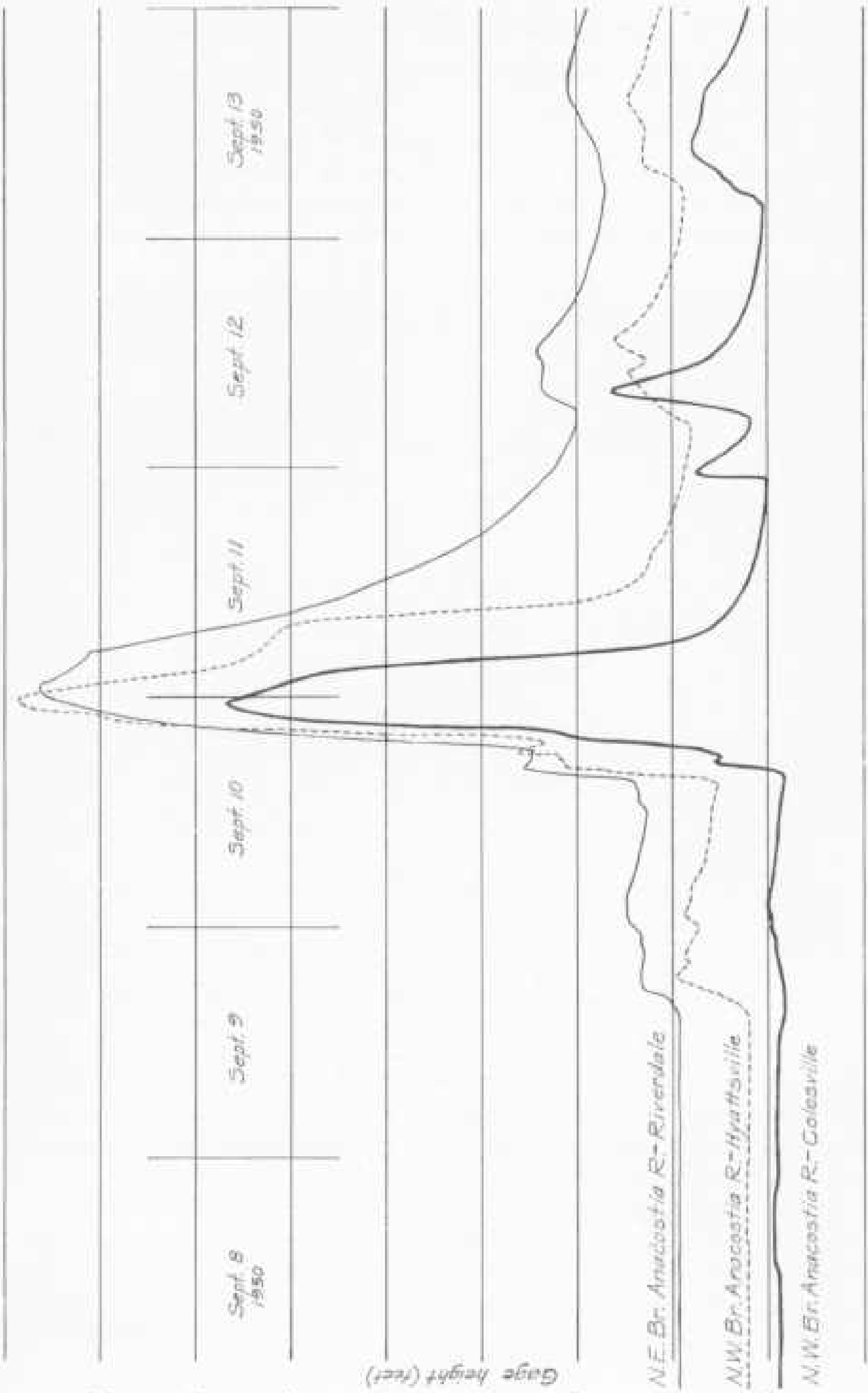


Figure 1. Graph of River Stage from Automatic Water-stage Recorder

SURFACE WATER RESOURCES OF PRINCE GEORGES COUNTY

The principal streams within Prince Georges County flow southwestward or southeastward and are tributary to either the Potomac River or the Chesapeake Bay. The divide between these two major basins roughly bisects the County along a meandering line running generally north and south. All main streams enter tidal water so that the lower reaches contain brackish water. Several streams serve as natural county boundaries, namely: the Patuxent

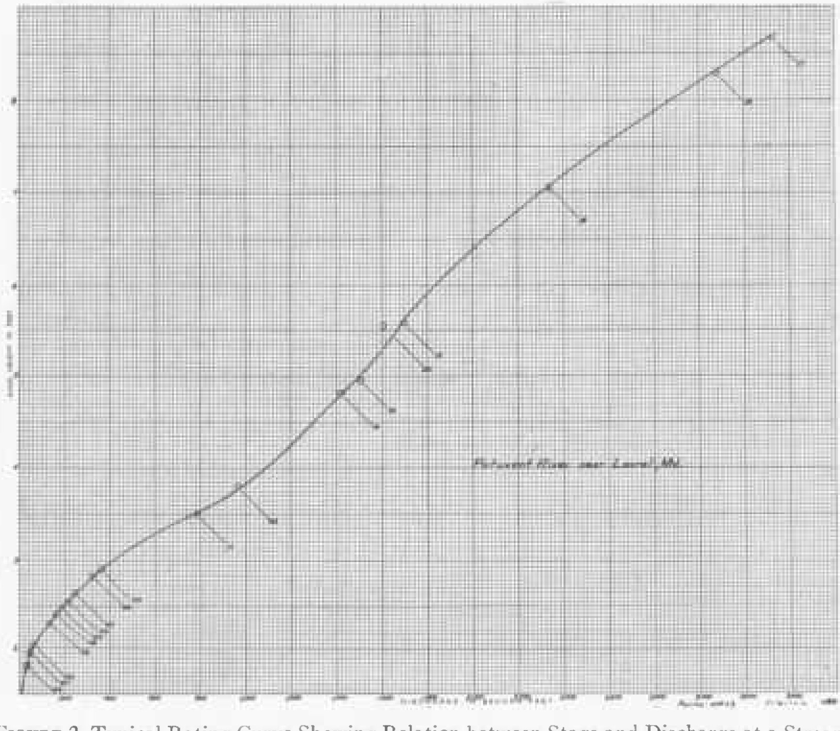


FIGURE 2. Typical Rating Curve Showing Relation between Stage and Discharge at a Stream-gaging Station

River, which forms the entire northeastern and eastern boundary; Swanson and Mattawoman Creeks, which form most of the southern boundary; and tidal reaches of the Potomac River, which form the western boundary downstream from the District of Columbia.

In general the topography of the county is characterized by low, rolling hills except for swampy areas found principally along lower tributaries and lower reaches of major streams. Stream-flow characteristics reflect the effect of this pattern of relief. In the areas with most relief, moderately steep gradients in headwater reaches and upper tributaries of main streams cause fairly high velocities at high stages with resultant erosion. Elsewhere in the county, gradients are flat and ineffective, channels are ill-defined, and velocities are slow. Gradual deposition of sand and silt tends to choke some of these channels and produces overbank flooding. In spite of some flooding of the lowlands, there are practically no natural lakes except those which form parts of swamps in the lower reaches of the streams.

Little information about the quality of surface waters in Prince Georges County is available. The chemical quality and sediment content vary depending upon rainfall, use of land and water resources, and the season of the year. In general, the surface waters are known to have low concentrations of dissolved solids and low hardness. Average values for 1949 for the Northwest Branch Anacostia River are 92 parts per million dissolved solids and 14 parts per million hardness. Although sedimentation is a problem in many of the streams, continuous records of sediment discharge are not available for estimating the load of sediment carried by the streams.

The fresh-water drainage suitable for domestic water supply is largely confined to the Patuxent River upstream from the town of Laurel and to a smaller extent to the Northwest Branch Anacostia River. The drainage areas involved for this suitable fresh-water supply are about 130 and 50 square miles respectively with practically the entire area confined to Montgomery County. In 1918 the Washington Suburban Sanitary District was created by the General Assembly of Maryland for the purpose of providing a water supply for the Maryland suburbs of Washington. Prince Georges County has now become the principal water consumer in this suburban area owing to its rapid development and remarkable expansion of population.

The result of this ever-expanding development is detrimental to a safe water supply. The discontinuance of the use of the Northwest Branch Anacostia River has been considered, owing to the encroachment on the drainage basin of many of the residences. An additional large storage dam will be built on the Patuxent River at Rocky Gorge, just upstream from Laurel, to supplement the storage in Brighton Reservoir. This will result in almost complete regulation of the flow of the Patuxent River. The remaining streams of Prince Georges County are small, and probably will never be used for public water supply.

Irrigation is not a serious economic factor in Prince Georges County as the rainfall is generally ample for farming. Long-term records at nearby Washington, D. C., show the average annual rainfall to be 40 inches or more and as much as 17.45 inches for the maximum monthly rainfall, which occurred during September 1934. There has been a trend in recent years for farmers to build small stock ponds in cooperation with the U. S. Soil Conservation Service in order to conserve and distribute some of the rainfall.

The principal streams of Prince Georges County and their areas at selected points are listed in Table 1, based chiefly on data in a "Report to the General

Assembly of Maryland by the Water Resources Commission of Maryland, January 1933." The locations of these streams are shown in Figure 3.

GAGING STATIONS IN AND NEAR PRINCE GEORGES COUNTY

Records of stream flow are collected at five gaging stations within the county. A long-term stream-flow record is also available for the Patuxent River near Burtonsville in Montgomery County, just upstream from the county line, but this station was discontinued February 6, 1945.

In Bulletin No. 1, Maryland Department of Geology, Mines and Water Resources, "Summary of Records of Surface Waters of Maryland and Potomac River Basin, 1892–1943," published in 1944, monthly discharge records are given of the maximum, mean, and minimum flow, discharge in cubic feet per second per square mile, runoff in inches, and discharge in million gallons per day per square mile for all gaging station records for Prince Georges County from their dates of establishment to September 30, 1943. The addition of the 1896–98 record for the Patuxent River at Laurel has been made in this report. The drainage areas and years of records available for all gaging stations, former and present, in and near Prince Georges County are presented in Table 2. The locations of the stations are shown in Figure 3.

RUNOFF IN PRINCE GEORGES COUNTY

AVERAGE RUNOFF

Stream-flow records for the periods 1925–39 and 1939–48 indicate an average yield of one second-foot per square mile of drainage area for the major streams of Prince Georges County.

Stream Gaging Station	Drainage area in sq. miles	Mean discharge in c.f.s.	C.f.s. per sq. mile
1925–39			
Patuxent River near Burtonsville.	127	129.3	1.02
N. W. Br. Anacostia River near Colesville.	21.3	21.2	1.00
1939–48			
N. E. Br. Anacostia River at Riverdale.	72.8	75.1	1.03

This yield is consistent with comparable stream-flow records at gaging stations throughout Maryland and applies only to those natural flowing streams unaffected by regulation. The periods selected were prior to later regulation.

MAXIMUM FLOOD RUNOFF

The maximum flood recorded in Prince Georges County occurred on August 23, 1933, according to the 37 years of continuous stream-gaging records on the Patuxent River at Burtonsville and Laurel, the 27 years of records on the North-

FIGURE 3. Map of Prince Georges County Showing Locations of Principal Streams and Locations of Gaging Stations

TABLE 1

Drainage Areas of Streams in Prince Georges County

Name of Stream	Tributary to:	Drainage area, in square miles			
		At mouth	In Maryland	At point	U. S. G. S. Gage
Anacostia River	Potomac	170	145		
Anacostia River, Northeast Branch	Potomac	75.6			
Gage at Riverdale	Potomac				72.8
Gage at Hyattsville	Potomac				75
Anacostia River, Northwest Branch	Potomac	53.2	49.6		
Gage near Colesville	Potomac				21.3
Gage near Hyattsville	Potomac				49.4
Gage at Bladensburg	Potomac				52
Beaverdam Branch	Anacostia	14.7	14.6		
Gage at Kenilworth	Anacostia				14
Beaverdam Creek	Indian Creek	13.7			
Broad Creek	Potomac	30.0			
Below Hunters Mill Branch	Potomac			23.6	
Charles Branch	Western Branch	17.6			
Collington Branch	Western Branch	21.9			
Henson Creek	Broad Creek	18.2			
Gage at Oxon Hill	Broad Creek				17.4
Horsepen Branch at High Bridge	Patuxent			5.00	
At Bowie	Patuxent			6.03	
Little Patuxent River	Patuxent	161			
Little Paint Branch	Paint Branch	10.8			
Lyons Creek	Patuxent	19.5			
Mataponi Creek	Western Branch	19.7			
Mattawoman Creek	Potomac	98.1			
Gage near Pomonkey	Potomac				57.7
At Mattawoman	Potomac			6.55	
At Mason Springs Highway Bridge	Potomac			71.9	
Newstep Branch near High Bridge	Horsepen Branch			1.87	
Oxon Run	Potomac	13.5	10.2		
Paint Branch	Anacostia	31.5			
At County line	Anacostia			14.0	
Patuxent River	Chesapeake	932			
Gage near Burtonsville	Chesapeake				127
Gage near Laurel	Chesapeake				133
Gage at Laurel	Chesapeake				137
Above Little Patuxent River	Chesapeake			181	
Piscataway Creek at mouth of estuary	Potomac	70.4			
½ mile west of Piscataway	Potomac			60.5	

TABLE 1—*Continued*

Name of Stream	Tributary to:	Drainage area, in square miles			
		At mouth	In Maryland	At point	U. S. G. S. Gage
Sligo Branch	Anacostia	13.3	11.3		
Southwest Branch	Western Branch	15.4			
Swanson Creek	Patuxent	27.4			
Timothy Branch near Mattawoman	Mattawoman Creek			2.79	
Tinkers Creek	Piscataway	16.2			
Western Branch	Patuxent	110			
Gage near Largo	Patuxent				30.1
Wicomico River	Potomac	247			
Zekiah Swamp at Allens Fresh	Wicomico			105	

TABLE 2

Stream Gaging Stations in and Near Prince Georges County

Map No.	Stream gaging station	Drainage area square miles	Records available*
1	Patuxent River near Burtonsville	127	1911–12; 1913–45
2	Patuxent River near Laurel	133	1944–
3	Patuxent River at Laurel	137	1896–98
4	Western Branch near Largo	30.1	1949–
5	N. E. Br. Anacostia River at Riverdale	72.8	1938–
6	N. E. Br. Anacostia River at Hyattsville	75	1911–12
7	N. W. Br. Anacostia River near Colesville	21.3	1924–
8	N. W. Br. Anacostia River near Hyattsville	49.4	1938–
9	N. W. Br. Anacostia River at Bladensburg	52	1911–12
10	Beaverdam Br. Anacostia River at Kenilworth Ave. at Washington, D. C.	14	1911–12
11	Henson Creek at Oxon Hill	17.4	1948–
12	Mattawoman Creek near Pomonkey	57.7	1949–

* Stations without closing date are still in operation.

west Branch Anacostia River at Colesville, and the 20 years of records on Seneca Creek at Dawsonville. Peak discharges at these long-term stations for the 1933 flood were:

Gaging Station	Drainage area in sq. miles	Peak discharge in c.f.s.	C.f.s. per sq. mile
Patuxent River near Burtonsville	127	11,000	86.6
Northwest Branch Anacostia River near Colesville	21.3	4,500	211
Seneca Creek at Dawsonville	101	6,500	64.4

The storm of August 23, 1933, although not the most severe in the history of Maryland, caused the most widespread damage. The 24-hour rainfall of 7.62 inches at Baltimore exceeded the record since 1817 and established August 1933 as the wettest month on record for a period of 133 years. The 24-hour rainfall at Washington, D. C. was 6.40 inches and was accompanied by wind velocity as high as 51 miles per hour.

MINIMUM DROUGHT RUNOFF

The most severe drought period commenced in 1930 when the precipitation for the year for the State of Maryland averaged only 24 inches as compared with a 54-year average of 42 inches. Extreme drought conditions prevailed from 1930 to 1934. For details on drought studies see U. S. Geological Survey Water-Supply Paper 680, "Droughts of 1930-34." On Aug. 11, 12, 1930 and Sept. 2, 1932, the daily discharge for the Northwest Branch Anacostia River near Colesville fell to 0.4 second-foot, or less than 0.02 second-foot per square mile.

STREAM-FLOW REGULATION

The history of stream gaging in Prince Georges County illustrates the development of the available water resources. Streams that were natural flow at the beginning of the gaging station records, in many instances, have become seriously affected by artificial regulation. The descriptions for each station in this report should be examined carefully before attempting to use the records in any interpretive studies. A good example of such changes is indicated in the history of stream gaging on the Patuxent River. The original gaging station at Burtonsville operated with natural flow for 27 years prior to August 1939, when initial diversion began with pumpage at Mink Hollow from the Patuxent River basin to the Northwest Branch Anacostia River basin. In June 1942, Brighton Dam several miles upstream began storage so that the Burtonsville stream-gaging record was discontinued in February 1945 after more than 32 years of record. In October 1944, a new stream-gaging record was started near Laurel at a gaging station site just downstream from the Rocky Gorge Pumping Station for the purpose of measuring the remaining stream flow after diversion to the Willis School Filtration Plant. The contemplated storage dam at Rocky Gorge will control to even a greater degree the regulation of the Patuxent River in the future. By receiving diverted flow from the Patuxent River, the Northwest Branch Anacostia River near Colesville likewise loses its natural flow characteristics, and the downstream gaging station at Hyattsville is complicated further by the additional diversion and storage at the Burnt Mills Filtration Plant. Consequently, the only gaging station in Prince Georges County having 10 or more years of record on an essentially natural-flow stream is on the Northeast

Branch Anacostia River at Riverdale. The small dams on the headwaters have very little regulatory effect.

DISCHARGE RECORDS

Monthly discharge records prior to October 1943 for the gaging stations included in this report are published in Bulletin 1, Maryland Department of Geology, Mines and Water Resources. Similar continued records for the water years 1944–1950 and for earlier periods not included in Bulletin 1 follow.

PATUXENT RIVER BASIN

1. Patuxent River near Burtonsville

Location.—Water-stage recorder, lat. 39°07′47″, long. 76°55′04″, 150 feet upstream from highway bridge, 1½ miles northeast of Burtonsville, Montgomery County, and 8 miles downstream from Hawlings River. Datum of gage 232.79 feet above mean sea level, adjustment of 1912. From July 22, 1914 to July 10, 1929, water-stage recorder 80 feet downstream from highway bridge at present datum. Prior to July 22, 1914, staff gage at highway bridge, datum 1.29 feet higher than present datum.

Drainage area.—127 square miles.

Monthly discharge of Patuxent River near Burtonsville

Month	Discharge in second-feet				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per sequare mile		
1943–44						
October	190	14	30.6			
November	857	24	141			
December	544	23	73.2			
January	1520	33	210			
February	226	42	86.8			
March	365	52	199			
April	329	124	170			
May	194	28	67.4			
June	402	22	45.8			
July	57	22	35.6			
August	111	28	37.5			
September	213	24	38.4			
The year	1520	14	94.6			
1944–45						
October	118	24	36.2			
November	110	24	34.1			
December	408	48	153			
January	679	70	241			
February	72	49	62.8			

Extremes.—Maximum discharge, 11,000 second-feet Aug. 24, 1933 (gage height, 21.7 feet, from floodmarks), from rating curve extended above 3,800 second-feet; minimum, 4.6 second feet Oct. 9, 10, 1942.

Records available.—July 1911 to June 1912, July 1913 to February 1945.

Remarks.—Records do not include diversion by pumps at Mink Hollow (drainage area 109 square miles), which began Aug. 12, 1939, of part of low-water flow into Anacostia River

Yearly discharge of Patuxent River near Burtonsville

Year	Year ending Sept. 30				Calendar year			
	Discharge in second-feet		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in second-feet		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1914	100	0.787	10.73	0.509	96.3	0.758	10.30	0.490
1915	141	1.11	15.05	.717	147	1.16	15.69	.750
1916	110	.866	11.85	.560	109	.858	11.71	.555
1917	128	1.01	13.70	.653	126	.992	13.45	.641
1918	124	.976	13.23	.631	124	.976	13.27	.631
1919	151	1.19	16.10	.769	168	1.32	17.94	.853
1920	184	1.45	19.66	.937	172	1.35	18.28	.873
1921	103	.811	11.00	.524	95.9	.755	10.25	.488
1922	99.1	.780	10.59	.504	95.7	.754	10.22	.487
1923	93.1	.733	9.93	.474	104	.819	11.15	.529
1924	201	1.58	21.57	1.02	208	1.64	22.24	1.06
1925	123	.969	13.16	.626	116	.913	12.45	.590
1926	119	.937	12.77	.606	141	1.11	15.11	.717
1927	153	1.20	16.31	.776	142	1.12	15.20	.724
1928	172	1.35	18.40	.873	160	1.26	17.10	.814
1929	116	.913	12.38	.590	117	.921	12.48	.595
1930	81.0	.638	8.65	.412	62.6	.493	6.68	.319
1931	51.7	.407	5.54	.263	52.1	.410	5.58	.265
1932	66.0	.520	7.08	.336	94.7	.746	10.15	.482
1933	187	1.47	19.95	.950	173	1.36	18.51	.879
1934	122	.961	13.03	.621	132	1.04	14.12	.672
1935	159	1.25	16.98	.808	154	1.21	16.48	.782
1936	166	1.31	17.79	.847	161	1.27	17.22	.821
1937	170	1.34	18.20	.866	205	1.61	21.96	1.04
1938	140	1.10	14.97	.711	103	.811	10.96	.524
1939	115				110			
1940	99.2				110			
1941	92.9				73.7			
1942	60.8				95.3			
1943	119				98.9			
1944	94.6				93.0			
1945	—				—			
Highest	201				208			
Average	124				125			
Lowest	51.7				52.1			

Basin to augment supply of Washington Suburban Sanitary District or change in storage of Brighton Reservoir (usable capacity, 2,913,000,000 gallons) which began June 27, 1942. Pumping station records and change in storage of Brighton Reservoir can be obtained from the Washington Suburban Sanitary Commission, Hyattsville, Md.

2. Patuxent River near Laurel

Location.—Water-stage recorder and concrete control, lat. 39°06′45″, long. 76°52′15″, 0.4 mile upstream from Walker Branch and 1.0 mile northwest of Laurel, Prince Georges County.

Drainage area.—133 square miles.

Records available.—October 1944 to September 1950.

Extremes.—Maximum discharge, 3,430 second-feet Aug. 1, 1945 (gage height, 8.78 feet); minimum, 2.0 second-feet (regulated) Feb. 20, 1947 (gage height, 1.25 feet); minimum daily, 18 second-feet (regulated) Oct. 6, 9, Nov. 24, 1944.

Remarks.—Records excellent except those for periods of ice effect, which are fair. Records do not include diversion, by pumps, of part of low flow into Anacostia River Basin and at Willis School Filtration plant for supply of Washington Suburban Sanitary District, and change in storage in Brighton Reservoir (usable capacity, 2,913,000,000 gallons between elevations 327.0 and 350.0 feet). Storage began June 27, 1942. Records of diversions and change in reservoir contents can be furnished by Washington Suburban Sanitary Commission, Hyattsville, Md.

Monthly discharge of Patuxent River near Laurel

Month	Discharge in second-feet				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1944–45						
October	110	18	30.5			
November	116	18	31.7			
December	372	44	144			
January	737	56	180			
February	401	40	190			
March	288	80	158			
April	151	33	58.0			
May	381	24	86.9			
June	766	24	112			
July	1530	45	280			
August	1800	80	206			
September	644	37	123			
The year	1800	18	134			
1945–46						
October	177	48	81.9			
November	363	82	118			
December	1240	125	235			
January	470	149	195			
February	356	145	198			

Monthly discharge of Patuxent River near Laurel—Continued

Month	Discharge in second-feet				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1945–46—*Continued*						
March	260	66	163			
April	86	58	71.3			
May	214	58	89.2			
June	682	69	160			
July	264	73	109			
August	221	70	103			
September	133	66	77.7			
The year	1240	48	133			
1946–47						
October	105	58	75.3			
November	86	38	61.6			
December	102	31	39.4			
January	97	35	51.9			
February	133	25	66.4			
March	108	38	59.0			
April	111	35	52.5			
May	764	53	133			
June	400	37	85.3			
July	180	24	60.2			
August	332	23	58.1			
September	116	23	36.5			
The year	764	23	64.9			
1947–48						
October	56	24	33.1			
November	589	28	127			
December	130	46	67.4			
January	1130	72	177			
February	1300	68	199			
March	190	113	139			
April	292	108	144			
May	410	108	180			
June	276	70	139			
July	371	49	77.8			
August	330	45	87.6			
September	149	34	49.4			
The year	1300	24	118			

Monthly discharge of Patuxent River near Laurel—Continued

Month	Discharge in second-feet				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1948–49						
October	172	40	61.7			
November	1,190	46	146			
December	1,330	100	280			
January	1,220	171	330			
February	561	193	298			
March	863	152	249			
April	398	105	191			
May	755	97	214			
June	322	66	103			
July	445	45	94.0			
August	302	38	75.6			
September	76	34	49.0			
The year	1,330	34	174			
1949–50						
October	235	41	59.9			
November	283	45	64.2			
December	239	50	96.0			
January	235	62	87.0			
February	603	76	200			
March	1,360	68	204			
April	193	99	129			
May	465	86	157			
June	666	58	157			
July	327	53	85.1			
August	183	39	59.5			
September	691	40	119			
The year	1,360	39	118			

Yearly discharge of Patuxent River near Laurel

Year	Year ending Sept. 30				Calendar year			
	Discharge in second-feet		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in second-feet		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1945	134				153			
1946	133				111			
1947	64.9				69.1			
1948	118				140			
1949	174				151			
1950	118							

3. Patuxent River at Laurel

Location.—Wire-weight gage, lat. 39°06 20″, long. 76°50 30″, on downstream side of iron truss highway bridge on the main cross street of the town of Laurel, Prince Georges

Monthly discharge of Patuxent River at Laurel

Month	Discharge in second-feet				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1896						
August	160	30	117	0.87	0.98	0.562
September	203	30	98	.72	.80	.465
1896–97						
October	165	45	98	.72	.83	.465
November	247	40	129	.94	1.04	.608
December	181	50	140	1.02	1.18	.659
January	184	49	120	.88	1.01	.569
February	2420	140	400	2.92	3.04	1.89
March	233	110	162	1.18	1.36	.763
April	329	63	148	1.08	1.20	.698
May	1180	90	203	1.48	1.71	.957
June	173	49	113	.82	.91	.530
July	4270	39	320	2.34	2.70	1.51
August	575	82	145	1.06	1.22	.685
September	261	25	86	.63	.70	.407
The year	4270	25	172	1.26	16.90	.814
1897–98						
October	151	17	92	.67	.77	.433
November	2030	102	251	1.83	2.04	1.18
December	705	98	199	1.45	1.67	.937
January	341	194	185	1.35	1.56	.873
February	323	110	161	1.18	1.23	.763
March	347	90	130	.95	1.09	.614
April	162	94	117	.85	.94	.549
May	630	78	177	1.29	1.49	.834
June	272	59	91	.66	.73	.427
July	255	6	50	.36	.41	.233
August 1–10	1590	56	272	[a]1.99	[a]2.29	1.29

[a] = Estimated for whole month.

County. Datum of gage is 21.22 feet below a copper bolt bench mark set in large capstone of the left downstream retaining wall of the bridge abutment.

Drainage area.—137 square miles (measured on U.S.G.S. topographic maps).

Records available.—August 3, 1896 to August 10, 1898.

Extremes.—Maximum discharge, 6,140 second-feet (gage height, 13.70 feet), from current-meter measurement July 22, 1897; minimum, no flow (gage height, 2.7 feet) during summer months during hours that large cotton mill 1 mile upstream was not operating and gates of dam were closed for storage.

Remarks.—Low water flow regulated by operation of gates of dam for cotton mill about 1 mile upstream from gage. During August 1896 the operation of the mill was sometimes limited to 7 a.m. to noon due to the scarcity of water. Gage was read by John H. Phair. Low water records were probahly poor. Results of eleven current-meter discharge measurements made during period of gage operation are given in Maryland Department of Geology, Mines and Water Resources Bulletin No. 1, page 278.

4. Western Branch near Largo

Location.—Water-stage recorder and concrete control, lat. 38°52′31″, long. 76°48′15″, 85 feet upstream from bridge on State Route 202, 200 feet downstream from unnamed tributary, 0.1 mile upstream from the confluence of Western Branch and Southwest Branch, 2.3 miles southeast of Largo, Prince Georges County and 4.8 miles northwest of Upper Marlboro.

Drainage area.—30.1 square miles.

Records available.—Record began Nov. 25, 1949.

Extremes for year.—Maximum discharge, (undetermined) Sept. 11, 1950 (gage height, 7.17 feet); minimum discharge, (undetermined) Feb. 3, 1950 (gage height, 1.34 feet).

Remarks.—Records withheld from publication in this report because of lack of definition of high water stage-discharge relation.

POTOMAC RIVER BASIN

5. Northeast Branch Anacostia River at Riverdale

Location.—Water-stage recorder and concrete control, lat. 38°57′37″, long. 76°55′34″, at Riverdale Road bridge in Riverdale, Prince Georges County, and 1-3/4 miles upstream from confluence with Northwest Branch. Datum of gage is 14.00 feet above mean sea level (Washington Suburban Sanitary Commission bench mark). Prior to June 12, 1942 wire-weight gage at same site and datum.

Drainage area.—72.8 square miles.

Records available.—August 1938 to September 1950.

Extremes.—Maximum discharge, 3,660 second-feet Oct. 16, 1942 (gage height, 12.93 feet), from rating curve extended above 2,950 second-feet; minimum observed, 5.6 second-feet Sept. 29, 30, Oct. 1, 1941 (gage height, 2.72 feet).

Maximum stage known, about 15.5 feet Aug. 23 or 24, 1933 from floodmarks (discharge, 10,500 second-feet, from rating curve extended above 2,950 second-feet).

Monthly discharge of Northeast Branch Anacostia River at Riverdale

Month	Discharge in second-feet				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1943–44						
October	304	11	36.6	0.503	.58	0.325
November	1350	28	95.2	1.31	1.46	.847
December	199	20	37.5	.515	.59	.333
January	1110	28	114	1.57	1.81	1.01

Monthly discharge of Northeast Branch Anacostia River at Riverdale—Continued

Month	Discharge in second-feet				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1943-44—*Continued*						
February	117	28	53.3	.732	.79	.473
March	758	58	167	2.29	2.65	1.48
April	255	58	103	1.41	1.58	.911
May	86	20	40.3	.554	.64	.358
June	108	13	22.3	.306	.34	.198
July	40	7.5	12.6	.173	.20	.112
August	969	7.5	60.2	.827	.95	.535
September	465	8.0	48.0	.659	.74	.426
The year	1350	7.5	65.9	.905	12.33	.585
1944-45						
October	162	22	40.3	.554	.64	.358
November	412	25	59.8	.821	.92	.531
December	566	42	91.4	1.26	1.45	.814
January	538	40	127	1.74	2.01	1.12
February	342	38	90.1	1.24	1.29	.801
March	185	43	70.6	.970	1.12	.627
April	162	34	58.9	.809	.90	.523
May	452	23	62.6	.860	.99	.556
June	453	22	63.4	.871	.97	.563
July	2540	21	335	4.60	5.30	2.97
August	624	30	95.4	1.31	1.51	.847
September	539	25	67.1	.922	1.03	.596
The year	2540	21	97.2	1.34	18.13	.866
1945-46						
October	57	29	37.7	0.518	0.60	0.335
November	486	33	86.6	1.19	1.33	.769
December	1100	58	199	2.73	3.15	1.76
January	352	64	103	1.41	1.63	.911
February	436	60	133	1.83	1.90	1.18
March	166	66	84.6	1.16	1.34	.750
April	108	40	55.1	.757	.84	.489
May	509	42	113	1.55	1.79	1.00
June	286	23	56.8	.780	.87	.504
July	200	18	30.5	.419	.48	.271
August	200	14	33.5	.460	.53	.297
September	156	11	29.9	.411	.46	.266
The year	1100	11	80.0	1.10	14.92	.711

Monthly discharge of Northeast Branch Anacostia River at Riverdale—Continued

Month	Discharge in second-feet				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1946–47						
October	90	18	36.0	.495	.57	.320
November	87	24	31.3	.430	.48	.278
December	218	20	40.5	.556	.64	.359
January	166	40	87.5	1.20	1.39	.776
February	49	25	39.3	.540	.56	.349
March	140	36	55.9	.768	.88	.496
April	105	33	52.8	.725	.81	.469
May	800	36	135	1.85	2.13	1.20
June	1090	29	124	1.70	1.89	1.10
July	70	18	34.1	.468	.54	.302
August	150	15	39.4	.541	.62	.350
September	105	19	35.7	.490	.55	.317
The year	1090	15	59.4	.816	11.06	.527
1947–48						
October	90	17	24.3	.334	.38	.216
November	528	24	129	1.77	1.98	1.14
December	152	38	52.4	.720	.83	.465
January	859	49	144	1.98	2.28	1.28
February	501	55	122	1.68	1.81	1.09
March	664	67	143	1.96	2.26	1.27
April	426	53	105	1.44	1.62	.931
May	718	47	178	2.45	2.81	1.58
June	1060	36	134	1.84	2.06	1.19
July	112	30	45.5	.625	.72	.404
August	1400	32	199	2.73	3.15	1.76
September	72	25	32.6	.448	.50	.290
The year	1400	17	109	1.50	20.40	.969
1948–49						
October	221	31	54.8	0.753	0.87	0.487
November	1,100	36	133	1.83	2.04	1.18
December	863	82	209	2.87	3.30	1.85
January	897	88	205	2.82	3.25	1.82
February	408	118	187	2.57	2.68	1.66
March	684	92	150	2.06	2.38	1.33
April	278	72	110	1.51	1.68	.976
May	594	53	127	1.74	2.01	1.12
June	196	31	50.0	.687	.77	.444
July	112	23	39.8	.547	.63	.354
August	114	21	31.5	.433	.50	.280
September	78	17	28.2	.387	.43	.250
The year	1,100	17	110	1.51	20.54	.976

Monthly discharge of Northeast Branch Anacostia River at Riverdale—Continued

Month	Discharge in second-feet				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1949–50						
October	167	19	32.3	0.444	0.51	0.287
November	82	31	38.8	.533	.60	.344
December	82	31	44.2	.607	.70	.392
January	105	34	41.0	.563	.65	.364
February	373	47	113	1.55	1.62	1.00
March	771	39	107	1.47	1.69	.950
April	74	44	54.0	.742	.83	.480
May	343	46	102	1.40	1.61	.905
June	186	26	58.9	.809	.90	.523
July	323	21	63.9	.878	1.01	.567
August	1,080	14	71.4	.981	1.13	.634
September	1,030	28	137	1.88	2.10	1.22
The year	1,080	14	71.6	.984	13.35	.636

Yearly discharge of Northeast Branch Anacostia River at Riverdale

Year	Year ending Sept. 30				Calendar year			
	Discharge in second-feet		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in second-feet		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1939	69.1	0.949	12.88	0.613	68.8	0.945	12.83	0.611
1940	69.3	.952	12.94	.615	75.3	1.03	14.08	.666
1941	57.3	.787	10.70	.509	46.1	.633	8.60	.409
1942	54.8	.753	10.20	.487	85.1	1.17	15.85	.756
1943	88.8	1.22	16.56	.789	67.8	.931	12.65	.602
1944	65.9	.905	12.33	.585	67.9	.933	12.71	.603
1945	97.2	1.34	18.13	.866	108	1.48	20.20	.957
1946	80.0	1.10	14.92	.711	61.9	.850	11.53	.549
1947	59.4	.816	11.06	.527	67.5	.927	12.56	.599
1948	109	1.50	20.40	.969	125	1.72	23.42	1.11
1949	110	1.51	20.54	.976	86.5	1.19	16.14	.769
1950	71.6	.984	13.35	.636				
Highest	110	1.51	20.54	.976	125	1.72	23.42	1.11
Average	77.7	1.07	14.50	.690	78.2	1.07	14.60	.694
Lowest	54.8	.753	10.20	.487	46.1	.633	8.60	.409

6. Northeast Branch Anacostia River at Hyattsville

Location.—Staff gage, lat. 38°57′00″, long. 76°56′07″, at highway bridge in Hyattsville, Prince Georges County, and 0.6 mile upstream from confluence with Northwest Branch. Datum of gage is 5.02 feet above mean sea level (Corps of Engineers, U. S. Army, bench mark).

Drainage area.—75 square miles.

Records available.—July 1911 to September 1912.

Extremes.—Maximum daily discharge, 1,760 second-feet May 7, 1912; minimum daily, 2.0 second-feet Sept. 13, 1912.

Monthly discharge of Northeast Branch Anacostia River at Hyattsville

Month	Discharge in second-feet				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1911						
July	11	3.5	6.15	0.082	0.09	0.053
August	404	3.7	35.2	.469	.54	.303
September	124	9.3	24.2	.323	.36	.209
1911–12						
October	308	9.5	32.3	.431	.50	.279
November	197	17.5	70.9	.945	1.05	.611
December	414	30	91.9	1.23	1.42	.795
January	786	59	169	2.25	2.59	1.45
February	800	21	165	2.20	2.37	1.42
March	992	7.5	219	2.92	3.37	1.89
April	258	57	107	1.43	1.60	.924
May	1760	44	204	2.72	3.14	1.76
June	886	11.0	96.0	1.28	1.43	.827
July	195	8.0	48.1	.641	.74	.414
August	58	4.0	16.2	.216	.25	.140
September 1–22	117	2.0	21.6	.288	.24	.186

7. Northwest Branch Anacostia River near Colesville

This station in Montgomery County is still in operation. Because of changes in the stream bed the records for high water discharges require recomputation. The recomputed records are not yet available.

8. Northwest Branch Anacostia River near Hyattsville

Location.—Water-stage recorder and concrete control, lat. 38°57′12″, long. 76°57′59″, at Queens Chapel Road Bridge, 1 mile west of Hyattsville, Prince Georges County and 1 mile downstream from Sligo Branch. Datum of gage is 17.30 feet above mean sea level, adjustment of 1912. Prior to Oct. 22, 1938, wire-weight gage at present site and datum.

Drainage area.—49.4 square miles.

Records available.—July 1938 to September 1950.

Extremes.—Maximum discharge, 2,280 second-feet Oct. 16, 1942 (gage height, 9.92 feet); minimum, 0.8 second-foot Oct. 3, 7, 1941, Aug. 26, 1943.

Maximum stage known, about 13.5 feet in August 1933.

Remarks.—Low flow regulated by storage and diversion at Burnt Mills Reservoir (drainage area, 26 square miles) and subsequent to Aug. 12, 1939 by inflow pumped from Patuxent River basin as required for water supply by Washington Suburban Sanitary District. Pumpage from Patuxent River basin and storage and diversion records at Burnt Mills filtration plant can be obtained from the Washington Suburban Sanitary Commission, Hyattsville, Md.

Monthly discharge of Northwest Branch Anacostia River near Hyattsville

Month	Discharge in second-feet				Runoff in inches	Discharge million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1943–44						
October	288	2.4	17.9			
November	804	8.1	49.0			
December	183	5.2	17.4			
January	501	8.0	52.7			
February	50	8.4	17.9			
March	351	16	65.6			
April	130	22	41.7			
May	46	7.7	15.8			
June	75	4.4	10.6			
July	23	2.2	4.07			
August	399	1.5	19.5			
September	384	1.7	22.4			
The year	804	1.5	27.9			
1944–45						
October	87	4.9	14.7			
November	148	5.8	22.0			
December	354	14	38.5			
January	616	17	65.2			
February	187	13	47.4			
March	94	17	34.5			
April	86	13	25.2			
May	101	6.9	17.3			
June	463	6.2	43.2			
July	1090	5.8	159			
August	476	12	49.4			
September	353	6.2	33.0			
The year	1090	4.9	45.9			

Monthly discharge of Northwest Branch Anacostia River near Hyattsville—Continued

Month	Discharge in second-feet				Runoff in inches	Discharge million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1945–46						
October	25	9.8	15.2			
November	494	9.8	45.5			
December	570	23	84.9			
January	127	28	50.4			
February	158	29	64.7			
March	105	34	45.8			
April	52	14	25.7			
May	450	21	67.0			
June	300	8.0	34.3			
July	181	5.9	16.9			
August	130	5.0	15.9			
September	39	3.3	9.03			
The year	570	3.3	39.5			
1946–47						
October	22	2.9	6.72			
November	24	5.3	7.72			
December	112	5.3	14.8			
January	90	12	35.1			
February	21	6.9	13.6			
March	62	11	24.1			
April	36	11	16.4			
May	319	14	43.5			
June	208	8.4	28.9			
July	55	5.0	15.3			
August	127	4.7	18.5			
September	181	5.6	24.2			
The year	319	2.9	20.8			
1947–48						
October	32	4.7	7.99			
November	297	6.9	53.2			
December	50	15	20.0			
January	700	18	69.4			
February	600	18	63.9			
March	450	26	68.3			
April	150	17	34.7			
May	326	18	84.8			
June	418	12	54.7			
July	37	8.0	14.9			
August	313	14	67.7			
September	42	6.5	12.3			
The year	700	4.7	46.0			

Monthly discharge of Northwest Branch Anacostia River near Hyattsville—Continued

Month	Discharge in second-feet				Runoff in inches	Discharge million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1948–49						
October	102	6.9	16.8			
November	785	8.8	77.2			
December	640	26	96.1			
January	486	39	107			
February	238	58	97.6			
March	600	44	81.7			
April	184	29	52.6			
May	757	22	75.8			
June	140	12	24.9			
July	60	7.0	17.9			
August	80	5.3	14.9			
September	70	4.0	12.2			
The year	785	4.0	56.0			
1949–50						
October	109	4.6	13.5			
November	39	6.1	10.1			
December	57	6.1	14.4			
January	94	8.2	15.7			
February	184	15	48.7			
March	667	14	59.0			
April	29	10	15.3			
May	379	12	51.1			
June	211	6.7	41.5			
July	168	5.8	22.3			
August	359	4.0	23.0			
September	725	5.8	77.3			
The year	725	4.0	32.5			

Yearly discharge of Northwest Branch Anacostia River near Hyattsville

Year	Year ending Sept. 30				Calendar year			
	Discharge in second-feet		Runoff in inches	Discharge in million gallons per day per square mile	Discharge in second-feet		Runoff in inches	Discharge in million gallons per day per square mile
	Mean	Per square mile			Mean	Per square mile		
1939	31.9				32.1			
1940	27.8				30.2			
1941	24.4				19.8			
1942	21.7				33.1			
1943	38.3				32.2			
1944	27.9				27.2			

Yearly discharge of Northwest Branch Anacostia River near Hyattsville—Continued

Year	Year ending Sept. 30: Discharge in second-feet: Mean	Year ending Sept. 30: Discharge in second-feet: Per square mile	Year ending Sept. 30: Runoff in inches	Year ending Sept. 30: Discharge in million gallons per day per square mile	Calendar year: Discharge in second-feet: Mean	Calendar year: Discharge in second-feet: Per square mile	Calendar year: Runoff in inches	Calendar year: Discharge in million gallons per day per square mile
1945	45.9				51.8			
1946	39.5				29.7			
1947	20.8				25.1			
1948	46.0				55.1			
1949	56.0				43.3			
1950	32.5							

9. Northwest Branch Anacostia River at Bladensburg

Location.—Staff gage, lat. 38°56′45″, long. 76°56′52″, 300 feet upstream from Capital Transit Co. railway bridge and 0.5 mile northwest of Bladensburg, Prince Georges County. Datum of gage is 3.33 feet above mean sea level (Corps of Engineers, U. S. Army, bench mark).

Drainage area.—52 square miles.

Records available.—July 1911 to September 1912.

Extremes.—Maximum daily discharge, 617 second-feet Feb. 27, 1912; minimum daily, 3.0 second-feet Aug. 2, 1911.

Remarks.—Medium and high stages on Northwest Branch Anacostia River or extreme high tides may cause backwater at this station.

Monthly discharge of Northwest Branch Anacostia River at Bladensburg

Month	Discharge in second-feet: Maximum	Discharge in second-feet: Minimum	Discharge in second-feet: Mean	Discharge in second-feet: Per square mile	Runoff in inches	Discharge in million gallons per day per square mile
1911						
July	16	3.2	5.25	0.101	0.12	0.065
August	468	3.0	30.2	.581	.67	.376
September	473	5.8	41.5	.798	.89	.516
1911–12						
October	218	6.0	23.2	.446	.51	.288
November	111	9.8	39.2	.754	.84	.487
December	387	13	58.8	1.13	1.30	.730
January	597	14	87.1	1.67	1.92	1.08
February	617	21	101	1.94	2.09	1.25
March	548	9.0	117	2.25	2.59	1.45
April	220	41	67.0	1.29	1.44	.834
May	366	24	88.8	1.71	1.97	1.11
June	310	14	57.4	1.10	1.23	.711
July	120	16	41.1	.790	.91	.511
August	48	14	20.2	.388	.45	.251
September 1–22	182	12	29.2	.562	.46	.363

10. Beaverdam Branch Anacostia River at Kenilworth, D. C.

Location.—Staff gage, lat. 38°54′57″, long. 76°55′57″, at Kenilworth Avenue bridge and 0.3 mile north of District of Columbia line at Kenilworth. Datum of gage is 2.42 feet above mean sea level (Corps of Engineers, U. S. Army, bench mark).

Drainage area.—14 square miles.

Records available.—July 1911 to September 1912.

Extremes.—Maximum daily discharge, 440 second-feet July 18, 1912; minimum daily, 0.2 second-foot June 14, 1912.

Remarks.—Records may be affected by backwater during abnormally high tides.

Monthly discharge of Beaverdam Branch Anacostia River at Kenilworth, D. C.

Month	Discharge in second-feet				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1911						
July	4.0	1.1	1.88	0.134	0.15	0.087
August	6.8	.5	2.30	.164	.19	.106
September	42	1.1	3.68	.263	.29	.170
1911–12						
October	48	2.5	6.69	.478	.55	.309
November	60	4.0	14.5	1.04	1.16	.672
December	95	5.5	18.6	1.33	1.53	.860
January	64	8.7	20.7	1.48	1.71	.957
February	89	6.0	21.6	1.54	1.66	.995
March	187	1.5	34.3	2.45	2.82	1.58
April	30	7.8	14.8	1.06	1.18	.685
May	76	1.8	15.3	1.09	1.26	.704
June	46	.2	7.14	.510	.57	.330
July	440	.5	19.4	1.39	1.60	.898
August	2.2	.7	1.31	.094	.11	.061
September 1–21	14	.5	1.68	.120	.09	.078

11. Henson Creek at Oxon Hill

Location.—Water-stage recorder and concrete control, lat. 38°47′05″, long. 76°58′50″, 100 feet downstream from bridge on Tucker Road, 1.0 mile south of Oxon Hill, Prince Georges County, 1.4 miles upstream from Carey Branch.

Drainage area.—16.7 square miles.

Records available.—June 1948 to September 1950.

Extremes.—Maximum discharge, 2,200 second-feet Sept. 11, 1950 (gage height, 6.63 feet), by slope-area method; minimum, 0.2 second-foot Aug. 12, 1949 (gage height, 0.38 foot).

Remarks.—Small diversion above station for irrigation of truck farm.

Monthly discharge of Henson Creek at Oxon Hill

Month	Discharge in second-feet				Runoff in inches	Discharge in million gallons per day per square mile
	Maximum	Minimum	Mean	Per square mile		
1948						
June 29, 30						
July	51	3.5	7.11	0.426	0.49	0.275
August	239	4.7	33.8	2.02	2.34	1.31
September	19	5.3	7.57	.453	.51	.293
1948–49						
October	77	5.8	16.6	.994	1.14	.642
November	234	9.6	28.4	1.70	1.90	1.10
December	410	23	54.7	3.28	3.78	2.12
January	118	23	44.4	2.66	3.07	1.72
February	88	26	40.8	2.44	2.54	1.58
March	99	20	30.9	1.85	2.13	1.20
April	58	15	26.4	1.58	1.77	1.02
May	195	13	35.3	2.11	2.43	1.36
June	20	3.2	7.95	.476	.53	.308
July	23	1.5	5.37	.322	.37	.208
August	18	.4	3.84	.230	.27	.149
September	30	1.7	4.89	.293	.33	.189
The year	410	.4	24.9	1.49	20.26	.963
1949–50						
October	48	2.4	6.52	.390	.45	.252
November	16	4.1	6.54	.392	.44	.253
December	17	3.9	7.69	.460	.53	.297
January	20	5.4	7.60	.455	.52	.294
February	46	8.0	16.2	.970	1.01	.627
March	142	7.0	20.2	1.21	1.39	.782
April	39	8.2	11.5	.689	.77	.445
May	98	8.2	22.8	1.37	1.57	.885
June	23	1.5	8.02	.480	.54	.310
July	67	1.8	12.7	.760	.88	.491
August	47	.8	6.05	.362	.42	.234
September	567	1.8	41.7	2.50	2.79	1.62
The year	567	.8	13.9	.832	11.31	.538

12. Mattawoman Creek near Pomonkey

Location.—Water-stage recorder and concrete control, lat. 38°35′48″, long. 77°03′25″, 50 feet downstream from bridge on State Route 227, 80 feet downstream from confluence with Old Womans Run, 1.2 miles southeast of Pomonkey, Charles County, 1.9 miles northeast of Pomfret, and 6.0 miles east of Indian Head.

Drainage area.—57.7 square miles.

Records available.—Record began Nov. 28, 1949.

Extremes for year.—Maximum discharge, (undetermined) Sept. 11, 1950 (gage height, 5.88 feet); no flow at many times during summer months.

Remarks.—Records withheld from publication in this report because of lack of definition of high water stage-discharge relation.

GROUND-WATER RESOURCES OF PRINCE GEORGES COUNTY

BY

GERALD MEYER

Abstract

Prince Georges County is in the south-central part of Maryland near the western shore of Chesapeake Bay. The county is almost entirely within the Coastal Plain province; pre-Cambrian crystalline rocks which characterize the Piedmont Plateau are exposed only in some stream valleys near the northwestern edge of the county. The geologic formations of the Coastal Plain in Prince Georges County are of Early and Late Cretaceous, Paleocene, Eocene, Miocene, Pliocene (?), and Pleistocene age and consist chiefly of unconsolidated sand, gravel, and clay. Excepting the Pliocene (?) and Pleistocene deposits, which form a thin cover over the older formations, the Coastal Plain formations strike northeast and dip gently to the southeast. Ground water occurs under water-table conditions in and near the outcrops of the formations and under artesian conditions down dip from the outcrops.

During 1949 and 1950 approximately 4,000,000 to 5,000,000 gallons of ground water a day was pumped from wells in Prince Georges County; about 65 percent of this pumpage was used for domestic, agricultural, and public supplies and about 35 percent for industrial and other commercial purposes. The important water-bearing formations are the Patuxent, Patapsco, and Magothy formations, the Aquia greensand, and the Pliocene (?) and Pleistocene deposits.

The Patuxent formation generally yields about 10 gallons a minute to domestic wells, but a few public-supply and industrial wells yield as much as 250 to 540 gallons a minute. The total pumpage from this formation is approximately 1,000,000 gallons a day. Most wells ending in the Patapsco formation yield between 10 and 60 gallons a minute, but one well at Fort Washington is reported to yield 137 gallons a minute. The total pumpage from this formation is approximately 1,000,000 gallons a day. Wells ending in the Magothy formation generally yield 20 to 50 gallons a minute, but a well near Cheltenham is reported to yield 239 gallons a minute and a public-supply well at Upper Marlboro, 180 gallons a minute. Approximately 700,000 gallons of water a day is pumped from the Magothy formation. Yields of wells ending in the Aquia greensand range from 6 to 65 gallons a minute. The total pumpage from this formation is approximately 100,000 gallons a day. The Pliocene (?) and Pleistocene deposits are the chief source of water for domestic and farm use. Although the largest yield

reported from wells ending in these deposits is only 12 gallons a minute, the total pumpage is approximately 1,300,000 gallons a day.

Old records of water-level measurements compared to recent measurements indicate that pumping has caused the piezometric surfaces to decline locally since the early part of the twentieth century, but in general periodic measurements made in observation wells show little net change in water levels during 1948–50.

The chemical character of the ground water is satisfactory for most uses, but in some places the water is acidic or contains a large amount of iron.

INTRODUCTION

LOCATION OF THE AREA

Prince Georges County is in the south-central part of Maryland (fig. 4). It is bounded by the Patuxent and Potomac Rivers, Montgomery and Charles Counties, and the District of Columbia.

PURPOSE AND SCOPE OF INVESTIGATION

The purpose of the investigation in Prince Georges County was chiefly to obtain basic data on the occurrence of ground water. The investigation included a study of the areal extent and thickness of the geologic formations, their lithologic and general hydrologic characteristics, their utilization as sources of ground water, and the chemical quality of the water they contain.

Field work was done intermittently chiefly during the period 1948–50. Hydrologic and geologic data were obtained on 500 wells (table 7) and chemical analyses of 33 samples of water from representative wells were made in the Water Resources Laboratory, U. S. Geological Survey (table 6). The logs of 30 wells were prepared from a microscopic examination of drill-cutting samples (table 9), and the logs of 181 wells were compiled from drillers' records (table 8). Geologic sections and structural maps were prepared. The fluctuations of water levels were determined from periodic measurements in 11 observation wells.

The wells used in this report are numbered according to a coordinate system. On the left and right sides of the well-location map (Pl. 6) upper-case letters designate each 5-minute interval of latitude, and on the top and bottom of the map lower-case letters designate each 5-minute interval of longitude. The 5-minute quadrangle formed by the intersection of lines of latitude and longitude is identified by a combination of the coordinate letters. For example, well Bc 2 is designated by the circle numbered "2" in the quadrangle formed by the intersection of the intervals marked "B" and "c". The initials of Prince Georges County may be placed before the coordinate letters to show that the well is in that county; thus, in the example given the complete well number is PG-Bc 2.

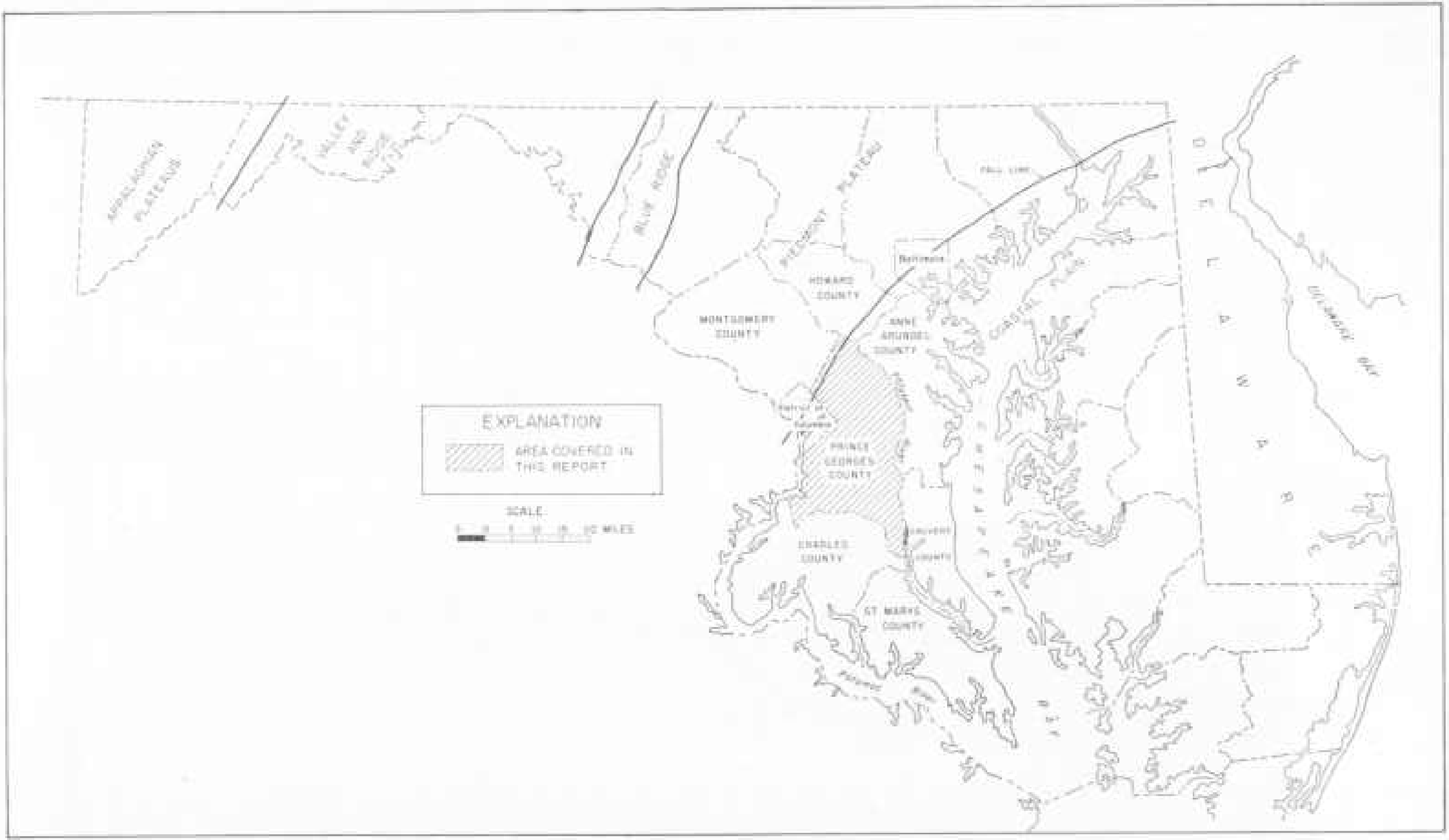


FIGURE 4. Map of Maryland Showing Physiographic Provinces and Area Covered in This Report

However, as practically all wells included in this report are in Prince Georges County, the county initials are omitted.

PREVIOUS INVESTIGATIONS

The ground-water resources of Prince Georges County are described briefly in several publications. Darton's report (1896, pp. 127–128, 133–135, and 151–152) on the occurrence of ground water in the Atlantic Coastal Plain includes a brief description of the water-bearing formations and records of five drilled wells in Prince Georges County. Darton and Keith's geologic folio (1901, p. 7) on the District of Columbia and adjacent area, which includes the central and northwestern part of Prince Georges County, contains a brief description of the water-bearing properties of the Cretaceous continental sediments and a structural contour map showing the position of the top and base of these sediments. A more detailed description of the water-bearing formations in a part of Prince Georges County is included in the geologic folio on the Patuxent quadrangle by Shattuck, Miller, and Bibbins (1907, p. 12). The folio also contains a map that shows the location of several wells in Prince Georges County, and, by means of contours, the approximate depth to four water-bearing zones. A report on the surface and ground water of Maryland, Delaware, and the District of Columbia, by Clark, Mathews, and Berry (1918, pp. 375–391), includes a section on Prince Georges County, which contains a brief description of the principal water-bearing formations, records of 31 drilled wells, 7 well logs, and 2 chemical analyses of ground water. Recent reports by Overbeck on Charles (1948) and Calvert (1951) Counties, and by Brookhart (1949) on Anne Arundel County, are helpful in understanding the occurrence of ground water in Prince Georges County, as most of the aquifers in those counties also occur in Prince Georges County. While the ground-water investigation was in progress, the geology of the area was restudied by Cooke whose report is included in this bulletin.

ACKNOWLEDGMENTS

The interested cooperation of the well drillers and residents in the county greatly facilitated the collection of geologic and hydrologic data. The investigation was made under the immediate supervision of R. R. Bennett, District Geologist of the U. S. Geological Survey in charge of cooperative ground-water investigations in Maryland.

GEOGRAPHY

CULTURE

Prince Georges County was almost entirely rural until the beginning of the twentieth century, when the small communities bordering the District of Columbia began to grow into densely populated suburban communities. By far the largest percentage of the population of Prince Georges County, which according to the 1950 census is 194,182, is in the western part of the county within the metropolitan area of Washington, D. C. These suburban areas have been served since 1918 by the water and sanitary-sewerage systems of the Washington Suburban Sanitary Commission.

The 1945 agricultural census (U. S. Dept. of Commerce, 1946, pp. 50, 51) of Prince Georges County shows that 11,102 people were engaged in farming, and that there were 2,070 farms comprising a total area of 304 square miles, or 62.6 percent of the county's 486 square miles. The total value of all farm products sold in 1945 was $6,460,055; tobacco, corn, potatoes, and wheat were the principal crops.

Prince Georges County contains only small industries. Bricks and cement blocks are produced in the northern part of the county; paint pigments are

TABLE 3

Mean Monthly Precipitation at Cheltenham, 1902–50

Month	Mean monthly precipitation (inches)	Month	Mean monthly precipitation (inches)
January	3.72	July	4.51
February	2.77	August	4.93
March	3.66	September	3.60
April	3.93	October	3.04
May	3.67	November	2.78
June	4.23	December	3.22

The total annual precipitation varies somewhat from year to year but the mean annual temperature is fairly uniform (fig. 5).

manufactured at Muirkirk, and oxygen at Bladensburg. In many places, particularly in the northern part of the county and in the western part near the District of Columbia, sand and gravel are mined for construction purposes.

Thousands of people visit the horse-race tracks at Laurel, Bowie, and near Oxon Hill during the racing seasons.

CLIMATE

Meteorological stations have been maintained since 1887 at College Park, in the northern part of the county, and since 1901 at Cheltenham, in the southern part. Other weather stations for which records extend over shorter periods of time have been established throughout the county.

The mean annual temperature at College Park is 54.7° F. and at Cheltenham, 55.0°F. July is generally the warmest month and January the coldest. The growing season, or period between the last and the first killing frosts, is usually from April to October.

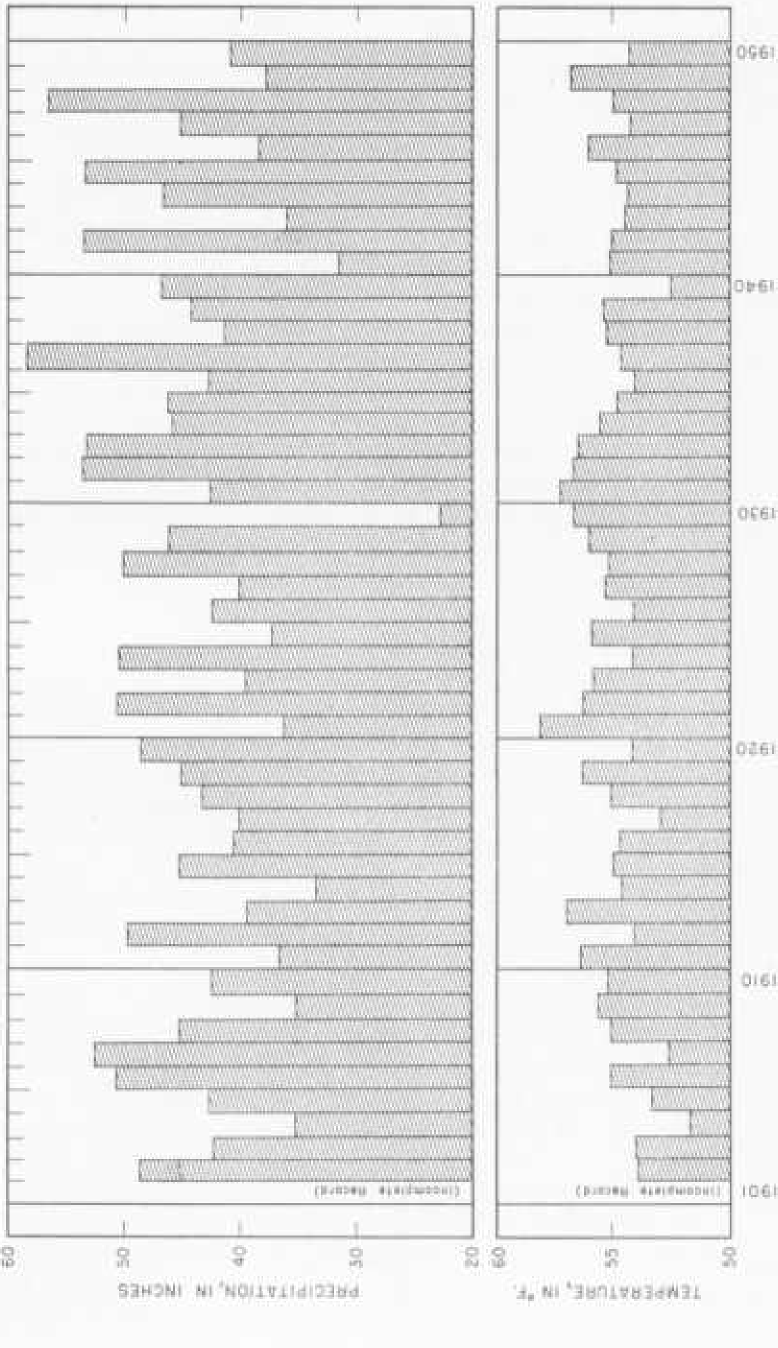


FIGURE 5. Graph Showing the Total Annual Precipitation and the Mean Annual Temperature at Cheltenham for the Period 1902–50

The mean annual precipitation at College Park is 41.79 inches and at Cheltenham, 44.06 inches. Although the mean monthly precipitation is higher during the summer than it is during the fall and winter, the precipitation is fairly well distributed throughout the year (table 3).

PHYSICAL FEATURES

Maryland contains parts of five physiographic provinces, which are, from west to east, the Appalachian Plateaus, the Valley and Ridge, the Blue Ridge, the Piedmont Plateau, and the Coastal Plain (fig. 4). Prince Georges County is almost entirely within the Coastal Plain province, its boundary with Montgomery County nearly coinciding with the Fall Line, the boundary between the Piedmont Plateau and the Coastal Plain.

The Piedmont Plateau, which is underlain by hard crystalline rocks, is moderately dissected and well drained, and accordingly the plateau generally is characterized by a hilly, rolling terrain. In general, the valleys are broad and shallow, but in some places near the Fall Line streams have incised the plateau more deeply and the valleys are relatively narrow. The land surface slopes gently eastward to the Coastal Plain, where, with an increase in slope, the rock surface passes beneath unconsolidated sediments that make up the Coastal Plain.

In Prince Georges County the Coastal Plain is characterized by a gently rolling land surface in the northern part of the county, and by a partly dissected upland plateau in the southern part. The upland plateau extends southward into Charles, Calvert, and St. Marys Counties. Near the Fall Line and along the edges of the upland plateau in the southern part of the county stream erosion has been rapid, and the relief is greater than in other parts of the county. Headward erosion by Piscataway Creek has almost completely transected the upland plateau.

The Patuxent and Potomac Rivers, in this area largely estuaries of Chesapeake Bay, form, respectively, the eastern and part of the western boundaries of the county. In contrast to the streams in the Piedmont Plateau the major streams flowing into these estuaries are typically sluggish and have broad valleys. The western part of the county is drained by the Anacostia River, Oxon Run, and Henson, Piscataway, and Mattawoman Creeks which flow westward to the Potomac River, and the eastern part by Western Branch, Rock, Black Swamp, and Swanson Creeks which flow eastward to the Patuxent River.

GENERAL GEOLOGY AND HYDROLOGY

Two distinctly different rock types are exposed in Prince Georges County, very old and hard crystalline rocks and much younger unconsolidated sedimentary rocks.

The crystalline rocks, here considered arbitrarily to be entirely pre-Cambrian in age, consist of hard and dense igneous and metamorphic rocks, chiefly gabbro, gneiss, granite, and schist. These rocks underlie the Piedmont Plateau, and in Prince Georges County they are exposed near the Fall Line in the valleys of major streams.

Sedimentary deposits of Cretaceous, Tertiary, and Quaternary age underlie the remainder of the county. These deposits are composed chiefly of unconsolidated sand, gravel, and clay of continental and marine origin. The formations of Cretaceous and Tertiary age are exposed as a series of northeast-trending bands more or less parallel to the Fall Line, the oldest cropping out at the Fall Line and the youngest at the southern end of the county. In a large part of the county they are covered by Pliocene(?) and by Pleistocene deposits which occur as a thin cap in the upland areas and which partly fill the stream valleys.

The Coastal Plain sediments form a large wedge-shaped mass that lies on the southeastward-sloping crystalline rock (bedrock) surface. The Cretaceous and Tertiary formations dip gently and thicken from the outcrop toward the southeast (Pl. 3).

The character, areal extent, and structure of the rock formations are such that ground water is distributed unequally. The dense crystalline rocks exposed in the Piedmont Plateau contain comparatively few porous and permeable zones and are less suited to the storage and transmission of water than are the more porous and permeable sediments of the Coastal Plain. The openings in the crystalline rocks that may contain or conduct water are chiefly joints and other fractures that do not occur uniformly.

In the Coastal Plain sediments relatively large quantities of water may be obtained from porous and permeable beds of sand and gravel. The continental sediments of Cretaceous age contain numerous lenses of water-bearing sand and gravel that are sufficiently hydrologically interconnected to form good aquifers; these sediments are the most important source of ground water in Prince Georges County. The marine Upper Cretaceous sediments are composed of materials that are too fine-grained to form satisfactory aquifers. The Tertiary sediments include an important aquifer in the southeastern part of the county. In a large part of the county, particularly in the central and southern parts, the Pliocene (?) and Pleistocene deposits contain beds of sand and gravel capable of storing and yielding adequate quantities of water for domestic purposes; however, during extended periods of low rainfall the supplies are inadequate in some places.

Except in and near the outcrop areas, where water-table conditions exist, the water in the water-bearing formations of Prince Georges County occurs under artesian conditions.

The character and water-bearing properties of the geologic formations in Prince Georges County are described briefly in table 4.

TABLE 4

Geologic Formations in Prince Georges County

System	Series	Group	Formation	Approximate Thickness (feet)	General Character	Water-Bearing Properties
Quaternary	Pleistocene		Lowland deposits	0–50±	Irregularly bedded sand, gravel, and clay.	Yield adequate supplies for domestic purposes to dug wells; may yield large supplies of water to large-diameter wells in major stream valleys.
Tertiary	Pliocene(?)		Upland deposits	10–50	Irregularly bedded cobbles, gravel, and fine sand, intermixed with silt or clay.	Yield adequate supplies for domestic purposes to dug wells in southern part of county. Some supplies may become inadequate during prolonged dry periods.
	Miocene	Chesapeake group	Choptank formation	50	Fine sand, sandy clay, and clay.	May yield small supplies of water to some shallow domestic and farm wells in the southeasternmost part of the county.
			Calvert formation	20–200	Gray and greenish-gray clay and sandy clay; generally contains diatoms.	Yields small supplies of water to domestic and farm dug wells.
	Eocene	Pamunkey group	Nanjemoy formation	0–225	Gray to dark-gray glauconitic silt and clay; 20–40 feet of dense and tough clay at base (Marlboro clay member).	Not an important aquifer.
			Aquia greensand	0–143	Gray and greenish-gray glauconitic sand and sandy clay; contains indurated layers, some with fossil shells.	Yields small to moderate supplies of water to dug wells in the outcrop area in the east-central part of the county; yields as much as 65 gallons a minute to drilled wells in the southeastern part of the county.
	Paleocene		Brightseat formation	0–70(?)	Gray to dark-gray micaceous silty and sandy clay.	Not an important aquifer.

Cretaceous	Upper Cretaceous		Monmouth formation	0–50±	Gray to dark-gray glauconitic, micaceous silty and sandy clay.	Not an important aquifer.
			Magothy formation	0–50	Light-gray sand and gravel and interbedded light-colored clay; generally contains lignite and pyrite and, in places, some glauconite.	Important water-bearing formation in southeastern half of county; yields as much as 239 gallons a minute to drilled wells.
		Potomac group	Patapsco formation	200–500+	Interbedded sand, clay, and sandy clay; in many places upper part consists of about 200 feet of red or pink clay.	Important water-bearing formation in northcentral and northwestern parts of county; yields as much as 137 gallons a minute to drilled wells.
			Arundel clay	0–200	Red and brown clay.	Not an important water-bearing formation.
	Lower Cretaceous		Patuxent formation	140–500+	Predominantly white, yellow, gray, and brown sand, and interbedded sandy clay and clay; contains kaolinized feldspar and lignite and pyrite.	Important water-bearing formation in northern, northwestern, and western parts of county; yields as much as 540 gallons a minute to drilled wells.
Pre-Cambrian					Chiefly schist, granite, gabbro, and gneiss.	Yields small supplies of water, generally less than 10 gallons a minute, to wells in northwestern part of county.

THE GEOLOGIC FORMATIONS AND THEIR WATER-BEARING PROPERTIES

PRE-CAMBRIAN CRYSTALLINE ROCKS

Pre-Cambrian crystalline rocks are exposed only near the Fall Line in the northern part of the County, in the valleys of Sligo Branch, Northwest Branch, Paint Branch, and the Patuxent River. The crystalline-rock surface slopes southeast from the Fall Line at a rate of about 85 feet to the mile for about 4 miles, where the slope steepens to about 125 feet to the mile. In general, the rock surface is even (fig. 6); however, a shallow depression trends northwest and passes between Beltsville and Muirkirk. If data on the altitude of the rock surface were as plentiful for other parts of the area as for the Beltsville-Muirkirk area, it is likely that additional irregularities in the rock surface would be revealed.

Well Ce 16, 1.5 miles south of Glenn Dale, is the deepest well in Prince Georges County known to penetrate crystalline rocks (bedrock). This well encountered bedrock at a depth of 946 feet, which is 801 feet below sea level. An oil-test well (Dd 15), which is 0.3 mile south of District Heights, was drilled to a depth about 840 feet below sea level, but it is not known whether bedrock was encountered. Well Ed 9, an oil-test well 2.3 miles east of Camp Springs, was drilled to a depth about 1,270 feet below sea level, but the log of the well shows that bedrock was not encountered. Another oil-test well, Ed 30, in the immediate vicinity of well Ed 9, extends to a depth of 1,728 feet, which is about 1,490 feet below sea level, but as no log was available it is not known whether the well reached bedrock. Well Fb 14, at Fort Washington, was drilled to a depth of 1,000 feet, which is approximately 900 feet below sea level, but did not reach bedrock.

A regional map, covering a large part of the Middle Atlantic States, compiled by Anderson (1948, fig. 24) from seismic and well data, shows bedrock at about 2,200 feet below sea level in the extreme southeastern part of the county. As the outcrop area of the crystalline rocks is about 28 miles northwest of this part of the county, it appears that the bedrock surface in Prince Georges County slopes southeast at an average rate of about 80 feet to the mile.

In their original state most of the crystalline rocks contained no openings in which water could occur; however, earth movements have formed joints and other fractures that store and transmit water. Some of these openings have been enlarged by the solution and removal of soluble minerals by the circulation of water. In general, the openings in the crystalline rocks become smaller and less numerous with depth. A zone of weathered bedrock of variable thickness, but generally not more than 40 feet, usually covers the hard unweathered rocks. "Rotten rock," "decomposed rock," "weathered granite," or, where the material is highly micaceous, "mica mud," are terms commonly used by well drillers to describe this relatively soft mantle of decomposed rock beneath the Coastal Plain sediments. This weathered zone is probably water bearing to some extent, but as it is cased in most wells its water-bearing characteristics are not well known.

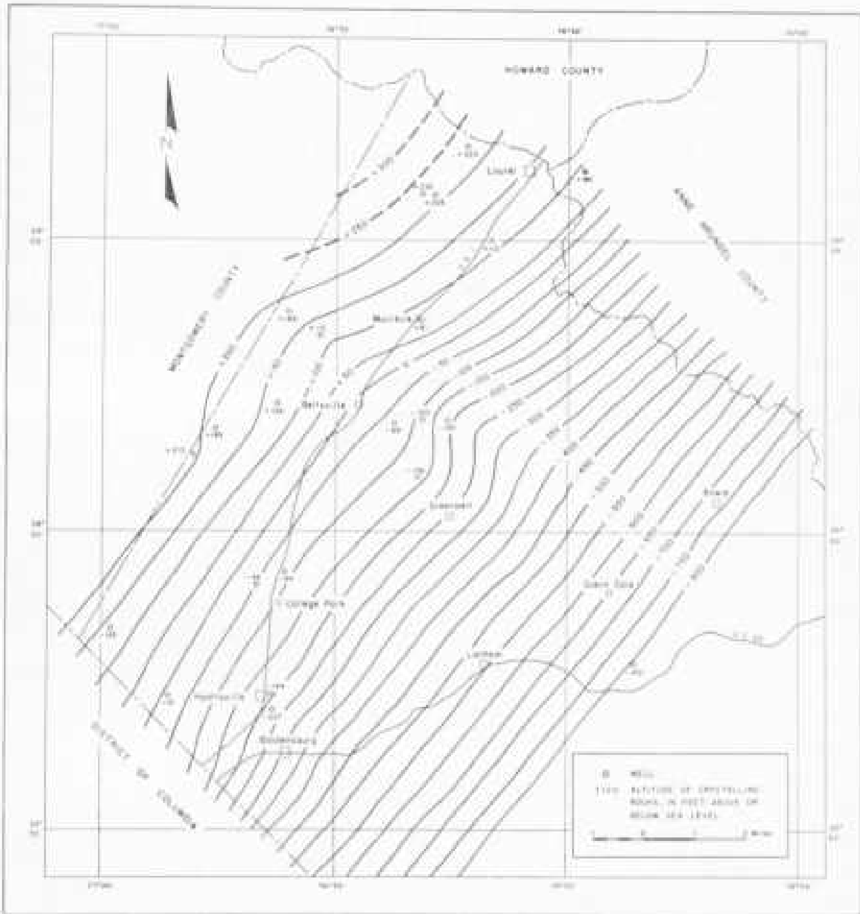


FIGURE 6. Map of Northern Prince Georges County Showing by Contours the Altitude of the Crystalline-Rock Surface Beneath the Coastal Plain Sediments

Many wells obtain water from the crystalline rocks in and near their outcrop area, but beyond a few miles southeast of the outcrop most wells end in the overlying more permeable Coastal Plain sediments.

The yield of wells in crystalline rocks depends largely on the number and size of openings penetrated. Records of wells in and near the outcrop area show that an adequate supply for domestic and farm purposes (2 to 5 gallons a minute) is generally obtained by penetrating the rocks 150 feet or less. However, a few wells are unsuccessful.

CRETACEOUS SYSTEM

LOWER CRETACEOUS SERIES

Patuxent Formation (Potomac Group)

The Patuxent formation, the oldest formation of the Potomac group, overlies the pre-Cambrian rocks. The Patuxent formation crops out in the northern part of Prince Georges County as a northeast-trending band about 3 to 5 miles wide. In general, the formation strikes northeast, approximately parallel with the trend of the outcrop, and it dips southeast at a rate of about 80 feet to the mile. In the southwestern part of the county the formation strikes north, as shown by the northerly trend of the outcrop in northern Virginia.

The Patuxent formation is composed chiefly of clay, sand, and gravel which occur as irregular and lenticular beds. In many places the sand contains disseminated kaolin, a white clay formed by the decomposition of grains of feldspar. The sand and gravel also contain pebbles or irregularly shaped pieces of clay, and thin lenses or masses of iron oxide-cemented sandstone which form indurated rock ledges or seams. Much of the sand is composed of medium to coarse subangular grains of quartz; particles of mica and lignite occur commonly in most of the sand beds.

The formation contains sediments having many shades of red, brown, and gray. The sand and gravel are generally light gray to buff; the clay is similarly colored but in some beds it has a mottled coloring of red, gray, and white.

The general character of the sediments, the cross bedding, the lenticular beds, the pebbles of clay, and plant remains show that the sediments were deposited chiefly along streams and in lakes.

In and near its outcrop the formation is generally about 140 feet thick; however, down dip, southeast of the outcrop, the thickness of the formation increases progressively. The log of well Ce 16, 1.5 miles south of Glenn Dale and about 10 miles down the dip, shows the formation is about 300 feet thick. The log of well Ed 9, 2.3 miles east of Camp Springs and about 12 miles down the dip, is inadequate to determine the exact thickness of the formation but it probably is at least 500 feet.

The Patuxent formation is an important aquifer in the northern, northwestern, and western parts of the county. It is also a potentially important water-bearing formation in much of the remaining part of the county, but it occurs at such great depth that no wells have been drilled to it. Because the bedding in the formation is irregular and lenticular it is difficult to foretell the exact depth at which water-bearing beds will be encountered. However, wells Bd 30, 2.2 miles southeast of Beltsville, and Ce 16, 1.5 miles south of Glenn Dale, show that the formation locally contains two ill-defined water-bearing zones, one in the upper part and the other in the lower part.

The highest recorded yield from a well screened in water-bearing sand in the Patuxent formation in Prince Georges County is 540 gallons a minute, the yield of public-supply well Eb 2, 1.5 miles northwest of Oxon Hill. However, a part of the water pumped from that well is obtained from the Patapsco formation. Public-supply well Eb 1, near well Eb 2, is screened in the Patuxent formation only and yields 439 gallons a minute. Well Cc 5, 0.5 mile north of Bladensburg, and well Bd 4, at Greenbelt, are reported to yield, respectively, 300 and 250 gallons a minute. The yields of most domestic wells are reported to be at least 10 gallons a minute; hence, adequate supplies of water for domestic uses generally are readily obtained from the Patuxent formation.

UPPER CRETACEOUS SERIES

Arundel Clay (Potomac Group)

The Arundel clay unconformably overlies the Patuxent formation, ". . .occupying what appear to be old drainage lines therein, but extending beyond these to the seaward where it spreads into a more or less continuous sheet" (Clark, Bibbins, and Berry, 1911, p. 66). The outcrop of the Arundel clay is about 1 to 4 miles wide and extends across the northern part of Prince Georges County, approximately parallel to the outcrop of the Patuxent formation. The Arundel clay dips southeast at an average rate of about 45 to 50 feet a mile; locally, however, the dip is much more or less than the average (Pl. 3).

The Arundel clay is composed essentially of red to brown clay. It contains layers and concretionary masses of sandstone cemented with iron oxide and iron carbonate and geodes and nodules of iron carbonate and limonitic material. In some places the clay contains lenses of sand and sandy clay. Drillers' logs of some wells, for example, wells Be 2 and Be 5, respectively 1.2 miles northeast and 2.0 miles northwest of Bowie, show that the Arundel clay in places is tough and hard. Drillers generally describe the clay as red or brown and where both colors are present the brown clay generally underlies the red. The Arundel clay is readily determined in most drillers' logs of wells at the Agricultural Research Center near Beltsville. In some places, however, the lowermost sediments of the Patapsco formation or the uppermost sediments of the Patuxent formation are reported as clay, as in the logs of wells Be 10 at Bowie and Bd 28 at the Agricultural Research Center, so that the Arundel clay cannot be distinguished. Drillers' logs of wells near the Potomac River in the southern part of the county show thick sections of clay, but the information is inadequate to determine what part, if any, represents the Arundel clay.

The thickness of the Arundel clay ranges from nearly nothing to about 200 feet. According to the geologic map of Prince Georges County published by the

Maryland Geological Survey in 1911, the Arundel clay is absent at Fort Foote and ranges in thickness from about 20 to 100 feet from the District of Columbia line northeastward to the Patuxent River. In the vicinity of Beltsville, Bowie, and Glenn Dale the thickness of the Arundel clay, as determined from logs of wells, varies greatly. In the logs of wells at the Agricultural Research Center, near Beltsville, the average thickness is about 70 feet. The log of well Be 6, 2.6 miles west of Bowie, shows the thickness to be 159 feet, and the log of well Be 2, 1.2 miles northeast of Bowie, 102 feet. In the Glenn Dale area it is approximately 200 feet thick, as shown by the log of well Ce 16, 1.5 miles south of Glenn Dale. The Arundel clay was not identified in any wells down dip from wells Be 2 and Ce 16, which are about 5 miles southeast of the outcrop.

Although the Arundel clay may contain isolated thin lenses of sand and gravel, it is composed essentially of relatively impermeable clay and, therefore, is not considered an important water-bearing formation. Only a comparatively few dug wells obtain water from it. Nevertheless, the Arundel clay is hydrologically important, at least in the northern part of the county, because it serves as an upper confining layer for the water in the Patuxent formation.

Patapsco Formation (Potomac Group)

The Patapsco formation, the youngest formation of the Potomac group, unconformably overlies the Arundel clay. In Prince Georges County the outcrop of the formation is east of and essentially parallel to the Patuxent formation and Arundel clay. Excluding isolated outliers, the outcrop area is about 4 to 5 miles wide.

The strike of the Patapsco formation is northeastward or about parallel to the trend of its outcrop, and it dips southeast at a rate of about 30 to 50 feet to the mile.

The Patapsco formation is composed chiefly of clay, sand, and some gravel. The beds of sand are usually light gray to buff and the clay varies in color from white to gray to shades of red. The upper part of this formation consists commonly of red, pink, or brown clay. The logs of well Fc 2, at Piscataway, and well Ed 4, at Morningside, show the thickness of this clay to be 255 and 86 feet, respectively. It is frequently described by drillers as variegated clay, and probably is the "red variegated clay" to which Darton (1939, fig. 1) refers. A thick section of multicolored clay containing beds of sand generally underlies this clay, as in the interval from 250 to 360 feet in the log of well cuttings from well Dd 3, 1.9 miles southwest of Largo. The sand ranges from fine- to coarse-grained and is generally light gray to buff. In some beds oxides of iron impart a reddish color to the sand. Clay is the predominant material of the formation but in places, particularly in the eastern part of the county, there are thick sand lenses. For example, logs of well Be 7, 2 miles northwest of Bowie, and well Cd 5, 1 mile southeast of Lanham, show sections of sand respectively 55 and 75 feet thick.

According to Miller (1911, pp. 91, 93), the thickness of the exposed sediments between the Arundel clay and the Magothy formation, arbitrarily considered here to be the Patapsco formation (see p. 7), is about 200 feet. Down dip the thickness of the formation cannot be determined accurately from available data. Well Ec 10, 1.8 miles south of Oxon Hill and close to the outcrop, penetrated 242 feet of clay and sand of the formation and probably ended in the lower part of it. Farther down the dip, at Camp Springs, well Ed 21 probably penetrated 297 feet of clay and sand of the Patapsco formation. Well Ce 16, 1.5 miles southeast of Glenn Dale, penetrated 474 feet of clay and sand of the Patapsco formation, indicating that in this area the formation may be as much as 500 feet thick. In the southwestern part of the county the formation could not be differentiated from other Cretaceous nonmarine formations in the logs of wells that presumably penetrate it completely so that its thickness there is not known. No wells in the southeastern part of the county are deep enough to reach the Patapsco formation; hence, its thickness there is not known. However, as the Coastal Plain formations thicken down dip (southeast), the greatest thickness of these sediments probably is in the southeastern part of the county.

The Patapsco formation is an important source of ground water in the northern, northwestern, and western parts of the county; it yields water to public-supply, institutional, and domestic wells. It may contain important water-bearing beds in the southeastern part of the county but it occurs at such great depth that no wells have been drilled to it. In general, the water-bearing beds occur in the lower part of the formation, the upper part consisting chiefly of clay. Because the bedding is irregular and lenticular, individual water-bearing beds may pinch out over relatively short distances, and it is difficult to predict the exact depth at which water-bearing beds will be reached. Many of the sand lenses are composed of fine-grained sand which, according to drillers, is not permeable enough to yield adequate supplies to wells.

The highest known yield reported from a well in the Patapsco formation is 137 gallons a minute, the yield of public-supply well Fb 11 at Fort Washington. Public-supply well Ed 3, at Morningside, is reported to yield 78 gallons a minute. Many wells yield between 10 and 60 gallons a minute. Water supplies for domestic use generally are readily obtained from the Patapsco formation.

The Raritan formation, which overlies the Patapsco formation in a large part of the Coastal Plain of Maryland, probably is present in the subsurface in Prince Georges County. However, as the lithologic character of the Raritan formation is similar to the Patapsco formation, detailed studies would be required to distinguish them. Consequently, in this report the Patapsco formation is arbitrarily considered to include the Raritan formation.

Magothy Formation

The Magothy formation was named by Darton (1893) after the Magothy River, in Anne Arundel County. The formation is shown on the 1911 Maryland Geological Survey geologic map of Prince Georges County as a thin and interrupted band that parallels the older formations except in the vicinity of Seat Pleasant and in the southwestern part of the county near Fort Foote and Fort Washington. Cooke (page 5) believes the formation in Prince Georges County is overlapped by the Monmouth formation.

The formation strikes approximately northeast and dips to the southeast 33 feet to the mile for about the first 6 miles from the outcrop, and then changes to 22 feet to the mile (Pl. 4).

The formation consists essentially of light-gray cross-bedded coarse sand containing a small amount of glauconite and pyrite, which oxidizes to iron oxide where exposed, and brown, white, or gray clay. Particles of carbonaceous matter or lignite are common throughout the formation.

In and near the outcrop the thickness ranges from nearly nothing to about 60 feet. Farther down dip the formation is at least 49 feet thick and, so far as is known from logs of many wells, it is nowhere absent. Well cuttings from well Ed 4, at Morningside about 4 miles down dip from the outcrop, show that the formation there is about 40 feet thick. The driller's log of well Fd 11, 1.2 miles southeast of Clinton, which is about 10 miles down dip from the outcrop shows that the Magothy is 49 feet thick.

The Magothy formation, which is one of the important aquifers in the county, yields adequate supplies of water to several municipal and institutional and many domestic drilled wells. The capacity of the water-bearing material to yield water is not uniform, however. In some parts of the area the first sand encountered in the formation is fine-grained. This sand grades downward into coarser material or is separated from the coarser material by clay. Consequently, in those parts of the area wells are generally drilled to the underlying coarse material. In and near the outcrop area the water-bearing sand is fine-grained or thin and wells ending in these sediments are generally unsuccessful.

Plate 4 shows by contours the altitude of the top of the water-bearing sand in the Magothy formation. The depth to the water-bearing sand at any locality can be determined by adding the altitude of the land surface to the altitude of the water-bearing sand if the sand is below sea level and by subtracting the altitude if it is above sea level.

The largest recorded yield from a well in the Magothy formation in Prince Georges County is 239 gallons a minute, the yield of well Fd 11, 2.8 miles southeast of Clinton. Wells Ee 6 and Ef 1, at Upper Marlboro, are reported to yield, respectively, 180 and 153 gallons a minute. Water supplies for domestic uses, which require 2 to 5 gallons a minute, generally are readily obtained from the

Magothy formation. Pumping tests, by drillers, on many domestic wells that contain only a short section of screen show yields of 20 to 50 gallons a minute.

Monmouth Formation

In a large part of Maryland the Monmouth formation is underlain by the Matawan formation; however in Prince Georges County the Matawan, except possibly at a few localities, is absent on the outcrop (p. 18). No lithologic basis for subdividing the marine Upper Cretaceous sediments was found in drillers' logs or in samples of drill cuttings; consequently in this report all these sediments are arbitrarily assigned to the Monmouth formation.

The Monmouth formation crops out as a continuous band in the northeastern part of the county, but in the southwestern part it apparently is absent in places (p. 10). The formation strikes northeast and dips southeast at a rate of about 30 feet to the mile. The formation consists chiefly of gray to dark-gray glauconitic, micaceous silty and sandy clay. Its thickness ranges from nearly nothing to about 50 feet.

As the sediments of the Monmouth formation consist largely of silty and sandy clay, they do not constitute an important aquifer and, so far as is known, no drilled wells draw water from them.

TERTIARY SYSTEM

PALEOCENE SERIES

Brightseat Formation

The Brightseat formation apparently crops out in only a few localities in Prince Georges County, but is present in the subsurface in a large part of the Maryland Coastal Plain.

At the type locality the Brightseat formation is about 8 to 10 feet thick and consists essentially of a dark-gray micaceous sandy clay containing many megafossils. It thickens down the dip, for in well Ef 3 near Upper Marlboro it may be 70 feet thick (Shifflett, 1948, pp. 21–23).

As the formation consists essentially of sandy clay, it is not an important water-bearing formation.

EOCENE SERIES

Aquia Greensand (Pamunkey Group)

The Aquia greensand is exposed in the northeastern part of the county as a band about 6 miles wide; the outcrop narrows abruptly in the vicinity of Seat Pleasant and extends southwest as a narrow discontinuous band. The formation strikes northeast and dips southeast about 20 feet to the mile (Pl. 5).

In many places the formation contains indurated layers, some with fossil shells; these hard layers are generally called "rock" by drillers. The sediments generally are dark gray to greenish gray; but, where exposed and weathered, they are light to dark buff. In general the Aquia greensand can be differentiated from the underlying sediments of either Cretaceous or Paleocene age by differences in lithology. The Aquia greensand is lighter colored, contains considerably more glauconite, is more sandy, and contains less mica than the underlying sediments.

In and near the outcrop the thickness of the Aquia greensand ranges from nearly nothing to about 60 feet. It increases in thickness down dip. Thus, in wells Df 16, 2.4 miles east of Hall, and Ee 31, 2.6 miles southwest of Upper Marlboro, the thickness of the Aquia greensand is, respectively, 143 and 140 feet.

Though the Aquia greensand is relatively thin and contains only a small proportion of sand in the outcrop area, it yields adequate supplies of water for domestic purposes to many dug wells. Down dip from the outcrop it contains permeable water-bearing material, but most wells in this part of the area end in the Magothy formation or in the Pliocene (?) or Pleistocene deposits. Eight drilled wells (Df 1 and 5, Ee 1, Fd 4, and Ff 1, 6, 15, and 16) are known to end in the Aquia greensand, and all but one are in the easternmost part of the county. Their yields range from 6 gallons a minute in well Df 1, 2.8 miles southeast of Hall, to 65 gallons a minute in well Ff 16, 2.3 miles west of Nottingham. These yields do not necessarily indicate the maximum capacity of the formation to yield water. It is likely that some other drilled wells that were inventoried end in the Aquia greensand but their principal water-bearing formation is not known with certainty.

Nanjemoy Formation (Pamunkey Group)

The Nanjemoy formation is exposed in the stream valleys in a large part of the southeastern half of Prince Georges County. It pinches out up dip and does not crop out in the vicinity of Camp Springs and Forestville (fig. 7). The formation strikes northeast and dips southeast about 15 to 40 feet to the mile.

The Nanjemoy formation consists chiefly of gray to dark-gray glauconitic silt and clay. Its lowermost part consists of about 20 to 40 feet of even-textured clay, the Marlboro clay member (Clark and Martin, 1901, p. 65), that is generally pink or red but in some places is gray or brown. This unit has been traced on the outcrop by Darton (1948, pp. 154–155) from northern Virginia through Prince Georges and Anne Arundel Counties, Md. With well logs it can be traced in the subsurface in Prince Georges County. As it occurs at the base of the Nanjemoy formation, it serves as an excellent key bed to the top of the Aquia greensand (Pl. 5).

The thickness of the Nanjemoy formation in the outcrop area ranges from nearly nothing to about 50 feet. It increases in thickness down dip. In well Ed 8, 3.4 miles east of Camp Springs, its thickness is 110 feet, and in well Ff 16, 2

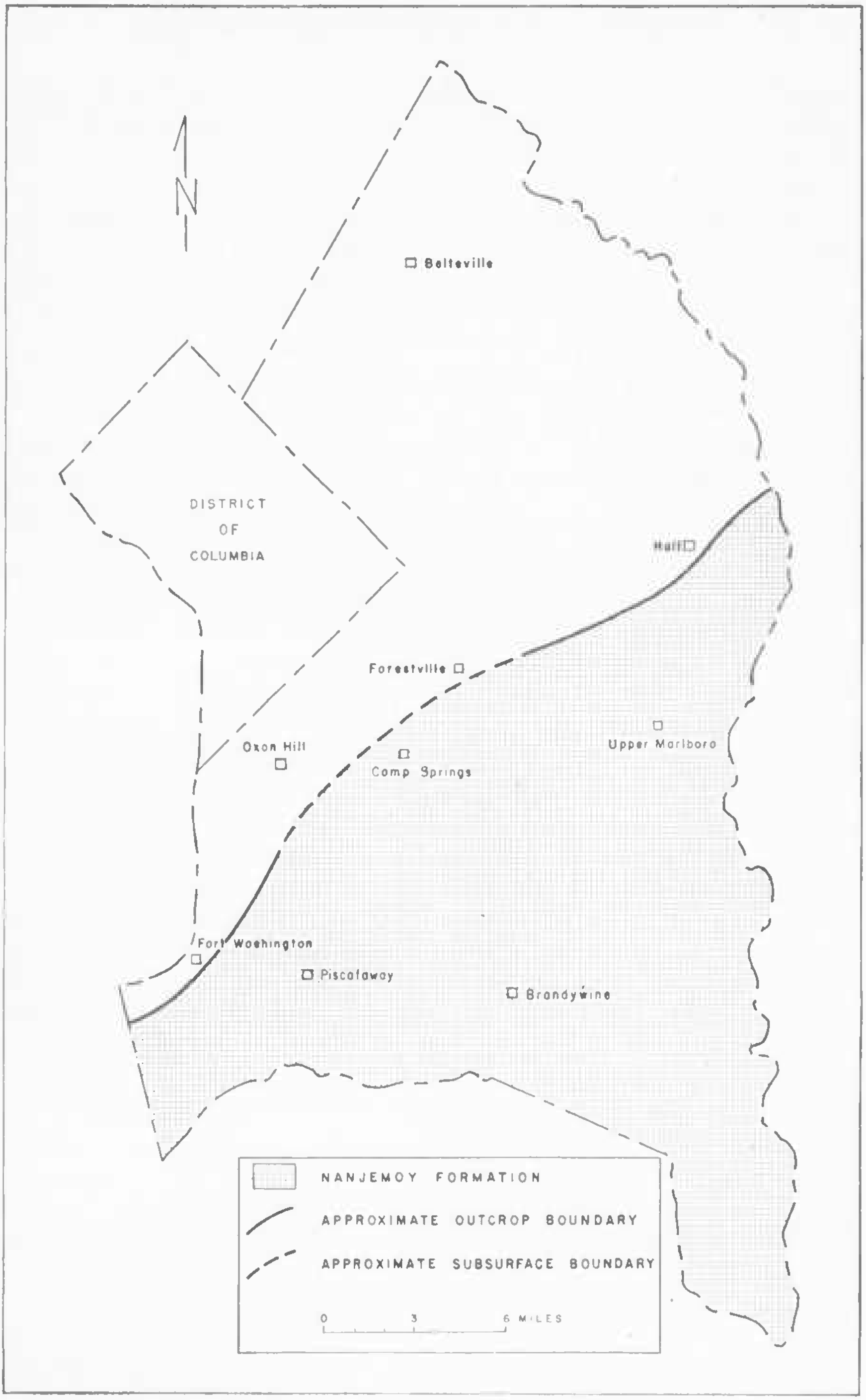


FIGURE 7. Map of Prince Georges County Showing Areal Distribution of Nanjemoy Formation

miles west of Nottingham, is 230 feet. Logs of wells in Charles and Calvert Counties indicate that the thickness does not change appreciably in Prince Georges County south of Nottingham.

The Nanjemoy formation is composed of such fine-grained material that it does not form an important aquifer in Prince Georges County. Only two drilled wells in the southeastern part of the county are known to end in the Nanjemoy formation: Well Gf 1, at Aquasco, is 360 feet deep and is reported to yield 15 gallons a minute; well Ff 7, at Nottingham, is 135 feet deep and flows slightly. A few other wells in this part of the county whose depths are not known accurately also may end in the Nanjemoy formation. Because the formation crops out in a relatively small area, only a few dug wells obtain water from it. It is likely that wells dug into the Marlboro clay member would be unsuccessful. This clay is an effective confining layer for the artesian water in the Aquia greensand.

MIOCENE SERIES

Calvert Formation (Chesapeake Group)

The Calvert formation crops out in a large part of southern Prince Georges County. In the southeasternmost part it is exposed chiefly in the stream beds, and to the northwest it is exposed principally along the banks of the streams. The formation strikes northeast and dips southeast about 15 feet to the mile.

The Calvert formation is composed chiefly of gray to dark-gray clay and sandy clay, and very fine-grained sand. It contains only a small amount of glauconite and contrasts markedly with the underlying Eocene sediments, which contain abundant glauconite. Diatoms are common in the Calvert formation, and serve as a convenient means of identifying the formation.

According to well logs, the thickness of the Calvert formation ranges from about 20 to 200 feet (Pl. 3, sec. B-B′). This wide range in thickness is caused partly by the relief on the surface of the underlying formation. Thus, in well Ed 8, 3.4 miles east of Camp Springs, the thickness of the Calvert is 30 feet, whereas in well Ed 9, 1.1 miles west of well Ed 8, the thickness is 90 feet. This increase is largely complemented by a decrease in thickness of the underlying Nanjemoy formation. It is likely that the Calvert formation is thicker in the southeasternmost part of Prince Georges County than elsewhere in the county.

So far as is known, the sediments of the Calvert formation are too fine-grained to yield adequate supplies of water to drilled wells in Prince Georges County. Where the formation is at or near the surface it yields small supplies of water to shallow dug wells.

Choptank Formation (Chesapeake Group)

The Choptank formation is exposed in the stream valleys in the extreme southeastern part of Prince Georges County (Md. Geol. Survey, Geologic Map of Prince Georges County, 1911).

Although the areal extent of the Choptank formation in Prince Georges County is small and there is little information on its strike and dip, it probably strikes northeast and dips southeast about 15 feet or less to the mile.

The Choptank formation in southern Maryland is composed of fine-grained yellow quartz sand, bluish-green sandy clay, slate-colored clay, and, at some places, ledges of indurated rock, but in Prince Georges County the formation is characterized chiefly by sand (Miller, 1911, p. 110). The thickness of the formation in the county is not well known but probably does not exceed about 50 feet.

The Choptank formation is not an important aquifer in Prince Georges County, owing chiefly to its small areal extent. Its water-bearing properties are not well known, but it may yield at least small supplies of water to domestic and farm wells.

TERTIARY AND QUATERNARY SYSTEMS

PLIOCENE (?) AND PLEISTOCENE SERIES

Primarily on the basis of their differences in altitude, Shattuck (1901) divided the Pliocene (?) and Pleistocene deposits in Maryland into several formations, the oldest formation occurring at the highest altitude in the uplands and the youngest at the lowest altitude along the major streams. In this report, for convenience of discussing the occurrence of ground water in them, the Pliocene (?) and Pleistocene deposits are arbitrarily considered to form two ill-defined units, an upland and a lowland. The upland unit (chiefly Pliocene (?) deposits, but including some upland Pleistocene deposits) occurs chiefly in the southern half of the county where it forms a plateaulike covering on the Cretaceous and Tertiary sediments. The lowland unit (Pleistocene deposits) occurs chiefly beneath the flood plains along the major streams—the Potomac, Anacostia, and Patuxent Rivers.

The lowland unit consists chiefly of irregular beds of sand, gravel, and clay. The upland unit contains similar material but cobbles and coarse gravel are more common. The thickness of the upland unit generally is about 10 to 20 feet but may be as much as 50 feet in places. The thickness of the lowland unit is not well known; it probably ranges from nearly nothing at the edges of the flood plains to as much as 50 feet in or near the center of the stream valleys.

Wells in Upland Deposits

The upland deposits cover a large part of the county and are utilized extensively as a source of ground water for domestic and farm supplies. These deposits contain much coarse material, but in most places it is intermixed with silt, clay, or fine sand. The log of well Ef 3, 1.5 miles northeast of Upper Marlboro, shows that the upland deposits there are composed of 40 feet of fine sand and silt or clay, and some gravel. Well Fd 5, 0.8 mile west of Cheltenham, penetrated 50 feet of upland deposits that contain some coarse material but a considerable amount of silt, fine sand, and clay. Although exposures of the upland deposits appear to contain an abundance of gravel and cobbles, in most places they are intermixed with fine material, which considerably reduces the permeability. Nearly all wells that end in the upland deposits are hand-dug and of large diameter; a few are driven or bored wells of small diameter. They generally yield adequate supplies (2 to 5 gallons a minute) for domestic and farm purposes, but during prolonged dry periods the yield of some of the wells may be inadequate. The largest yield reported from these wells in the upland deposits is 12 gallons a minute (well Ed 19, 0.6 mile south of Clinton).

Wells in Lowland Deposits

As few wells have been drilled in the lowland deposits, little is known about their water-bearing properties. Well Fb 1, 1 mile north of Fort Washington, encountered 15 feet of sandy clay underlain by 15 feet of sand and gravel. In some places sand and gravel is dredged from the bed of the Potomac River or from its flood plain. According to Darton (1939, p. 25), in the deltas of Broad Creek and Piscataway Creek there is much coarse material brought down from the plateau and terraces to the east and north; the deposits consist of an irregular mixture and alternation of coarse and fine materials. It is not known, however, whether similar coarse material is present beneath the flood plains of the Patuxent River, the Anacostia River, or other parts of the Potomac River. Three collector-type wells in the lowland deposits along the Potomac River at Marshall Hall (in Charles County) were reported to yield a total of 200 gallons a minute in 1945, although the initial yield was much higher. Whether or not large yields could be obtained from wells in the lowland deposits is problematical; however, it is likely that adequate supplies for domestic purposes can be obtained from dug wells in these deposits.

OCCURRENCE OF GROUND WATER

GENERAL PRINCIPLES

In Prince Georges County ground water is derived almost entirely from precipitation. Some of the water from precipitation flows directly from the land surface into streams as surface runoff and some is returned to the atmosphere by evaporation; another part percolates downward into the ground but some of this water returns to the atmosphere through plants or by evaporation before reaching the water table, the upper surface of the zone of saturation. Thus only a part of the precipitation replenishes, or recharges, the ground-water reservoirs. In Prince Georges County water from the zone of saturation is discharged through seeps or springs along the banks of streams, by evapotranspiration, and through wells. The flow of the streams is sustained during dry periods by the natural discharge of ground water.

POROSITY AND PERMEABILITY

Ground water occurs in the open spaces, or interstices, of rocks. The percentage of the total volume of a rock that is occupied by interstices is its porosity. The porosity of the Coastal Plain sediments in Prince Georges County generally is high, but locally where they have been indurated, usually by calcium carbonate or iron oxide, or where they are poorly sorted, the porosity is low. In the crystalline rocks ground water occurs chiefly in joints and other fractures, which make up only a small percentage of the total rock volume; thus, the porosity of those rocks is low.

The permeability of a rock determines the amount of water it can transmit. Permeability is governed chiefly by the number, size, and degree of interconnection of the pore spaces, not by their total volume. Thus the permeability of a rock is not necessarily proportional to its porosity. Clay is highly porous, but its interstices are so small that they are largely filled with water that clings to the rock particles by molecular attraction, and water does not move freely through them. In sand and gravel, however, the much larger interstices enable the water to be transmitted freely. The amount of water that can be transmitted by an aquifer is dependent not only on its permeability but also on its thickness. With the same permeability an aquifer half as thick as another can transmit only half as much water, assuming other factors to be equal. Thus the permeability of the water-bearing material in the Magothy and Patuxent formations may be similar but, owing to its greater thickness of water-bearing material, the Patuxent formation can transmit more water.

WATER-TABLE AND ARTESIAN CONDITIONS

Ground water occurs under two types of conditions, water-table and artesian. Water-table conditions exist where the water-bearing material that makes up the ground-water reservoir is not overlain by impervious rock and water from precipitation may directly enter the reservoir by downward percolation. The upper surface of the saturated zone is called the water table, and its position is marked by the static water levels in wells. Artesian conditions exist where water that moves along the water-bearing bed passes beneath impervious rock and is confined there under pressure. If an artesian reservoir is penetrated by a well the water level in the well will rise above the bottom of the confining bed. The imaginary surface coinciding with the levels to which the ground water rises in wells is called the piezometric surface.

In Prince Georges County water-table conditions exist in the aquifers in and near their outcrops and artesian conditions occur down dip from the outcrops, where the water-bearing material is overlain by relatively impervious rock. Hence in most aquifers in Prince Georges County water occurs under both water-table and artesian conditions. Under water-table conditions an aquifer functions chiefly as a storage reservoir, whereas under artesian conditions it functions essentially as a conduit that transmits the water from the outcrop areas. As the water table declines in the outcrop area large quantities of water are drained from the sediments. However, as the piezometric surface is lowered the sediments of an artesian aquifer are not dewatered. The quantity of water available from storage is relatively small and is for the most part the small amount of water released from storage owing to the slight compaction of the beds when the pressure in them is lowered. In general, with the same decline in water level, the quantity of water released from storage in an artesian aquifer ranges from a hundredth to a ten-thousandth of that released in a water-table aquifer.

Water-Table Aquifers. The configuration of the water table is in general similar to that of the land surface; that is, the water table is relatively high in the interstream areas and slopes toward the streams, into which ground water is discharged. Although over a period of time the quantity of water discharged is equal to the quantity of water recharged, there are times when the aquifer is receiving no recharge but in which the discharge continues. During these times the water discharged to the streams is derived from storage and the loss from storage is marked by a decline of the water table. In general, the water table is highest in early spring after the ground thaws and before plants and foliage become dense, and lowest in late summer and early fall. The amplitude of this seasonal fluctuation may amount to several feet. However, in those parts of the artesian aquifers far from the locality of recharge and discharge, seasonal fluctuations of water levels in wells is considerably less or negligible. Wells that are dug in the water-table areas during periods in which the water table is high, such as in the spring, may become dry when the water table declines to its normal position in the late summer or early fall. Moreover, even if the wells furnish an adequate supply of water throughout a year of normal rainfall, they may go dry during periods of extended drought. Consequently, so far as hydrologic conditions are concerned, wells should be dug when the water table is low, and should be dug as deeply as practicable below the water table.

The availability of water in outcrop areas depends on the quantity of water in storage; for example, small isolated outliers of water-bearing material contain a relatively small quantity of water in storage. Near the edges of the outcrops of the aquifers, where they are partly drained, the water-bearing material may also contain relatively small quantities of water in storage. For example, well Ec 16, which is 1.4 miles south of Oxon Hill and near the edge of the plateaulike deposits of Pliocene (?) age, is reported to have gone dry during a drought in 1930, and well Ee 16, which is 1.8 miles south of Upper Marlboro and near the edge of upland deposits of Pleistocene age, is reported to have gone dry during a drought in 1943.

Artesian Aquifers. The artesian aquifers in Prince Georges County in general occur as large sheet deposits that dip toward the southeast. Consequently, each artesian aquifer lies at increasingly greater depth southeastward across the county. Plates 4 and 5 show, by lines of equal altitude (contours), the position of the Magothy formation and the Aquia greensand in relation to sea level. These formations contain the principal artesian aquifers utilized in the southern part of the county. With the possible exception of the northern fringe of the contoured area, artesian conditions exist in the Magothy formation in the area shown on Plate 4. In the Aquia greensand artesian conditions exist southeast of a line extending approximately from Upper Marlboro to Forestville to Piscataway. The Patuxent and Patapsco formations contain the principal artesian aquifers utilized in the northern and western parts of the county. These aquifers are at such great depth in the southeastern part of the county that few wells are drilled to them.

The piezometric surfaces of the artesian aquifers in Prince Georges County are as much as 100 feet or more below the land surface in the upland areas but may be a few feet above the land surface in the lowland areas. For example, water levels in well Df 21, 1.5 miles south of Hall, and in well Ef 1, 0.5 mile southeast of Upper Marlboro, ending in the Magothy formation, are approximately 170 feet above the top of the formation; however, the water level in well Df 21 is 115 feet below the land surface and the water level in well Ef 1 is 2 feet above the land surface.

Flowing wells occur only where the piezometric surface is above the land surface. The largest known natural flow from a well in Prince Georges County is 45 gallons a minute (1949) from well Ef 5, at Upper Marlboro. The well is 8 inches in diameter and ends in the Magothy formation. Flows of 2 to 3 gallons a minute are common from small-diameter wells ending in the Aquia greensand or Nanjemoy formation along the Patuxent River in the southern part of the county. For example, well Ff 6, at Nottingham, is 2 inches in diameter and flowed at a rate of 2.5 gallons a minute in 1949. A few wells in the Patuxent formation along the Anacostia River have water levels above the land surface; however, most of those wells are capped or the casings are extended, which prevents them from flowing. In 1948 well Cc 5, 0.5 mile southeast of Hyattsville, had a water level 4.8 feet above the land surface but as the casing extended 10 feet above the land surface, the well did not flow. Well Fb 3, 2 miles southeast of Fort Foote, is the only known flowing well in the Patapsco formation, although the water levels in wells ending in this formation are within a few feet of the land surface in other lowland areas of the county. In 1948 well Fb 3 flowed at a rate of 1 gallon a minute from a 1-inch pipe at an elevation of about 12 feet above sea level.

Owing to the scarcity of wells that can be measured and the lack of precise altitudes of the wells that can be measured, it has not been possible to map accurately the piezometric surfaces of the aquifers in Prince Georges County. In general, the water enters the aquifers at the outcrop areas and migrates slowly down dip. Thus, in general, the altitude of the piezometric surfaces declines gradually to the southeast. In the Magothy formation, for example, the altitude of the water level in well Ec 8, 1.3 miles southwest of Camp Springs, is about 84 feet above sea level, and in well Fd 24, which is 7.5 miles southeast of well Ec 8, it is 50 feet above sea level, showing a decline in the piezometric surface of about 5 feet a mile. Pumping from wells ending in this formation, chiefly at Upper Marlboro and Cheltenham, has caused local depressions in the piezometric surface.

TEMPERATURE AND CHEMICAL CHARACTER OF GROUND WATER

The temperature of ground water at a depth of a few tens of feet is about the same as the mean annual air temperature and is consistent throughout the year. For this reason ground water is well suited for air conditioning and industrial cooling purposes. In the Coastal Plain sediments in the Baltimore area the temperature of ground water increases with depth at a rate of approximately 1 degree per 60 feet (Bennett and Meyer, 1952, p. 173). In Prince Georges County the temperature of water pumped from 16 wells at depths between 23 and 200 feet ranges from 47.5° F. to 59° F. and averages 55°; in 18 wells at depths between 220 and 588 feet the temperature ranges from 52.5° F. to 61.4° F. and averages 56.3°.

The chemical character of ground water is dependent primarily upon the solubility of the minerals contained in the sediments and the solvent power of the ground water. The minerals in the Coastal Plain sediments are relatively insoluble and consequently the ground water in them is generally low in mineral content (see pp. 118–126).

HYDRAULICS OF WELLS

When a well is pumped the water table or piezometric surface is depressed so that it forms an inverted cone with its apex at the well. The area in which this depression takes place is called the cone of depression. As a hydraulic gradient is created toward the well within the cone of depression, water from the aquifer flows into the well. The size, shape, and rate of growth of the cone of depression are controlled chiefly by the hydrologic properties of the aquifer and the rate and duration of pumping. As shown by the cone of depression, pumping causes the lowering of the water level in the aquifer to be greatest in the pumped well and to decrease progressively with distance from the well.

When the well is pumped, the decline of the water level in and near the well is at first rapid and then increasingly slower. When pumping ceases the water in the well rises, rapidly at first and then at a progressively slower rate, to or nearly to its original level. The measured drawdown and recovery of the water level in well Fd 5, 0.8 mile west of Cheltenham, is shown in figure 8. This well ends in the Magothy formation and is 272 feet north of well Fd 6, which ends in the same formation. The drawdown and recovery was caused by pumping well Fd 6 for 3.5 hours at a rate of 165 gallons a minute. The graph shows that 50 percent of the total drawdown occurred within 25 minutes after the pump in well Fd 6 was turned on and that 2.5 hours after the pump was turned off the water level had returned nearly to its original position.

The yield of a well is dependent not only upon the hydrologic properties of the aquifer but also upon the type and construction of the well. It is affected by the size of openings and length of the screen, the amount of aquifer screened,

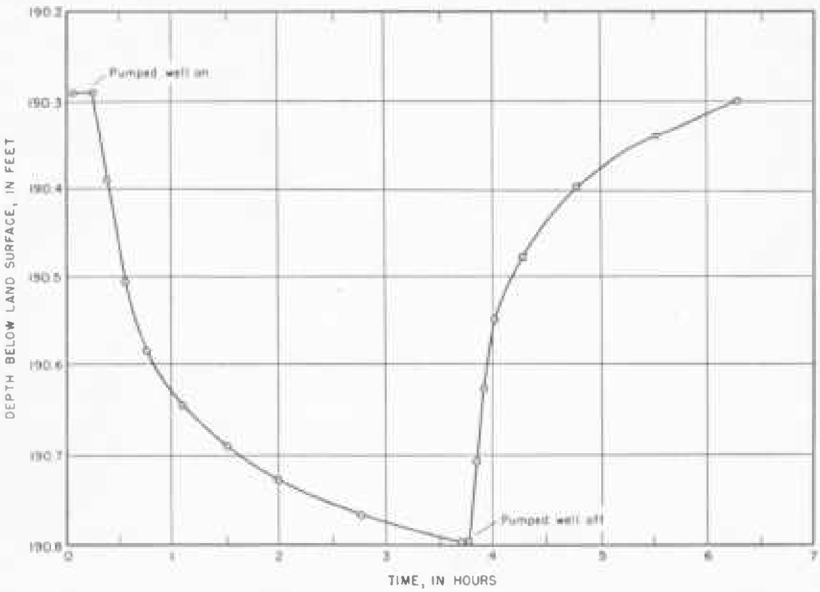


FIGURE 8. Graph Showing the Drawdown and Recovery of Well PG-Fd 5, at Cheltenham. Well PG-Fd 6, 272 Feet Away, Was Pumped at an Average Rate of 165 Gallons a Minute for 3½ Hours

the amount of fine material removed from immediately outside the screen, and to some extent, the diameter of the well. For example, well Eb 2, 1.5 miles northwest of Oxon Hill, is 20 to 8 inches in diameter, has a total screen length of 30 feet, and is reported to yield 540 gallons a minute, whereas well Ec 2, 1.3 miles east of well Eb 2, is 6 inches in diameter, has a screen length of 10 feet, and is reported to yield 10 gallons a minute.

Water is taken from wells in Prince Georges County by cylinder, jet, and impeller-type pumps, and by buckets. Where the water level is less than 25 feet below the land surface, cylinder-suction, centrifugal, or jet pumps and buckets are generally used. Where the water level is more than 25 feet below the land surface, turbine-type, jet, or deep-well cylinder pumps are commonly used.

Yields for domestic, agricultural, and small commercial supplies are obtained by use of hand-operated bucket and cylinder-suction pumps and electrically operated suction and jet pumps. The pumps generally have capacities of less than 10 gallons a minute. Large yields for industrial, institutional, and public supplies are commonly obtained from electric- or gasoline-driven turbine or deep-well cylinder pumps. The highest yield reported in the county (540 gallons a minute) is from well Eb 2, 1.5 miles northwest of Oxon Hill, which is equipped with a deep-well turbine pump.

DISTRIBUTION OF PUMPING

Approximately 4,000,000 to 5,000,000 gallons of ground water a day was pumped from wells in Prince Georges County during 1949 and 1950. Part of this pumpage was estimated on the basis of population, assuming a per-capita consumption of 50 gallons a day. Industrial, institutional, and commercial pumpage, where not metered or otherwise measured, was estimated either by the owner of the supply or by the writer. Of the total pumpage it is estimated that 65 percent was used for domestic, agricultural, and public supplies, and 35 percent for industrial and other commercial purposes.

Much of the area north of U. S. Highway 50 and practically all of the thickly populated part of the county bordering the District of Columbia is served by the water and sewerage facilities of the Washington Suburban Sanitary District. It is estimated that approximately 70 percent of the population of the county is concentrated within the bounds of the Sanitary District. Prior to the formation of the Sanitary District in 1918, the towns bordering the District of Columbia were supplied with water by their own municipal wells, and those living in the more rural areas were supplied by private wells. The water was pumped principally from the water-bearing sands in the Patuxent formation. Most of the ground-water supplies within the area of the Sanitary District gradually were abandoned and were replaced by the surface-water supply of the Sanitary District. The boundaries of the Sanitary District have been extended from time to time to include additional populated areas in the county, and as the boundaries of the District increased many wells within the newly annexed areas were abandoned. Consequently, a large part of the present ground-water pumping is in the area outside the Sanitary District.

Crystalline Rocks

Near the Fall Line, along the boundary with Montgomery County, wells obtain water chiefly for domestic purposes from the crystalline rocks. It is estimated that the pumpage is about 10,000 gallons a day.

Patuxent Formation

The total pumpage from the Patuxent formation is estimated to be about 1,000,000 gallons a day. Of this quantity at least 800,000 gallons a day is used for industrial, institutional, and public supplies. In the vicinities of Beltsville, Muirkirk, and the Agricultural Research Center the Patuxent formation supplies practically all the ground water pumped for these uses. Twelve wells at the Agricultural Research Center are pumped at a rate of approximately 500,000 gallons a day for experimental agricultural projects and domestic use. Two of these wells (Bd 15 and 21), which are screened in the Patuxent formation, were drilled 65 and 100 feet, respectively, into the crystalline rocks; consequently they may obtain some water from the crystalline rocks. Well Bd 33, at Muirkirk, supplies about 40,000 gallons a day for the production of paint pigments, and well Dd 17, 2.6 miles southeast of Bladensburg, supplies about 35,000 gallons a day for the manufacture of cinder blocks and bricks. Well Cc 8, 1.5 miles north of Hyattsville, well Cc 21, at Hyattsville, and well Bd 4, at Greenbelt, are the only wells in the county known to supply water for air conditioning. It is estimated that approximately 100,000 to 200,000 gallons of water a day from the Patuxent formation is used for this purpose. The Washington Suburban Sanitary District owns two wells, Eb 1 and 2, 1.5 miles northwest of Oxon Hill, which supply water to a housing development in that area. In 1949 an average of 107,000 gallons a day was pumped from well Eb 1, which is screened in the Patuxent formation. Well Eb 2 was not pumped that year. It is estimated that 5,000 to 10,000 gallons a day are pumped from well Fb 13 for the public-supply system at Fort Washington. Domestic use of water from the Patuxent formation, which is estimated to total 200,000 gallons a day, is confined essentially to the northern part of the county. In the southern part of the county, along the Potomac River, only a few domestic wells obtain water from this formation.

Patapsco Formation

The total pumpage from the Patapsco formation is about 1,000,000 gallons a day. The only known public supplies obtained from this formation are in the western part of the county and they total about 100,000 gallons of water daily. No large supplies for industrial purposes are obtained from this formation. The largest center of pumping from the Patapsco formation is at Morningside, where about 80,000 gallons a day is pumped for the public supply from wells Ed 2, 3, and 4. Three wells, Fb 7, 11, and 12, ending in this formation yield a total of 5,000 to 10,000 gallons a day to the public supply at Fort Washington. The largest part of the total pumpage from this formation is from shallow-dug and drilled wells for domestic and agricultural supplies. Largely on the basis of population, it is estimated these wells yield a total of 1,000,000 gallons a day.

Magothy Formation

Approximately 700,000 gallons of ground water a day is pumped from the Magothy formation in central and southern Prince Georges County. The pumpage for institutional and public supplies is about 500,000 gallons a day. The largest centers of pumping from this formation are in the vicinity of Cheltenham and at Upper Marlboro. At Cheltenham the U. S. Navy pumps a total of about 300,000 gallons a day from three wells (Fd 9, 10, and 11), and the Cheltenham School for Boys pumps about 40,000 gallons a day from two wells (Fd 5 and 6). At Upper Marlboro about 125,000 gallons a day is pumped for public and industrial supplies. Owing to the small area in which this formation crops out, few dug wells end in it, and almost all the domestic wells inventoried that obtain water from this formation are drilled wells. Approximately 200,000 gallons a day is pumped from these domestic wells.

Aquia and Nanjemoy Formations

The water obtained from the Aquia and Nanjemoy formations, probably about 100,000 gallons a day, is used chiefly for domestic purposes. The largest known industrial supply is from well Gf 1, which supplies about 6,500 gallons a day for a chicken hatchery. Flowing wells that end in these formations, chiefly along the Patuxent River, are estimated to discharge about 30,000 to 40,000 gallons a day.

Calvert and Choptank Formations

The Calvert and Choptank formations yield water only to a few shallow-dug domestic wells. It is estimated that about 10,000 to 20,000 gallons a day is obtained from them.

Pliocene (?) and Pleistocene Deposits

The Pliocene (?) and Pleistocene deposits are the most important source of ground water for domestic supplies in the county. Although the quantity of water withdrawn from each dug or driven well is relatively small, the total yield of all these wells is estimated to be about 1,300,000 gallons daily. Some small commercial establishments, such as gasoline stations, obtain water from these deposits.

WATER-LEVEL FLUCTUATIONS

Prior to this investigation, the water levels in two artesian wells, Dc 6 at Suitland and Cc 15 at Hyattsville, were measured approximately weekly during 1940–41 by the U. S. Geological Survey. The records of the measurements of these wells are published in the annual water-level reports of the Survey for the years 1940 and 1941 (Water Supply Papers 907, pp. 57–58, and 937, pp. 63–64). With the two exceptions shown in the "Location" column, water levels in the following eleven wells were measured periodically from the latter part of 1948 or the first part of 1949 through 1950:

Well number	Water-bearing formation	Location
Ad 8	Patuxent	At Laurel
Bd 17	Do.	At the Agricultural Research Center, near Beltsville
Cc 3	Do.	0.7 mile south of Bladensburg
Eb 1	Do.	1.5 miles northwest of Oxon Hill
Eb 2	Patuxent and Patapsco	1.5 miles northwest of Oxon Hill. No measurements in 1950
Dc 1	Patapsco	0.8 mile northwest of Suitland
Ec 10	Do.	2.25 miles south of Oxon Hill
Ef 1	Magothy	At Upper Marlboro. Measurements began in 1947
Df 5	Aquia greensand	3.25 miles east of Hall
Df 2	Nanjemoy	2.75 miles southeast of Hall
Fd 16	Pliocene (?) deposits	1.5 miles southwest of Brandywine

Periodic measurements are being continued in some of these wells, and the records will be published in the annual water-level reports of the Geological Survey.

Precipitation was below normal in Prince Georges County during 1949 and this deficiency is reflected in the declining water levels in shallow dug observation wells. The water-level fluctuations in well Ad 8 (fig. 9), which is a shallow-dug well on the outcrop of the Patuxent formation at Laurel, show the seasonal fluctuations that generally occur in water-table wells and the close correlation with the variations in precipitation that is typical of such wells. The water level in this well was highest in February 1949, and lowest in October 1949. During June, July, and August the precipitation was considerably below normal and, although it was near normal in September and October, the soil-moisture content was so low that only a small part of the precipitation reached the water table. From October 1949 to the end of March 1950 the water level rose almost continuously.

Although the available water-level records do not extend back to 1930, numerous residents of the county said that the severe drought of that year (fig. 5) resulted in a considerable decline of the water table. During this drought many shallow dug wells were deepened in order to increase their yields or were replaced by drilled artesian wells. In 1941, when the precipitation was 23.82 inches below normal, the water levels in many water-table wells in the county are said to have declined enough to substantially reduce their yields.

The fluctuations of the water levels caused by changes in the rate of recharge are progressively less down dip from the outcrop where artesian conditions occur. Thus the record obtained from well Dc 1 (fig. 9) shows only small fluctuations in the water level in this well. This is an artesian well 365 feet deep ending in the Patapsco formation about 2 to 3 miles down dip from its outcrop. The small fluctuations may be largely caused either by changes in the rate of pumping from the Patapsco formation or by changes in barometric pressure.

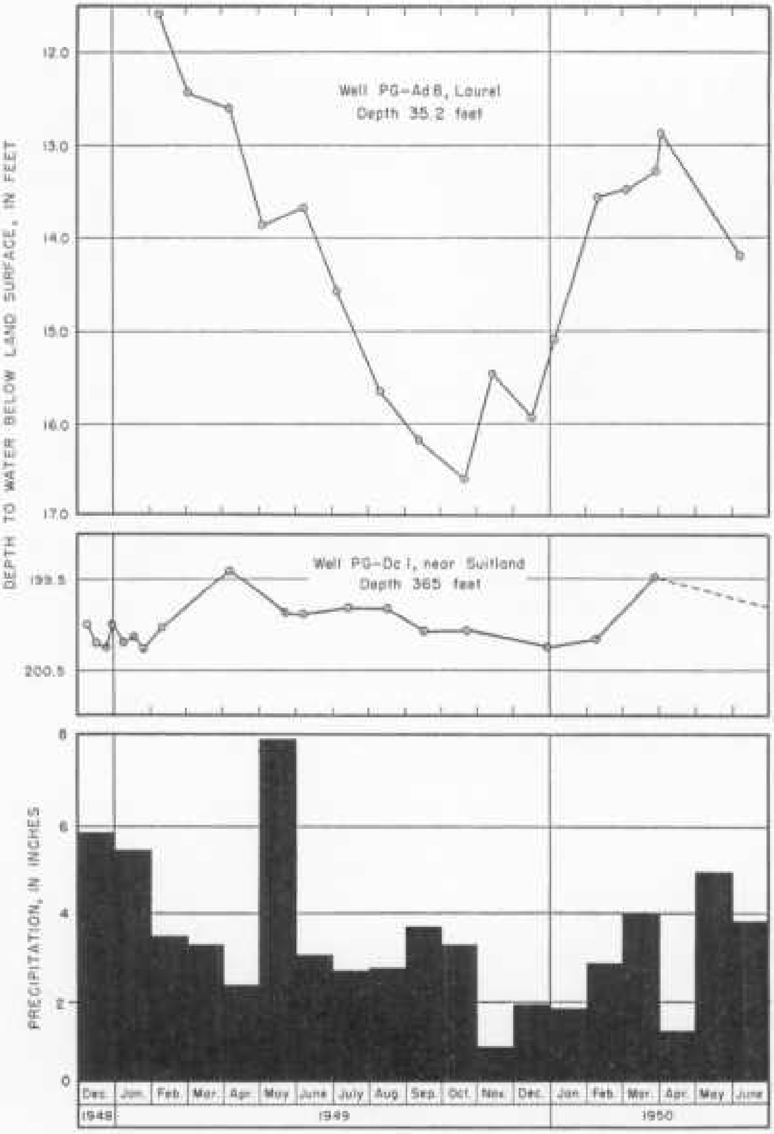


FIGURE 9. Hydrographs Showing the Fluctuations of Water Levels in Well PG-Ad 8 at Laurel and Well PG-Dc 1 near Suitland, and the Monthly Precipitation at Glenn Dale

Fluctuations in the Patuxent Formation

Of the five observation wells that end in the Patuxent formation two (Ad 8 and Cc 3) reflect essentially only natural changes in the water level and three (Bd 17, Eb 1 and 2) are affected also by nearby pumping or at times are pumped themselves. Wells in the Patuxent formation in the lowland areas near Hyattsville were reported to be flowing in 1905, and the piezometric surface of this aquifer in these areas is still above the land surface. For example, the altitude of the land surface at well Cc 5, 0.5 mile south of Hyattsville, is about 18 feet, and the static water level in the well was 4.8 feet above the land surface in December 1948. The static water level in well Bd 20, which ends in the Patuxent formation, at the Agricultural Research Center, was reported to be 30 feet below the land surface in 1911; in December 1948 it was 46.70 feet below, indicating that pumping from the Patuxent formation may have caused the water table in the Agricultural Research Center to decline as much as 17 feet in 37 years; however, a comparison of reported static water levels measured between 1934 and 1945 with recently measured water levels in six wells at the Research Center show only small declines to essentially no change. The water level in well Bd 17, also at the Research Center, which was measured periodically from the latter part of 1948 through 1950, shows essentially no net change during this period. The static water level in well Eb 1, 1.5 miles northwest of Oxon Hill, which ends in the Patuxent formation, was 90 feet below the land surface in 1948. The well was pumped intermittently during 1949–50 causing the water level to decline to about 120 feet below the land surface by the end of 1950. Well Eb 2, at the same location, is screened in the Patuxent and Patapsco formations and pumping has caused a similar decline in the water level in this well. Both these wells are in or near the center of the cone of depression caused by the pumping. The lowering of the artesian head in the aquifers decreases progressively at increasing distances from the wells.

Fluctuations in the Patapsco Formation

Well Dc 1, 0.8 mile northwest of Suitland, and well Ec 10, 2.3 miles south of Oxon Hill, are the only two observation wells that tap only the Patapsco formation. Measurements in well Dc 1, from the latter part of 1948 through 1950, show a net rise in water level of about 0.5 foot. The water-level measurements from June 1949 through 1950 in well Ec 10 indicate a net decline of less than 1 foot. As these wells are not in the immediate vicinity of pumped wells, they probably reflect essentially only natural changes in the water level. The static water level in well Ce 14, 1.8 miles south of Glenn Dale, was reported to be 79 feet below the land surface in 1934; in December 1951 it was 77.52 feet, indicating essentially no net change to a slight rise in 18 years. The static water level in well Ed 2, at Morningside, was reported to be 160 feet below the land surface in 1941; in March 1949 it was 182.20 feet, indicating that pumping from the public supply wells at Morningside may have caused a local cone of depression of as much as 22 feet.

Fluctuations in the Magothy Formation

Periodic measurements of the water-level fluctuations in the Magothy formation are not available except in the Upper Marlboro area; however, single measurements on many wells indicate that in general the artesian head in this formation is about 40 to 55 feet above sea level, and in and near the outcrop area the water table is as high as 80 to 100 feet above sea level. This information shows that there has been no general lowering of water levels in wells ending in the Magothy formation. In the vicinity of Upper Marlboro, however, the artesian head has declined, owing to the progressive increase in pumping from public-supply wells. The artesian head in well Ee 30, at the courthouse in Upper Marlboro, was 13 feet above the land surface about 1895 (Darton, 1896, p. 134). The altitude of the land surface at the well is about 40 feet; therefore the artesian head was about 53 feet above sea level at that time. It is reported that this well flowed continuously until about 1940, when pumping was started from a new public-supply well. It is apparent, however, that the decline in head has not been great, for wells in the Magothy formation at lower altitudes in Upper Marlboro still flow; moreover, the artesian head in the formation within about 2 miles of Upper Marlboro generally is about 40 to 50 feet above sea level. It is not likely that the artesian head has declined appreciably during the last 2 or 3 years, for measurements in observation well Ef 1, 0.5 mile southeast of Upper Marlboro, show a net decline of only 0.67 foot during the period of June 1947 to November 1950.

The only other major center of pumping from the Magothy formation is in the vicinity of Cheltenham, where the U. S. Navy and the Cheltenham School for Boys pump a total of about 340,000 gallons a day. Although periodic water-level measurements are not available, single measurements on wells in this area show that the lowering of the artesian head caused by this pumping has been slight.

Fluctuations in the Aquia Greensand

The high altitude of the water levels in wells ending in the Aquia greensand indicate that in general there has been no appreciable lowering of artesian head in that formation. Inasmuch as pumping from the formation in the outcrop area is slight and widely dispersed, fluctuations of the water table are caused chiefly by changes in the rates of recharge and natural discharge. Measurements of water level have been made periodically, from April 1949 through 1950, in well Df 5, 3.3 miles east of Hall, which is near the outcrop of the formation. The highest water level measured in this well was 3.76 feet below the land surface, in March 1950, and the lowest, 5.46 feet, in June 1950. For the period of record there has been no appreciable net change in the water level in this well. In the down-dip area there are no large centers of pumping and local depressions in the piezometric surface are caused by widely dispersed pumped wells, and by flowing wells chiefly at Nottingham.

Fluctuations in the Nanjemoy Formation

Periodic measurements were made on one well ending in the Nanjemoy formation, well Df 2, 2.8 miles southeast of Hall. Although this well is near the outcrop, fluctuations of the water level do not show clearly the usual effects of seasonal changes in the rate of recharge in the outcrop area. In 1949 the water level rose irregularly from the first of the year until October and then declined to its lowest stage of the year, in December. From November 1948 to the first part of January 1951 the water level in this well showed a net decline of 0.67 foot. In the down-dip area, pumping from one well at Aquasco (Gf 1) and flow from wells along the Patuxent River at Nottingham and Eagle Harbor have caused local depressions in the piezometric surface, but their magnitude probably is small.

Fluctuations in the Calvert and Choptank Formations

As the aquifers in the Calvert and Choptank formations supply water to only a relatively few shallow dug wells, the quantity of water pumped from these formations is small; hence, the water levels respond primarily to changes in natural discharge and recharge. During prolonged dry periods some dug wells ending in the Calvert formation are reported to have gone dry.

Fluctuations in the Pliocene (?) and Pleistocene Deposits

As water in the Pliocene (?) and Pleistocene deposits generally occurs under water-table conditions, water levels in wells in these deposits fluctuate in accordance with local precipitation. During periods of prolonged drought the water levels in many of the shallow dug wells ending in these deposits decline so that the yields decrease or the wells go dry.

Well Fd 16, 1.5 miles southwest of Brandywine, ends in the Pliocene (?) deposits; it was measured periodically from April 1949 through 1950 and showed a net decline in the water level of 3.48 feet for the period of record. During 1949 the precipitation was about 6 inches below normal and the water level in this well declined continuously from 8.50 feet below the land surface in April 1949 to 17.64 feet in December 1949. In 1950 the precipitation was about 3 inches below normal. During the first part of the year the water level rose to 12.45 feet below the land surface near the end of May, then declined continuously to 15.17 feet in the first part of November, and rose again to 11.98 feet at the beginning of 1951. Thus, during 1950 the water level in well Fd 16 had a net rise of 5.66 feet.

QUALITY OF GROUND WATER

The chemical character of ground water in Prince Georges County is shown by the range in concentration of the significant mineral constituents in table 5 and by the 55 analyses in table 6. Water samples from 33 wells were analyzed in

TABLE 5

Range in Dissolved Solids, Hardness, Iron, and pH in Ground Water in Prince Georges County

(In parts per million, except pH)

Water-bearing formation	Dissolved solids				Total hardness (as $CaCO_3$)				Iron (Fe)				pH			
	Number of analyses	Max.	Min.	Avg.	Number of analyses	Max.	Min.	Avg.	Number of analyses	Max.	Min.	Avg.	Number of analyses	Max.	Min.	Avg.
Pliocene (?) and Pleistocene deposits	7	265	46	114	7	146	18	57	7	2.0	0.03	0.83	6	7.4	5.1	6.3
Nanjemoy	1	—	—	163	1	—	—	102	1	—	—	.32	1	—	—	8.0
Aquia greensand	2	212	67	140	2	163	21	92	2	16	5.2	10.6	2	7.8	6.1	7.0
Magothy	9	264	108	174	10	178	51	135	10	14	.02	3.08	9	8.0	6.5	7.5
Patapsco	10	209	20	117	10	141	8.2	64	11	26	.40	4.67	10	8.1	5.3	6.7
Patuxent	18	180	20	61	19	80	3	20	20	15	.0	2.80	19	8.0	4.7	5.9
Pre-Cambrian rocks	1	—	—	196	1	—	—	20	1	—	—	.36	1	—	—	7.9
All formations	48	265	20	138	50	178	3	70	52	26	.0	3.24	48	8.1	4.7	7.0

the Water Resources Laboratory of the U. S. Geological Survey, 18 analyses of water were obtained from the Maryland State Department of Health, and 4 were obtained from other sources.

CHEMICAL CONSTITUENTS IN RELATION TO USE

Dissolved Solids. Dissolved solids is the residue from complete evaporation of water and consists almost entirely of the constituents reported in table 6, with which may be included small quantities of organic material and water of crystallization. According to the U. S. Public Health Service (1946, p. 383), water of good chemical quality, for public consumption on interstate carriers, should not exceed 500 parts per million in total solids; however, if such water is not available a total solids content of 1,000 parts per million may be permitted. In 48 analyses of samples of ground water in Prince Georges County the dissolved solids ranges from 20 to 265 parts per million, which is well below the standards set by the Public Health Service.

Hardness. Hardness is the capacity of water for consuming or precipitating soap; it is recognized by the sticky insoluble curd that is formed in washing with soap before a lather is obtained. Hardness is objectionable because of the difficulty of removing this curd from containers and fabrics, the greater quantity of soap consumed to produce a lather, and the scale formed in boilers, water pipes, and cooking utensils. The presence of relatively large quantities of calcium and magnesium is the chief cause of hardness, although other mineral constituents—for example, iron, aluminum, and manganese—may also cause hardness.

Water is frequently classed according to the following scale of hardness (Lohman, 1938, pp. 76, 77):

Range in parts per million of hardness	
0–50	Soft water.
50–150	Water may be used for most purposes without treatment. Soap consumption is greater.
150–300	Hardness definitely noticeable; water may require treatment.

In Prince Georges County the hardness ranges from 3 to 178 parts per million in 50 analyses and averages 70. Of these analyses, 27 are in the first range, 18 in the second, and 5 in the third.

Iron. Iron is the most troublesome constituent in the ground water in Prince Georges County. In many parts of the aquifers it is present in sufficient quantity to give the water a disagreeable taste and to stain sanitary fixtures, cooking utensils, and laundry. If present in excess of about 0.1 part per million iron may separate out of the water after exposure to the air and settle as a reddish sediment. Analyses of water from 52 wells show the iron content to range from 0.0 to 26 parts per million, and average about 3.2 parts per million. According to the

TABLE 6

Chemical Analyses of Ground Water in Prince Georges County

[In parts per million, except pH and specific conductance]

Well No.	Water-bearing formation	Date of collection	Dissolved solids	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Manganese (Mn)	Aluminum (Al)	Total hardness as $CaCO_3$	pH	Specific conductance ($K \times 10^6$ at 25° C.)	Analyst
Bc 1	Pre-Cambrian	Mar. 21, 1949	196	18	0.36	4.2	2.4	64	1.5	184	10	2.5	0.2	0.2	—	—	20	7.9	299	A
Bc 5	Patuxent	1948	—	—	3.0	—	—	—	—	—	—	4.8	—	—	—	—	51	—	—	D
Bc 10	Do	Mar. 17, 1950	64	3.7	2.3	5.6	4.4	6.0	3.8	36	1.8	11	.2	6.5	0.12	—	21	7.3	136	A
Bd 4	Do	1950	42	5.4	.40	0.3	0.3	—	—	—	3.0	5.0	—	.0	.0	0.5	10	5.3	—	B
Bd 18	Do	1945	36	—	.10	—	—	—	—	—	—	4.0	—	.0	—	—	4	5.0	—	B
Bd 19	Do	1946	20	—	.0	—	—	—	—	—	—	3.2	—	.4	—	—	5	5.4	—	B
Bd 22	Do	1936	84	—	12.0	—	—	—	—	—	—	8.0	—	—	—	—	26	6.0	—	B
Bd 26	Do	1945	30	—	.8	—	—	—	—	—	—	3.9	—	—	—	—	9	5.0	—	B
Bd 29	Do	Mar. 22, 1949	27	7.4	.47	1.0	.6	2.0	0.4	4	1.8	3.0	.0	2.2	—	—	5	6.0	27.1	A
Bd 30	Do	1943	26	—	.18	—	—	—	—	—	—	4.1	—	.5	—	—	33	4.9	—	B
Bd 31	Do	1950	44	—	.80	—	—	—	—	—	—	7.7	—	.7	—	—	8	5.3	—	B
Be 2	Do	1943	34	4.7	1.7	.3	.0	—	—	—	11	20	—	—	—	—	10	4.7	—	B
Be 4	Patapsco	1944	—	—	1.7	—	—	—	—	—	—	3.4	—	—	—	—	—	5.3	—	B
Be 5	Patuxent	1942	66	8.6	5.2	2.7	.4	—	—	—	9.2	5.8	—	.18	.50	.0	—	6.0	—	B
Be 6	Do	Apr. 13, 1950	57	3.1	58[a]	1.0	.8	14	2.3	6	31	3.0	.0	.0	.45	—	7	5.3	97.1	A
Be 7	Do	1945	24	—	.4	—	—	—	—	—	—	3.5	—	—	—	—	8	5.3	—	B
Be 8	Do	1940	—	—	1.19	—	—	—	—	5	—	3	—	—	—	—	—	5.3	—	A
Cd 2	Do	1947	—	—	15	—	—	—	—	—	—	—	—	—	—	—	34	—	—	?
Cd 7	Patapsco	Apr. 13, 1950	26	7.7	4.5	—	—	—	—	19	2.3	2.2	.0	.1	—	.3	14	5.8	34.6	A
Ce 16	Patuxent	Nov. 8, 1935	30	8.8	1.4	.9	.6	4.0		1.0	10	1.5	—	.0	.0	—	5	4.7	—	A
Ce 17	Magothy	Nov. 4, 1949	108	4.4	.32	21	2.0	3.4	2.1	40	18	12	.1	1.4	.00	1.0	61	7.5	149	A
Ce 18	Patapsco	Nov. 4, 1949	99	7.6	1.8	20	6.8	3.5	2.6	73	22	2.4	.1	.1	.2	.6	78	6.5	177	A
Cf 1	Do	Nov. 4, 1949	20	3.7	26	2.1	.7	2.4	1.3	10	5.4	1.8	—	.1	.3	.3	8	5.7	41	A
Cf 2	Magothy	Mar. 22, 1949	128	45	12.7	17	2.0	3.1	1.0	58	13	2.5	.1	.8	.1	—	51	6.5	132	A
Cf 11	Aquia greensand	Apr. 17, 1950	67	20	16	6.0	1.5	5.1	3.5	18	4.1	11	.0	3.7	.02	—	21	6.1	80.5	A
Dc 4	Patapsco	1941	104	—	.80	—	—	—	—	—	—	4.1	.2	.10	—	—	74	6.7	—	B
Dc 8	Do	Nov. 12, 1919	112	16	7.1	19	6.9	4.0		81	16	.8	—	.4	—	—	76	—	—	A

Dc 9	Pliocene(?) deposits	Nov. 9, 1919	181	11	.50	9.4	13	13		)	1.6	26	—	83	—	—	77	—	—	A
Dd 6	Pleistocene deposits	Mar. 21, 1949	91	8.7	.30	11	4.2	4.1	1.0	2.0	43	5.5	.2	2.8	—	—	45	5.1	135	A
Dd 17	Patuxent	Apr. 18, 1951	58	10	10	8.8	3.9	1.5	1.9	39	5.9	3.8	.0	.5	.21	.0	38	6.6	95.3	A
Df 5	Aquia greensand	Mar. 26, 1950	212	33	5.2	59	3.8	2.5	4.1	198[b]	9.7	2.1	.1	.2	.04	—	163	7.8	320	A
Eb 1	Patuxent	Mar. 28, 1949	180	24	.19	1.2	.1	60	.8	132	20	4.5	.1	1.6	—	—	3	8.0	255	A
Eb 2	Patapsco and Patuxent	1946	214	19	.10	.7	.2	30	—	—	9.9	—	—	.0	.00	.6	9	7.5	—	C
Eb 3	Patapsco or Patuxent	Mar. 17, 1950	163	21	1.3	1.3	.6	53	2.4	120	21	2.0	.3	.4	.00	—	5	7.8	237	A
Ec 1	Patapsco	1948	140	—	.40	—	—	—	—	—	—	4.2	—	.60	—	—	60	6.9	—	B
Ec 5	Patuxent	1950	140	—	.60	—	—	—	—	—	—	4.5	—	.50	—	—	29	7.4	—	B
Ec 14	Patapsco	1950	104	—	3.0	—	—	—	—	—	—	3.3	—	.30	—	—	45	6.9	—	B
Ed 2	Do	1941	176	—	4.9	—	—	—	—	—	—	3.3	—	.0	—	—	130	7.5	—	B
Ed 4	Do	Mar. 31, 1949	179	30	.62	48	5.2	3.1	.5	158	8.5	2.0	.1	1.7	—	—	141	7.7	264	A
Ed 8	Magothy	Apr. 17, 1950	171	16	.69	46	8.5	4.6	4.4	185[c]	8.3	2.0	.0	.3	.01	—	150	8.0	296	A
Ed 17	Pliocene(?) deposits	Apr. 13, 1950	52	6.4	2.0	4.1	2.0	6.9	2.1	8	9.2	9.9	.0	7.6	.3	—	18	5.4	83.4	A
Ed 32	Patuxent	Mar. 6, 1951	136	10	.20	17	9.1	5.9	16	113	22	1.6	.3	.2	.17	.4	80	7.7	236	A
Ee 6	Magothy	1947	264	24	.30	100	4.6	—	—	—	22	4.4	—	.0	.0	.9	178	7.6	—	B
Ee 30	Do	Before 1918	—	26	.02	61	6.0	5.1	—	205	13.9	2.7	—	.0	—	.8	178	—	—	?
Ef 3	Do	June 6, 1949	183	15	14	50	5.2	5.0	1.9	178	10	2.1	.2	.2	—	—	146	6.9	307	A
Ef 5	Do	Apr. 15, 1946	210	25	.31	60	6.7	3.1	1.7	192	18	2.0	.3	.2	—	—	177	7.5	33.8	A
Fb 7	Patapsco	Mar. 31, 1949	209	32	.59	2.8	1.0	6.0	.6	130	28	1.5	.3	1.1	—	—	11	8.1	265	A
Fc 14	Magothy	Apr. 13, 1950	149	13	1.8	29	11	4.2	9.2	147	13	1.2	.3	.6	.00	—	118	7.7	263	A
Fd 6	Do	Mar. 25, 1949	169	13	.21	37	7.9	3.4	1.2	158	13	1.5	.2	1.8	—	—	125	7.7	285	A
Fd 16	Pliocene(?) deposits	Mar. 28, 1950	265	18	1.9	48	6.1	16	17	166	40	6.5	.1	7.5	.00	—	146	7.2	380	A
Fd 24	Magothy	1945	180	4.0	.40	38	3.0	—	—	—	1.3	5.2	—	.06	.0	.5	170	7.8	—	B
Fd 34	Pliocene(?) deposits	Mar. 15, 1951	88	5.2	.11	22	2.5	7.9	.7	84	1.9	8.8	.0	.1	—	—	65	7.4	163	A
Ff 5	Pleistocene deposits	Mar. 20, 1951	78	22	.85	5.6	2.7	5.3	1.9	6	8.1	8.5	.0	18	.00	.2	25	5.8	102	A
Ge 10	Pliocene(?) deposits	Mar. 6, 1951	46	7.8	.03	8.2	1.1	2.9	1.5	28	5.1	3.9	.1	.4	.06	.1	25	6.9	71.4	A
Gf 1	Nanjemoy	Mar. 28, 1949	163	33	.32	21	12	2.1	5.6	142	4.3	2.0	.3	1.3	—	—	102	8.0	239	A

Analyst: A—U. S. Geological Survey.
B—Maryland State Health Department.
C—Penniman and Browne.
D—The Duro Company.

[a] Iron content of sample may be due in large part to rust from well casing.
[b] Includes 4 parts per million of carbonate.
[c] Includes 8 parts per million of carbonate.

Public Health Service standards (1946, p. 383) the total content of iron and manganese preferably should not exceed 0.3 part per million, which is far less than the average iron content of analyses in Prince Georges County. Twenty-three analyses show that the manganese in ground water in Prince Georges County is 0.0 to 0.5 part per million. The quantity of iron in the ground water may change over very short distances, even in the same formation. Analyses of water from wells ending in the Patuxent formation at the Agricultural Research Center, near Beltsville, show that the iron content there ranges from 0.0 to 12 parts per million.

Hydrogen-ion Concentration. The pH, or hydrogen-ion concentration, is the quantitative measure of the alkalinity or acidity of water. Neutral water is considered to have a pH value of 7, acid water of less than 7, and alkaline water more than 7. Water having a low pH may corrode well screens, casings, and plumbing fixtures; analyses of water from 48 wells in Prince Georges County show the pH values to range from 4.7 to 8.1.

QUALITY OF WATER IN RELATION TO WATER-BEARING FORMATIONS

Crystalline Rocks

Because of their relative unimportance as an aquifer in the county, only one sample of water from the crystalline rocks was analyzed. This analysis, from well Bc 1, 3.0 miles southwest of Beltsville, shows the water to be of the sodium-bicarbonate type, soft, and of moderate dissolved-mineral content. The water contains 0.32 part per million of iron, and the owner of the well reports that the water has an "irony" taste. However, owners of other wells ending in the crystalline rocks report that, in general, the iron content is not objectionably high and that the water is chemically satisfactory for domestic purposes.

Patuxent Formation

Analyses of water from 21 wells ending in the Patuxent formation show that the mineral content of the water is very low and the water is soft; 18 analyses show the dissolved solids to range from 20 to 180 parts per million, and 19 analyses show the total hardness to range from 3 to 80 parts per million. The iron content of the water from this formation varies from place to place, ranging in 20 analyses from 0.0 to 15 parts per million and averaging 2.80 parts per million. The pH also is variable, ranging from acid water, with a pH value of 4.7, to slightly alkaline water, with a pH value of 8.0.

With the exception of well Be 6, which yields water containing relatively large amounts of sodium and sulfate, the dissolved solids reported indicate that the mineral constituents of the water in the Patuxent formation in the northern part of the county are present in small quantities. The analyses of water from well Eb 1, 1.5 miles northwest of Oxon Hill, and well Ec 5, 1.4 miles east of Oxon

Hill, show that in the southwestern part of the county the mineralization of the water in the Patuxent formation is generally higher than in the northern part of the county. The highest content of dissolved solids of the water in the northern part of the county is 84 parts per million (well Bd 22, at the Agricultural Research Center) and the average dissolved-solids content of the water in the southwestern part is about 160 parts per million. The analysis of the water from well Eb 1 shows that the sodium (60 parts per million) and the bicarbonate (132 parts per million) are higher than those determined for the water from any well in the northern part of the county. The analyses show that the water is soft in both areas and does not exceed 80 parts per million in hardness. The iron content is high in some places in the northern part of the county but generally is low in the southwestern part. In general, the pH of the water is lower in the northern part of the county where it averages 5.4, than in the southwestern part, where it averages 7.7. At the Agricultural Research Center, which obtains nearly all its water from the Patuxent formation, the iron content of the water generally is not high, but the mild acidity of the water (pH averaging 5.5) is reported to cause corrosion of pipes. Thus, the extremely high iron content, 58 parts per million, of the water from well Be 6 at the Agricultural Research Center, 2.8 miles northeast of Greenbelt, may result largely from corrosion of the well casing and may not truly represent the quantity of iron in the water of the Patuxent formation in this vicinity.

Patapsco Formation

Analyses of water obtained from 11 wells ending in the Patapsco formation show, in general, that the water is more highly mineralized than the water from the Patuxent formation. The dissolved solids in the water in this formation averages 117 parts per million, as compared with 61 parts per million for the Patuxent formation. Analyses of water from 10 wells ending in the Patapsco formation show that the hardness is variable, ranging from 8 to 141 parts per million and averaging 64 parts per million. In general the water is higher in iron content than the water in the Patuxent formation, averaging 4.67 parts per million as compared with 2.80 parts for the Patuxent formation. The analyses of water from 10 wells that end in the Patapsco formation show that the pH ranges from 5.3 to 8.1 and averages 6.7.

In general the water in the Patapsco formation in the northern part of the county is lower in dissolved solids, hardness and pH than that in the southern part of the county. In the northern part of the county analyses show the dissolved-solids content to average about 48 parts per million and the total hardness to average 33 parts per million. In the southern part of the county, however, the dissolved-solids content averages about 147 parts per million and the hardness averages 80 parts per million. The average pH of the water in the northern part of the county is 7.4 and in the southern part is 5.6. The iron content of the water changes over short distances, but in most areas it is relatively high. The range in iron content in the northern and southern parts of the county is about the same—1.7 to 4.5 and 0.40 to 7.1 parts per million, respectively. However, the analysis of water from well Cf 1, 0.6 mile southwest of Priest Bridge on the northeastern border of the county, shows the unusually high iron content of 26 parts per million. The bicarbonate content of the water is lower in the northern part of the county than in the southern part. Analyses of water from wells Ce 18, 2.5 miles north of Largo, and Cf 1, 0.6 mile southwest of Priest Bridge, show the bicarbonate content of the water to be 73 and 10 parts per million, respectively; analyses of water from wells Ed 4 at Morningside and Fb 7 at Fort Washington show the bicarbonate content to be 158 and 130 parts per million, respectively.

Magothy Formation

Analyses of water from 10 wells ending in the Magothy formation show that the mineral content of the water is variable: 9 analyses show the dissolved solids to range from 108 to 264 parts per million; 10 analyses show the total hardness to range from 51 to 178 parts per million, and the calcium from 17 to 100 parts per million; and 9 analyses show the bicarbonate to range from 40 to 205 parts per million. The iron content of water from well Cf 2, 1.5 miles north of Hall, and well Ef 3, 1.5 miles northeast of Upper Marlboro, is 13 and 14 parts per million, respectively. However, the highest iron content in the eight other analyses is 1.8 parts per million (in well Fc 14, 1.4 miles east of Piscataway); the other seven wells yield water containing less than 1.0 part per million of iron. Thus, in general, wells drilled into the Magothy formation can be expected to yield water that is not objectionably high in iron. The water generally is approximately neutral, the pH averaging 7.5 in analyses from nine wells.

Unlike the Patuxent and Patapsco formations, the chemical character of the water in the Magothy formation is fairly uniform throughout the county, and it may be classified as a calcium-bicarbonate type water. Near the outcrop in the northern part of the county the calcium, bicarbonate, and hardness of the water are lower than in the southern part.

Aquia Greensand

Two analyses of water from the Aquia greensand are available, one of water from well Cf 11, 2.7 miles south of Priest Bridge, a shallow dug well in the outcrop, and one of water from well Df 5, 3.3 miles east of Hall, a deeper drilled well in the outcrop. These analyses show that the waters differ in chemical character. The water from the drilled well, Df 5, is much higher in dissolved solids, hardness, calcium, and bicarbonate and lower in iron than the water from the shallow dug well, Cf 11.

Nanjemoy Formation

An analysis of water from well Gf 1 at Aquasco, ending in the Nanjemoy formation, a relatively unimportant water-bearing formation in Prince Georges County, shows that the water from this formation is similar in chemical character to the water from the drilled well, Df 5, in the Aquia greensand. However, the iron content of the water from Gf 1 is only 0.32 part per million, as compared with 5.2 parts per million in the water from well Df 5 in the Aquia greensand.

Calvert Formation

As the Calvert formation is a relatively unimportant aquifer in Prince Georges County, no analyses of ground water were made for this formation. Oral reports from residents in the area whose wells end in this formation indicate that in places the water from the Calvert formation is hard. The water from some wells ending in this formation is reported to form a white precipitate, which may be calcium carbonate, in cooking utensils.

Pliocene (?) and Pleistocene Deposits

Chiefly because the Pliocene (?) and Pleistocene deposits vary in composition and occur under different topographic and geologic conditions throughout the county, the water they contain varies in chemical character from place to place.

Analyses were made of water from five wells ending in upland deposits of Pliocene (?) age. Well Dc 9, at Suitland, yields moderately soft magnesium-nitrate water having 181 parts per million of dissolved solids. The unusually high nitrate, 83 parts per million, and the relatively high chloride content, 26 parts per million, of the water from this well indicates that it probably was contaminated from surface sources. Well Ed 17, at Clinton, yields soft sodium-chloride water having only 52 parts per million of dissolved solids; well Fd 16, 1.2 miles south of T. B., yields moderately hard calcium-bicarbonate water having 265 parts per million of dissolved solids; and wells Fd 34, at Brandywine, and Ge 10, 5.5 miles southeast of Brandywine, yield soft calcium-bicarbonate water having 88 and 46 parts per million of dissolved solids, respectively.

Analyses were made of water from two wells ending in deposits of Pleistocene age. Well Dd 6, 1.6 miles west of Largo, ends in lowland deposits and yields soft calcium-sulfate water containing 91 parts per million of dissolved solids. The water from this well has a hardness of 45 parts per million, of which 43 parts is noncarbonate or "permanent" hardness. Permanent hardness of this magnitude is uncommon in the ground water of Prince Georges County, the hardness generally being of the carbonate or "temporary" type. Well Ff 5, 0.5 mile northwest of Nottingham, ends in lowland deposits bordering the Patuxent River and yields very soft calcium-nitrate water containing 78 parts per million of dissolved solids.

The iron content in the water of the Pliocene (?) and Pleistocene wells sampled ranges from 0.03 to 2 parts per million and averages 0.83; the pH ranges from 5.1 to 7.4 and averages 6.3.

RECORDS OF WELLS

Descriptions of the wells inventoried in Prince Georges County are given in table 7. The locations of the wells are shown on Plate 6.

The altitude of the land surface at the wells was taken from topographic maps having either a 10-foot or a 20-foot contour interval. A few elevations were determined by an altimeter or by hand leveling from nearby bench marks.

"Type of well" refers to the method of construction. Five types are distinguished: Drilled (includes cable-tool and rotary methods), Jetted, Dug, Driven, and Bored (augered). In general, the well depths are considered to be reasonably accurate; most of the depths of drilled wells were reported by well drillers or were measured by the writer. The depths of dug wells were measured by the writer or reported by the well owner.

Wherever it was practicable, depths to water level were measured and the measurements recorded to the nearest hundredth of a foot. The depths to water level in many wells were reported by drillers and well owners As most wells are not tested for their maximum capacity, most of the yields given are less than the maximum rate at which the wells can be pumped.

The measurement of the temperature of water from most of the wells shows only the approximate temperature of the ground water, for most of the temperature measurements were made on wells that have small yields or that were pumped only for a short time.

Static water level: Reported depths are designated by "a."Water levels above land surface are recorded under "Remarks."
Pumping equipment: Method of lift: B, bucket; C, cylinder; I, impeller (either turbine or centrifugal).
Type of power: J, jet; E, electric motor; G, gasoline engine; H, hand; N, none; W, windmill.
Use of water: C, commercial or institutional; D, domestic; F, farming; N, not used or destroyed; P, public supply; S, school.

TABLE

Records of Wells in

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Ad 1	Thomas B. Connell	Derflinger	1946	310	Drilled	164	6	None	Pre-Cambrian rocks
Ad 2	W. L. Faust	do	1947	326	do	220	6	do	do
Ad 3	R. J. Johnson	do	1946	219	do	75	6	do	Patuxent
Ad 4	E. Whistler	do	1947	210	do	212	6	do	Pre-Cambrian rocks
Ad 5	R. H. Whitehead	do	1947	210	do	253	6	do	do
Ad 6	Harold H. Harding	Rogers	1947	260	do	70	6	—	do
Ad 7	C. B. Spence	Derflinger	1947	270	do	102	6	None	do
Ad 8	Francis Gosnell	—	Before 1850	179	Dug	35	48	—	Patuxent
Ad 9	J. F. Hance	—	—	160	do	34	48	—	do
Ad 10	W. H. Kelley	Robinson	1904	400	Drilled	70	4	—	do
Ad 11	C. Robey	—	Old	347	Dug	56	60	—	do
Ad 12	Alexander Groves	—	1947	414	do	27	30	—	do
Ad 13	Mr. Collier	Green (or Greene)	1951	298	Drilled	100	6	—	Pre-Cambrian rocks
Ad 14	Russell Paul	Derflinger	1950	196	do	130	6	None	Patuxent and Pre-Cambrian rocks
Ad 15	George Hall	—	1928	192	Dug	42	36–24	—	Patuxent
Bc 1	W. C. Beach	Derflinger	1947	325	Drilled	308	6	None	Pre-Cambrian rocks
Bc 2	John Hottenstein, Jr.	do	1946	250	do	184	6	do	do
Bc 3	Claude E. Derflinger	do	1946	235	do	124	6	do	Patuxent
Bc 4	Oscar Zook	do	1948	255	do	248	6	do	Pre-Cambrian rocks
Bc 5	G. A. Wills	do	1948	284	do	163	6	do	Patuxent
Bc 6	William Schulze	Giles	About 1939	245	Dug	70	48	—	do
Bc 7	Washington Memorial Cemetery	Van Hoy	1932	200	Drilled	400	8	—	Pre-Cambrian rocks
Bc 8	William L. Spicknall	Derflinger	1948	255	do	271	6	None	do
Bc 9	F. B. Morgan	do	1946	185	do	123	6	do	do
Bc 10	W. D. Normandy	do	1947	315	do	110	6	do	Patuxent
Bc 11	Mr. Rhine	Harper	1936	160	Dug	28	—	—	Pre-Cambrian rocks

Prince Georges County

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date		Gallons a minute	Date				
57.70		Nov. 4, 1948	C, H	10	Sept. 9, 1946	0.2	D	52	See well log.
	121.5[a]	Sept. 9, 1946							
60.64		Nov. 4, 1948	C, E	3	July 15, 1947	0.03	D	—	Do.
	190[a]	July 15, 1947							
35[a]		June 21, 1946	I, E	18	June 21, 1946	3.6	D	—	Do.
43.27		Nov. 20, 1951							
	40[a]	June 21, 1946							
53.47		Nov. 4, 1948	C, E	3	Apr. 30, 1947	0.1	D	—	See well log. Water reported soft.
	110[a]	Apr. 30, 1947							
67.71		Nov. 17, 1948	J, E	5	Dec. 3, 1947	0.03	D	—	See well log. Originally 90 ft. deep; deepened because of low yield.
	230[a]	Dec. 3, 1947							
12.9	—	Dec. 7, 1948	J, E	3	Oct. 23, 1947	—	C	—	See well log.
14.0		Dec. 10, 1948	C, H	6	Oct. 8, 1947	0.1	D	—	Do.
	90[a]	Oct. 8, 1947							
11.59	—	Feb. 9, 1949	N	—	—	—	N	—	Observation well.
27.80	—	Sept. 7, 1949	J, E	—	—	—	D	—	
—	—	—	N	—	—	—	N	—	See well log. Exact location unknown.
34.37	—	Oct. 20, 1949	J, E	1.1	Old	—	D	—	
19.70	—	Oct. 20, 1949	J, E; C, H	—	—	—	D	—	
13.13	—	Nov. 16, 1951	C, H	—	—	—	D	—	
29.47		Nov. 20, 1951	C, H	2	June 1950	0.02	D	—	See well log.
	120[a]	June 1950							
35.20	—	Nov. 21, 1951	C, E	—	—	—	D	—	Originally 32 ft. deep; deepened because of low yield.
93.50		Nov. 9, 1948	C, E	5	Sept. 25, 1947	0.03	D	—	See well log and chemical analysis. Water reported to taste "irony."
	250[a]	Sept. 25, 1947							
30[a]		Nov. 4, 1946	C, E	5	Nov. 4, 1946	0.1	D	—	See well log.
80.2		Nov. 9, 1948							
	80[a]	Nov. 4, 1946							
96.5		Nov. 17, 1948	J, E	20	Aug. 28, 1946	5.0	D	—	Do.
	102[a]	Aug. 28, 1946							
57.4		Nov. 26, 1948	N	10	May 8, 1948	0.1	D	—	Do.
	219[a]	May 8, 1948							
92[a]		Apr. 21, 1948	C, E	11	Apr. 21, 1948	0.3	D	—	See well log and chemical analysis.
136.9		Nov. 29, 1948							
	133[a]	Apr. 21, 1948							
66.0	—	Dec. 27, 1948	J, E	—	—	—	D	—	Low yield reported.
57±	—	Dec. 27, 1948	C, N	—	—	—	N	—	
100.00	271[a]	Nov. 26, 1948	C, E	0.7	Nov. 26, 1948	—	D, F	—	See well log. Depth of pump, 265 ft.
25[a]	60[a]	Aug. 3, 1946	J, E	7	Aug. 3, 1946	0.2	D	—	See well log.
70[a]	80[a]	Aug. 12, 1947	C, H	10	Aug. 12, 1947	1.0	D	47.5	See well log and chemical analysis.
12.10	—	July 6, 1949	C, H	—	—	—	N	—	Using Washington Suburban Sanitary District water.

TABLE

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Bd 1	F. C. Ross	Derflinger	1946	175	Drilled	89	6	None	Patuxent
Bd 2	H. B. Persinger	do	1947	110	do	65	6	do	do
Bd 3	Paul R. Shipley	Rogers	1946	180	do	107	6	—	do
Bd 4	Greenbelt Consumers' Service	Washington Pump & Well Co.	1947	155	do	396	8–6	See remarks	do
Bd 5	D. W. King	Derflinger	1946	175	do	85	6	None	do
Bd 6	Alonzo Gross	do	1947	170	do	79	6	do	do
Bd 7	Oscar Carry	do	1946	157	do	92	6	do	do
Bd 8	James Taylor	do	1946	210	do	145	6	do	do
Bd 9	C. P. Llewellyn	do	1946	209	do	79	6	do	do
Bd 10	New Beltsville School	Washington Pump & Well Co.	1940	185	do	98	6	See remarks	do
Bd 11	Old Beltsville School	do	1939	125	do	93	6	do	do
Bd 12	Bryan P. Warren	—	1941	140	Dug	38	—	—	Pleistocene deposit
Bd 13	Chateau Le Paradis	William Strothoff Co., Inc.	1925	180	Drilled	465	8	—	Pre-Cambrian rock
Bd 14	Beltsville Agricultural Research Center	do	1931	150	do	304	8	See remarks	Patuxent and Pre-Cambrian rocks
Bd 15	Do	Columbia Well Drilling Co.	1934	116	do	250	8	147–167	do
Bd 16	Do	Virginia Machinery & Well Co., Inc.	1925	125	do	600	8	165–185	Patuxent
Bd 17	Do	William Strothoff Co., Inc.	1931	124	do	251	8	72–90	Patuxent and Pre-Cambrian rocks
Bd 18	Do	Washington Pump & Well Co.	1934	125	do	363	6	156–172 214–220 226–231	do
Bd 19	Do	do	1937	125	do	197	6	—	Patuxent
Bd 20	Do	Columbia Pump & Well Co.	1911	130	do	323	8–6	—	do
Bd 21	Do	Washington Pump & Well Co.	1934	153	do	425	6	160–190 235–265	Patuxent and Pre-Cambrian rocks
Bd 22	Do	do	1934	150	do	262	6(?)	—	Patuxent
Bd 23	Do	do	1932	190	do	221	6(?)	—	do
Bd 24	Do	do	1932	155	do	82	6(?)	—	Patapsco
Bd 25	Do	Kohl Bros.	1938	162	do	180	6	157–176	Patuxent
Bd 26	Do	Kohl Bros. and Sydnor Pump & Well Co.	1938 & 1939	120	do	367 or 369	6	—	do

—*Continued*

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date		Gallons a mintue	Date				
37[a]		Oct. 7, 1946	C, E	15	Oct. 7, 1946	1.9	D	54.5	See well log.
60.45		June 24, 1948							
	45[a]	Oct. 7, 1946							
8.00		June 24, 1948	N	10	July 22, 1947	2.0	D	—	Do.
	40[a]	July 22, 1947							
19[a]	—	Aug. 14, 1946	N	21	Aug. 10, 1946	—	D	—	Do.
70[a]	150[a]	Aug. 21, 1947	I, E	250	Aug. 21, 1947	3.1	C	—	See well log and chemical analysis. 15 ft. of screen used; position unknown.
35[a]	40[a]	Sept. 30, 1946	C, E	15	Sept. 30, 1946	3.0	D	—	See well log.
54[a]	65[a]	Sept. 10, 1947	C, E	7	Sept. 10, 1947	0.6	D	—	Do.
13.95		Nov. 15, 1951	I, E	25	June 7, 1946	5.0	D	—	Do.
	25[a]	June 7, 1946							
80[a]	85[a]	Nov. 30, 1946	J, E	20	Nov. 30, 1946	4.0	D	—	Do.
39.80		Nov. 15, 1951	I, E	20	June 13, 1946	6.6	D	—	See well log. Water reported "irony."
	42[a]	June 13, 1946							
55.43		Dec. 6, 1948	N	20	March 1940	0.6	N	—	8 ft. of screen used; position unknown. Using Washington Suburban Sanitary District water.
	90[a]	March 1940							
26[a]	58[a]	1939	N	20	1939	0.6	N	—	See well log. 8 ft. of screen used; position unknown. Using Washington Suburban Sanitary District water.
27.00	—	Dec. 10, 1948		—	—	—	D	—	
54±	—	Dec. 10, 1948	C, E	½	1925	—	N	—	See well log.
30[a]	180[a]	May 1931	N	19	May 1931	0.1	N	—	See well log. 20 ft. of screen used; position unknown. Well is covered.
16[a]	130[a]	1934	I, E	110	1934	0.9	F, D	—	See well log.
15[a]		Nov. 1925	I, E	60	Nov. 1925	8.6	F, D	—	See well log. Backfilled to 185 ft. in 1945.
18.60		Nov. 23, 1951							
	22[a]	Nov. 1925		80	Apr. 16, 1945	5.3	F, D	—	
22.45		Nov. 20, 1951	N	20	June 1931	0.6	N	—	See well log. Reported to have failed from overpumping. Observation well.
	55[a]	June 1931							
45[a]	155[a]	1934	I, E	47	1934	0.4	N	—	See well log and chemical analysis.
35[a]	170[a]	1937	I, E	100	1937	0.7	F, D	56	Do.
46.97		Nov. 23, 1951	N	70	1911	0.5	N	—	See well log.
	1.80[a]	1911							
57.65		Nov. 23, 1951	I, E	100	1934	1.1	F, D	—	Do.
	145[a]	1934							
65[a]	150[a]	1934	N	60	1934	0.7	N	—	See well log and chemical analysis. Well is covered.
—	—	—	N	60	1932	—	N	—	See well log. Well is covered.
—	—	—	N	10	1932	—	N	—	Do.
41.7		Dec. 22, 1948	I, E	73	1938	0.9	F, D	—	See well log.
	119[a]	1938							
	55.83	Nov. 23, 1951							
13.88	—	Nov. 27, 1951	N	80(?)	—	—	F, D	—	See well log and chemical analysis. Pump setting, 115 ft.

TABLE 7

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Bd 27	Beltsville Agricultural Research Center	Washington Pump & Well Co.	1939	145	Drilled	255	6	230½–252	Patuxent
Bd 28	Do	do	1939	162	do	167	6	124½–167	do
Bd 29	Do	Sydnor Pump & Well Co.	1939	120	do	232	8–6	204–220	do
Bd 30	Do	Washington Pump & Well Co.	1937	155	do	310	8	—	do
Bd 31	Do	Sydnor Pump & Well Co.	1939	125	do	185	8	166½–183	do
Bd 32	Mineral Pigments Corp.	Brown	About 1943	170	do	100±	8	—	do
Bd 33	Do	Columbia Pump & Well Co.	1947	170	do	100	8	62–69	do
Bd 34	A. J. Auth Co.	—	1940	160	do	90	8	—	do
Bd 35	Washington Brick Corp.	—	1940	160	do	80	—	—	do
Bd 36	Maurice Kiddy	Derflinger	1948	210	do	103	6	None	do
Bd 37	George E. Derflinger	do	1949	200	do	112	6	do	do
Bd 38	Berwyn Gun Club	do	1949	240	do	86	6	do	do
Bd 39	J. A. Weems	do	1949	219	do	141	6	—	do
Bd 40	Washington Tourist Court	—	About 1931	144	do	76	6	—	do
Bd 41	H. Burrhus	Derflinger	1949	270	do	76	6	None	do
Be 1	Jacob H. Gichner	do	1948	110	do	102	6	92–102(?)	Patapsco
Be 2	State Teachers College	Washington Pump & Well Co.	1943	102	do	380	—	—	Patuxent
Be 3	Do	—	1920	105	do	360	—	—	do
Be 4	Do	—	Before 1934	103	do	176.5	—	—	Patapsco
Be 5	Beltsville Agricultural Research Center	J. E. Greiner Co.	1942	174	do	417	8–6	403–417	Patuxent
Be 6	Do	Washington Pump & Well Co.	1934	177	do	430	8–6	—	do
Be 7	Do	Sydnor Pump & Well Co.	1939	155	do	381	8–6	364–380	do
Be 8	Patuxent Research Refuge	Layne-Atlantic Co.	1940	165	do	302	10	240–245 280–295	do
Be 9	Do	—	—	130	Dug	50	—	—	Arundel clay
Be 10	Bowie School	Washington Pump & Well Co.	1942	170	Drilled	377	6	—	Patuxent
Be 11	Mrs. Clara V. Lee	Smith	1946	170	do	186	6	None	Patapsco
Be 12	Dr. Cox	Columbia Pump & Well Co.	1942	220	do	184	—	—	do
Be 13	Mrs. Mary Williams	Read	1949	210	Dug	23	30	—	do
Be 14	Beltsville Agricultural Research Center	Layne-Atlantic Co.	1950	155	Drilled	115.3	4–2	106½–111½	do

—Continued

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date		Gallons a minute	Date				
55[a]	164[a]	1939	I, E	120	1939	1.1	F, D	55	See well log.
49.24		Nov. 23, 1951	I, E	165	1939	3.1	F, D	—	Do.
	105[a]	1939							
20.12	—	Nov. 23, 1951	I, E	—	—	—	F, D	56	See well log and chemical analysis.
66.61	—	Nov. 23, 1951	N	125	1937	—	N	—	Do.
15[a]	—	1939	I, E	—	—	—	F, D	—	Do.
8.36	—	July 31, 1949	I, E	—	—	—	N	—	Reported to have pumped sand.
9.83	62	July 31, 1949	I, E	27.2	July 31, 1949	0.5	C	57	See well log. Pump setting, 75 ft.
9[a]	—	Apr. 7, 1949	J, E	—	—	—	C	—	
—	—	—	N	—	—	—	N	—	Reported to have pumped sand. Well is covered by cement floor.
50[a]	70[a]	Mar. 30, 1948	J(?), E	18	Mar. 30, 1948	0.9	D	—	See well log.
69.30	—	Nov. 15, 1951	N	20	Feb. 15, 1949	2.2	D	—	Do.
40[a]	67[a]	Apr. 15, 1949	I, E	23	Apr. 15, 1949	0.9	C	—	Do.
95.10		June 30, 1949	C, E	22	June 27, 1949	2.7	D	—	Do.
	106[a]	June 27, 1949							
24.88	—	Nov. 21, 1951	N	—	—	—	N	—	Using Washington Suburban Sanitary District water.
55[a]	58[a]	Oct. 19, 1949	C, E	—	—	—	D	—	See well log.
18.70		Dec. 10, 1951	J, E	15	Feb. 19, 1948	0.3	C	56	See well log. Water reported to be high in iron and corrosive.
	72[a]	Feb. 19, 1948							
39.0		Nov. 27, 1951	I, E	100	May 17, 1943	1.3	S	—	See well log and chemical analysis.
	110[a]	May 17, 1943							
—	—	—	N	—	—	—	N	—	"No water" reported. Exact location unknown.
45.40	—	Nov. 27, 1951	I, E	40	Before 1934	—	N	—	See chemical analysis. Clayey and sandy water reported.
80[a]	90-92[a]	Nov. 1, 1942	N	55	Nov. 1, 1942	5.0	N	—	See well log and chemical analysis. Well is covered.
94.90		Dec. 12, 1951	I, E	80	1934	0.7	F, D	54.5	See well log and chemical analysis.
	215[a]	1934							
48.2	—	Dec. 22, 1948	N	—	—	—	N	—	See well log and chemical analysis. Well is covered.
60[a]	83[a]	Mar. 12, 1940	I, E	125	Mar. 12, 1940	5.4	C, D	—	See chemical analysis.
8.48	—	Feb. 9, 1949	C, E	—	—	—	D	—	
70[a]	120[a]	Aug. 4, 1942	I, E	17	Aug. 4, 1942	2.0	S	—	See well log.
53[a]	—	Jan. 15, 1946	C, H	—	—	—	D	—	See well log. Water reported to taste "irony."
107.03	—	Dec. 12, 1951	N	—	—	—	N	—	Yielded muddy water.
21.53	—	July 2, 1949	N	—	—	—	D	—	
42.51	—	Dec. 10, 1951	J, E	22	Dec. 10, 1951	—	D	—	See well log. Water reported "irony" and acidic.

TABLE

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Cc 1	Mrs. Elbertie Foudray	Smith	1946	170	Drilled	303	6	None	Patuxent
Cc 2	Mr. Aiton	Washington Pump & Well Co.	1941	150	do	135	—	—	Patuxent and Pre-Cambrian rocks
Cc 3	Southern Oxygen Co., Inc.	do	1942	18	do	162	6	—	Patuxent
Cc 4	Do	do	1942	32	do	165±	6	—	do
Cc 5	Washington Suburban Gas Co.	Layne-Atlantic Co.	1945	18	do	162	10–8	120–150	do
Cc 6	Robert Parlett	Washington Pump & Well Co.	1946	128	do	120	6	None	do
Cc 7	Engineering and Research Corp.	do	1939	50	do	71	8	—	do
Cc 8	Do	do	1940–42	50	do	280	8	—	do
Cc 9	Do	do	—	50	do	174	8	—	do
Cc 10	Mr. Pumphrey	—	—	160	Dug	34	48	—	do
Cc 11	Gregg Estate	—	Before 1924	80	Drilled	53	6	—	Pre-Cambrian rocks
Cc 12	W. F. Bladen	—	—	120	Dug	15.7	30	—	Patuxent
Cc 13	George Brown	Derflinger	1949	170	Drilled	145	6	None	Pre-Cambrian rocks
Cc 14	Town of Hyattsville	Shannahan or Downing	1900	20	do	242	8, 6, or 2	—	Patuxent
Cc 15	Do	do	1900	20	do	242	10 or 8	—	do
Cc 16	Do	Shannahan	1905	20	do	247	6	222–240	do
Cc 17	Do	do	1905	20	do	108	6	—	do
Cc 18	Do	Shannahan or Downing	1900	20	do	250	8, 6, or 2	—	do
Cc 19	Do	do	1900	20	do	242	8, 6, or 2	—	do
Cc 20	William M. Lewin	—	Before 1915	30	do	206	—	—	do
Cc 21	A. & N. Hot Shoppe	Washington Pump & Well Co.	1940	50	do	242	—	—	do
Cc 22	University of Maryland	—	1916	65	do	154	—	—	Patuxent and Pre-Cambrian rocks
Cc 23	Do	—	Before 1918	145	do	284	—	—	Patuxent
Cc 24	Do	—	Before 1918	—	do	227	6	—	Patuxent and Pre-Cambrian rocks
Cc 25	Do	—	Before 1896	—	do	150	4	—	Patuxent
Cc 26	Mr. Bright	Lee	About 1935	30	Dug	10	—	—	Pleistocene deposits

—Continued

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date		Gallons a minute	Date				
179(?)	—	Nov. 8, 1948	C, E	—	—	—	D	—	See well log. Water reported to taste "irony."
60[a]	80[a]	1941	J, E	8	1941	0.4	D	—	See well log. Water reported to be acidic and yellowish.
9.65	120[a]	Oct. 21, 1949	N	58	1942	0.6	N	59.5	See well log. Water reported to be "irony." Observation well. Using Washington Suburban Sanitary District water.
23.44	—	Apr. 25, 1951	N	—	—	—	N	—	
See remarks	71±[a]	Aug. 13, 1951 Nov. 9, 1945	N	300	Nov. 9, 1945	5.3	N	55.5	See well log. Static water level 5.46 ft. above land surface.
106.38	112[a]	Nov. 21, 1951 Mar. 7, 1946	N	10	Mar. 7, 1946	0.7	D	—	See well log. Water reported to taste "irony."
35[a]	120[a]	1939	I, E	125	1939	1.4	N	—	See well log. Collapsed screen.
—	—	—	I, E	—	—	—	C	—	Reportedly drilled to bedrock. Air-conditioning well.
—	135[a]	—	N	110	—	—	N		See well log. Covered by cement floor.
29.03	—	July 5, 1949	C, E	—	—	—	D	—	
20.88	—	July 5, 1949	N	—	—	—	N	—	Drilled through bottom of 15-ft. dug well.
7.74	—	Mar. 22, 1949	C, H	—	—	—	D	—	
14[a]	140[a]	July 18, 1949	J, E	0.8	July 18, 1949	—	D	—	See well log.
See remarks	—	1908	N	—	—	—	N	—	Slight flow reported.
do	—	Sept. 15, 1949	N	—	—	—	N	—	Observation well during 1940–41. Static water level above land surface.
do	—	October 1905	N	44	October 1905	—	N	—	See well log. Reported static water level 15 ft. above land surface. Water reported high in iron.
do	—	August 1905	N	24	August 1905	—	N	—	Reported static water level 5 ft. above land surface. Water reported high in iron.
do	—	1908	N	40	1900	—	N	—	Slight flow reported.
do	—	1908	N	—	—	—	N	—	Slight flow reported. Principal supply reported from 212–242 ft.
15[a]	—	Before 1918	—	—	—	—	—	—	See well log. Exact location unknown.
—	—	—	—	—	—	—	C	—	See well log. Air-conditioning well.
—	—	—	N	—	—	—	N	—	Penetrated "green rock" from 128½–154 ft.
—	—	—	N	—	—	—	N	—	See well log.
—	—	—	N	1.5	Before 1918	—	N	—	Principal supply reported from 96 ft. Water reported soft. Exact location unknown.
—	—	—	N	5	Before 1896	—	N	—	Water reported "irony." Exact location unknown.
—	—	—	(?), E	—	—	—	C	—	

TABLE 7

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Cc 27	Washington Suburban Gas Co.	—	1934	35	Drilled	68	—	—	Patuxent
Cc 28	George Lee	Lee	About 1925	30	Dug	13	36	—	Pleistocene deposits
Cc 29	R. A. Barrett	—	1910	45	do	—	—	—	do
Cd 1	Mrs. Esther Dodge	Washington Pump & Well Co.	1947	190	Drilled	227	6	See remarks	Potomac group
Cd 2	M. K. Jones	do	1947	185	do	290	6	284–290	Patuxent
Cd 3	W. C. Allen	Derflinger	1947	150	do	92	6	84–92	Patapsco
Cd 4	James E. Baxter	do	1947	110	do	147	6	None	do
Cd 5	M. J. Earley	Washington Pump & Well Co.	1947	170	do	201	6	194–201	Potomac group
Cd 6	D. W. Martin	do	1931	205	do	188	6	See remarks	Patapsco
Cd 7	Al Rowell	Derflinger	1949	185	do	179	6	169–179	do
Cd 8	George C. Howard	—	1945	180	do	175	6	—	do
Cd 9	St. Joseph Church	Washington Pump & Well Co.	1946	140	do	185	6	175–185	do
Cd 10	Village of Glenarden	—	Before 1940	160	Dug	34.5	36	—	do
Cd 11	S. C. Harris	—	—	145	do	21.5	48	—	do
Cd 12	Mrs. Miles	Green	1929	160	do	23.6	48	—	do
Cd 13	R. G. Dodson	Brown	1948	110	do	20	48	—	do
Cd 14	Lincoln School	—	—	130	do	20	—	—	do
Cd 15	Ardmore School	—	—	160	do	16	—	—	Aquia greensand (?)
Ce 1	J. K. Williams	Derflinger	1947	160	Drilled	78	6	None	Patapsco
Ce 2	C. Bluett	do	1947	160	do	114	6	do	do
Ce 3	Frank E. Brown	Washington Pump & Well Co.	1948	165	do	130	6	—	do
Ce 4	Mitchellville Holy Family Church	do	1942	140	do	245	6	—	do
Ce 5	Rectory, Collington	Local labor	1934	140	Dug	30	42	—	Brightseat and/or Monmouth
Ce 6	Mrs. Baker	—	1947	145	do	23	—	—	Aquia greensand, or Brightseat and/or Monmouth
Ce 7	A. C. Waescher	Local labor	1909	150	do	20	—	—	Aquia greensand
Ce 8	Herbert Ball	—	1900	150	do	42	72	—	do
Ce 9	Adolph Rodenhauser	—	Before 1907	160	do	17	36	—	do
Ce 10	George T. Arnold	Scott	1887	160	do	25	42	—	do

—Continued

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date		Gallons a minute	Date				
—	—	—	N	—	—	—	N	—	See well log. Well is covered.
3[a]	—	1950	C, H	—	—	—	D	—	
—	—	—	C, H	—	—	—	N	—	Using Washington Suburban Sanitary District water.
145[a]	154[a]	Feb. 3, 1947	C, (?)	10	Feb. 3, 1947	1.1	D	57	See well log. 6 ft. of screen used; position unknown.
120[a]	185[a]	Oct. 15, 1947	C, E	20	Oct. 15, 1947	0.3	D	—	See well log and chemical analysis.
45.42	 60[a]	Dec. 1, 1948 Apr. 19, 1947	C, E	10	Apr. 19, 1947	0.3	D	—	See well log.
87[a]	90[a]	Mar. 14, 1947	J, E	10	Mar. 14, 1947	3.3	C	—	See well log. High iron content and poor yield reported.
90[a]	139[a]	Aug. 12, 1947	—	10	Aug. 12, 1947	0.2	D	—	See well log. High iron content reported.
—	—	—	C, E	40	1931	—	D	—	Water reported "irony." 8 ft. of screen used; position unknown.
59.41	 130[a]	May 6, 1949 Jan. 3, 1949	C, E	8	Jan. 3, 1949	0.1	D	55	See well log and chemical analysis.
70±	—	May 6, 1949	C, E	—	—	—	D	—	Well casing coated with iron-oxide slime.
75[a]	140[a]	Jan. 1, 1946	J, E	30	Jan. 1, 1946	0.5	D	—	See well log.
32.2	—	June 30, 1949	N	—	—	—	N	—	Water reported to be high in iron.
15.6	—	June 30, 1949	B, H	—	—	—	D	—	
20.2	—	June 30, 1949	B, H	—	—	—	D	—	Originally 15 ft. deep; deepened in 1930 because of low yield.
14.5	—	June 30, 1949	C, H	—	—	—	D	—	
—	—	—	—	4	—	—	S	—	
—	—	—	—	1	—	—	S	—	
43[a]	53[a]	July 5, 1947	J, E	10	July 5, 1947	1.0	D	—	See well log. Water reported high in iron.
36.24	 55[a]	Nov. 17, 1948 Aug. 2, 1947	J, E	10	Aug. 2, 1947	2.0	D	—	Do.
79.04	 102[a]	Nov. 17, 1948 Aug. 2, 1948	J, E	10	Aug. 2, 1948	0.7	D	—	See well log.
See remarks	—	1942	I, E	—	—	—	D	—	Reported to pump white clay with water. Soft water reported. Static water level reported above land surface.
—	—	—	—	4	—	—	D	—	Water reported hard.
14.0	—	June 30, 1949	C, H	—	—	—	D	—	
16.5[a]	—	—	C, E	—	—	—	D	—	Water reported high in iron.
31.7	—	Sept. 2, 1949	J, E	—	—	—	F, D	—	Do.
14.59	—	Sept. 2, 1949	J, E	—	—	—	F, D	—	Poor yield during winters reported.
15–17[a]	—	—	C, H	—	—	—	D	—	Water reported high in iron.

TABLE 7

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Ce 11	Collington School	—	—	150	Dug	26	36	—	Aquia greensand
Ce 12	Mr. Brady	—	Before 1931	150	do	32	—	—	Brightseat and/or Monmouth
Ce 13	Glenn Dale Sanitorium	Virginia Machinery & Well Co.	1932–33	160	Drilled	798	10–4½	—	Patapsco
Ce 14	Do	do	1934	160	do	316	20–8	—	do
Ce 15	Fred Dearstein	Shade	1941	140	Dug	15.5	48	—	do
Ce 16	Glenn Dale Sanitorium	Virginia Machinery & Well Co.	1938	145	Drilled	946	—	—	Patapsco and Patuxent
Ce 17	Newton H. White	Sydnor Pump & Well Co.	1939	170	do	118	6	106–112	Magothy
Ce 18	Do	do	1939	140	do	464	6–4	449½–460	Patapsco
Ce 19	Do	—	Before 1900	130	Dug	28	48	—	Aquia greensand
Ce 20	Glenn Dale School	—	—	155	do	17	36	—	Patapsco
Ce 21	Collington School	—	—	200	do	26	—	—	Aquia greensand
Ce 22	R. W. Baird	Derflinger	1950	140	Drilled	100	6	See remarks	Patapsco
Ce 23	Robert(?) O'Neil	—	1947	160	do	55	6	—	do
Ce 24	Glenn Dale School	Washington Pump & Well Co.	1950	155	do	203	6	198–203	do
Cf 1	Chaney Lumber Co.	do	1947	35	do	105	6	See remarks	do
Cf 2	Mitchellville School	do	—	110	do	171	—	—	Magothy
Cf 3	William Woodward	do	About 1920	180	do	230±	6	—	Patapsco
Cf 4	Do	do	1946	130	do	270	6	264–270	do
Cf 5	Do	—	1930	204	do	207±	8	—	do
Cf 6	Do	—	1930	150	do	207±	6	—	do
Cf 7	Do	—	1949	150	Dug	22	48	—	Aquia greensand
Cf 8	H. J. Wilson	Grommer	1941	120	do	13	48	—	Brightseat and/or Monmouth
Cf 9	Richard H. Slingluff	—	1935	130	do	39	42	—	Aquia greensand
Cf 10	L. Simmons	—	—	160	do	47	48	—	Aquia greensand, or Brightseat and/or Monmouth
Cf 11	Morris Suit	—	Before 1940	130	do	23	42	—	Aquia greensand
Cf 12	Walker Pontiac Sales	—	1948	110	do	24.5	48	—	do
Cf 13	Sacred Heart Church	Thomas	1938	160	do	50	—	—	Brightseat and/or Monmouth

—*Continued*

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date		Gallons a minute	Date				
16.40	—	Sept. 2, 1949	C, H	—	—	—	S	—	
24–25[a]	—	—	C, H	—	—	—	D	—	
100[a]	115[a]	1933	N	50	1933	3.3	N	—	See well log. Well is covered. Using Washington Suburban Sanitary District water.
77.52		Dec. 13, 1951	I, E	65–70	Jan. 31, 1934	8.5	N	—	
	87[a]	Jan. 31, 1934							
10.14	—	Apr. 26, 1951	C, E	—	—	—	D	—	
71.80	—	Dec. 6, 1948	N	—	—	—	N	—	See well log and chemical analysis. Test hole; covered.
85[a]	—	1939	I, E	30	1939	—	D	59	See well log and chemical analysis. Well screen reported to clog frequently.
93[a]	113[a]	1939	I, E	45	1949	2.3	F, D	57.5	See well log and chemical analysis. Pump setting, 170 ft.
8.02	—	Nov. 4, 1949	C, H	—	—	—	F, D	—	
—	—	—	N	1	—	—	N	—	
—	—	—	C, H	2	—	—	S	—	
—	—	—	J, E	—	—	—	D	—	See well log. Water reported "irony." Screen used; position unknown.
19.33	—	April 26, 1951	C, H	—	—	—	N	—	Water reported cloudy.
42.53		Dec. 12, 1951	I, E	30	Nov. 8, 1950	0.3	S	—	See well log. Water reported to taste "irony."
	160[a]	Nov. 8, 1950							
5.74	—	Oct. 28, 1948	C, H	10	Sept. 10, 1947	—	C	—	See well log and chemical analysis. 5 ft. of screen used; position unknown.
60[a]	—	—	I, E	—	—	—	N	57	See well log and chemical analysis.
110.89	—	Mar. 30, 1949	C, G	—	—	—	F	50.5	Water reported to have disagreeable taste and high iron content.
33.81		Mar. 30, 1949	C, G	15	Oct. 7, 1946	0.5	D	—	See well log. Water reported to have high iron content.
	70[a]	Oct. 7, 1946							
69.26	—	Mar. 30, 1949	N	—	—	—	N	—	Water reported to be corrosive and high in iron content.
87.10	—	Mar. 30, 1949	C, E	—	—	—	F	—	Water reported to be corrosive, high in iron content, and to have a disagreeable taste. Casing coated with iron-oxide slime.
8.20	—	Mar. 30, 1949	B, H	—	—	—	D	—	
8[a]	—	Apr. 25, 1949	C, H	—	—	—	D	—	
24.75	—	Apr. 25, 1949	C, H	—	—	—	F, D	—	Eight other dug wells on property, depths 18–40 ft.
36.17	—	Apr. 25, 1949	J, E; C, H	—	—	—	D	—	
14.34	—	Apr. 25, 1949	C, H	—	—	—	D	55	See chemical analysis.
16.68	—	Apr. 25, 1949	I, E	—	—	—	C, D	—	
42.47	—	Aug. 2, 1949	C, E; C, H	—	—	—	D	—	Water reported high in iron.

TABLE 7

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Cf 14	H. E. Brewer	—	—	110	Dug	29	48	—	Magothy
Cf 15	Bowie Inn	—	1939	160	do	39	48	—	Aquia greensand
Cf 16	Do	—	1947	160	do	39	48	—	do
Cf 17	Mrs. J. W. Heim	Heim	1930	130	do	39	—	—	do
Cf 18	J. H. Garner	—	—	120	do	15	48	—	do
Cf 19	John Thomas	—	—	150	do	46	48	—	do
Cf 20	Mr. Harmel	—	Before 1930	130	do	18–20	48	—	do
Cf 21	A. B. Poula	Local labor	1914	115	do	20	42	—	Pleistocene deposits and Aquia greensand
Cf 22	Do	do	1944	110	do	16	36	—	do
Cf 23	Adolph Entzian	—	1885	110	do	39.5	60	—	Nanjemoy or Aquia greensand
Cf 24	Archer Brady	—	—	100	do	18	48	—	Aquia greensand
Cf 25	Mitchellville School	Washington Pump & Well Co.	1950	110	Drilled	398	6	392–398	Patapsco
Cf 26	Bowie Inn	Bunker	1950	160	do	143	5	136–141	Magothy
Dc 1	C. L. Jenkins & Sons	L. R. Bee & Co.	1924	290	do	365	6	—	Patapsco
Dc 2	H. Witt	Local labor	1911	280	Dug	30	48	—	Pliocene (?) deposits
Dc 3	Chesapeake & Potomac Tel. Co.	Washington Pump & Well Co.	About 1941	293	Drilled	388	6	See remarks	Patapsco
Dc 4	Colebrooke Development	do	1941	280	do	620	8–6	do	do
Dc 5	Joseph I. Baden	do	1939	180	do	165	6	do	Magothy (?)
Dc 6	Harrison Nursery	—	Before 1940	285	do	106	8	—	do
Dc 7	Walter Vaughan	Washington Pump & Well Co.	—	290	do	400	6	—	Patapsco
Dc 8	Ernest Gerstenberg	—	—	290	do	450	6	437–450	do
Dc 9	J. A. West	J. A. West	—	290	Dug	36	96	—	Pliocene (?) deposits
Dd 1	C. E. Summers	—	1935	165	do	48.5	—	—	Aquia greensand
Dd 2	H. Norair	Columbia Pump & Well Co.	1947	185	Drilled	377	6	367–377	Patapsco
Dd 3	Washington Suburban Sanitary District	Hagmann	1948	135	do	409	8	See remarks	Potomac group
Dd 4	Z. M. Brady	Columbia Pump & Well Co.	1945	250	do	476	6–4	do	Patapsco
Dd 5	Wall Florist	—	About 1923	150	Dug	47	—	—	Aquia greensand

—Continued

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date		Gallons a minute	Date				
9.86	—	Aug. 2, 1949	C, H	—	—	—	D	—	
27.85	—	Aug. 2, 1949	J, E	—	—	—	N	—	Well is covered.
—	—	—	J, E	—	—	—	N	—	do
28.70	—	Aug. 2, 1949	C, E	—	—	—	D	—	
7.05	—	Aug. 2, 1949	C, H	—	—	—	D	—	
32.73	—	Aug. 3, 1949	C, H	—	—	—	D	—	Water reported high in iron and corrosive.
12.05	—	Aug. 3, 1949	C, E	—	—	—	D	—	Water reported high in iron.
13.62	—	Sept. 1, 1949	I, E	—	—	—	D	—	Water reported soft.
8.98	—	Sept. 1, 1949	C, G	—	—	—	F	—	Water reported to be hard and to have a limy taste.
31.79	—	Sept. 1, 1949	C, H; W, E	—	—	—	F, D	—	
17.50	—	Sept. 1, 1949	C, H	—	—	—	F, D	—	Water reported high in iron.
100[a]	140[a]	July 12, 1950	I, E	60	July 12, 1950	0.7	S	—	See well log.
100[a]	—	July 15, 1950	J, E	5	July 15, 1950	—	C	—	Do.
199.87	205[a]	June 7, 1949 1924	N	23	1924	0.9	N	—	See well log. Water reported to be soft. Observation well. Using Washington Suburban Sanitary Commission water.
16.00	—	Dec. 6, 1948	N	—	—	—	N	—	Water reported "irony."
210[a]	350[a]	About 1941	C, E	20	About 1941	0.1	N	—	See well log. Water reported very "irony." Screen used; position unknown.
255[a]	380[a]	1941	I, E	50	1941	0.4	P	—	See well log and chemical analysis. 15 ft. of screen used; position unknown.
—	—	—	C, E	25	1939	—	N	—	10 ft. of screen used; position unknown. Using Washington Suburban Sanitary District water.
—	—	—	N	—	—	—	N	—	Observation well during 1940–41. Well is covered.
—	—	—	—	20	—	—	N	—	Exact location unknown.
—	—	—	N	5	—	—	N	—	See chemical analysis. Well is covered. Exact location unknown.
32[a]	34[a]	1919	N	10	1919	5.0	N	—	See chemical analysis.
16.87	—	Dec. 1, 1948	C, E	—	—	—	D	—	
105.71	150[a]	Mar. 10, 1949 Apr. 5, 1947	N	20	Apr. 5, 1947	1.0	N	—	See well log. Abandoned because of sandy water.
54.14	226[a]	Dec. 1, 1948 Mar. 20, 1948	I, E	25	Mar. 30, 1948	0.2	P	—	See well log. 11½ ft. of screen used; position unknown.
230[a]	—	Sept. 20, 1945	C, E	20	Sept. 20, 1945	—	D	—	See well log. Water reported high in iron. 14 ft. of screen used; position unknown.
4.70	—	Dec. 1, 1948	J, E	—	—	—	F	—	Water reported to have noticeable iron content.

TABLE 7

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Dd 6	Wall Florist	—	—	140	Dug	15.5	120±	—	Pleistocene deposits
Dd 7	J. L Watkins	—	Before 1939	165	do	30	48	—	Calvert or Aquia greensand
Dd 8	Do		Before 1939	170	do	30	48	—	do
Dd 9	E. M. Beall	Washington Pump & Well Co.	1949	170	Drilled	143	6	138–143	Magothy
Dd 10	Highland Park School	—	—	170	Dug	40	—	—	Patapsco
Dd 11	Ritchie School	—	Before 1944	190	do	18	—	—	Pleistocene deposits
Dd 12	Forestville School	—	Before 1944	270	do	25	—	—	Pliocene(?) deposits
Dd 13	Do	—	Before 1944	270	do	30	—	—	do
Dd 14	Community Institutional Church	—	Old	280	do	28	36	—	do
Dd 15	Potomac Gas and Oil Co.	—	1920	280	Drilled	1120	—	None	—
Dd 16	S. W. Lowry	Columbia Pump & Well Co.	1950	230	do	157	6	149–157	Magothy
Dd 17	West Bros. Brick Co.	Washington Pump & Well Co.	1949	50	do	214	8	202–214	Patuxent
De 1	J. McC. Miller	Local labor	About 1920	130	Dug	54	48	—	Calvert
De 2	Lee Suit	—	1934	225	do	64	—	—	Pliocene(?) deposits and Calvert
De 3	A. M. Demarr	—	1925	100	do	22	—	—	Pleistocene deposits
De 4	Ralph Powers	—	—	105	do	58±	—	—	Aquia greensand
De 5	E. M. Kolbe	—	Before 1887	120	do	29	48	—	do
De 6	Do	—	About 1926	120	do	19	48	—	do
De 7	Wallace Plotz	Plotz	1931	105	do	20	48	—	Pleistocene deposits
De 8	C. C. Barger	—	1924	70	do	22	—	—	Pleistocene deposits and Aquia greensand
De 9	Do	—	—	65	do	11	—	—	Pleistocene deposits
De 10	Mary A. Rawlings	—	—	125	do	43	42	—	Aquia greensand
De 11	Charles Brown	—	—	100	do	17	48	—	do
De 12	Roger Wood	—	—	125	do	16	42	—	do
De 13	J. L. Rawlings	—	—	160	do	17	—	—	do
De 14	Mr. Pumphrey	—	Before 1940	150	do	49	—	—	do
De 15	A. C. Waescher	—	1947	180	do	50	—	—	do
De 16	W. S. Belt	—	Before 1900	140	do	22	—	—	do
De 17	Do	—	1889	180	do	40.5	36	—	Calvert or Aquia greensand
Df 1	Dr. Bowie	Leatherbury	1948	125	Jetted	169	3	None	Aquia greensand
Df 2	Do	—	1946	145	Dug	81.5	48	—	Nanjemoy

—*Continued*

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date		Gallons a minute	Date				
4.30	—	Mar. 21, 1949	C, E	—	—	—	F	—	See chemical analysis.
17.62	—	Apr. 20, 1949	J, E; C, H	—	—	—	F	—	
8[a]	—	Apr. 20, 1949	J, E	—	—	—	D	—	
84.10		Sept. 19, 1949	J, E	20	July 12, 1949	0.5	D	—	See well log.
	120[a]	July 12, 1949							
—	—	—	N	6	—	—	N	—	Well destroyed.
—	—	—	C, H	1	—	—	N	—	
—	—	—	N	6	—	—	N	—	
—	—	—	C, H	3	—	—	S	—	
25.83	—	Oct. 10, 1949	C, H	—	—	—	D	—	
—	—	—	N	—	—	—	—	—	Oil or gas test hole. May have penetrated bedrock.
80[a]	—	February 1950	C, E	15	February 1950	—	D	—	See well log.
11.01		Jan. 3, 1951	C, E	120	Aug. 26, 1949	1.3	C	—	See well log and chemical analysis.
	110[a]	Aug. 26, 1949							
47.6	—	Dec. 6, 1948	C, H	—	—	—	D	—	Water reported hard; forms white precipitate on cooking utensils.
16.15	—	Mar. 23, 1949	C, H	—	—	—	D	—	
20[a]	—	1949	C, H	—	—	—	D	—	
19.41	—	Mar. 23, 1949	J, E	—	—	—	D	—	Water reported very high in iron.
24.14	—	Apr. 20, 1949	N	—	—	—	N	—	Reportedly went "dry" in drought of 1930.
14.22	—	Apr. 20, 1949	C, E	—	—	—	F, D	—	Water reported soft.
14.2	—	July 15, 1949	C, H	—	—	—	D	—	
—	—	—	C, E	—	—	—	D	—	Water reported hard.
See remarks	—	July 15, 1949	N	—	—	—	N	—	No water in well.
36.35	—	July 15, 1949	B, H	—	—	—	D	—	
7.40	—	July 15, 1949	C, H	—	—	—	N	—	
11.36	—	July 15, 1949	C, E	—	—	—	D	—	
5.58	—	July 15, 1949	C, H	—	—	—	D	—	Water reported high in iron.
26.19	—	July 15, 1949	C, E	—	—	—	D	—	Water reported hard; forms white precipitate on cooking utensils
39.92	—	July 22, 1949	C, H	—	—	—	D	—	7 other dug wells on property; all reported to yield adequate supplies.
8.52	—	Sept. 2, 1949	C, H	—	—	—	F, D	—	
29.09	—	Sept. 2, 1949	B, H	—	—	—	D	—	Water reported high in iron.
105[a]	—	June 26, 1948	C, E	6	June 26, 1948	—	D	—	See well log. Pump setting, 127 ft.
72.72	—	June 28, 1949	J, E	—	—	—	N	—	Poor yield reported. Observation well.

TABLE 7

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Df 3	G. N. Hamilton	—	—	190	Dug	82	—	—	Aquia greensand
Df 4	Phil's Esso Station	—	1948	120	do	21	48	—	do
Df 5	Charles F. Thorington	Rogers	1948	31	Drilled	90	5	—	do
Df 6	Lee Naselhoffer	—	1937	30	Dug	13	60	—	Pleistocene deposits
Df 7	Mr. Drumm	Montgomery	1943	150	do	35	—	—	Calvert or Aquia greensand
Df 8	Sam Harrison	—	Before 1900	140	do	33	36	—	Aquia greensand
Df 9	John Curtin	—	—	125	do	34	48	—	do
Df 10	George Buck	Local labor	1945	160	do	33	60	—	Calvert
Df 11	J. F. Bealle	—	—	135	do	65	48	—	Aquia greensand
Df 12	E . J. Bidding	Gommer	1932	100	do	43	48	—	do
Df 13	W. T. Nicholson, Jr.	Local labor	1929	110	do	32.5	48	—	do
Df 14	W. T. Nicholson	Gommer	1943	50	do	11.5	60	—	Aquia greensand or Pleistocene deposits
Df 15	Earl W. Heathcote	—	1938	90	do	28.5	60	—	Aquia greensand
Df 16	Do	Layne-Atlantic Co.	1948	90	Drilled	289	6	251–261	Magothy
Df 17	W. C. Hopkins	—	Before 1850	100	Dug	24	—	—	Aquia greensand
Df 18	Mr. Banger	—	1919	140	do	56	48	—	do
Df 19	Gardner Edelen	—	—	170	do	50.5	—	—	do
Df 20	Unknown	—	—	80	do	15	42	—	do
Df 21	Thomas E. Hayes	Washington Pump & Well Co.	1949	167	Drilled	298	6	292–298	Magothy
Df 22	Robert Allen	Purner	1950	30	Jetted	42	2	30–40	Pleistocene deposits
Eb 1	Washington Suburban Sanitary District	Layne-Atlantic Co.	1945	20	Drilled	603	18–10–8	357–377 568–588	Patuxent
Eb 2	Do	do	1946	22	do	630	20–10–8	277–282 347–352 521–526 550–560 600–605	Patapsco and Patuxent
Eb 3	Mr. R. Walters	Columbia Pump & Well Co.	1948	115	do	290	6	None	Potomac group
Eb 4	Arthur W. Kendall	do	1948	60	do	192	6	—	Patapsco
Eb 5	J. W. Green	—	Before 1919	160	Dug	23	54	—	Pleistocene deposits
Eb 6	Carter Bryan	Washington Pump & Well Co.	1950	160	Drilled	322	6	316–322	Potomac group
Eb 7	Careybrook Co.	Hagmann	1950	135	do	275	6	269–275	do
Ec 1	J. Chester Pyles	Washington Pump & Well Co.	1941	275	do	510	—	—	Patapsco

-*Continued*

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date		Gallons a minute	Date				
62[a]	—	Mar. 23, 1949	J, E; C, H	—	—	—	D	—	Reported to end in black sand.
9.51	—	Apr. 20, 1949	I, E	—	—	—	C	—	
4.38	—	Apr. 27, 1949	C, H	20	June 23, 1948	0.5	C, D	—	See well log and chemical analysis. Observation well.
4.28	—	Apr. 27, 1949	C, H	—	—	—	N	—	
31.22	—	Aug. 2, 1949	J, E	—	—	—	D	—	Water reported soft.
21.43	—	Aug. 3, 1949	B, H	—	—	—	D	—	Supplies 2 families.
23.22	—	Aug. 10, 1949	I, E	—	—	—	D	—	
28.71	—	Aug. 10, 1949	C, E	—	—	—	D	—	
9.96	—	Sept. 1, 1949	C, H	—	—	—	F, D	—	
35.31	—	Sept. 1, 1949	B, H	—	—	—	D	—	
24.04	—	Sept. 1, 1949	J, E	—	—	—	D	—	Water reported to contain noticeable amount of iron.
7.95	—	Sept. 1, 1949	C, E	—	—	—	D	—	Do.
22.40	—	Sept. 1, 1949	N	—	—	—	N	—	Do.
45[a]	—	June 1, 1948	C, E	15	June 1, 1948	—	D	—	See well log. Noticeable iron content in water reported. Pump setting, 150 ft.
—	—	—	C, E	—	—	—	D	—	Water reported to contain noticeable amount of iron.
48.48	—	Sept. 2, 1949	J, E; C, W	—	—	—	D	—	Water reported "irony" and hard.
30.47	—	Sept. 2, 1949	C, H	—	—	—	D	—	Water reported to contain noticeable amount of iron.
11.05	—	Sept. 2, 1949	B, H	—	—	—	D	—	
115.23		Sept. 21, 1949	I, E	60	Sept. 30, 1949	0.9	C	—	See well log.
	185[a]	Sept. 30, 1949							
6[a]	11[a]	Dec. 1950	J, E	6	Dec. 1950	1.2	D	—	Reportedly penetrated sand and gravel for entire depth.
93.04		Apr. 19, 1949	I, E	439	Dec. 18, 1945	1.8	P	52.5	See well log and chemical analysis. Pump setting, 337 ft. Observation well.
	337[a]	Dec. 18, 1945							
108.91		May 20, 1949	I, E	540	Sept. 10, 1946	4.4	P	—	See well log and chemical analysis. Observation well.
	224[a]	Sept. 10, 1946							
113.00		Jan. 7, 1949	C, E	10	Jan. 14, 1948	1.0	D	56	See well log and chemical analysis. Water reported to be cloudy frequently.
	121[a]	Jan. 14, 1948							
80[a]	—	June 2, 1949	J, E	—	—	—	D	—	See well log. Water reported very "irony."
20.2	—	Sept. 22, 1949	J, E	—	—	—	F, D	—	
148[a]	236[a]	July 25, 1950	C, E	60	July 1950	0.7	D	—	See well log.
120.58		Feb. 14, 1951	I, E	33	Oct. 19, 1950	0.3	P	—	Do.
	214.7[a]	Apr. 15, 1951							
250[a]	280[a]	1941	I, E	40	1941	1.3	P	—	See well log and chemical analysis.

TABLE

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Ec 2	I. P. Frohmans	Columbia Pump & Well Co.	1946	205	Drilled	327	6	See remarks	Potomac group
Ec 3	O. V. Todd	do	1947	150	do	297	6	—	Patapsco
Ec 4	Louis Singer	do	1947	195	do	330	6	None	Potomac group
Ec 5	Rosecroft Trotting and Pacing Assoc., Inc.	Washington Pump & Well Co.	1949	120	do	720	8–6	694–720	Patuxent
Ec 6	Donald Smith	—	—	260	Dug	25	42	—	Pliocene(?) deposits
Ec 7	William Farmer	Green	1948	250	do	33	36	—	do
Ec 8	Do	Columbia Pump & Well Co.	1949	250	Drilled	208	6	—	Magothy
Ec 9	John B. Ernshaw	—	—	250	Dug	21	42	—	Pliocene(?) deposits
Ec 10	Ralph E. Clark	Washington Pump & Well Co.	1946	58	Drilled	252	6	See remarks	Patapsco
Ec 11	Oxon Hill School	—	—	240	Dug	33	36	—	Pliocene(?) deposits
Ec 12	Do	—	—	240	do	42	36	—	do
Ec 13	W. H. Barnett, Jr.	Layne-Atlantic Co.	1949	250	Drilled	515	4	495½–505½	Potomac group
Ec 14	Henson Hill Water Co.	Columbia Pump & Well Co.	1949	230	do	358	6	348–358	Patapsco
Ec 15	Mr. Carnell	Johnson	1946	250	Dug	25	42	—	Pliocene(?) deposits
Ec 16	I. W. Dennison	—	1891	280	do	32	48	—	Pliocene(?) deposits and Calvert
Ec 17	Hartwell Tucker	Burch	1919	100	do	26	—	—	Aquia greensand
Ec 18	Ralph Payne	—	1947	270	do	29	42	—	Pliocene(?) deposits
Ec 19	Temple Hills Church	—	1948	270	do	23	36	—	do
Ec 20	Herbert Thom	—	1948	265	do	19	36	—	do
Ec 21	James B. Russell	—	1946	185	do	19	36	—	Calvert or Aquia greensand
Ec 22	Harry E. Lusk	—	1947	260	do	14	—	—	Pliocene(?) deposits
Ec 23	Marshall Bell	—	—	200	do	40	36	—	Aquia greensand
Ec 24	Mrs. Mary A. Slye	Columbia Pump & Well Co.	1949	240	Drilled	240	6	None	—
Ec 25	Glen Shank	Washington Pump & Well Co.	1950	255	do	312	6	299–312	Patapsco
Ec 26	Oxon Hill School	do	1950	240	do	324	6	318–324	do
Ed 1	Celeste L. Sweeney	—	1889	240	Dug	30	—	—	Pliocene(?) deposits and Calvert
Ed 2	Hopkins and Wayson	Washington Pump & Well Co.	1941	265	Drilled	497	8 or 6	—	Patapsco
Ed 3	Do	do	1949	260	do	566	8	320–340	do
Ed 4	Do	do	1946	265	do	385	8	See remarks	do
Ed 5	Surrattsville School	do	1942	230	do	375	6	do	Magothy
Ed 6	Shang Chen	do	1946	250	do	342	6	do	do

—Continued

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date		Gallons a minute	Date				
200[a]	230[a]	Apr. 18, 1946	C, E	10	Apr. 18, 1946	0.3	D	—	See well log. Water reported to contain a little iron. 10 ft. of screen used; position unknown.
109.1	—	Jan. 7, 1949	C, E	—	—	—	D	—	See well log. Water reported to contain a noticeable quantity of iron.
190[a]	—	Dec. 28, 1947	(?), E	10	Dec. 28, 1947	0.3	D	—	See well log.
63[a]	250[a]	Feb. 23, 1919	I, E	120	Feb. 23, 1949	0.6	C	—	See well log and chemical analysis.
20.61	—	May 19, 1949	J, E	—	—	—	D	—	Water reported to contain iron.
29.24	—	May 19, 1949	N	—	—	—	D	—	
166.10	—	Oct. 27, 1949	C, E	—	—	—	D	—	See well log.
17.11	—	May 19, 1949	C, H	—	—	—	F, D	—	
30.90	155[a]	June 22, 1949	N	40	Jan. 11, 1946	0.4	N	—	See well log. 11 ft. of screen; position unknown. Observation well.
15.50	—	July 14, 1949	I, E	—	—	—	S	—	
14.95	—	July 14, 1949	I, E	—	—	—	S	—	
196[a]	—	July 21, 1949	I, E	20	July 21, 1949	—	D	—	See well log. Pump setting, 232 ft.
150[a]	300[a]	July 29, 1949	I, E	20	July 29, 1949	0.1	P	—	See well log and chemical analysis.
20[a]	—	1949	J, E	—	—	—	D	—	
29.66	—	Sept. 22, 1949	J, E	—	—	—	D	—	Reportedly went "dry" during drought of 1930.
23[a]	—	1949	C, H	—	—	—	N	—	Inadequate yield and corrosive water reported.
27.11	—	Sept. 22, 1949	J, E	—	—	—	D	—	
22.05	—	Oct. 27, 1949	—		—	—	D	—	
17.80	—	Oct. 27, 1949	N	—	—	—	N	—	Poor yield reported. Using Washington Suburban Sanitary District water.
16.50	—	Oct. 27, 1949	J, E	—	—	—	D	—	
9.68	—	Oct. 27, 1949	(?), E	—	—	—	D	—	
28.00	—	May 19, 1949	B, H	—	—	—	D	—	
—	—	—	N	0	Dec. 6, 1949	—	N	—	See well log.
195[a]	231[a]	June 28, 1950	C, E	40	June 28, 1950	1.1	D	—	See well log. Pump setting, 275 ft.
207[a]	273[a]	Oct. 6, 1950	I, E	40	Oct. 6, 1950	1.6	S	—	See well log.
23.48	—	Sept. 15, 1949	C, H	—	—	—	D	—	Water reported "irony" and corrosive.
182.20		Mar. 31, 1949	I, E	60	1941	1.0	P	—	See well log and chemical analysis.
	220[a]	1941							
215[a]	301[a]	Jan. 12, 1950	I, E	78	Jan. 12, 1950	0.9	P	—	See well log.
173[a]	196[a]	June 20, 1946	I, E	50	June 20, 1946	2.2	P	59	See well log and chemical analysis; 10 ft. of screen used; position unknown.
—	215[a]	May 1942	I, E	50	May 1942	—	S	—	See well log. 15 ft. of screen used; position unknown.
40[a]	75[a]	Oct. 31, 1946	—	40	Oct. 31, 1946	1.1	D	—	See well log. 7 ft. of screen used; position unknown.

TABLE 7

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Ed 7	Shang Chen	—	—	250	Dug	24	36	—	Pliocene(?) deposits
Ed 8	Frank Kearney	Columbia Pump & Well Co.	1946	257	Drilled	350	6	See remarks	Magothy
Ed 9	Maryland Oil and Development Co.	—	1906	240	do	1511	6	None	—
Ed 10	G. S. Oursler	—	1919	225	Dug	42	42	—	Pliocene(?) deposits and Calvert
Ed 11	Do	—	—	190	do	11.5	42	—	Calvert
Ed 12	Hudson's Esso Station	—	1947	260	do	35	36	—	Pliocene(?) deposits
Ed 13	Do	Kaler	1949	260	do	39	36	—	do
Ed 14	James A. Bailey	—	1936	260	do	25	42	—	do
Ed 15	Meadows School	—	Before 1942	260	do	20	—	—	do
Ed 16	Do	—	Before 1942	260	do	24	—	—	do
Ed 17	Clinton School	—	—	250	do	23.5	—	—	do
Ed 18	Mrs. Juanita Ryan	—	1900	210	do	15	36	—	Calvert or Nanjemoy
Ed 19	Old Surrattsville School	—	Old	230	do	32	—	—	Pliocene(?) deposits
Ed 20	J. F. Wood	Wood	1922	290	do	17.5	24	—	do
Ed 21	W. Eugene Pyles	Washington Pump & Well Co.	1941	265	Drilled	607	—	—	Patapsco(?)
Ed 22	Andrews Army Air Base	—	1943	270	do	427	—	—	Patapsco
Ed 23	Do	—	1942–43	270	do	—	—	—	—
Ed 24	Do	Sydnor Pump & Well Co.	1943	270	do	595	—	—	Magothy and/or Patapsco
Ed 25	Do	do	1943	270	do	345	—	—	Magothy
Ed 26	Do	—	1943	270	do	332	8	320–332	Patapsco
Ed 27	Do	Washington Pump & Well Co.	1942	270	do	338	6	—	Magothy
Ed 28	Do	—	1943	260	do	400	—	—	Magothy and/or Patapsco
Ed 29	Do	—	1942–43	260	do	—	—	—	—
Ed 30	Unknown	—	About 1910	260	do	1728	—	None	—
Ed 31	B. K. Miller	Columbia Pump & Well Co.	1950	245	do	347	6	335–345	Magothy
Ed 32	Dewey Freeman	Washington Pump & Well Co.	1950	270	do	759	8–6	720–758	Patuxent
Ee 1	State Roads Commission	Leatherbury	1947	74	Jetted	85	4	55–85(?)	Aquia greensand
Ee 2	Albert W. Posey	do	1947	28	do	220	2	—	Magothy
Ee 3	S. A Wyvill	Washington Pump & Well Co.	1948	150	Drilled	321	6	See remarks	do

—*Continued*

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date		Gallons a minute	Date				
18.55	—	May 3, 1948	N	—	—	—	N	—	
192.53		Dec. 13, 1951	C, E	50	Sept. 20, 1946	2.0	D	59	See well log and chemical analysis 12 ft. of screen used; position unknown.
	275[a]	Sept. 20, 1946							
—	—	—	—	—	—	—	—	—	See well log. Well-cuttings samples collected by S. Sanford and described by N. H. Darton. Oil or gas test hole.
31.92	—	July 27, 1949	J, E	—	—	—	D	—	
8.90	—	July 27, 1949	B, H	—	—	—	D	—	
25.89	—	Sept. 15, 1949	J, E	—	—	—	C	—	Inadequate yield reported.
23.60	—	Sept. 15, 1949	J, E	—	—	—	C	—	
20.5	—	August 1948	J, E	—	—	—	D	—	
—	—	—	N	1	—	—	N	—	Well is destroyed.
—	—	—	N	3	—	—	N	—	Do.
—	—	—	C, H	1	—	—	S	53.5	See chemical analysis.
—	—	—	C, E	—	—	—	D	—	
—	—	—	N	12	—	—	N	—	Well is destroyed.
15.31	—	Oct. 27, 1949	C, E	—	—	—	F, D	—	
—	—	—	N	25	1941	—	N	—	See well log. Reported to have pumped sand; destroyed.
—	—	—	I, E and G	50	1943	—	N	—	See well log. Reported to have "caved in."
—	—	—	I, E	35-50	1948	—	N	—	Reported to pump sand.
—	—	—	I, E	—	—	—	N	—	See well log.
—	—	—	I, E	—	—	—	N	—	Do.
—	—	—	I, N	—	—	—	N	—	Do.
195[a]	280[a]	Oct. 20, 1942	N	25	Oct. 20, 1942	0.3	N	—	See well log. Well is covered.
—	—	—	I, E	35	1948	—	N	—	See well log.
—	—	—	I, E	—	—	—	N	—	
—	—	—	N	—	—	—	—	—	Record obtained from Arthur Bibbins by N. H. Darton. Oil or gas test hole. Exact location unknown.
190[a]	215[a]	Sept. 29, 1950	N	40	Sept. 29, 1950	1.6	C	—	See well log.
232[a]	—	Sept. 5, 1950	I, E	80	Sept. 5, 1950	—	P	—	See well log and chemical analysis. Pump setting, 370 ft.
21.08	36[a]	Dec. 13, 1951	C, E	8	July 10, 1947	0.6	—	—	See well log. Pump setting, 60 ft.
See remarks		Nov. 29, 1951	I, E	8	Sept. 30, 1947	1.3	D	57	See well log. Static water level 10.5 ft. above land surface.
	4[a]	Sept. 30, 1947							
130[a]	160[a]	Jan. 8, 1948	I, E	60	Jan. 8, 1948	2.0	P	—	See well log. 12 ft. of screen used; position unknown.

TABLE 7

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Ee 4	M. E. Gardner	Washington Pump & Well Co.	1948	145	Drilled	319	6	See remarks	Magothy
Ee 5	J. F. Grierson	—	—	140	Dug	36	48	—	Calvert
Ee 6	Town of Upper Marlboro	Do	1946	64	Drilled	262	8-6	See remarks	Magothy
Ee 7	Mrs. Claudia Porter	—	—	230	Dug	23	36	—	Pliocene(?) deposits
Ee 8	Frederick Sasser	—	About 1899	190	do	85	48	—	Calvert
Ee 9	Mrs. E. H. Garner	—	Before 1924	80	do	42	48	—	Pleistocene deposits and Nanjemoy
Ee 10	Bennett Duley	Columbia Pump & Well Co.	1945	205	Drilled	322	—	—	Aquia greensand(?)
Ee 11	Do	Local labor	1933	205	Dug	85	48	—	Pliocene(?) deposits and Calvert
Ee 12	Oscar Duley	—	1926	210	do	80	—	—	do
Ee 13	Ernest Hennison	—	Before 1935	230	do	35	48	—	do
Ee 14	Mr. Merrick	—	1936	40	do	13	48	—	Pleistocene deposits
Ee 15	William C. Butler	—	About 1939	40	do	21	36	—	do
Ee 16	Mr. Wyvill	Duley	—	160	do	48	—	—	Calvert
Ee 17	Hal Claggett	—	Before 1937	180	do	31	60	—	Pliocene(?) deposits and Calvert
Ee 18	Mareen Moore	Moore	1940	110	do	24	36	—	Pleistocene deposits and Calvert
Ee 19	A. Preston DeVaugh	—	1890	160	do	44	48	—	do
Ee 20	School near Croome	—	—	250	do	64	—	—	Calvert
Ee 21	J. H. Mitchell	Mitchell	1941	210	do	40	48	—	do
Ee 22	Chester Brooks	—	—	210	do	54	42	—	Pliocene(?) deposits and Calvert
Ee 23	Robert F. Hardesty	—	1936	180	do	36	42	—	Calvert
Ee 24	Dr. Stiefel	Zeller	1940	170	Drilled	125-175	4	—	Aquia greensand(?)
Ee 25	Mrs. Eleanor Patterson	Washington Pump & Well Co.	1930-34	220	do	432	6	See remarks	Magothy
Ee 26	Do	—	Before 1922	220	Dug	76.5	—	—	Pliocene(?) deposits and Calvert
Ee 27	Mrs. Myrtle Rozman	—	Before 1919	190	do	30±	42	—	Calvert
Ee 28	Do	—	Before 1940	190	do	27	42	—	do
Ee 29	Abandoned Tavern	—	—	100	do	37	—	—	Calvert(?)
Ee 30	County Court House	—	1895	40	Drilled	222	—	—	Magothy

—Continued

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date		Gallons a minute	Date				
107.2		Nov. 30, 1948	N	12	Jan. 5, 1948	0.1	C	—	See well log. 6 ft. of screen used; position unknown.
	300[a]	Jan. 5, 1948							
15.5	—	Mar. 23, 1949	C, H	—	—	—	D	—	Odd taste reported.
23.08		Sept. 20, 1949	I, E and G	180	July 15, 1946	2.1	P	—	See well log and chemical analysis. 15 ft. of screen used; position unknown.
	110[a]	July 15, 1946							
22.5	—	Apr. 6, 1949	B, H	—	—	—	D	—	
58.76	—	Apr. 25, 1949	J, E	—	—	—	D	—	Deepened 10 ft. to present depth in 1948 because well went "dry." Water reported hard; white precipitate forms in pipes.
38[a]	—	1949	C, H	—	—	—	F, D	—	
185[a]	—	1945	C, E	—	—	—	D	—	Pump setting, 240 ft.
65.05	—	Apr. 25, 1949	N	—	—	—	N	—	Poor yield reported.
33.82	—	Apr. 25, 1949	I, E	—	—	—	D	—	Well went "dry" recently; deepened to present depth. Water reported to contain small amount of iron and to be slightly hard.
32.88	—	Apr. 27, 1949	C, H	—	—	—	D	—	
7.75	—	July 15, 1949	B, H	—	—	—	D	—	Supplies 4 families.
19.00	—	July 15, 1949	C, H	—	—	—	D	—	
32.88	—	July 22, 1949	C, E	—	—	—	D	—	Reportedly went "dry" in 1943.
20.32	—	July 22, 1949	J, E	—	—	—	D	—	
23.45	—	July 22, 1949	B, H	—	—	—	D	—	
32.70	—	July 22, 1949	C, E	—	—	—	D	—	
43.50	—	July 29, 1949	C, H	—	—	—	S	—	
—	—	—	N	—	—	—	N	—	Very low yield reported. Well is destroyed.
41.24	—	Sept. 8, 1949	C, H	—	—	—	D	—	Water reported hard and to taste odd.
29.45	—	Sept. 8, 1949	B, H	—	—	—	D	—	Well reported to go "dry" occasionally.
44.20	—	Oct. 21, 1949	C, E	—	—	—	D	—	Water reported hard.
—	—	—	I, E	40	1930–34	—	F, D	—	Reportedly pumped sand until deepened 25 ft. to present depth. 16 ft. of screen used; position unknown.
12.5[a]	—	1949	N	—	—	—	D	—	Pumped only occasionally.
—	—	—	J, E	—	—	—	N	—	Inadequate yield during summers reported.
24.82	—	Sept. 15, 1949	J, E	—	—	—	N	—	Do.
12.83	—	Oct. 27, 1949	C, H	—	—	—	N	—	
See remarks	—	1895	N	—	—	—	N	—	See chemical analysis. Static water level reported 13 ft. above land surface in 1895. Reported to have flowed 25 gal. a min. in 1895, no flow in 1949.

TABLE 7

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Ee 31	Thomas L. Steward	Washington Pump & Well Co.	1950	190	Drilled	340	6	See remarks	Magothy
Ee 32	George Perry	do	1950	210	do	329	6	320–329	do
Ef 1	Southern Maryland Agricultural Fair Assoc.	do	1946	32	do	235	8	227–235(?)	do
Ef 2	Wyvill Esso Station	—	—	150	Dug	49.5	48	—	Calvert
Ef 3	Gustav Buchheister	Washington Pump & Well Co.	1948	165	Drilled	366	6	351–366	Magothy
Ef 4	F. M. Kearney	Leatherbury	1946	20	Jetted	234	3–2	None	do
Ef 5	Town of Upper Marlboro	Washington Pump & Well Co.	1940	25	Drilled	226(?)	8	—	do
Ef 6	Upper Marlboro High School	do	1935	25	do	210	4	See remarks	do
Ef 7	John Herbert	Columbia Pump & Well Co.	1948	162	do	334	6	—	do
Ef 8	Charles Traband	—	—	140	Dug	38	48	—	Nanjemoy
Ef 9	Columbia Air Center	Greene	1947	40	do	22	48	—	Pleistocene deposits
Ef 10	Henry Duvall	Hamilton	1925	105	do	24.5	48	—	Calvert or Nanjemoy
Ef 11	McClure Gun Club	—	About 1920	40	Drilled	Below 100	6	—	Aquia greensand(?) or Magothy(?)
Fb 1	F. M. Holcomb	Columbia Pump & Well Co.	1948	30	do	217	6	—	Patapsco
Fb 2	C. W. Collins	do	1946	90	do	244	6	See remarks	do
Fb 3	Do	Local labor	1932	10	—	125	—	—	do
Fb 4	Bonds Retreat Water Co.	Hoppe	1948	150	Drilled	345	6	—	do
Fb 5	Max North	Local labor	1945	110	Dug	36	36	—	Nanjemoy (?)
Fb 6	Mrs. Dunn Carter	Washington Pump & Well Co.	1946	160	Drilled	488	6	480–488	Potomac group
Fb 7	Fort Washington	Sydnor Pump & Well Co.	1902	35	do	263	—	—	Patapsco
Fb 8	Do	—	1903	19	do	260	8–6	—	do
Fb 9	Do	—	1903	13	do	260	—	—	do

—Continued

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date		Gallons a minute	Date				
140[a]	180[a]	Feb. 7, 1950	C, E	30	Feb. 7, 1950	0.8	D	—	See well log. Slight iron content reported. Hardness 154 ppm.; field test, Feb. 28, 1950. About 8 ft. of screen used; position unknown.
165[a]	200[a]	Dec. 19, 1950	C, E	3	Dec. 19, 1950	0.9	D	—	See well log.
See remarks		Aug. 31, 1951	I, E	110	Aug. 31, 1951	1.8	C	56.6	See well log. Water reported to have noticeable iron content. Static water level 2.25 ft. above land surface. Observation well.
	88[a]	Mar. 20, 1946		153	Mar. 20, 1946				
34.45	—	Nov. 22, 1948	I, E	—	—	—	C, D	—	Observation well in 1947–48.
125[a]	200[a]	June 20, 1948	C, E	35	June 20, 1948	0.5	D	—	See well log and chemical analysis. Drilled to 334 ft. in 1945; water reported sandy and high in iron. Deepened to 366 ft. in 1948 with reportedly no improvement in quality.
See remarks	See remarks	Nov. 30, 1948	(?), E	15	Apr. 24, 1946	—	C	57	See well log. Flow of 8.4 gal. a min. measured. Reportedly continues to flow when pumped.
do	—	1940 and 1949	I, E	70+	1949	—	P	—	See well log and chemical analysis. Flow of 58 gal. a min. in 1940 and 45 gal. a min. in 1949 reported. Well may be 317 ft. deep.
do	—	1935	N	—	—	—	N	—	See well log. Water reported hard. Screen used; position unknown. Flow of 40 gal. a min. reported. Well is covered.
121.37		Dec. 13, 1951	C, E	10	Nov. 14, 1948	2.0	C	—	See well log.
	125[a]	Nov. 14, 1948							
31.15	—	Mar. 29, 1949	J, E	—	—	—	D	—	
18.6	—	Apr. 25, 1949	N	—	—	—	C	—	Water reported to have strong odor.
22.64	—	July 29, 1949	C, E; C, H	—	—	—	D	—	
3.70	—	July 29, 1949	C, E	—	—	—	C, D	—	Water reported to taste of gasoline.
26.12		Dec. 24, 1948	J, E	10	Nov. 1, 1948	0.5	D	—	See well log.
	80[a]	Nov. 1, 1948							
52.85		Dec. 24, 1948	J, E	40	Sept. 27, 1946	4.0	D	—	See well log. Water reported high in iron. Screen used; position unknown.
	81[a]	Sept. 27, 1946							
See remarks	—	Dec. 24, 1948	C(?), E	—	—	—	D	—	Water reported high in iron. Flow of 1 gal. a min. measured.
124[a]	—	Nov. 14, 1948	I, E	—	—	—	P	—	See well log. Drilled to supply about 10 families.
16.20	—	Mar. 30, 1949	C, H	—	—	—	D	—	
150[a]	190[a]	May 13, 1946	C, E	20	May 13, 1946	0.5	F, D	—	See well log.
—	—	—	I, E	60	—	—	P	59.5	See chemical analysis.
—	—	—	N	—	—	—	N	—	Water reported soft. Well is covered.
—	—	—	N	20	—	—	N	—	Well is covered.

TABLE 7

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Fb 10	Fort Washington	—	1903	13	Drilled	260	—	—	Patapsco
Fb 11	Do	Virginia Machinery & Well Co.	1930	28	do	280	8	—	do
Fb 12	Do	Sydnor Pump & Well Co.	1942	18	do	260±	—	—	do
Fb 13	Do	do	1942–43	165	do	500–600	—	—	Patuxent
Fb 14	Do	—	Before 1918	—	do	1000	—	—	—
Fb 15	Mason Bray	—	—	160	Dug	30	42	—	Pleistocene deposits
Fb 16	Do	Leatherbury	1949	165	Jetted	410	—	None	—
Fb 17	U. S. Army Engineers	Columbia Pump & Well Co.	1948	70	Drilled	259	6	See remarks	Patapsco
Fb 18	William Kenneaster	do	1950	5	do	395	6–4	—	Patuxent (?)
Fb 19	John C. Harris	Hoppe	1948	120	do	93	6	—	Aquia greensand (?)
Fc 1	Hyde Field	Washington Pump & Well Co.	1943	240	do	315	8–6	—	Magothy
Fc 2	A. E. Dyer	Columbia Pump & Well Co.	1946	30	do	440	6	None	—
Fc 3	F. P. Kierstead	do	1946	50	do	173	6	—	Magothy
Fc 4	Mrs. Neddie Travers	—	—	225	Dug	23	42	—	Pliocene (?) deposits
Fc 5	H. T. Brown	Roby	1938	225	Bored	18	8	—	do
Fc 6	D. C. Harper	—	—	230	Dug	19	42	—	do
Fc 7	H. B. Tucker	Tucker	1949	90	do	12	42	—	Pleistocene deposits
Fc 8	James E. Poore	Washington Pump & Well Co.	1939	20	Drilled	213	6	See remarks	Patapsco(?)
Fc 9	Sharpersville School	—	—	200	Dug	—	—	—	Pleistocene deposits (?)
Fc 10	Danville School	—	—	220	do	21	—	—	Pleistocene deposits
Fc 11	Mrs. Walters	Biggs	1926	230	do	32	60	—	Pliocene(?) deposits
Fc 12	Mr. Dixon	Thorne	—	60	do	9	36	—	Pleistocene deposits
Fc 13	J. B. Wilson	Hoppe	Before 1947	40	Drilled	125±	6	—	Magothy
Fc 14	G. Finch	do	—	30	do	150	6	—	do
Fc 15	W. Coleman Jones	—	Before 1943	230	Dug	18	36	—	Pliocene(?) deposits
Fd 1	Gwynn Park School	Washington Pump & Well Co.	1942	225	Drilled	427	6	See remarks	Magothy
Fd 2	Cheltenham Magnetic Observatory	do	1938	225	do	391	6	—	do
Fd 3	Do	—	About 1902	235	Dug	45.6	36	—	Pliocene(?) deposits
Fd 4	H. Butterworth	Hoppe	1938	200	Drilled	155.5	6	None	Aquia greensand
Fd 5	Cheltenham School for Boys	Columbia Pump & Well Co.	1949	237	do	438	8	417–438	Magothy

—Continued

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date		Gallons a minute	Date				
—	—	—	N	30	—	—	N	—	Well is covered.
45[a]	123[a]	1930	I, E	137	1930	1.7	P	—	
1.90	—	Dec. 10, 1951	I, E	—	—	—	P	61	
169.50		Dec. 10, 1951	I, E	342	1942–43	3.1	P	—	See well log.
	280[a]	1942–43							
—	—	—	N	—	—	—	N	—	See well log. Well is covered; exact location unknown.
27.40	—	July 1, 1949	B, H	—	—	—	D	—	
—	—	—	N	0	August 1949	—	N	—	See well log. Drilled through bottom of dug well 43 ft. deep. Reportedly no satisfactory aquifer was penetrated.
60[a]	225[a]	Nov. 22, 1948	I, E	22	Nov. 22, 1948	0.1	—	—	See well log. 20 ft. of screen used; position unknown.
5[a]	—	July 1950	C, H	—	—	—	D	—	See well log.
49.55	—	Mar. 30, 1949	C, H	—	—	—	D	—	
180[a]	240[a]	Jan. 12, 1943	I, E	55	Jan. 12, 1943	0.9	C	—	See well log.
—	—	—	N	0	Dec. 2, 1946	—	N	—	See well log. Reportedly no water-bearing sand was penetrated.
6[a]	10[a]	Nov. 15, 1946	C, E	20	Nov. 15, 1946	5.0	D	—	See well log. Water reported to be high in iron content.
19.56	—	July 26, 1949	B, H	—	—	—	C, D	—	
16.10	—	July 26, 1949	C, H	—	—	—	N	—	Reported to pump sand.
15.75	—	July 26, 1949	C, H	—	—	—	D	—	
10.40	—	July 26, 1949	B, H	—	—	—	D	—	
—	90[a]	1939	—	15	1939(?)	—	—	—	Screen used; position unknown.
—	—	—	—	1	—	—	N	—	Well is covered.
—	—	—	—	3	—	—	N	—	Do.
27.85	—	Oct. 10, 1949	J, E	—	—	—	F, D	—	Very low yield reported during drought of 1930.
8[a]	—	Oct. 10, 1949	J, E	—	—	—	D	—	Water reported slightly "irony."
—	—	—	C, E	—	—	—	D	—	
—	—	—	C, E	—	—	—	D	54	See chemical analysis.
14.91	—	Oct. 10, 1949	I, G	—	—	—	D	—	
193[a]	275[a]	May 27, 1942	I, E	35	May 27, 1942	0.4	S	—	See well log. Screen used; position unknown.
175[a]	198[a]	1939	I, E	42	1939	1.8	—	—	See well log.
26.9	—	Dec. 17, 1948	C, E	—	—	—	—	—	
See remarks	—	Nov. 25, 1946	—	—	—	—	F, D	57	Reported to flow 9–12 gal. a min.
188.79		May 7, 1949	N	165	Jan. 20, 1949	1.4	S	—	See well log.
	311[a]	Jan. 20, 1949							

TABLE 7

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Fd 6	Cheltenham School for Boys	Washington Pump & Well Co.	1944	230	Drilled	404	8	See remarks	Magothy
Fd 7	Do	Shannahan Artesian Well Co., Inc.	1931	220	do	416.5	10–8–6	396–416	do
Fd 8	Do	—	Before 1944	230	Dug	23	42	—	Pliocene(?) deposits
Fd 9	U. S. Navy Communication Station	—	1937	190	Drilled	365	6	—	Magothy
Fd 10	Do	Shannahan Artesian Well Co., Inc.	1944	190	do	365.8	8	—	do
Fd 11	Do	do	1949	230	do	444	8	See remarks	do
Fd 12	Guy H. Robinson	—	Before 1933	230	Dug	18	48	—	Pliocene(?) deposits
Fd 13	Do	Wills	Before 1933	230	do	19	48	—	do
Fd 14	John Dyson	—	—	230	do	24	48	—	do
Fd 15	A. T. Robinson	—	1946	225	do	15.6	48	—	do
Fd 16	Do	—	1946	225	do	22	48	—	do
Fd 17	W. A. Proctor	—	Before 1936	220	do	19.5	48	—	do
Fd 18	Brandywine Ice Plant	—	—	235	Driven	25.5	1½	—	do
Fd 19	Do	—	—	235	Dug	13.5	60	—	do
Fd 20	Do	—	—	235	do	25	—	—	do
Fd 21	C. E. Clark	Clark	1933	225	do	20	48	—	do
Fd 22	James E. Washington	Duckett	1921	220	Dug and driven	21	36–1¼	18–21	do
Fd 23	George W. Estep	—	1938	245	Dug	20.5	48	—	do
Fd 24	Hopkins and Wayson	Washington Pump & Well Co.	1948	237	Drilled	459	8	445–459	Magothy
Fd 25	Jack Millard	do	1944	245	do	400	6	—	do
Fd 26	Margaret Gray	Newman	1946	230	Dug	15	36	—	Pliocene(?) deposits
Fd 27	John Bond	—	1945	240	do	31.5	—	—	do
Fd 28	W. C. Lusby	—	—	225	do	30	—	—	do
Fd 29	Old T.B. School	—	Old	240	do	18	—	—	do
Fd 30	McKendree School	—	Old	220	do	24	—	—	do
Fd 31	Townsend School	—	Old	200	do	23	—	—	do
Fd 32	Brandywine School	Washington Pump & Well Co.	1950	230	Drilled	490	8	478–490	Magothy
Fd 33	Sherwood Oil Co.	Bunker	1951	230	do	370	4	365–370	Aquia greensand
Fd 34	U. S. Navy	—	—	230	—	25	2	—	Pliocene(?) deposits
Fe 1	Harry Moore	Local labor	1948	185	Dug	91	—	—	Calvert
Fe 2	Charles Rawlings	—	1915	250	do	21	48	—	Pliocene(?) deposits
Fe 3	L. M. Rinehart	—	—	230	do	22.5	30	—	do
Fe 4	Unknown	—	—	160	do	10	48	—	do
Fe 5	James J. Proctor	—	Before 1890	220	do	18	—	—	do

—Continued

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date		Gallons a minute	Date				
150[a]	190[a]	1944	I, E	150	1944	3.8	S	60.5	See well log and chemical analysis. 30 ft. of screen; position unknown.
160[a]	—	March, 1931	N	65	March 1931	—	N	—	See well log. Back filled to 140 ft.
13.26	—	July 27, 1949	C, H	—	—	—	D	—	
145.60	—	May 3, 1949	I, E	33	1937	—	—	61.4	
144.34	—	July 19, 1949	I, E	40	1944	—	—	—	See well log.
78[a]		May 12, 1949							
183.93		July 19, 1949	I, E	239	May 12, 1949	3.9	—	—	See well log. 46 ft. of screen used; position unknown.
	139[a]	May 12, 1949							
10[a]	—	Apr. 20, 1949	I, E	—	—	—	D	—	
11.98	—	Apr. 20, 1949	C, H	—	—	—	F	—	
15.26	—	Apr. 20, 1949	C, H	—	—	—	F, D	—	
7.10	—	Apr. 6, 1949	C, E	—	—	—	D	—	Water reported slightly "irony".
9.67	—	Apr. 20, 1949	C, E	—	—	—	F	—	See chemical analysis. Observation well.
14.80	—	May 23, 1949	C, H	—	—	—	D	—	
9.74	—	May 24, 1949	C, H	—	—	—	C	—	
8.92	—	May 24, 1949	C, E	—	—	—	C	—	
10.30	—	May 24, 1949	C, E	—	—	—	C	—	
—	—	—	C, H	—	—	—	D	—	
—	—	—	C, H	—	—	—	D	—	Well 7 ft. deep driven through bottom of dug well 14 ft. deep.
19.72	—	July 22, 1949	C, E	—	—	—	D	—	
181.92		May 5, 1949	I, E	70	Dec. 2, 1948	1.3	P	—	See well log and chemical analysis.
	240[a]	Dec. 2, 1948							
180[a]	190[a]	Jan. 13, 1944	C, E	10	Jan. 13, 1944	1.0	D	—	See well log.
7[a]	—	1946	C, H	—	—	—	D	—	
27.05	—	Sept. 8, 1949	J, E	—	—	—	D	—	
28.52	—	Oct. 10, 1949	C, H	—	—	—	D	—	
—	—	—	N	2.5	—	—	N	—	Well is destroyed.
—	—	—	N	1	—	—	N	—	Do.
—	—	—	N	3	—	—	N	—	Do.
181.27		Nov. 30, 1950	I, E	80	Nov. 25, 1950	0.6	S	—	See well log. Pump setting, 300 ft.
	340[a]	Nov. 25, 1950							
183.62	—	June 19, 1951	C, E	7	June, 1951	—	C	—	See well log.
—	—	—	—	6	Mar. 15, 1951	—	—	—	See chemical analysis.
63.45	—	Dec. 17, 1948	C, E	—	—	—	D	—	
17.3	—	Apr. 27, 1949	C, E	—	—	—	D	—	Water reported soft.
17.4	—	May 23, 1949	C, E	—	—	—	D	—	
3.4	—	May 23, 1949	B, H	—	—	—	D	—	
12.60	—	May 23, 1949	C, H	—	—	—	D	—	

TABLE 7

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Fe 6	Robert Fleet	—	—	220	Dug	25	42	—	Pliocene(?) deposits
Fe 7	John S. Tayman	Hawkins	1907	230	Driven	19	2	17-19	do
Fe 8	J. E. Johnson	Johnson	1944	220	Dug	15.5	48	—	do
Fe 9	James Meade	—	Before 1940	230	do	30	42	—	do
Fe 10	William Dockum	—	Before 1938	210	do	19	48	—	do
Fe 11	Harrison Windsor	—	About 1910	130	do	29	—	—	Pleistocene deposits or Calvert
Fe 12	Do	—	Before 1915	150	do	19	48	—	do
Fe 13	Russell Cross	—	1920	160	do	52	—	—	Calvert
Fe 14	James A. Hall	—	1942	235	do	29	—	—	Pliocene(?) deposits
Fe 15	D. West	West	1900	230	do	25	48	—	do
Fe 16	John Proctor	—	Before 1944	230	do	31	—	—	do
Fe 17	American Legion	—	—	250	do	20	48	—	do
Fe 18	Ralph Savoy	—	1926	245	do	27	42	—	do
Fe 19	John Windsor	Clark	1947	90	do	10.5	36	—	Nanjemoy
Fe 20	Hester Rollings	—	Before 1944	210	do	20	—	—	do
Fe 21	Croome School	—	—	200	do	30	—	—	Pliocene(?) deposits or Calvert
Ff 1	C. Elwood Sager	Washington Pump & Well Co.	1945	130	Drilled	291	6	See remarks	Aquia greensand
Ff 2	Leo Ford	—	—	130	Dug	26	—	—	Pleistocene deposits
Ff 3	Robert E. Goldsmith	—	1936	150	do	51	—	—	do
Ff 4	Marbury Watson	—	Before 1930	140	do	10.6	—	—	do
Ff 5	John R. Windsor	—	Before 1944	30	do	25.5	—	—	do
Ff 6	Mrs. Irene Downing	Leatherbury	1941	2	Jetted	200-250	2	—	Aquia greensand
Ff 7	Do	—	1928	2	do	135	2	—	Nanjemoy
Ff 8	Mr. Smith	Wilson	—	3	do	About 200	—	—	Aquia greensand(?)
Ff 9	Do	—	—	20	Dug	12.5	48	—	Pleistocene deposits
Ff 10	Edward Windsor	—	Before 1933	65	do	30	—	—	do
Ff 11	Mrs. Dollie Duvall	—	—	150	do	39	—	—	do
Ff 12	Unknown	—	—	140	do	37	42	—	Calvert
Ff 13	Naylor School	—	Old	140	do	15	—	—	do

—*Continued*

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pump-ing	Date		Gal-lons a min-ute	Date				
13.95	—	May 24, 1949	B, H	—	—	—	D	—	
—	—	—	C, H	—	—	—	D	—	
8.78	—	May 24, 1949	C, E	—	—	—	D	—	
24.98	—	July 7, 1949	C, H	—	—	—	D	—	
15.32	—	July 7, 1949	B, H	—	—	—	D	—	
—	—	—	C, H	—	—	—	D	—	
14.54	—	July 7, 1949	B, H	—	—	—	F	—	
33.30	—	July 7, 1949	N	—	—	—	N	—	Inadequate yield reported. Water supply consists of 3 cement-improved springs.
26.42	—	July 7, 1949	C, H	—	—	—	D	—	
22.17	—	July 7, 1949	B, H	—	—	—	D	—	Reportedly went dry during drought of 1930.
27.5	—	1947	C, H	—	—	—	D	—	
18.87	—	July 27, 1949	C, E	—	—	—	D	—	
26.21	—	Sept. 8, 1949	B, H	—	—	—	D	—	Poor yield reported.
9.70	—	Sept. 8, 1949	B, H	—	—	—	D	—	
13.03	—	Sept. 8, 1949	C, H	—	—	—	D	—	
—	—	—	N	3	—	—	N	—	Well is destroyed.
80[a]	199.5[a]	Dec. 3, 1945	I, E	40	Dec. 3, 1945	0.3	D	—	See well log. 12 ft. of screen used; position unknown. Pump setting, 250 ft.
20.7	—	July 6, 1949	C, H	—	—	—	D	—	
34.92	—	July 6, 1949	C, H	—	—	—	D	—	Adequate supply for 2 families.
7.35	—	July 6, 1949	B, H	—	—	—	D	—	
22.20	—	July 27, 1949	C, H	—	—	—	D	—	See chemical analysis.
ee remarks	—	Nov. 30, 1951	C, E	—	—	—	D	59	Flow of 2.5 gal. a min. into brick collecting basin. Static water level 15 ft. above land surface.
do	—	Nov. 30, 1951	N	—	—	—	N	58.5	Flow of 0.3 gal. a min. estimated. Static water level 19 ft. above land surface.
do	—	July 27, 1949	C, E	—	—	—	D	—	Well flows into cement collecting basin.
10.05	—	July 27, 1949	C, E	—	—	—	F	—	
—	—	—	C, H	—	—	—	D	—	
38.20	—	July 27, 1949	C, H	—	—	—	D	—	
21.25	—	July 27, 1949	B, H	—	—	—	D	—	
—	—	—	N	—	—	—	N	—	No water in well.

TABLE

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Ff 14	Naylor School	—	—	135	Dug	—	—	—	Calvert
Ff 15	E. A. Markle	Purner	1950	30	Jetted	300	2–1½	—	Aquia greensand
Ff 16	Naylor School	Washington Pump & Well Co.	1951	129	Drilled	379	6	371½–379	do
Gc 1	W. Gwynn Gardiner	—	About 1926	210	do	355	8–6	See remarks	Magothy(?)
Gd 1	Schwein's Garage	Local labor	1925	215	Dug	20	48	—	Pliocene(?) deposits
Gd 2	G. H. Anderson	—	Before 1920	215	do	22	48	—	do
Gd 3	H. L. Curtis	Washington Pump & Well Co.	1937	210	Drilled	345	6	—	Aquia greensand(?)
Ge 1	Baden School	Edelen	About 1910	215	Dug	28	48	—	Pliocene(?) deposits
Ge 2	N. P. Hyde	do	1936	210	do	15	—	—	do
Ge 3	Elizabeth Rawlings	do	1915	220	do	19.5	36	—	do
Ge 4	S. O. Willett	Newman	1948	215	do	16	42	—	do
Ge 5	O. B. Willett	—	1949	215	Driven	20	1½	—	do
Ge 6	Cecil Myers	—	—	215	do	10	1½	—	do
Ge 7	L. D. Miller	—	1934	215	Dug	19	48	—	do
Ge 8	Charles Tibbett	—	—	200	do	25.5	48	—	do
Ge 9	C. E. Richards	—	—	210	do	40±	48	—	do
Ge 10	Percy S. Wilkinson	—	1951	200	do	30±	36	—	do
Gf 1	Lloyd E. Holsinger	Washington Pump & Well Co.	1947	169	Drilled	360	6	See remarks	Nanjemoy
Gf 2	Joseph Adams	Local labor	—	145	Dug	82.5	—	—	Calvert
Gf 3	Dobson Implement Co.	Dobson	1945	145	do	52	48	—	Pleistocene deposits and Calvert
Gf 4	G. M. Baden	—	1947	150	do	47	—	—	Calvert
Gf 5	Duncan T. Elliott	Washington Pump & Well Co.	1944	160	Drilled	375±	6	285(?)	Nanjemoy(?)
Gf 6	C. H. Macfurson	Reeder	1928	170	Dug	48	—	—	Pleistocene deposits and Choptank
Gf 7	H. C. Macfurson	—	Before 1900	160	do	59	48	—	do
Gf 8	M. Chitterston	—	—	170	do	48	60	—	do
Gf 9	Do	Ferguson	1934	130	do	63	36	—	Calvert
Gf 10	Mrs. Fanny Glascow	Glascow	1926	190	do	35	48	—	Pleistocene deposits
Gf 11	J. E. Turner	Edelen	Before 1850	180	do	37	48	—	do
Gf 12	Mr. Estep	—	—	80	do	33.5	60	—	do
Gf 13	Charles Trueman	Keefall	1948	190	Bored	22	12	—	Pliocene(?) deposits
Gf 14	H. J. Trueman	—	Before 1910	190	Dug	29	36	—	do

Continued

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date		Gallons a minute	Date				
19.41	—	July 27, 1949	C, H	—	—	—	N	—	
35[a]	43[a]	Oct. 13, 1950	J, E	6	Oct. 13, 1950	0.8	D	—	Pump setting, 50 ft.
93.17		Apr. 6, 1951	I, E	65	Feb. 19, 1951	0.9	S	—	See well log. Pump setting, 190 ft.
	170[a]	Feb. 19, 1951							
—	—	—	C, E	—	—	—	D, F	—	See well log. Water reported high in iron. Screen used; position unknown.
9.82	—	Apr. 20, 1949	C, H	—	—	—	C	—	
18.95	—	May 3, 1949	J, E; C, H	—	—	—	D	—	
155.91		Nov. 30, 1951	I, E	—	—	—	D	—	Water reported hard and "irony."
	190[a]	1949							
—	—	—	C, E	—	—	—	S	—	Adequate supply for 110 students and heating system.
8.50	—	May 23, 1949	C, H	—	—	—	D	—	
10.40	—	May 23, 1949	C, H	—	—	—	D	—	
13.55	—	May 23, 1949	J, E	—	—	—	D	—	
—	—	—	C, H	—	—	—	D	—	
—	—	—	C, H	—	—	—	N	—	Poor yield reported.
13.03	—	May 23, 1949	C, H	—	—	—	D	—	
21.65	—	May 24, 1949	C, H	—	—	—	D, F	—	
36.10	—	July 6, 1949	(?), E	—	—	—	D	—	
—	—	—	C, H	—	—	—	D	—	See chemical analysis.
91.10		Dec. 29, 1948	I, E	15	Sept. 25, 1947	0.1	D, C	59	See well log and chemical analysis. 11 ft. of screen used; position unknown.
	195[a]	Sept. 25, 1947							
67.00	—	Dec. 29, 1948	C, H	—	—	—	D	—	
32.01	—	Dec. 29, 1948	J, E	—	—	—	C	—	
27[a]	—	1948	C, H	—	—	—	D	—	"Shell rock" reported at 47 ft. Water reported to be hard.
18[a]	—	1944	C, E	—	—	—	D, F	—	Water reported "irony."
44[a]	—	1949	J, E; C, H	—	—	—	D	—	Water reported soft. Reportedly went dry in 1947; deepened 8 ft.
40.2	—	Apr. 26, 1949	C, H	—	—	—	D	—	Water reported high in iron and hard.
41.2	—	Apr. 26, 1949	C, E	—	—	—	D	—	Water reported corrosive.
43.22	—	Apr. 26, 1949	B, H	—	—	—	D	—	
27.80	—	Apr. 26, 1949	B, H	—	—	—	D	—	
26.89	—	Apr. 27, 1949	I, E; C, H	—	—	—	D	—	
29.50	—	Apr. 27, 1949	B, H	—	—	—	D	—	
20.36	—	May 24, 1949	C, H	—	—	—	D	—	
22.20	—	May 24, 1949	C, H	—	—	—	D	—	

TABLE

Well number (PG-)	Owner or name	Driller	Date completed	Altitude (feet)	Type of well	Depth of well (feet)	Diameter of well (inches)	Depth of screen below land surface (feet)	Water-bearing formation
Gf 15	Sydney Douglas	—	—	160	Dug	44	48	—	Pleistocene deposits
Gf 16	Martin Gray	Jennifer	1948	20	do	11	—	—	do
Gf 17	V. C. Richards	—	1948	170	do	40	—	—	Choptank and Calvert
Gf 18	Ernest Reeder	—	About 1920	170	do	18	36	—	Pleistocene deposits
Gf 19	B. E. Richards	—	About 1880	110	do	28	48	—	Calvert
Gf 20	H. B. Leary	—	Before 1920	100	do	82	48	—	Pleistocene deposits and Calvert
Gf 21	Leonard Goldsmith	—	—	100	do	24	—	—	Calvert
Hf 1	John Ford	—	Before 1914	140	do	40	48	—	Pleistocene deposits
Hf 2	Mr. Nickson	—	1925	2	Drilled	200±	4	—	Nanjemoy(?)
Hf 3	Town of Eagle Harbor	—	1925	1	do	200±	—	—	do
Hf 4	C. N. Jones	Reeder	—	40	Dug	22	48	—	Pleistocene deposits
Hf 5	Abandoned house	—	—	140	do	44	48	—	do
Hf 6	Sarah Magruder	—	Before 1900	170	do	35.5	60	—	do
Hf 7	F. F. Burroughs	Smallwood	1920	170	do	23.5	42	—	do
Hf 8	Mrs. Blake	—	1948	170	do	30.5	48	—	do
Hf 9	Samuel L. Canter	Smallwood	1909	150	do	54	48	—	Pleistocene deposits and Choptank
Hf 10	Charles Turner	—	1949	100	do	50±	—	—	do
Hf 11	Rossie Wills	—	Before 1900	160	do	54	60	—	do
Hf 12	Mrs. W. B. Fenwick	Reeder	1947	160	do	40	42	—	Pleistocene deposits

—*Concluded*

Water level (feet below land surface)			Pumping equipment	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Static	Pumping	Date		Gallons a minute	Date				
36.91	—	July 6, 1949	C, H	—	—	—	D	—	
9.05	—	July 6, 1949	C, H	—	—	—	D	—	
34.26	—	July 6, 1949	C, H	—	—	—	D	—	
13.6	—	July 6, 1949	B, H	—	—	—	D	—	Reportedly dry during drought of 1930.
23.55	—	July 6, 1949	C, H	—	—	—	D	—	
44.8	—	July 6, 1949	C, G	—	—	—	D, F	—	
24[a]	—	1949	C, H	—	—	—	D	—	
30.27	—	Apr. 26, 1949	B, H	—	—	—	D	—	
See remarks	—	Apr. 26, 1949	N	—	—	—	N	57.5	Well flows approximately 2 gal. a min. Static water level 5.3 + ft. above land surface
do	—	Nov. 29, 1951	N	—	—	—	P	59 (?)	Well flows 1 gal. a min. Static water level 10.8 ft. above land surface.
20[a]	—	1949	C, H	—	—	—	D	—	Reported necessary to replace corroded pump pipe about every 2 years.
40.9	—	Apr. 26, 1949	B, H	—	—	—	N	—	
27.2	—	Apr. 26, 1949	B, H	—	—	—	D	—	Water reported to taste peculiar.
13.5	—	Apr. 26, 1949	B, H	—	—	—	D	—	
22.28	—	Apr. 26, 1949	C, H	—	—	—	D	—	
50[a]	—	1949	J, E; C, H	—	—	—	D	—	Water reported slightly corrosive.
41.15	—	Apr. 27, 1949	C, H	—	—	—	D	—	
46.1	—	Apr. 27, 1949	C, H	—	—	—	D	—	
36.22	—	Apr. 27, 1949	B, H	—	—	—	D	—	

TABLE 8

Drillers' Logs of Wells

	Thickness (feet)	Depth (feet)
Ad 1		
Patuxent formation:		
Clay and gravel	45	45
Sand and gravel	35	80
Clay, white	25	105
Pre-Cambrian rocks:		
"Mica rock"	59	164
Ad 2		
Pliocene (?) deposits and Patuxent formation:		
Clay and gravel	40	40
Patuxent formation:		
Sand	50	90
Clay, blue	10	100
Pre-Cambrian rocks:		
"Mica rock"	120	220
Ad 3		
Patuxent formation:		
Clay and gravel	10	10
Sand and gravel	49	59
Clay, white	5	64
Gravel, hard	11	75
Ad 4		
Patuxent formation:		
Sand and gravel	12	12
Sand, hard	3	15
Clay, red	35	50
Clay, white	48	98
Sand (water)	14	112
Pre-Cambrian rocks:		
"Mica rock"	100	212
Ad 5		
Patuxent formation:		
Sand and clay	15	15
Sand (water)	30	45
Clay, white	5	50
Sand	36	86
Gravel	14	100
Pre-Cambrian rocks:		
"Mica mud"	20	120
Bedrock	133	253

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ad 6		
Patuxent formation:		
Clay, red	10	10
Clay, yellow	10	20
Sand, dark gray, and clay	17	37
Patuxent formation or pre-Cambrian rocks:		
Sandstone, gray	8	45
Pre-Cambrian rocks:		
"Mica rock," gray, and "granite," gray	25	70
Ad 7		
Patuxent formation:		
Clay, red	20	20
Clay and sand	30	50
Pre-Cambrian rocks:		
"Mica rock"	52	102
Ad 10		
Pliocene (?) deposits:		
Clay, red, and gravel, mixed (water)	18	18
Patuxent formation:		
Clay, variegated, and sand, in layers	52	70
Thin iron crust	—	At 40
Ad 14		
Patuxent formation:		
Clay, yellow	30	30
Clay, yellow, and gravel	10	40
Sand	20	60
Pre-Cambrian rocks:		
Clay, micaceous	10	70
Rock, micaceous, black	10	80
Rock, micaceous	50	130
Bc 1		
Patuxent formation:		
Gravel and clay	20	20
Clay	70	90
Sand and clay	23½	113½
Pre-Cambrian rocks:		
"Mica rock"	194½	308
Bc 2		
Patuxent formation:		
Gravel, large, and sand	65	65
Pre-Cambrian rocks:		
"Mica granite"	119	184

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Bc 3		
Patuxent formation:		
Sand	35	35
Clay, white	55	90
Sand and gravel	34	124
Bc 4		
Patuxent formation:		
Sand and clay	60	60
Gravel	11	71
Pre-Cambrian rocks:		
"Mica mud"	31	102
"Mica rock"	146	248
Bc 5		
Patuxent formation:		
Sand and gravel	30	30
Clay, white	10	40
Sand and gravel	55	95
Gravel, large	68	163
Bc 8		
Patuxent formation:		
Clay and gravel	11	11
Sand, fine	20	31
Clay, red	29	60
Clay, red, and sand	12	72
Gravel	6	78
Clay, brown	11	90
Clay, pink	6	96
Clay, white, and gravel	25	121
Clay, white, and sand	21	142
Pre-Cambrian rocks:		
"Mica mud"	23	165
Bedrock, micaceous (water)	106	271
Bc 9		
Patuxent formation:		
Clay, sand, and gravel	59	59
Pre-Cambrian rocks:		
"Mica rock"	64	123
Bc 10		
Patuxent formation:		
Sand and gravel	49	49
Gravel, clean	61	110

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Bd 1		
Arundel and Patuxent formations:		
Clay	78	78
Patuxent formation:		
Gravel, large	11	89
Bd 2		
Arundel clay:		
Sand and clay	10	10
Clay, red	35	45
Patuxent formation:		
Clay, white	10	55
Sand	5	60
Gravel	5	65
Bd 3		
Patuxent formation:		
Sand and clay	5	5
Clay, orange	10	15
Clay, yellow	15	30
Clay, orange	15	45
Clay, gray	40	85
Clay, pink	22	107
Sand and gravel, coarse (water)	—	107+
Bd 4		
Patapsco formation:		
Clay, red	15	15
Clay, brown	18	33
Sand and gravel	4	37
Clay, red and brown	18	55
Clay, sandy, brown	5	60
Sand and gravel	10	70
Gravel	13	83
Clay, white	2	85
Gravel	10	95
Clay, blue	10	105
Clay, sandy, blue	9	114
Sand, fine, and gravel	5	119
Arundel clay:		
Clay, red and brown	23	142
Clay, variegated	9	151
Clay, brown	100	251
Clay, blue	10	261
Clay, brown	9	270
Patuxent formation:		
Clay, white	6	276

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Bd 4—*Continued*		
Sand and gravel (water)	24	300
Clay, white	2	302
Sand and gravel	10	312
Clay, brown and red	8	320
Clay, variegated	10	330
Clay, brown	9	339
Sand and gravel	12	351
Clay, blue	28	379
Clay, red and white	4	383
Sand (water)	7	390
Gravel (water)	6	396
Bd 5		
Arundel and Patuxent formations:		
Clay	75	75
Patuxent formation:		
Gravel, "heavy"	10	85
Bd 6		
Arundel and Patuxent formations:		
Clay, red	70	70
Patuxent formation:		
Sand	5	75
Gravel	4	79
Bd 7		
Patuxent formation:		
Clay, red	45	45
Sand and clay, white	20	65
Sand	15	80
Gravel, large	12	92
Bd 8		
Arundel clay:		
Clay, red	90	90
Patuxent formation:		
Sand and clay	5	95
Clay, brown	25	120
Sand and gravel	15	135
Gravel	10	145
Bd 9		
Arundel clay:		
Clay, red	40	40
Patuxent formation:		
Clay, white	15	55

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Bd 9—*Continued*		
Sand	10	65
Gravel, "pure"	5	70
Not reported	9	79
Bd 11		
Patuxent formation:		
Topsoil, sandy	3	3
Clay, sandy	18	21
Sand and gravel	17	38
Clay, red	14	52
Clay, brown	13	65
Clay, sandy, brown	13	78
Clay, sandy, white	5	83
Sand (water)	10	93
Bd 13		
Arundel clay:		
Soil, sandy, yellow	3	3
Clay, yellow and red	57	60
Patuxent formation:		
Sand and pebbles	18	78
Sand, red, and pebbles	9	87
Clay, blue and red	73	160
Clay, red, a little sand	5	165
Clay, red	14	179
Clay, dark-red, and gravel, coarse	31	210
Pre-Cambrian rocks:		
"Crystalline" rock, gray	255	465
Bd 14		
Arundel clay:		
Clay, red	48	48
Patuxent formation:		
Clay, white	6	54
Sand and gravel	18	72
Clay, sandy	6	78
Sand, fine	24	102
Clay, sandy, white	44	146
Sand, white (water)	10	156
Sand, fine, white	28	184
Sand and gravel, coarse, white (water)	21	205
Sand, red	3	208
Clay, white	4	212
Clay, black	12	224
Clay, sandy	4	228
Pre-Cambrian rocks:		
"Gneiss"	76	304

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Bd 15		
Arundel clay:		
Clay, red	45	45
Patuxent formation:		
Clay, brown	23	68
Clay, white	9	77
Clay, white	3	80
Clay, red	22	102
Sand and clay, white (water)	5	107
Sand, fine, white	37	144
Clay, white	3	147
Sand and clay, white	20	167
Clay, brown	6	173
Clay, yellow	12	185
Pre-Cambrian rocks:		
Rock, "rotten"	11	196
Rock, blue	54	250
Bd 16		
Arundel clay:		
Clay, red	50	50
Patuxent formation:		
Sand and clay	10	60
Sand	10	70
Sand and gravel	5	75
Gravel	22	97
Clay, red	8	105
Clay, white	20	125
Sand	30	155
"Silicate"	10	165
Gravel (water)	20	185
Clay, yellow	10	195
Clay, gray	20	215
Pre-Cambrian rocks:		
Rock	385	600
Bd 17		
Arundel clay:		
Clay	4	4
Sand, fine	4	8
Clay, red	42	50
Patuxent formation:		
Sand, fine, red	24	74
Gravel and sand, coarse, gray (water)	12	86
Sand and gravel, fine, gray (water)	7	93
Sand and gravel; gravel finer than above	5	98
Gravel and sand, coarse	11	109

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Bd 17—*Continued*		
Clay, gray and red	18	127
Clay, white	41	168
Sand, fine	6	174
Sand, fine, white, and clay	13	187
Sand, coarse	7	194
Sand, fine, yellow, and clay	12	206
Clay, white	9	215
Pre-Cambrian rocks:		
Sand, gray, and rock, "broken"	18	233
Rock, gray	18	251
Bd 18		
Patapsco formation:		
Sand and gravel, brown	6	6
Arundel clay:		
Clay, red	72	78
Patuxent formation:		
Clay, brown	46	124
Clay, sandy, yellow	7	131
Sand, fine, yellow (water)	11	142
Sand, fine, white	6	148
Clay, sandy, yellow	5	153
Sand, fine, white, some gravel	6	159
Sand and gravel, coarse, white (water)	9	168
Gravel and sand, coarse (water)	4	172
Clay, white, and gravel	11	183
Sand, coarse, white, and clay	7	190
Sand, white (water)	7	197
Clay, white	17	214
Sand, white	6	220
Clay, white, and sand, coarse	6	226
Sand and gravel	5	231
Clay and sand, white	21	252
Clay and gravel, white	5	257
Clay, yellow	6	263
Pre-Cambrian rocks:		
Rock, "rotten"	9	272
"Gneiss," blue	10	282
"Quartz"	14	296
"Quartz" and "gneiss," blue	14	310
"Gneiss," blue	45	355
Rock	8	363
Bd 19		
Patapsco and Arundel formations:		
Clay, brown	50	50

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Bd 19—*Continued*		
Arundel clay:		
Clay, red	30	80
Patuxent formation:		
Clay, brown	40	120
Clay, brown	40	160
Clay, red	15	175
Sand, medium coarse, white (water)	20	195
Clay, dark brown	2	197
Bd 20		
Arundel and Patuxent formations:		
Sand	20	20
Clay	84	104
Patuxent formation:		
Sand	20	124
Clay	12	136
Sand	6	142
Clay	108	250
Pre-Cambrian rocks:		
"Gneiss," blue	10	260
"Quartz," white	12	272
"Gneiss," blue	28	300
"Quartz," white	23	323
Bd 21		
Patapsco formation:		
Clay, brown	15	15
Clay, brown and yellow	5	20
Clay, sandy, brown and gray	10	30
Sand and clay, brown	5	35
Arundel clay:		
Clay, brown	45	80
Clay, red and brown	5	85
Clay, brown	40	125
Clay, light brown	5	130
Clay, brown and red	10	140
Clay, red	5	145
Patuxent formation:		
Clay, sandy, yellow	10	155
Sand, fine	5	160
Sand and gravel (water)	30	190
Clay, white, and gravel	5	195
Clay, white	5	200
Clay, brown, and gravel	10	210
Clay, gray and brown	5	215
Clay, brown	5	220

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Bd 21—*Continued*		
Sand, coarse	5	225
Sand, medium, white (water)	5	230
Sand, coarse, white (water)	5	235
Sand, medium coarse (water)	15	250
Sand and gravel, coarse (water)	5	255
Sand, medium, white (water)	10	265
Clay, sandy, white	15	280
"Quartz rock," white	20	300
Clay, white	5	305
Clay, sandy, bluish white	5	310
Clay, sandy, blue	5	315
Pre-Cambrian rocks:		
"Gneiss," blue	110	425
Bd 22		
Arundel clay:		
Topsoil	4	4
Clay, red	22	26
Clay, blue	5½	31½
Clay, blue	43	74½
"Ledge rock"	1½	76
Clay, blue	6	82
Clay, red	43	125
Patuxent formation (?):		
Clay, brown	70	195
Patuxent formation:		
Clay, white	14	209
Sand and gravel, coarse, gray (water)	21	230
Clay and sand, white	30	260
Clay, blue	2	262
Bd 23		
Patapsco formation:		
Soil, sandy, yellow, and gravel	9	9
Sand, white, and gravel	13	22
Clay, yellow, and gravel	24	46
Clay, red	3	49
Clay, yellow	16	65
Marl, black	24	89
Clay, sandy, brown	7	96
Clay, sandy, red	29	125
Sand, yellow, some clay	9	134
Arundel clay:		
Clay, red	61	195
Patuxent formation:		
Sand, yellow	6	201

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Bd 23—*Continued*		
Sand, white (water)	11	212
Not reported	9	221
Bd 24		
Patapsco formation:		
Clay, sandy, yellow	8	8
Gravel and clay	3	11
Clay, red	60	71
Sand (water)	11	82
Bd 25		
Patapsco formation:		
Topsoil, sand	5	5
Arundel clay:		
Clay, red	15	20
Patuxent formation:		
Sand, blue, tinted with yellow	5	25
Sand, blue	5	30
Sand, gray	9	39
Clay, reddish brown, and sand, mixed	36	75
Sand, red	7	82
Sand and gravel, trace of clay, white	8	90
Sand and clay, red	10	100
Sand, fine, light brown	20	120
Sand, fine, gray, trace of gravel	5	125
Sand, fine, yellow	5	130
Sand, medium, yellow	6	136
Clay, red, trace of gravel	4	140
Clay, red	5	145
Sand, fine, yellow	5	150
Sand, fine and coarse, mixed	7	157
Gravel (water)	19	176
Clay, white and red	4	180
Bd 26		
Patapsco formation:		
Topsoil and sand, yellow	10	10
Arundel clay:		
Clay, yellow and black, mixed	10	20
Clay, black; traces of broken rock from 20 feet to 35 feet	30	50
Patuxent formation:		
Sand and clay, blue-gray	10	60
Sand, red; sand, fine, and gravel at 65 feet (water)	5	65
Gravel (water)	1	66
Sand, clay, and gravel, mixed	10	76
Gravel, coarse (water)	2	78

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Bd 26—*Continued*		
Sand, fine, brown	7	85
Sand, fine	40	125
Sand, fine, changing to clay	10	135
Sand, fine, and clay	10	145
Sand, fine	10	155
Sand, fine, and clay	5	160
Sand, fine, traces of gravel	5	165
Sand, fine, trace of gravel	4	169
Clay, red, and sand, fine	1	170
Clay, red	8	178
Clay, grayish blue	10	188
Clay, grayish blue	8	196
Sand, red	4	200
Sand, fine, yellow, heaving at 208 feet	8	208
Sand, fine, gray, pink-tinted, caving type	12	220
Sand, fine	10	230
Sand, fine	2	232
Sand, fine and medium, mixed	12	244
Sand and gravel cemented in clay	9	253
Sand, fine, and clay, traces of gravel	9	262
Sand and gravel	4	266
Clay, yellow	11	277
Sand, fine and medium, mixed with clay, yellow and blue, turning darker toward 287 feet	10	287
Sand, fine and medium, mixed with clay, yellow and blue; appears to be getting solid around 298 feet	18	305
Pre-Cambrian rocks (?):		
Appears to be solid	2	307
Appears to be solid	60	367
Bd 27		
Patapsco formation:		
Clay, sandy	10	10
Arundel clay:		
Clay, red	10	20
Clay, brown	60	80
Patuxent formation:		
Sand, fine	10	90
Clay, brown	50	140
Sand, fine, brown	20	160
Clay, white	3	163
Sand, light	3	166
Clay, white	2	168
Sand and gravel	4	172
Clay, white	8	180
Sand and clay	29	209

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Bd 27—*Continued*		
Clay, white	5	220
Sand, fine	10	230
Sand and gravel	6	236
Sand and gravel (water)	13	249
Sand and gravel	6	255
Bd 28		
Patapsco and Arundel formations:		
Clay, brown	70	70
Clay, sandy	40	110
Patuxent formation:		
Sand, brown	10	120
Sand, brown (water)	5	125
Sand and gravel (water)	35	160
Clay, tough, white	7	167
Bd 29		
Patapsco formation:		
Clay, red	8	8
Clay, red, and sand	6	14
Sand, yellow	13	27
Arundel clay:		
Clay, pink	9	36
Clay, red	33	69
Clay, red, some sand (water)	7	76
Clay, pink	12	88
Patuxent formation:		
Mud and sand, red	31	119
Clay, white	2	121
Sand, fine, red, some mud (water)	12	133
Gravel, sand, and mud	3	136
Sand, gravel, mud (water)	1	137
Clay, white, and sand	8	145
Sand (water)	12	157
Clay and sand, white	4	161
Sand (water)	10	171
Sand, fine, pink	11½	182½
Sand, coarse (water)	2	184½
Clay, gray, and sand, fine	10½	195
Clay, white, and sand	11	206
Sand, fine, white	11	217
Gravel, large, clean (water)	1	218
Sand, fine, white	2	220
Clay, white, and sand	12	232

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Bd 30		
Patapsco formation:		
Clay, sandy, red	40	40
Clay, red	10	50
Sand, fine, and some clay	10	60
Arundel clay:		
Clay, red	140	200
Patuxent formation:		
Sand, fine (water)	48	248
Clay, white	12	260
Clay, red	20	280
Clay, white	11	291
Sand (water)	19	310
Bd 31		
Arundel clay:		
Clay, reddish brown	40	40
Patuxent formation:		
Clay, light brown	15	55
Clay, sandy, light brown (water)	2	57
Sand, fine (water)	3	60
Clay, red	1	61
Sand, fine (water)	4	65
Gravel, fine, and sand (water)	10	75
Sand and gravel (water)	5	80
Gravel, sandy, coarse (water)	7	87
Clay, white	3	90
Clay, yellow	7	97
Clay, brown and white, mixed	3	100
Sand, red (water)	6	106
Clay, light brown	14	120
Clay, blue	20	140
Clay, white and blue, mixed	10	150
Clay, blue and red, mixed	16	166
Sand, red (water)	6	172
Sand and some gravel	11	183
Clay, white, and gravel	2	185
Bd 33		
Patuxent formation:		
Clay, sandy	8	8
Clay, red	47	55
Clay, brown	7	62
Sand (water)	7	69
Clay, white	12	81
Sand (water)	8	89
Pre-Cambrian rocks:		
Rock, "rotten"	11	100

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Bd 36		
Patuxent formation:		
Clay, red	35	35
Clay and sand	15	50
Sand (water)	10	60
Clay, brown	15	75
Clay, blue	9	84
Sand	10	94
Clay, white	4	98
Gravel	5	103
Bd 37		
Patuxent formation:		
Sand and clay	23	23
Sand (water)	18	41
Clay, white	42	83
Clay, red	4	87
Clay, gray	11	98
Sand and gravel	14	112
Bd 38		
Patuxent formation:		
Clay, white, and sand	6	6
Sand	24	30
Clay, yellow, and sand	20	50
Clay, white, and gravel	26	76
Sand, coarse	4	80
Gravel, ½-inch	6	86
Bd 39		
Arundel clay:		
Clay, red, and gravel	3	3
Clay, red	8	11
Clay, blue	11	22
Clay, red	49	71
Sand, fine, and clay, red	8	79
Clay, red	19	98
Clay, blue	25	123
Patuxent formation:		
Clay, white, and sand, fine	3	126
Sand (water)	12	138
Gravel	3	141
Bd 41		
Patuxent formation:		
Clay and gravel	3	3
Clay, red	18	21

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Bd 41—*Continued*		
Clay, red, and gravel	48	69
Clay, white	2	71
Gravel	5	76
Be 1		
Patapsco formation:		
Sand and clay	15	15
Sand	38	53
Clay	33	86
Sand and gravel	16	102
Be 2		
Patapsco formation:		
Clay, yellow	112	112
Sand, fine, dry (?)	4	116
Arundel clay:		
Clay, red or blue	46	162
Sand and clay	8	170
Clay, tough, red and blue	42	212
Clay and sand, blue	6	218
Patuxent formation:		
Clay, brown	14	232
Sand, fine	6	238
Clay, white	2	240
Silt, sand, and clay	5	245
Clay, brown, and sand	13	258
Clay, tough, red	16	274
Clay, tough, brown	58	332
Sand, muddy, fine (water)	28	360
Sand, fine	10	370
Sand and gravel, medium (water)	10	380
Be 5		
Patapsco formation:		
Clay, brown	20	20
Clay, yellow	10	30
Clay, red	10	40
Clay, sandy, blue	10	50
Clay, sandy, yellow	10	60
Clay, sandy, brown	10	70
Sand, light brown	8	78
Clay, white	24	102
Sand, brown	15	117
Clay, red	50	167
Sand, light brown (water)	23	190
Clay, white and brown	10	200

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Be 5—*Continued*		
Sand, light brown	42	242
Arundel clay:		
Clay, red, hard	3	245
Clay, blue, hard	37	282
Clay, brown and blue	23	305
Patuxent formation:		
Sand, brown (water)	2	307
Clay, brown	26	333
Clay, red	12	345
Sand, gray (water)	2	347
Clay, light brown	27	374
Clay, red	20	394
"Iron pyrites," sand, red	3	397
Clay, light red	5	402
Sandstone and clay, red	2	404
Clay, red	1	405
Sand (water)	12	417
Be 6		
Patapsco formation:		
Clay, red	15	15
Clay, sandy, yellow	40	55
Clay, sandy, white	50	105
Clay, red	40	145
Clay, brown	22	167
Sand, fine, yellow (water)	12	179
Arundel clay:		
Clay, blue	43	222
"Iron pyrite"	2	224
Sand, very fine, white	12	236
Clay, red	85	321
Clay, blue	17	338
Patuxent formation:		
Sand, gray (water)	17	355
Clay, brown	58	413
Sand (water)	17	430
Be 7		
Pleistocene deposits and Patapsco formation:		
Clay, red, sand and gravel	10	10
Patapsco formation:		
Clay, pink	12	22
Clay, red, and sand	11	33
Sand, brown (caving)	55	88
Clay, white, and sand	17	105
Sand and mud, brown	7	112

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Be 7—*Continued*		
Arundel and Patuxent formations:		
Clay, red, hard	8	120
Clay, red, and sand (caving)	10	130
Mud, red, and sand (caving)	17	147
Sand and mud, white (caving)	19	166
Sand and mud, white	2	168
Clay, hard, gummy, red (caving)	12	180
Clay, hard, gummy, red	20	200
Clay, hard, red	26	226
Clay, red	22	248
Sand	5	253
Clay, red	22	275
Clay, very hard and sticky, brown and red	6	281
Clay, very sticky, brown and red	42	323
Clay, sticky, brown	13	336
Clay, gray	7	343
Clay, streaked	18	361
Clay, brown, some sand	5	366
Patuxent formation:		
Gravel, some sand and clay	4	370
Gravel with sand	9	379
Clay, white	2	381
Be 10		
Patapsco and Arundel formations:		
Sand	8	8
Clay	55	63
Sand	5	68
Clay, red	9	77
Clay, blue	13	90
Clay, blue, and wood	7	97
Clay, brown	73	170
Clay, yellow	25	195
Patuxent formation (?):		
Clay, sandy	17	212
Clay, pink	35	247
Clay, white	4	251
Sand, fine	6	257
Clay, red	98	355
Patuxent formation:		
Clay, sandy	10	365
Sand and gravel (water)	12	377
Be 11		
Patapsco formation:		
Clay, red	—	At 75

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Be 11—*Continued*		
Loam, brown, sand, fine, silt (water)	—	At 107
Clay, sandy, red	—	At 117
Sand, fine, white (water) and clay	—	At 126
Sand and clay, mixed	—	At 155
Sand, fine (water)	—	At 160
Clay, sand, gravel, mixed	—	At 169
Sand, fine, white	—	At 175
Sand, coarse	2	182
Be 14		
Pleistocene deposits:		
Surface soil	6	6
Patapsco formation:		
Clay, medium hard, white	14	20
Clay, medium hard, light pink	14	34
Sand, tight, fine	23	57
Sand, fine; clay, thin streaks, white	3	60
Sand, fine, brown	10	70
Sand, fine and coarse, white	10	80
Sand, fine, brown	9	89
Clay, medium hard, white	3	92
Clay, white	3	95
Sand, fine, white	11	106
Sand, fine and coarse (water)	6	112
Arundel clay (?):		
Clay, hard, red	3	115
Cc 1		
Potomac group:		
Sand, yellow, clay	15	15
Sand, yellow and white, clay, "iron rock"	8	23
Sand, variegated	5	28
Clay, red	2	30
Sand, variegated, clay, mostly red	34	64
Sand, coarse, and clay, yellow	1	65
Sand and clay, variegated	7	72
"Iron rock"	1	73
Clay, fine, brown	12	85
Clay, blue, rock, gray, in layers	5	90
Sand and clay, gray, rock, gray, in layers	20	110
Clay, variegated	20	130
"Iron rock," in layers	2	132
Sand and clay, in layers, variegated	92	224
Sand, fine, some clay	3	227
Clay, variegated	68	295
Clay, blue, rock, gray, sand and "peat," in layers (water)	13	308

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Cc 1—*Continued*		
Clay, in layers, blue and gray, some red	18	326
Sand, fine, white, "peat," "sand crust" layers, blue (water)	4	330
Cc 2		
Patuxent formation:		
Topsoil and clay, sandy	70	70
Sand and gravel (water)	4	74
Pre-Cambrian rocks:		
Rock, "decomposed"	22	96
"Granite"	39	135
Cc 3		
Pleistocene deposits and Arundel clay (?):		
Sand and clay	75	75
Arundel clay (?) and Patuxent formation:		
Clay, red	60	135
Clay	22	157
Sand (water)	8	165
Cc 5		
Pleistocene deposits:		
Clay, yellow	4	4
Gravel	8	12
Patuxent formation:		
Clay, red	28	40
Clay, red and brown	38	78
Sand, brown, some white	14	92
Clay, red, and sand	25	117
Sand, white (water)	28	145
"Granite," weathered	15	160
"Granite," hard, weathered	2	162
Cc 6		
Patuxent formation:		
Topsoil	4	4
Clay, yellow	7	11
Sand, fine	9	20
Clay, blue	45	65
Clay, sandy, blue	45	110
Sand, gray (water)	10	120
Cc 7		
Pleistocene deposits:		
Clay, yellow	3	3
Gravel	30	33

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Cc 7—*Continued*		
Arundel clay (?) and Patuxent formation:		
Clay, sandy	7	40
Clay, red	20	60
Clay, blue	20	80
Clay, red	30	110
Clay, brown	8	118
Clay, blue	18	136
Clay, red and brown	15	151
Sand (water)	20	171
Cc 9		
Pleistocene deposits:		
Topsoil and clay	8	8
Gravel, coarse	13	21
Sand and gravel	7	28
Arundel clay (?) and Patuxent formation:		
Clay, sandy, yellow	15	43
Clay, red	12	55
Clay, yellow	28	83
Clay, gray	21	104
Clay, red	44	148
Clay, blue, and wood	4	152
Sand, medium, blue (water)	13	165
Gravel, medium, coarse	3	168
Sand, medium, coarse, blue	6	174
Cc 13		
Patuxent formation:		
Sand	10	10
Sand, yellow	5	15
Clay, yellow	5	20
Clay, white and yellow	5	25
Clay and gravel	5	30
Sand, fine, and clay	5	35
Clay, blue and yellow, a little mica	5	40
Pre-Cambrian rocks:		
"Mica rock"	105	145
Cc 16		
Pleistocene deposits:		
Clay	13	13
Gravel (water)	4	17
Arundel clay (?) and Patuxent formation:		
Clay	33	50
Sand (water)	2	52
Clay	48	100

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Cc 16—*Continued*		
Sand (water)	8	108
Clay, very tough	82	190
Sand	12	202
Clay	3	205
Sand	4	209
Clay	2	211
Sand	29	240
Clay	7	247
Pre Cambrian rocks:		
Bedrock, "granite"	—	At 247
Cc 20		
Pleistocene deposits and Patuxent formation (?):		
Clay, sandy, yellow	35	35
Patuxent formation:		
Clay, yellow	25	60
Clay, blue	108	168
Clay, red	20	188
Clay, blue, with sand streaks (water)	12	200
Sand, coarse (water)	6	206
Cc 21		
Pleistocene deposits and Patuxent formation (?):		
Clay, sandy, brown	25	25
Patuxent formation:		
Clay, blue	43	68
Sand, fine	24	92
Clay, blue	28	120
Clay, red	25	145
Clay, blue	25	170
Sand, gray (water)	15	185
Clay, blue	9	194
Sand (water)	4	198
Sand and clay in streaks (water)	3	201
Sand (water)	3	204
Clay, gray	4	208
Sand and gravel	4	212
Sand and clay in streaks (water)	7	219
Sand and gravel, coarse	3	222
Clay	12	234
Pre-Cambrian rocks:		
Rock	8	242
Cc 23		
Patapsco formation:		
Clay, sandy, yellow, some gravel	11	11
Sand, yellow	7	18

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Cc 23—*Continued*		
Arundel and Patuxent formations:		
Clay, red	14	32
Clay, blue	17	49
Clay, red	71	120
Clay, blue	6	126
Clay, blue, with streaks of sand (water)	19	145
Rock, soft, of soapstone nature	46	191
Pre-Cambrian rocks:		
"Quartz"	2	193
"Gneiss rock," soft	16	209
"Gneiss rock," hard	75	284
Cc 27		
Pleistocene deposits:		
"Muck" and soil	10	10
Patuxent formation:		
Clay, white, very compact	8	18
Sand	18	36
Clay, yellow above blue	9	45
Pre-Cambrian rocks:		
Rock, "rotten"	23	68
Rock, hard	—	At 68
Cd 1		
Potomac group:		
Clay, brown	5	5
Clay, red	15	20
Clay, sandy	18	38
Clay, red	22	60
Clay, sandy	51	111
Sand	2	113
Clay, brown	50	163
Sand	7	170
Clay, brown	48	218
Sand (water)	9	227
Cd 2		
Potomac group:		
Clay, red	20	20
Clay, sandy, red	25	45
Clay, red and white	6	51
Clay, brown	50	101
Clay, variegated	20	121
Clay, variegated	156	277
Clay, white	7	284
Sand (water)	6	290

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Cd 3		
Patapsco formation:		
Clay, red, and sand	20	20
Clay, red	50	70
Sand	22	92
Cd 4		
Patapsco formation:		
Clay and sand, hard	15	15
Clay, red	50	65
Clay, blue	5	70
Sand	15	85
Clay, white	55	140
Gravel	7	147
Cd 5		
Potomac group:		
Clay, yellow	30	30
Sand, yellow	75	105
Clay, yellow	15	120
Clay, red	35	155
Clay, blue	34	189
Clay, red	4	193
Clay, white	1	194
Sand (water)	7	201
Cd 7		
Patapsco formation:		
Clay, red, and sand	4	4
Clay, gray	15	19
Clay, red	32	51
Clay, brown	12	63
Clay, red	56	119
Clay, white	7	126
Clay, white, and sand	4	130
Sand, white	20	150
Sand, coarser than above, light gray, and gravel, about 10 percent of sample	29	179
Cd 9		
Patapsco formation:		
Sand and gravel	70	70
Sand, fine, white	5	75
Clay, sandy, red	80	155
Gravel	15	170
Clay, white	5	175
Sand (water)	10	185

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ce 1		
Brightseat formation and/or Monmouth formation:		
Sand and clay	10	10
Clay, black	11	21
Magothy and Patapsco formations:		
Clay, white	5	26
Clay, red	10	36
Clay, white	15	51
Sand (water)	9	60
Clay, white	10	70
Gravel	8	78
Ce 2		
Brightseat formation and/or Monmouth formation:		
Sand	7	7
Magothy and Patapsco formations:		
Clay, white	23	30
Clay, sandy	55	85
Clay, white	23	108
Gravel	6	114
Ce 3		
Patapsco formation:		
Sand	8	8
Clay, sandy	22	30
Gravel	2	32
Sand	19	51
Clay, red	5	56
Sand	33	89
Clay, white	16	105
Sand	7	112
Clay, white	9	121
Sand (water)	9	130
Ce 13		
Patapsco formation:		
"Pipe clay," stiff	40	40
Clay, red, blue, brown, mixed	185	225
Clay, yellow	25	250
Clay, red, brown, mixed	26	276
Sand, very fine, yellow (water)	4	280
Clay, blue	1	281
Clay, blue and white	17	298
Sand, very fine, yellow (water)	10	308
Clay, white	2	310
Clay, very sticky, red and white	22	332
Clay, very sticky, red and blue	31	363

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ce 13—*Continued*		
Sand, fine, "dirty" (water)	5	368
Clay, red and brown	25	393
Clay, red, brown, and blue	40	433
Clay and gravel, mixed	47	480
Arundel clay (?):		
Clay, stiff, brown, red, and yellow	147	627
Patuxent formation (?):		
Clay, soft, and sand, fine	37	664
Clay, very hard	11	675
Clay, soft	20	695
Clay, and sand, very fine	15	710
Clay, blue	14	724
Clay, red and yellow	71	795
Clay, soft, and sand	2	797
Clay	1	798
Ce 17		
Aquia greensand:		
Clay, brown	25	25
Clay, brown	5	30
Brightseat formation and/or Monmouth formation:		
Clay, blue	45	75
Magothy formation:		
Sand with "mud"	29	104
Sand and gravel	4	108
Patapsco formation:		
Clay, white	1	109
Clay, gray	9	118
Ce 18		
Aquia greensand:		
Clay, yellow	30	30
Brightseat formation and/or Monmouth formation:		
Clay, blue	28	58
Magothy formation:		
Sand	7	65
Clay, gray	14	79
Sand	6	85
Patapsco formation:		
Clay, tight, pink and white	6	91
Clay, pink	10	101
Clay, tight, dry, pink or red	41	142
Clay, pink	28	170
Clay, pink	30	200
Clay, pink	137	337
Sand, fine (water)	5	342

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ce 18—*Continued*		
Clay, red	3	345
Clay, yellow, with pink streaks	5	350
Not reported	15	365
Clay, red	15	380
"Pipe clay," hard, gummy, red	10	390
Clay, gummy, red and white	15	405
Not reported	10	415
"Mud," white	18	433
Sand, blue	3	436
"Mud," blue	7	443
"Hardpan"	2	445
Sand, fine (water)	8	453
Sand, coarse (water)	7	460
Clay, red	4	464
Ce 22		
Patapsco formation:		
Sand, "rusty"	10	10
Clay, gray and white; sand	20	30
Clay, yellow; sand	10	40
Clay, white; sand	10	50
Clay, yellow; sand	10	60
Sand, yellow	20	80
Clay, white; sand	10	90
Sand, red and white	10	100
Ce 24		
Patapsco formation:		
Clay, red	14	14
Clay, brown and pink	21	35
Clay, red	83	118
Clay, brown	6	124
Clay, pink	13	137
Clay, brown	10	147
Clay, sandy	11	158
Sand, fine, gray	13	171
Sand and clay, gray	6	177
Sand, fine, gray	20	197
Clay, white	1	198
Sand, coarse (water)	5	203
Cf 1		
Magothy (?) and Patapsco formations:		
Sand and gravel	33	33
Clay, gray	1	34
Sand	25	59

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Cf 1—*Continued*		
Clay, white	4	63
Sand	4	67
Clay	1	68
Sand and gravel	6	74
Clay, white	6	80
Sand and gravel	5	85
Clay	4	89
Sand and gravel	6	95
Clay, white	4	99
Sand and gravel	6	105
Cf 2		
Aquia greensand:		
Clay	20	20
Marl	23	43
Rock	1	44
Brightseat formation (?) and/or Monmouth formation (?):		
Marl	92	136
Magothy formation:		
Sand (water)	26	162
Sand (water)	9	171
Cf 4		
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Sand and gravel	14	14
Rock	1	15
Sand (water)	13	28
Marl, blue	23	51
Magothy and Patapsco formations:		
Sand	29	80
Sand and gravel	6	86
Sand, white	12	98
Gravel	4	102
Clay, red	18	120
Clay, brown	27	147
Sand, fine	5	152
Clay, red and brown	88	240
Sand, fine, brown	4	244
Clay, sandy, red	20	264
Sand, white (water)	6	270
Cf 25		
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Soil	10	10
Marl	113	123

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Cf 25—*Continued*		
Magothy formation:		
Clay, white	5	128
Sand, fine, muddy	35	163
Patapsco formation:		
Clay, red	75	238
Sand, fine, muddy	56	294
Clay, white	19	313
Sand, very fine	15	328
Clay, yellow	37	365
Sand, white	28	393
Sand, medium coarse (water)	5	398
Cf 26		
Brightseat formation and/or Monmouth formation:		
Clay, yellow	7	7
Clay and sand	24	31
Mud, black	22	53
Gravel (no water)	18	71
Mud, black	22	93
Magothy formation:		
Sand and gravel (water)	20	113
Clay, white, and gravel	8	121
Sand and gravel (water)	22	143
Dc 1		
Pliocene (?) deposits:		
Gravel	26	26
Calvert formation and Aquia greensand:		
"Quicksand"	3	29
Marl, green	60	89
Brightseat formation and/or Monmouth formation:		
Shells	9	98
"Mud," black	12	110
Shells	9	119
Magothy (?) and Patapsco formations:		
Clay, pink; Clay, red; Clay, yellow; Clay, blue; Clay, red	236	355
Sand	10	365
Clay, blue	—	At 365
Dc 3		
Pliocene (?) deposits:		
Clay, brown, and gravel	25	25

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Dc 3—*Continued*		
Gravel	30	55
Calvert formation:		
Clay, yellow	15	70
Calvert formation and Aquia greensand:		
Marl	25	95
Marl and shells	18	113
Rock	1	114
Marl and shells	9	123
Brightseat formation and/or Monmouth formation:		
Rock and shells	2	125
Marl	46	171
Magothy (?) and Patapsco formations:		
Clay	206	377
Sand	11	388
Dc 4		
Pliocene (?) deposits:		
Clay, sand, and gravel	30	30
Calvert formation, Aquia greensand, Brightseat formation and/or Monmouth formation:		
Clay	30	60
Marl	180	240
Magothy formation (?):		
Sand, fine (water)	12	252
Potomac group:		
Clay, variegated	118	370
Clay, sandy	36	406
Clay, tough	52	458
Sand, medium fine, gray (water)	17	475
Clay, tough	145	620
Dd 2		
Aquia greensand:		
Clay, yellow	35	35
Clay, blue	21	56
Brightseat formation and/or Monmouth formation:		
Marl	40	96
Patapsco formation:		
Clay, red	264	360
Clay, blue	5	365
Sand (water)	12	377
Dd 3		
Pleistocene deposits:		
Clay, sandy, gray, some gravel	10	10

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Dd 3—*Continued*		
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl, black, and gravel	12	22
Marl, black	12	34
Magothy formation (?):		
Sand, white	8	42
Sand, white	37	79
Potomac group:		
Clay, red	49	128
Clay, brown	39	167
Clay, red	90	257
Clay, dark gray	7	264
Clay, sandy, brown	21	285
Clay, brown	7	292
Clay, red	26	318
Clay, brown	15	333
Clay, blue	13	346
Clay, brown	10	356
Clay, blue	12	368
"Iron ore rock"	7	375
Sand, fine, "muddy"	8	383
Clay, brown	7	390
Clay, blue	8	398
Sand (water)	9	407
Clay, red	2	409
Dd 4		
Pliocene (?) deposits and Calvert formation:		
Clay, sandy	40	40
Calvert formation, Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl, green	75	115
Marl, shells	3	118
Marl, green	108	226
Magothy formation:		
Sand, white	5	231
Patapsco formation:		
Clay, red	44	275
Clay, brown	121	396
Clay, red	67	463
Clay, blue	3	466
Sand, medium (water)	10	476
Dd 9		
Pleistocene deposits:		
Sand	25	25

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Dd 9—*Continued*		
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl	6	31
Rock	2	33
Marl	10	43
Rock	1	44
Marl	5	49
Rock	7	56
Marl	7	63
Rock	3	66
Marl	66	132
Magothy formation:		
Clay, white	6	138
Water-bearing strata	5	143
Dd 16		
Pliocene (?) deposits:		
Clay and gravel	20	20
Calvert formation:		
Marl, blue	40	60
Aquia greensand, and Brightseat formation and/or Monmouth formation:		
Marl, green	62	122
Marl, blue	25	147
Clay, blue	2	149
Magothy formation:		
Sand (water)	8	157
Dd 17		
Potomac group:		
Clay, red	25	25
Clay, mixed colored	24	49
Clay, gray	2	51
Sand	17	68
Clay, white	3	71
Sand	3	74
Clay, mixed colored	5	79
Clay, sandy, gray	24	103
Clay, mixed colored	95	198
Clay, white	3	201
Sand, medium (water)	13	214
Df 1		
Calvert formation:		
Clay and sand, yellow	45	45
Nanjemoy formation:		
"Fuller's earth," brown	8	53

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Df 1—*Continued*		
Aquia greensand (?):		
Not reported	27	80
Aquia greensand:		
Clay, sandy, mixed with shells	30	110
"Salt and pepper" with rock	25	135
"Salt and pepper" sand (water)	34	169
Df 5		
Pleistocene deposits:		
Sand and gravel	10	10
Aquia greensand:		
Shale, gray	40	50
Sand, gray	30	80
Sand, gray (water)	10	90
Df 16		
Nanjemoy formation:		
Clay, red	5	5
Aquia greensand:		
Sand, fine, soft, dark	40	45
Sandstone	3	48
Sand, fine, soft in spots, dark (water)	27	75
Sand, dark, and shells, hard in spots	73	148
Brightseat formation and/or Monmouth formation:		
Clay, sandy, medium hard, dark blue	69	217
Sand, dark (water)	26	243
Magothy formation:		
Clay, hard, white	4	247
Sand, medium coarse, white (water)	14	261
Magothy and Patapsco formations (?):		
Clay, medium hard, white and red	28	289
Df 21		
Pleistocene deposits and Calvert formation (?):		
Clay, sandy	35	35
Nanjemoy formation:		
Marl	18	53
Clay, brown	16	69
Aquia greensand:		
Marl	45	114
Rock	28	142
Marl and shells	49	191
Marl, sandy	21	212
Brightseat formation and/or Monmouth formation:		
Clay, black	74	286
Magothy formation:		
Sand (water)	12	298

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Eb 1		
Pleistocene deposits:		
Topsoil and clay	6½	6½
Gravel and "stones," large	12½	19
Potomac group:		
Clay, variegated	19	38
Clay, gray	9	47
Clay, sandy, gray	5	52
Clay, brownish red	3	55
Clay, brownish red	24	79
Clay, red and gray, mixed	11	90
Sand, medium-fine, gray	8	98
Clay, gummy, gray	9	107
Sand (water)	16	123
Sand (water) and clay in streaks	46	169
Clay, tough, red and gray	15	184
Clay, tough (very slow drilling)	23	207
Shale (hard drilling), in hard and soft streaks	49	256
Shale and clay, in hard and soft streaks	27	283
Clay, in hard and soft streaks, some sand	56	339
Clay, mucky, and sand, fine	90	429
Clay and sand, sand a little coarser than above	111	540
Thin sand lens and thick clay lens	27	567
Sand and gravel with thin clay lens (rough drilling)	23	590
Drills like hard rock, getting harder as it gets deeper; no rock returns except what appears to be small quartz gravel	13	603
Eb 2		
Pleistocene deposits:		
Topsoil, sand, and gravel	25	25
Potomac group:		
Clay, brown and blue	14	39
Clay, blue	11	50
Clay, brown	32	82
Clay, blue-brown	15	97
Clay, blue	7	104
Clay, sandy, blue	12	116
Sand	5	121
Clay, brown, and soft streaks of sand	9	130
Clay, blue and brown, with sand	11	141
Clay, blue and brown	10	151
Clay, blue, and sand	20	171
Clay, blue-green	10	181
Clay, hard, red	29	210
Clay, sandy, brown	32	242
Clay, coarse, sandy, blue	32	274
Sand	7	281

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Eb 2—*Continued*		
Clay, brown	22	303
Clay, sandy, blue	38	341
Sand and clay, blue	15	356
Clay, sandy, blue	48	404
Sand and clay, blue, in lenses	18	422
Clay, sandy, blue	94	516
Sand, coarse, and clay, blue	14	530
Sand, gravel, and clay	46	576
Sand and clay	24	600
Gravel and clay	12	612
Clay, hard	18	630
Eb 3		
Potomac group:		
Topsoil	5	5
Gravel, clay	15	20
Clay, red	40	60
Gravel, clay	60	120
Clay, red	60	180
Clay, blue-red	40	220
Clay, red	40	260
Clay, brown	20	280
Sand (water)	10	290
Eb 4		
Pleistocene deposits:		
Clay, red	20	20
Gravel and clay	10	30
Patapsco formation (?):		
Clay, yellow	30	60
Clay, brown	60	120
Clay, sandy, yellow	40	160
Clay, blue	32	192
Sand (water)	—	At 192
Eb 6		
Pleistocene deposits:		
Soil and clay	12	12
Sand and gravel	16	28
Potomac group:		
Marl	48	76
Clay	215	291
Sand, gray	4	295
Clay, blue	8	303
Sand, gray	2	305
Clay, blue	2	307

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Eb 6—*Continued*		
Clay, gray	2	309
Clay, blue	7	316
Sand, gray (water)	6	322
Eb 7		
Pleistocene deposits:		
Loam, brown	10	10
Potomac group:		
Clay, brown; small amount of blue	20	30
Marl, black	20	50
Clay, tough, brown	60	110
Clay, brown and blue	26	136
Clay, tough, red	17	153
Clay, brown and blue	29	182
Sand, fine, and clay (water)	16	198
Clay, sandy, gray	18	216
Clay, brown	19	235
Clay, gray-brown	16	251
Clay, dark brown	9	260
Clay, gray	6	266
Sand (water)	9	275
Ec 1		
Pliocene (?) deposits:		
Clay, sand, and gravel	32	32
Calvert formation:		
Clay	28	60
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl	185	245
Magothy formation (?):		
Sand, fine	5	250
Patapsco formation:		
Clay, variegated, very tough	115	365
Clay, sandy	55	420
Clay, tough	78	498
Sand, medium, gray (water)	12	510
Ec 2		
Calvert formation and Aquia greensand (?):		
Topsoil	2	2
Clay, yellow	58	60
Potomac group:		
Clay, red	70	130
Clay, yellow and blue	85	215
"Mud" and sand	45	260

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ec 2—*Continued*		
Clay, red	60	320
Sand (water)	7	327
Ec 3		
Aquia greensand:		
Clay, yellow	40	40
Brightseat formation (?) and/or Monmouth formation (?):		
Marl	56	96
Patapsco formation:		
Clay, red	174	270
Clay, brown	14	284
Sand (water)	11	295
Ec 4		
Pleistocene deposits:		
Sand and gravel	40	40
Potomac group:		
Clay, brown	150	190
Clay, sandy	70	260
Clay, gray	40	300
Clay, blue	25	325
Sand (water)	5	330
Ec 5		
Pleistocene deposits:		
Gravel	20	20
Brightseat formation (?) and/or Monmouth formation (?):		
Clay, blue	20	40
Potomac group:		
Clay, red	150	190
Clay, pink	72	262
Clay, white	3	265
Sand, very fine	5	270
Clay, blue	20	290
Clay, brown	5	295
Clay, white	15	310
Clay, brown	102	412
Sand, fine, muddy	3	415
Clay, brown	38	453
Sand, fine, muddy	3	456
Clay, blue	54	510
Sand, very fine (water)	10	520
Clay, brown and blue	42	562
Clay, blue	8	570
Clay, brown	99	669
Sand, muddy	5	674

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ec 5—*Continued*		
Clay, blue	26	700
Sand, muddy, medium gray (water)	20	720
Ec 8		
Pliocene (?) deposits:		
Clay, sandy, yellow	31	31
Calvert formation:		
Marl, blue	83	114
Aquia greensand:		
Marl, sandy, shells	47	161
Brightseat formation and/or Monmouth formation:		
Marl, blue	47	208
Magothy formation:		
Sand (water)	—	At 208
Ec 10		
Pleistocene deposits:		
Topsoil	10	10
Patapsco formation:		
Clay, variegated	133	143
Sand, fine, "muddy"	29	172
Clay, brown	15	187
Clay, sandy	4	191
Clay, brown and blue	47	238
Sand, medium	14	252
Ec 13		
Pliocene (?) deposits:		
Clay, red, and gravel, heavy	8	8
Calvert formation:		
Clay, yellow	13	21
Clay, blue	84	105
Aquia greensand (?):		
Shell layer	12	117
"Sand rock"	5	122
Brightseat formation (?) and/or Monmouth formation (?):		
Sand, thin layers, dark, shells in streaks	23	145
Sand, mucky, dark, and shells	22	167
Clay, soft, dark, and shells	22	189
Potomac group:		
Clay, pink	62	251
Clay, pink and gray	49	300
Clay, pink and gray, wood	39	339
Sand, fine (water)	11	350
Clay, pink and gray	59	409
Clay, sandy, brown, blue, and pink	55	464

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ec 13—*Continued*		
Sand, fine (water)	10	474
Sand, medium coarse (water)	35	509
Clay, pink, blue, and brown	6	515
Ec 14		
Pliocene(?) deposits:		
Sand and gravel	32	32
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl	98	130
Patapsco formation:		
Clay, red	41	171
Clay, yellow and pink	63	234
Clay, sandy, blue	57	291
Clay, blue	23	314
Clay, brown	34	348
Sand (water)	10	358
Ec 24		
Pliocene (?) deposits:		
Clay, sandy, yellow	20	20
Calvert formation:		
Marl, blue	70	90
Rock	1	91
Calvert formation, Aquia greensand, Brightseat and/or Monmouth formation:		
Marl, blue	81	172
Rock	1	173
Brightseat formation and/or Monmouth formation:		
Marl, blue	40	213
Patapsco formation:		
Clay, red	27	240
Ec 25		
Pliocene (?) deposits:		
Soil	5	5
Sand and gravel	35	40
Calvert formation:		
Clay, sandy	10	50
Aquia greensand (?):		
Marl	77	127
Patapsco formation:		
Clay, gray	80	207
Sand, fine	2	209
Clay, red	80	289
Sand, fine	6	295

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ec 25—*Continued*		
Clay, white	4	299
Sand, medium coarse (water)	13	312
Ec 26		
Pliocene (?) deposits:		
Sand and gravel	20	20
Calvert formation, Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl	117	137
Patapsco formation:		
Sand, fine	3	140
Clay, blue and brown	14	154
Sand, fine	1	155
Clay	85	240
Sand, fine	11	251
Clay, mixed colored	62	313
Sand, coarse (water)	11	324
Ed 2		
Pliocene (?) deposits:		
Sand and gravel	30	30
Calvert formation:		
Clay, blue	30	60
Marl, green	75	135
Aquia greensand:		
Rock, hard	2	137
Marl, green	6	143
Rock, hard	5	148
Marl, green	17	165
Brightseat formation and/or Monmouth formation:		
Marl, black	68	233
Magothy formation:		
Sand, fine	16	249
Patapsco formation:		
Clay, red	96	345
Clay, blue	18	363
Sand, very fine (water)	22	385
Clay, sandy, blue	10	395
Clay, blue	8	403
Clay, pink	36	439
Clay, blue	2	441
Clay, red	18	459
Clay, blue	2	461
Clay, soft, blue	2	463
Clay, blue	15	478
Sand (water)	19	497

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ed 3		
Pliocene (?) deposits:		
Sand and gravel	22	22
Calvert formation:		
Clay, sandy, red	9	31
Clay, blue	31	62
Calvert and Nanjemoy formations (?):		
Marl	47	109
Nanjemoy formation:		
Clay, blue	10	119
Clay, brown	11	130
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl	19	149
Shells	2	151
Marl	8	159
Rock, brown	2	161
Marl	94	255
Magothy formation and Potomac group:		
Clay, white	14	269
Sand, fine	6	275
Clay, gray	10	285
Sand, fine	20	305
Clay, gray	18	323
Sand, fine	17	340
Clay, white	10	350
Clay, mixed colored	35	385
Clay, blue	22	407
Sand, fine	3	410
Clay, blue	7	417
Sand, fine	4	421
Clay, blue	12	433
Clay, red	17	450
Clay, mixed colored	30	480
Clay, dark gray	5	485
Clay, mixed colored	21	506
Clay, brown	8	514
Clay, blue, and wood	37	551
Sand	15	566
Ed 4		
Pliocene (?) deposits:		
Rock	32	32
Calvert formation:		
Clay, black	43	75
Marl	9	84
Clay, blue	26	110

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ed 4—*Continued*		
Aquia greensand:		
Marl	10	120
Marl and shells	31	151
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl	92	243
Magothy formation:		
Clay, white	9	252
Sand, fine	12	264
Patapsco formation:		
Clay, red	86	350
Clay, blue	17	367
Sand, medium (water)	18	385
Ed 5		
Pliocene (?) deposits:		
Clay, brown	9	9
Gravel	11	20
Sand	20	40
Calvert and Nanjemoy formations:		
Marl	93	133
Shells and marl	47	180
Clay, brown	30	210
Aquia greensand:		
Marl and shells	27	237
Rock	2	239
Marl and shells	44	283
Rock	1½	284½
Brightseat formation and/or Monmouth formation:		
Marl	71½	356
Magothy formation:		
Clay	3	359
Sand (water)	16	375
Ed 6		
Pliocene (?) deposits:		
Clay, brown	5	5
Clay, blue or black	10	15
Sand and gravel	15	30
Calvert and Nanjemoy formations:		
Clay, blue or black	45	75
Marl	53	128
Marl and shells	12	140
Clay, gray	15	155
Marl and shells	13	168
Clay, brown	27	195
Clay, gray	10	205

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ed 6—*Continued*		
Aquia greensand:		
Marl and shells	11	216
Rock	1	217
Marl and shells	8	225
Rock	3	228
Marl and shells	7	235
Rock	1	236
Marl	22	258
Rock	1	259
Marl	6	265
Rock	1	266
Brightseat formation and/or Monmouth formation:		
Marl	71	337
Magothy formation:		
Clay, gray	1	338
Sand (water)	4	342
Ed 8		
Pliocene (?) deposits:		
Sand and gravel	20	20
Calvert and Nanjemoy formations:		
Marl, blue	100	120
Nanjemoy formation:		
Clay, blue	10	130
Clay, brown	30	160
Aquia greensand:		
Marl, blue	70	230
Marl, sandy	30	260
Brightseat formation and/or Monmouth formation:		
Marl, blue	70	330
Magothy formation:		
Clay, sandy	10	340
Sand (water)	10	350
Ed 21		
Pliocene (?) deposits:		
Sand and gravel	48	48
Calvert and Nanjemoy (?) formations, Aquia greensand, Brightseat formation and/or Monmouth formation:		
Clay	22	70
Marl	210	280
Magothy formation (?):		
Sand, very fine	30	310
Potomac group:		
Clay, very tough, variegated	110	420
Clay, sandy	70	490

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ed 21—*Continued*		
Clay, tough	105	595
Sand, gray (water)	12	607
Ed 22		
Pliocene (?) deposits:		
Clay, sandy, red (water)	30	30
Calvert and Nanjemoy formations:		
Clay, sandy, blue	10	40
Clay, blue	10	50
Clay, sandy, blue	20	70
Clay, blue	10	80
Clay, sandy, blue	30	110
Clay, brown	60	170
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Clay, sandy, blue	160	330
Magothy and Patapsco formations:		
Clay, light, tough	20	350
Clay, light, and sand, mixed (water)	8	358
Sand and clay	56	414
Sand (water)	13	427
Ed 24		
Pliocene (?) deposits:		
Clay, sandy, yellow	5	5
Clay, sandy, yellow, and gravel	12	17
Clay, sandy, yellow	10	27
Calvert and Nanjemoy formations:		
Clay, blue	56	83
Clay, sandy, green	35	118
Clay, gray	8	126
Clay, red and brown	20	146
Clay, gray	5	151
Aquia greensand:		
Clay, sandy, green	11	162
Clay, sandy, green, and shells	20	182
Rock, gray-green	2	184
Clay, sandy, green, and shells	8	192
Rock, gray-green	2	194
Clay, sandy, green, and shells	18	212
Rock, gray-green	10	222
Brightseat formation and/or Monmouth formation:		
Clay, gray, and sand, black	68	290
Sand, coarse	1	291
Clay, sandy, light gray	1	292
Clay, gray, and sand, black	10	302

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ed 24—*Continued*		
Magothy formation:		
Clay, sandy, white	3	305
Sand, very fine, white	9	314
Sand, white	7	321
Clay, white	10	331
Sand, coarse	5	336
Gravel, and clay, white	4	340
Clay, white	5	345
Potomac group:		
Clay, red	11	356
Clay, brown	7	363
Clay, gray	1	364
Sand, fine, gray	11	375
Clay, brown	9	384
Clay, gray	6	390
Sand, white	3	393
Clay, brown	32	425
Sand, fine, white	14	439
Clay, white, stiff	1	440
Clay, white	2	442
Clay, gray	6	448
Sand, fine, white	8	456
Sand, fine, white, with streaks of clay	17	473
Sand, fine, white	12	485
Clay, blue and red	2	487
Sand, coarser	9	496
Clay, gray	2	498
Clay, red	2	500
Clay, gray, blue and red	29	529
Clay, red and gray	4	533
Sand, white	36	569
Clay, white	2	571
Clay, red	24	595
Ed 25		
Pliocene (?) deposits:		
Clay, yellow, and gravel	29	29
Calvert and Nanjemoy formations:		
Clay, blue	29	58
Clay, green	35	93
Clay, sandy, green	26	119
Clay, gray	8	127
Clay, red-brown	14	141
Clay, gray	6	147
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Clay, sandy, green	19	166

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ed 25—*Continued*		
Clay, sandy, green, and shells	8	174
Clay, sandy, green	8	182
Rock, gray-green	1	183
Clay, sandy, green	7	190
Rock, gray-green	1	191
Clay, sandy, green	17	208
Rock, gray-green	4	212
Clay, gray, and shells	5	217
Rock, gray-green	7	224
Clay, sandy, green	58	282
Magothy formation:		
Sand, coarse, white	6	288
Clay, white, and sand	14	302
(Material not reported), sandy, fine, white	31	333
Patapsco formation:		
Clay, red	12	345
Ed 26		
Pliocene (?) deposits:		
Clay, sandy	10	10
Clay, light	10	20
Sand and gravel	10	30
Calvert and Nanjemoy formations:		
Marl, blue	10	40
Marl and sand	10	50
Marl	10	60
Marl and sand, fine	10	70
Marl and clay, blue	10	80
Clay, light brown	10	90
Clay, red	10	100
Nanjemoy formation or Aquia greensand:		
Clay and gravel	10	110
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl and shell	10	120
Marl, green	10	130
Marl and sand	10	140
Clay, sandy	10	150
Shell and gravel	10	160
Rock, hard	10	170
Rock and shell	10	180
Marl and shell	10	190
Marl, and sand, black	10	200
Clay, sandy, blue	10	210
Clay, sandy	10	220
Marl and sand	10	230
Marl, green	10	240

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ed 26—*Continued*		
Marl and clay	10	250
Marl, light	10	260
Magothy and Patapsco formations:		
Clay, white	10	270
Clay, sandy, white	10	280
Clay, light brown	10	290
Clay, sandy	10	300
Sand, fine	10	310
Sand, fine, and clay	10	320
Sand (water)	12	332
Ed 27		
Pliocene (?) deposits:		
Clay, light brown	21	21
Calvert formation (?):		
Marl, sandy	19	40
Calvert and Nanjemoy formations:		
Marl, blue	50	90
Marl, sandy	31	121
Clay, gray, tough	16	137
Clay, brown, tough	15	152
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl, blue	25	177
Rock and shells, hard	5	182
Rock, very hard	32	214
Marl, blue	71	285
Magothy formation (?):		
Clay, light	20	305
Clay, blue	22	327
Magothy formation:		
Sand (water)	11	338
Ed 28		
Pliocene (?) deposits:		
Dirt, dark	8	8
Sand and gravel, white	12	20
Sand and gravel, gray	2	22
Sand, yellow	9	31
Calvert and Nanjemoy formations:		
Clay, blue	94	125
Nanjemoy formation:		
Clay, gray	5	130
Clay, brown	4	134
Clay, gray	4	138
Clay, brown	9	147

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ed 28—*Continued*		
Clay, gray	5	152
Clay, blue	8	160
Aquia greensand (?):		
Marl, blue, and shell rock, some of the shell rock very hard	32	192
Marl, blue, and shells	20	212
Brightseat formation (?) and/or Monmouth formation (?):		
Clay, blue, and rock	64	276
Magothy and Patapsco formations:		
Sand, fine	3	279
Sand, coarse	7	286
Sand, fine	11	297
Sand, hard	18	315
Sand, fine, hard	10	325
Sand, white, hard	5	330
Sand, coarse	4	334
Sand, fine, hard, with streaks of clay	6	340
Sand, dark	5	345
Sand, white	11	356
Clay, sandy	8	364
Clay, dark	6	370
Clay, light	3	373
Clay, brown, sticky	17	390
Clay, brown	10	400
Ed 31		
Pliocene (?) deposits:		
Clay, yellow	30	30
Calvert and Nanjemoy formations:		
Marl	130	160
Clay, yellow	30	190
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl	145	335
Magothy formation:		
Sand (water)	12	347
Ed 32		
Pliocene (?) deposits:		
Gravel	20	20
Calvert formation, Aquia greensand, Brightseat formation and/or Monmouth formation:		
Clay, mixed colored	245	265
Magothy formation (?):		
Sand, very fine, "muddy"	15	280
Potomac group:		
Clay, brown and blue	132	412
Sand, "muddy"	13	425

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ed 32—*Continued*		
Clay, brown	28	453
Sand, fine, "muddy"	5	458
Clay, blue	52	510
Sand, fine (water)	10	520
Clay, blue and brown	154	674
Sand, "muddy"	4	678
Clay, blue	32	710
Sand (water)	49	759
Ee 1		
Nanjemoy formation (?):		
Clay	20	20
Aquia greensand:		
Marl, black	20	40
Sand	15	55
Sandstone	—	At 55
Sand (water)	30	85
Ee 2		
Pleistocene deposits:		
Clay	10	10
Clay and sand	20	30
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Clay, sandy (water)	70	100
Clay, "muddy"	90	190
Magothy formation:		
Sand, coarse, white	30	220
Ee 3		
Pleistocene deposits:		
Clay, brown	9	9
Clay, yellow	29	38
Nanjemoy formation:		
Marl, sandy	32	70
Clay	23	93
Aquia greensand:		
Marl	41	134
Rock	3	137
Marl	19	156
Rock	5	161
Marl	6	167
Marl, sandy	71	238
Brightseat formation and/or Monmouth formation:		
Clay, gray	9	247
Marl	63	310

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ee 3—*Continued*		
Magothy formation:		
Clay	2	312
Sand	5	317
Clay	1	318
Sand	3	321
Ee 4		
Pleistocene deposits:		
Soil	10	10
Clay and gravel	10	20
Nanjemoy formation:		
Marl	50	70
Clay	28	98
Aquia greensand:		
Marl	35	133
Rock	4	137
Marl	18	155
Rock	2	157
Marl, green	84	241
Brightseat formation and/or Monmouth formation:		
Clay	65	306
Magothy formation:		
Sand (water)	13	319
Ee 6		
Pleistocene deposits:		
Topsoil	5	5
Aquia greensand (?):		
Marl	35	40
Sand	10	50
Aquia greensand:		
Rock	2	52
Marl	53	105
Gravel	7	112
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl	73	185
Brightseat formation and/or Monmouth formation:		
Shells and marl	21	206
Rock	1	207
Marl	20	227
Clay, pink	9	236
Clay, white	3	239
Magothy formation:		
Sand (water)	23	262

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ee 31		
Calvert formation:		
Soil, and clay, light	20	20
Calvert and Nanjemoy formations:		
Marl	76	96
Nanjemoy formation:		
Clay, brown	18	114
Aquia greensand:		
Marl	40	154
Marl with streaks of rock	22	176
Marl, sandy	20	196
Rock	2	198
Marl, sandy	34	232
Rock	3	235
Marl, sticky	30	265
Rock	1	266
Brightseat formation and/or Monmouth formation:		
Marl, black, tough	63	329
Magothy formation:		
Sand, medium, gray (water)	11	340
Ee 32		
Calvert formation:		
Clay, brown	30	30
Nanjemoy formation:		
Marl	89	119
Clay, brown	27	146
Aquia greensand:		
Marl	34	180
Rock	2	182
Marl	38	220
Rock	2	222
Marl	2	224
Rock	20	244
Brightseat formation and/or Monmouth formation:		
Marl	72	316
Magothy formation:		
Clay, white	4	320
Sand (water)	9	329
Ef 1		
Pleistocene deposits:		
Soil	5	5
Sand and gravel	15	20
Aquia greensand:		
Marl, green	10	30
Sand, hard	1	31

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ef 1—*Continued*		
Marl, green	5	36
Sand, hard	1	37
Marl, green	107	144
Brightseat formation and/or Monmouth formation:		
Not reported	43	187
Rock	3	190
Marl, blue	26	216
Magothy formation:		
Sand, fine, blue	9	225
Clay, gray	3	228
Sand, medium, gray (water)	7	235
Ef 3		
Pleistocene deposits and Calvert formation:		
Clay, yellow	40	40
Nanjemoy formation:		
Marl, black	40	80
Aquia greensand:		
Marl, green	40	120
Marl, shells	30	150
Marl, green	50	200
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl, black	120	320
Magothy formation:		
Clay, white	4	324
Sand (water)	10	334
Clay, brown	17	351
Sand, coarse, gray (water)	15	366
Ef 4		
Pleistocene deposits:		
"Mud"	25	25
Aquia greensand:		
Clay, sandy	25	50
Sand, fine (water)	30	80
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Clay, silty	110	190
Magothy formation:		
Sand (water)	20	210
Ef 5		
Pleistocene deposits:		
Topsoil, sandy, brown	2	2
Sand and gravel, yellow	4	6
Aquia greensand:		
Marl, green, and sand, black	121	127

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Ef 5—*Continued*		
Brightseat formation and/or Monmouth formation:		
Marl, black	68	195
Magothy formation:		
Sand, medium coarse	31	226
Ef 6		
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl, sandy	159	159
Magothy formation:		
Clay, brown	5	164
Sand, fine (water)	5	169
Clay, brown	41	210
Sand, coarse, gray (water)	—	At 210
Ef 7		
Pleistocene deposits and Calvert formation:		
Clay, yellow	30	30
Nanjemoy formation, Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl, black	40	70
Marl, green	55	125
Marl, shells	10	135
Rock	2	137
Marl, green	88	225
Marl, shells	35	260
Clay, red	20	280
Marl, sandy	25	305
Marl, green	20	325
Marl, black	9	334
Magothy formation:		
Sand (water)	—	At 334
Fb 1		
Pleistocene deposits:		
Clay, sandy	15	15
Sand and gravel	15	30
Patapsco formation:		
Clay, red	30	60
Clay, reddish brown	60	120
Clay, sandy	60	180
Clay, brown	25	205
Clay, blue	12	217
Sand (water)	—	At 217
Fb 2		
Pleistocene deposits:		
Sand and gravel	25	25

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Fb 2—*Continued*		
Patapsco formation:		
Clay, black	20	45
Clay, red	40	85
Clay, blue and brown	30	115
Clay, red	50	165
Clay, blue and brown	50	215
Clay, white and brown	10	225
Clay, brown	13	238
Sand (water)	6	244
Fb 4		
Pleistocene deposits, Calvert and Nanjemoy formations (?):		
Soil	7	7
Clay and gravel	5	12
Clay	10	22
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl, black	58	80
Rock (water)	5	85
Marl	45	130
Patapsco formation:		
Clay, gray	10	140
Clay, sandy	8	148
Clay, yellow	12	160
Clay, sandy, gray	77	237
Clay, sandy	11	248
Clay, brown	6	254
Clay, sandy	24	278
Clay	61	339
Sand, white	6	345
Fb 6		
Pliocene (?) deposits:		
Clay and gravel	10	10
Calvert and Nanjemoy formations, Aquia greensand, Brightseat formation and/or Monmouth formation:		
Clay	121	131
Marl and shells	5	136
Rock	8	144
Potomac group:		
Clay, blue	46	190
Clay, brown	110	300
Clay, brown	100	400
Clay, red	15	415
Sand, "muddy"	6	421
Clay, blue	59	480
Sand, medium (water)	8	488

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Fb 13		
Pleistocene deposits:		
Clay, yellow, with "river rock"	25	25
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Mud, blue	15	40
Mud, dark	20	60
Clay, gray	20	80
Clay, green	5	85
"Shell rock", hard	7	92
Clay, blue	6	98
Hard	7	105
Shells	6	111
Hard like rock	4	115
"Shell rock"	3	118
Mud, blue	4	122
Mud, blue, and rock	6	128
Potomac group:		
Clay, dark, sticky	24	152
Hard streak	3	155
Clay, blue, sticky	2	157
Clay, brown, sticky	18	175
Hard	5	180
Clay, dark, sticky	18	198
Clay, yellow, sticky	17	215
Clay, dark, sticky	3	218
Clay, sandy, yellow	8	226
Clay, brown, sticky	56	282
Clay, gray, sticky	28	310
Clay, yellow, sticky	25	335
Clay, brown, sticky	27	362
Clay, sandy	3	365
Clay, gray	53	418
Clay, green	14	432
Sand, fine	16	448
Clay, green, sticky	17	465
Sand	10	475
Clay, sticky	4	479
Sand	16	495
Clay, green	5	500
Fb 14		
No record	583	583
Potomac group:		
Clay, blue	2	585
Sandstone, soft, gray	15	600
Clay, yellow	23	623
Clay, blue	4	627

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Fb 14—*Continued*		
Clay, blue, with sand	50	677
Clay, yellow	41	718
Rock	1	719
Clay, yellow	2	721
Rock	6	727
Clay, blue, with sand	6	733
Sand, fine, white	5	738
Clay, light red, with sand	28	766
Gravel, coarse	19	785
"Slate"	5	790
Sand; small amount clay, yellow	55	845
Clay, yellow and blue	20	865
Clay, yellow and blue; small amount of sand	31	896
Clay, yellow and blue	104	1,000
Fb 16		
(Dug well)	43	43
Nanjemoy formation (?), Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl	107	150
Potomac group:		
"Fuller's earth," brown	30	180
Clay, sandy	70	250
Clay, red	160	410
Fb 17		
Pleistocene deposits:		
Clay, sandy, yellow	35	35
Pleistocene deposits and/or Patapsco formation:		
Clay, blue, and gravel	30	65
Patapsco formation:		
Clay, brown and blue	25	90
Clay, brown	17	107
Clay, blue	11	118
Clay, brown	20	138
Clay, red	18	155
Clay, brown	11	166
Clay, blue	18	184
Clay, red	13	197
Clay, blue	17	214
Sand, fine (water)	3	217
Clay, brown	6	223
Sand (water)	15	238
Clay, blue, and sand	4	242
Sand (water)	17	259

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Fb 18		
Pleistocene deposits:		
Clay, sandy	35	35
Potomac group:		
Marl, blue	39	74
Clay, red	52	126
Clay, brown	55	181
Clay, blue	37	218
Clay, yellow	23	241
Clay, blue	37	278
Clay, brown	37	315
Clay, blue	34	349
Clay, brown	46	395
Sand (water)	—	395+
Fc 1		
Pliocene (?) deposits:		
Clay, yellow	25	25
Gravel	10	35
Calvert and Nanjemoy formations:		
Marl	65	100
Clay, blue	50	150
Clay, brown	25	175
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl	32	207
Rock	2	209
Marl	91	300
Marl, black	2	302
Magothy formation:		
Sand (water)	13	315
Fc 2		
Pleistocene deposits:		
Soil, sandy	5	5
Clay, brown	15	20
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Clay, black	40	60
Marl, sandy	65	125
Potomac group:		
Clay, red	255	380
Clay, black	60	440
Fc 3		
Pleistocene deposits:		
Clay, sandy	29	29
Nanjemoy formation (?), Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl, blue	31	60

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Fc 3—*Continued*		
Marl, sandy	60	120
Marl, blue	40	160
Marl, sandy	13	173
Magothy formation:		
Sand (water)	—	At 173
Fd 1		
Pliocene (?) deposits:		
Sand and gravel	40	40
Calvert and Nanjemoy formations:		
Marl	150	190
Clay, brown	28	218
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl and shells	26	244
"Pyrite rock," marl, and shells	32	276
Marl, sandy	42	318
Rock, hard	1	319
Marl	76	395
Magothy formation:		
Clay, brown	8	403
Sand, fine	7	410
Clay	2	412
Sand, medium, gray (water)	15	427
Fd 2		
Pliocene (?) deposits:		
Gravel and clay	20	20
Sand and gravel	10	30
Calvert and Nanjemoy formations:		
Marl, sandy	90	120
Marl	10	130
Marl, blue	20	150
Clay, brown	30	180
Aquia greensand:		
Marl and shells	27	207
Rock	5	212
Marl, blue	48	260
Marl, green	20	280
Brightseat formation and/or Monmouth formation:		
Marl, black	96	376
Magothy formation:		
Sand, fine, and wood	4	380
Sand, medium, gray (water)	11	391
Fd 5		
Pliocene (?) deposits:		
Clay, yellow, and gravel	50	50

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Fd 5—*Continued*		
Calvert formation:		
Marl, sandy	60	110
Nanjemoy formation:		
Marl, blue	50	160
Clay, red	30	190
Aquia greensand:		
Marl, black	10	200
Marl, sandy	10	210
Marl, shells, and rock	10	220
Marl, green	90	310
Brightseat formation and/or Monmouth formation:		
Marl, black	80	390
Clay, blue	10	400
Marl, black	10	410
Magothy formation:		
Clay, blue	5	415
Sand, fine	3	418
Sand (water)	20	438
Fd 6		
Pliocene (?) deposits:		
Soil	2	2
Sand and gravel	8	10
Clay, yellow	10	20
Calvert and Nanjemoy formations:		
Marl, blue	110	130
Marl, brown	20	150
Clay, brown	30	180
Aquia greensand:		
Marl and shells	25	205
Rock	3	208
Marl	10	218
Clay, black, and gravel	8	226
Clay, black	19	245
Brightseat formation and/or Monmouth formation:		
Clay, blue	95	340
Marl	27	367
Magothy formation:		
Sand, fine	10	377
Clay, blue	2	379
Clay, white	3	382
Sand, coarse (water)	22	404
Fd 7		
Pliocene (?) deposits:		
Gravel	7	7

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Fd 7—*Continued*		
Calvert and Nanjemoy formations and Aquia greensand:		
Clay, soft, dark	73	80
"Boulder"	½	80½
Clay, soft, dark	17	97½
"Boulder"	1	98½
Clay, soft, some hard streaks	153½	252
"Boulder", not very hard	3½	255½
Sandstone	3	258½
Clay, hard	1	259½
"Boulder", not very hard	½	260
Brightseat formation and/or Monmouth formation:		
Clay, sandy, black	38	298
Clay, soft, dark	59	357
Clay, sandy	4½	361½
Clay	1½	363
Clay, hard	4	367
Sand	1	368
Clay, sandy, hard	6½	374½
Sand	1	375½
Clay, hard	½	376
Soft and hard material, alternately	3	379
Clay, sandy, hard	2	381
Sand	3	384
Sand	3	387
Clay	1	388
Sand	1	389
Magothy formation:		
Clay and sand streaks	6	395
Sand, "free"	1	396
Clay	½	396½
Sand, "free"	5½	402
Clay, sandy	1	403
Sand, "free"	3½	406½
"Free" streaks of sand and clay	3½	410
Sand and gravel	6½	416½
Fd 10		
Pliocene (?) deposits:		
Sand and gravel, some clay	15	15
Calvert and Nanjemoy formations:		
Marl, blue	105	120
Nanjemoy formation and Aquia greensand (?):		
Clay, red, and marl	52	172
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl, reddish-blue	79	251
Marl, blue	85	336

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Fd 10—*Continued*		
Magothy formation:		
Clay, brown	8	344
Sand (water)	22	366
Fd 11		
Pliocene (?) deposits:		
Clay, sandy, brown, and gravel	24	24
Calvert and Nanjemoy formations:		
Clay, sandy, soft, brown	3	27
Clay, sandy, soft, gray to green	89	116
Clay, sandy, gray-green, with "pepper"	34	150
Clay, sandy, gray-green, with "pepper" and shells	39	189
Clay, pink and gray	16	205
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Clay, sandy, green	8	213
Clay, sandy, green, with shells	8	221
Clay, gray-green	15	236
Rock	1	237
Clay, sandy, gray-green	113	350
Clay, sandy, gray-green, with shells	19	369
Clay, dark gray	16	385
Sand, coarse, white	2	387
Clay, gray	4	391
Shells and sand, hard	2	393
Magothy formation:		
Sand, white and gray	2	395
Sand, coarse	2	397
Sand	6	403
Sand, coarse	3	406
Sand, gray, clay streaks, wood	2	408
Sand	8	416
Sand with clay streaks	2	418
Gravel, fine, and sand	24	442
Patapsco formation (?):		
Clay, pink	2	444
Fd 24		
Pliocene (?) deposits:		
Clay, brown	7	7
Sand and gravel	18	25
Calvert and Nanjemoy formations:		
Clay, blue and gray	50	75
Marl	50	125
Clay, gray	34	159
Marl	29	188
Clay, brown	32	220

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Fd 24—*Continued*		
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Shells and marl	187	407
Clay, brown and gray	16	423
Sand, fine, and shells	9	432
Magothy formation:		
Clay, brown	3	435
Sand and clay	6	441
Clay, gray	5	446
Sand, coarse, gray (water)	13	459
Fd 25		
Pliocene (?) deposits:		
Sand and gravel	20	20
Calvert and Nanjemoy formations:		
Marl	109	129
Rock	1	130
Marl	50	180
Clay, brown	20	200
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl	35	235
Rock	2	237
Marl and shells	5	242
Marl, black	128	370
Magothy formation:		
Sand, very fine	10	380
Clay	5	385
Sand, medium coarse (water)	15	400
Fd 32		
Pliocene (?) deposits:		
Clay and gravel, sandy	35	35
Calvert and Nanjemoy formations:		
Marl	15	50
Clay, blue	3	53
Marl	159	212
Clay, blue and brown	29	241
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Marl	33	274
Rock	5	279
Marl	69	348
Rock	2	350
Marl	91	441
Magothy formation:		
Clay, sandy, gray	20	461
Sand, fine	10	471

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Fd 32—*Continued*		
Clay, brown	2	473
Sand, medium coarse (water)	17	490
Fd 33		
Pliocene (?) deposits:		
Gravel fill	9	9
Clay, brown	11	20
Gravel	10	30
Calvert and Nanjemoy formations:		
Marl, blue	110	140
Marl, blue, mixed with sand, black	83	223
Clay, brown, and "mud," black	26	249
Aquia greensand (?):		
Rock, hard	1	250
"Mud," blue	2	252
Sand rock, hard	3	255
Layers of sand rock; "mud," blue, with sand	60	315
Sand rock, hard	2	317
Sand, soft, black, with "mud," blue	47	364
Sand, coarse, gray	6	370
Ff 1		
Pleistocene deposits:		
Topsoil	20	20
Calvert and Nanjemoy formations:		
Marl	152	172
Clay, brown	28	200
Aquia greensand:		
Clay, sandy, brown	80	280
Sand (water)	11	291
Ff 16		
Calvert formation:		
Clay, brown	18	18
Nanjemoy formation:		
Marl	67	85
Rock	1	86
Marl	143	229
Clay, brown	23	252
Aquia greensand:		
Marl	28	280
Marl and rock streaks	28	308
Marl	62	370
Sand (water)	9	379

TABLE 8—*Concluded*

	Thickness (feet)	Depth (feet)
Gc 1		
Pliocene (?) deposits:		
Clay	20	20
Sand and gravel (water)	—	At 30
Calvert and Nanjemoy formations:		
Sand, dark, loam	120	150
Clay, light red	25	175
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Sand, dark, loam	75	250
"Hardpan", dark	3	253
Sand, dark (water)	25	278
(Log completed from memory by well owner)		
Material unknown; large bone at 303 ft	52	330
Magothy formation (?):		
Sand, white (water)	25	355
Gf 1		
Pleistocene deposits:		
Gravel	10	10
Choptank (?), Calvert, and Nanjemoy formations:		
Sand, muddy	30	40
Marl	220	260
Clay, gray	33	293
Rock	1	294
Clay, gray	57	351
Sand (water)	9	360

TABLE 9

Logs of Wells from Which Cuttings Were Obtained

	Thickness (feet)	Depth (feet)
Ad 14		
Patuxent formation:		
Clay, silty, dark yellowish-orange	10	10
Sand, coarse, slightly clayey, pale yellowish-orange	10	20
Sand, slightly clayey, pale yellowish-orange	10	30
Gravel and sand, clayey, pale yellowish-orange	10	40
Sand, clayey, pale yellowish-orange	10	50
Sand, clayey, micaceous, pale yellowish-orange	10	60
Pre-Cambrian rocks:		
Rock, clayey, soft, micaceous, yellowish gray	10	70
Sand and rock fragments, mottled yellowish gray	10	80
Rock, micaceous, gray, crushed and pulverized	10	90
Rock, as above	40	130

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Be 11		
Patapsco formation:		
No samples	45	45
Clay, smooth, brick-red; pellets of siderite abundant	—	At 45
Clay, same as above, streaked gray and red	10	55
Clay, smooth, pink and gray	10	65
Clay, red and white, streaked; small pellets siderite prominent	10	75
Clay, tan and white, streaked	10	85
Clay, pink-red, finely micaceous; small pellets siderite	10	95
Clay, same as above, silty	10	105
Clay, red; few siderite pellets	10	115
Silt or fine sand, clayey, tan, finely micaceous; iron-oxide pellets	10	125
Sand, very fine, slightly clayey, white to tan	10	135
Sand, same as above, coarser, pink	10	145
Clay, slightly sandy, red and tan, lignitic	10	155
Clay, slightly sandy, red and gray, streaked and mottled	10	165
Sand, medium to fine, clean, red; contains a few rounded gravel pebbles up to ½ inch in diameter	4	169
Same, slightly coarser	6	175
Sand, clean, medium-grained, well-sorted, white	11	186
Be 14		
Pleistocene deposits:		
Sand and gravel, about 50% each, quartz, yellowish brown; mica flakes.	6	6
Patapsco formation:		
Clay, light gray and pinkish gray; a little sand, quartz, fine	28	34
Sand, medium to coarse, quartz, chiefly gray and cloudy; few pebbles gravel, quartz	23	57
Same as above, with a few particles clay, white	3	60
Sand, fine to coarse, quartz, light and dark gray, many grains stained yellow; a few particles clay, white	10	70
Same as above, with some gravel, small to medium, quartz	10	80
Sand, quartz, fine to coarse, yellowish orange	9	89
Clay, light gray; a few gravel, quartz	6	95
Sand, quartz, grayish yellow; a little gravel, quartz	17.5	112.5
Arundel clay (?):		
Clay, brick-red, some sand and gravel	2.5	115
Cc 5		
Pleistocene deposits:		
Silt, clayey, tan, micaceous	4	4
Gravel, rounded; quartz pebbles, white and yellow, 1 inch maximum diameter	8	12
Patuxent formation:		
Clay, red to red-pink, with streaks of clay, silty, white; a few gravel pebbles	28	40

TABLE 8—*Continued*

	Thickness (feet)	Depth (feet)
Cc 5—*Continued*		
Clay, sandy, red and pink; a few gravel pebbles and fragments of black mineral (hornblende (?))	38	78
Sand, medium-coarse, angular, well-sorted, buff-yellow; contains iron oxides in small amount	14	92
Clay, sandy and gravelly, red and red-pink; fragments of shiny black mineral imbedded in clay matrix	25	117
Sand, coarse, angular, gray-buff; as much as 35 percent of sample consists of smoky quartz grains; milky quartz grains are also abundant	28	145
Same as above	15	160
No sample	2	162
Cc 13		
Patuxent formation:		
Sand, clayey, grayish orange to light brown	10	10
Clay, silty, grayish orange, finely micaceous	5	15
Clay, silty, grayish orange and dark yellowish-orange, micaceous; lignite fragments	5	20
Clay, dense, tough, grayish orange to pale yellowish-orange	5	25
Clay, sandy, grayish orange to very pale orange	5	30
Clay, silty, soft, very pale orange to white	5	35
Pre-Cambrian rocks:		
Rock, schistose, soft, clayey and partly quartzitic, light olive-gray to greenish gray; mica	5	40
Rock, same as above, but somewhat darker in color, mica smaller, quartz grains less common	5	45
Rock, same as above, few fragments feldspar, pink	5	50
Rock, schistose, loose mica flakes, fine quartz grains	5	55
No sample; driller reports "mica rock"	35	90
Rock, schistose, similar to above samples	10	100
No sample; driller reports "mica rock"	32	132
Rock, schistose, similar to 50–55 feet sample	2	134
Cd 9		
Patapsco formation:		
No sample	10	10
Clay, silty, red-ochre	10	20
Silt, sandy, cream-tan, slightly micaceous	10	30
Same as above, red-pink	10	40
Same as above, with dark nodules	10	50
Clay, sandy, buff-cream	10	60
No sample	10	70
Sand, medium to coarse, subangular, translucent and transparent; some grains pink and yellow quartz; some tripoli	10	80
Sand, well-sorted, medium-grained, angular, pink-yellow; contains few black pellets of siderite (?)	10	90

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Cd 9—*Continued*		
Sand, coarse, angular, moderately well-sorted, pink-white; contains some iron oxides	10	100
Clay, silty, buff-white; contains some pellets dark material	10	110
Clay, sandy, red-ochre	10	120
Clay, same as above; contains some quartz fragments	10	130
Clay, slightly sandy, huff-white	10	140
Clay, very sandy, red	10	150
Sand, clean, angular, medium to coarse, pink-white	10	160
No samples	25	185
Ce 16		
Patapsco formation:		
Clay, red and white, banded, few small pebbles and sand grains, intermixed	60	60
Clay, brick-red	10	70
Clay, red and white, banded	30	100
Clay, reddish brown and white	20	120
Clay, red and white, banded, a few ironstone concretions (?), sandy near base (water)	114	234
Sand, reddish brown, muddy, with minor amount intermixed clay, reddish	10	244
Clay, blocky, brown to buff, small nodules of clay, red, and a few pebbles	10	254
Clay, sandy, gray and huff	10	264
Clay, tough, hrick-red, brown, and gray	10	274
Clay, reddish brown, gray and white, banded	10	284
Clay, sandy, red	16	300
Sand, fine, clean, pinkish white (water)	10	310
Sand, dirty, pinkish, small amount of intermixed clay	7	317
Clay, sandy, white	2	319
Sand, medium fine, clean, white	10	329
Sand, moderately fine, with coarser sand and fine gravel admixed (Sand, coarse, pink, and gravel, fine, 333–340 feet)	10	339
Sand, impure, pink, and clay, pink, intermixed, a few small pebbles	10	349
Clay, sandy, white and red	5	354
Sand, moderately coarse, reddish, and clay, sandy, white, with ironstone concretions (?) (water)	15	369
Sand and gravel, coarse, red	4	373
Clay, tough, dense, brick-red	17	390
Clay, tough, dense, dark gray	4	394
Clay, fine grained, brick-red, thinly banded, with ironstone concretions (?)	20	414
Clay, sandy, reddish brown and white, with small pebbles intermixed	10	424
Sand, moderately fine, red-brown, muddy	26	450
Sand, coarse, dirty, red (water)	10	460
Sand and gravel, coarse (up to ½ inch in diameter)	14	474

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Ce 16—*Continued*		
Arundel clay (?):		
Clay, blocky, brown to buff, and intermixed gravel	10	484
Clay, brick-red and gray	10	494
Clay, tough, brown	4	498
Clay, tough, yellowish brown, with small pebbles	10	508
Clay, sandy, tough, yellowish brown and gray	16	524
Clay, sandy, buff, with intermixed gravel	10	534
Clay, tough, brick-red	6	540
Clay, slightly sandy, hard, brown to buff	20	560
Clay, dense, thinly banded, brick-red	10	570
Clay, reddish purple and brown	10	580
Clay, dense, thinly banded, brick-red	40	620
Clay, tough, thinly banded, brownish red	40	660
Clay, thinly banded, yellowish brown	10	670
Patuxent formation (?):		
Clay, sandy, thinly banded, pink and white, with ironstone concretions (?)	36	706
Sand, moderately fine, clean, white	20	726
Sand and gravel, coarse (water)	6	732
Sand, coarse, impure, pink	2	734
Clay, sandy, coarse, gray	11	745
Sand and gravel, coarse, pink-gray	5	750
Sand and gravel, coarse, pink, with small amount of intermixed clay (water)	3	753
Sand, fine, dirty, gray	7	760
Sand, very fine, gray, and intermixed clay	7	767
Sand and gravel, coarse, red	3	770
Clay, sandy, gray, with intermixed pebbles	15	785
Clay, blocky, tough, brick-red	10	795
Clay, sandy, brown and blue-gray	20	815
Clay, soft, dark gray	20	835
Clay, sandy, dark gray	5	840
Clay, sandy, light gray to white and red	14	854
Sand and gravel, coarse, gray, (water)	2	856
Sand and gravel, medium coarse, gray (washed sample)	4	860
Sand, fine, dirty, gray (washed sample)	4	864
Clay, gray and pink-brown	20	884
Sand, fine, light brown and gray	16	890
Sand, coarse, gray-brown	10	910
Clay, tough, dark gray	—	930±
Sand, medium coarse, gray	10	945
Pre-Cambrian rocks:		
Bedrock, weathered, rusty, brown, with fragments of quartz, feldspar, and hornblende	—	At 946

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Cf 1		
Magothy (?) and Patapsco formations:		
Sand, clean, angular to subangular, pink-white	10	10
Sand, medium to coarse, partly cemented by clay, red	10	20
Same as above, slightly micaceous	10	30
Sand, fine to medium, angular and rounded, red; appears to be semi-indurated by clay, red	10	40
Sand, same as above	10	50
Same as above, but generally noncoherent	10	60
Same as above	10	70
Sand, medium-grained, angular and subangular, noncoherent, light pink-gray	10	80
Same as above	10	90
Sand, finer than above	10	100
Sand and gravel, reddish pink; sand is fine to medium-grained and semi-indurated; gravel pebbles up to 1 inch in mean diameter	10	110
Cf 26		
Brightseat formation and/or Monmouth formation:		
Sand, moderate yellowish-brown	7	7
Sand, slightly clayey, mottled, moderate yellowish-brown	24	31
Clay, silty, olive-gray, micaceous	22	53
Sand, clean, mottled, gray-white	18	71
Clay, sandy, micaceous, olive-gray	22	93
Magothy formation:		
Sand, clean, gray-white	20	113
Sand, very clayey, light gray; gravel	8	121
Sand, clean, medium to coarse	22	143
Dd 3		
Pleistocene deposits:		
Sand, clayey, buff-green, finely micaceous, glauconitic; contains some cherty gravel	10	10
Sand and gravel, brown, micaceous; pebbles of rounded and sub-rounded chert	10	20
Aquia greensand, Brightseat formation and/or Monmouth formation:		
Silt, sandy, gray, finely micaceous, glauconitic; contains a few rounded quartz pebbles	10	30
Magothy formation (?)		
Sand, clayey, fine, white, glauconitic	10	40
Same as above	10	50
Same as above, sand coarser	10	60
Same as above, finely micaceous	10	70
Potomac group:		
Clay, red, with a few plant fragments; contains a few sand grains, rounded, coarse	10	80

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Dd 3—*Continued*		
Same as above, with a few siderite pellets	10	90
Same as above, with clay, white, and siderite pellets	10	100
Same as above, with a few plant fragments	10	110
Same as above, with plant impressions	10	120
Same as above, with recemented, silty, concretion-like globs	10	130
Same as above, with one fragment lignitic or bituminous material	10	140
Same as above, with one chert pebble, rounded and pitted	10	150
Clay, red, tan, and white, mottled	10	160
Clay, red, with few pellets siderite	10	170
Clay, red with white streaks	10	180
Same as above; siderite globs	10	190
Clay, red and white, streaked and mottled	10	200
Same as above	10	210
Same as above, mostly red	10	220
Same as above; siderite	20	240
Same, red and white, streaked	10	250
Clay, soft, dark gray, with some carbonaceous material	10	260
Clay, silty, buff to red	10	270
Clay, buff-pink, with large globs siderite-cemented sand or silt	10	280
Same as above, silty	10	290
Clay, red and pink, streaked	10	300
Same as above, with a few siderite pellets	10	310
Clay, lavender-red; siderite abundant	10	320
Clay, sandy, buff and pink	10	330
Clay, gray, red-streaked, sideritic	10	340
Clay, slightly sandy, red, sideritic	10	350
Clay, gray, finely micaceous	10	360
No sample	10	370
Sand, slightly clayey, fine to medium, red	10	380
Clay, red and tan	10	390
Clay, color as above, with plant impressions	8	398
No sample	2	400
Sand, medium to coarse, angular to subangular, light gray (consists of gray, pink, and white quartz)	7	407
Df 21		
Pleistocene deposits:		
Sand, fine, clayey, dark yellowish-orange	5	5
No sample; driller's log reports sandy clay for this interval	10	15
Silt, clayey, color similar to above	5	20
Silt, clayey, dusky yellow to grayish; small amount glauconite, very fine-grained	5	25
Pleistocene deposits or Calvert formation:		
Same, mottled grayish-orange	8	33
Clay, silty, grades from above color to light olive-gray, finely micaceous	2	35

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Df 21—*Continued*		
Nanjemoy formation:		
Clay, sandy, olive-gray; glauconite, rare	5	40
Same as above, silty	5	45
Same as above, sandy and silty	5	50
Clay, light gray, smoother than above	5	55
Clay, pale red to light brownish-gray; contains small amount fine glauconite	5	60
Clay, as above, with some clay, sandy, gray	10	70
Clay, as above; glauconite	5	75
Aquia greensand:		
Clay, sandy, dark greenish-gray, glauconitic	5	80
Clay, as above; glauconite, fine-grained, black	5	85
Clay, as above, with some sand, fine	5	90
Same as above; a few fossil fragments; glauconite common	5	95
Clay, silty, dark greenish-gray, finely micaceous; occasional small fossil fragments; glauconite, fine-grained	5	100
Same as above	5	105
Clay, silty, medium gray, glauconitic; some phosphatic fragments; fossil fragments, abundant	5	110
Clay, sandy, dark greenish-gray; glauconite, very fine	5	115
Clay, dark greenish-gray; sand, medium to coarse-grained; glauconite, moderately coarse; fossil fragments, common; one foraminifer	5	120
Sand, fine-grained, glauconitic, clean; glauconite, fine-grained	5	125
Clay, sandy, dark greenish-gray, glauconitic	5	130
Siltstone, indurated, medium gray; glauconite	—	At 130
Sand, clayey, glauconitic fossil fragments, abundant; several tubular foraminifera, one small pelecypod	5	135
Clay, fossiliferous, glauconitic, with associated sand, fine	3	138
Sand, fine, glauconitic; fossil fragments noted; quartz grains, angular to subrounded, white to clear	2	140
Same as above, glauconite coarser	2	142
Clay, sandy, grayish olive-green	3	145
Sand, fine glauconitic; one foraminifer noted; one pellet phosphatic material	5	150
Clay, sandy, dusky yellow-green, glauconitic; some indurated fragments	10	160
Sand, fine, glauconitic, fossiliferous	1	161
Clay, sandy, dusky yellow-green; one foraminifer noted	4	165
Clay, sandy, semi-indurated, color as above	5	170
Sand, fine, clayey, grayish olive, micaceous; glauconite less common, fine-grained	5	175
Same as above, grading to clay, sandy	5	180
Clay, silty, grayish olive, finely micaceous	5	185
Clay, smooth, slightly sandy, olive-gray and grayish olive, fine grains of glauconite	5	190
Clay, silty, mostly olive-gray, finely micaceous	5	195

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Df 21—*Continued*		
Silt or clay, as above, grayish olive	5	200
Silt, as above	5	205
Brightseat formation and/or Monmouth formation:		
Clay, silty, olive-gray, micaceous; glauconite rare or absent	5	210
Same as above, very micaceous; glauconite absent	5	215
Same as above	5	220
Same as above, glauconite rare; fine mica common	5	225
Same as above	5	230
Clay, as above; one fossil fragment noted; few grains quartz, blue-white.	5	235
Clay, as above	5	240
Same as above, with a few grains quartz, blue-gray	5	245
Clay, finer grained	5	250
Same as above, sandy	5	255
Same as above, sand grains about 5–10 percent of sample	5	260
Clay, same as above, one shell fragment	10	270
Clay, same as above, few fragments clay, light brown	5	275
Clay, same as above, olive-gray	5	280
No sample	5	285
Magothy formation:		
Sand, medium to coarse-grained, clean, grains angular to subangular, blue-gray, translucent to pink-gray; pyrite	1	286
Sand, medium-grained, as above, with small amount of glauconite	3	289
Sand, coarser and cleaner than above, very little glauconite or pyrite	13	302
Eb 4		
Pleistocene deposits:		
Clay, very sandy, light brown, slightly micaceous; plant fragments	10	10
Gravel and sand, clayey, light brown; plant remains	10	20
Sand and gravel, very clayey, moderate yellowish-brown; plant remains	10	30
Patapsco formation (?):		
Clay, slightly sandy, mottled light brownish-gray, light olive-gray, moderate reddish-orange; siderite	10	40
Clay, sandy, mottled dusky yellow to light brown; siderite	10	50
Clay, sandy and gravelly, light brown, heterogeneous	10	60
Clay, slightly sandy, mottled light brownish-gray to olive-gray and dusky yellow; siderite	10	70
Sand, medium to coarse, very clayey, moderate brown; hematite (?) globs	10	80
Clay, very sandy, moderate brown, plant remains; glauconite; few shell fragments	10	90
Clay, sandy, mottled yellowish gray, pale red, pale yellowish-brown; glauconite; few shell fragments	10	100
Clay, sandy, mottled and streaked, dusky yellow to yellowish gray; glauconite; few shell fragments	10	110

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Eb 4—*Continued*		
Clay, silty, mottled pale brown and dusky yellow; siderite	10	120
Clay, very sandy, color as above but more reddish; siderite	10	130
Clay, sandy, yellowish gray to dusky yellow and dark yellowish-orange; glauconite; limonitic globs	10	140
Clay, slightly sandy, color as above; glauconite; few shell fragments	10	150
Clay, sandy, color as above, limonitic globs; glauconite; shell fragments	10	160
Clay, silty and sandy, medium dark-gray	10	170
Clay, silty and sandy, medium dark-gray; few granules siderite; glauconite; shell fragments	10	180
Clay, very sandy, mottled moderate brown; siderite; glauconite; shell fragments	10	190
Sand, clean, mottled, medium light-gray	2	192
Ec 4		
Pleistocene deposits:		
Sand and gravel, clayey, tan	10	10
Same as above	10	20
Same as above, more clayey; chert pebbles up to $\frac{3}{4}$ inch in maximum diameter	10	30
Gravel, clayey, sandy, red-tan	10	40
Potomac group:		
Clay, silty, red, finely micaceous; few black pellets	10	50
Clay, silty, red; contains a few iron-carbonate spherules	10	60
Same as above; spherules of iron carbonate or oxide	10	70
Clay, sandy, red; about 50 percent of sample consists of silt and sand size particles of quartz	10	80
Clay, silty, red; spherules of iron carbonate	10	90
Clay, sandy, red	10	100
Clay, silty, red; spherules of siderite	10	110
Clay, silty, red; siderite spherules and globs	10	120
Same as above	40	160
Same as above, with inclusions of clay, pale green	10	170
Same as above, sandy; spherules common	10	180
Same as above, with plant impressions	10	190
Sand, medium, clayey and silty, gray-buff, dirty, grains angular; varicolored quartz and chert	10	200
Same as above	30	230
Clay, sandy, tan to buff; estimated 50 percent clay and 50 percent quartz sand	10	240
Same as above	10	250
Sand, clayey, similar to above	10	260
Clay, sandy, tan to buff, abundant plant impressions, contains streaks clay, gray	10	270
Same as above, with white kaolin	10	280
Clay, sandy, red to buff, plant impressions	10	290
Silt, clayey, olive-green to buff, micaceous	10	300

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Ec 4—*Continued*		
Same as above	10	310
Clay, silty, red, with inclusions clay, green	10	320
Sand, medium to coarse, gray, noncoherent, clean; chert grains, milky; quartz, smoky and pink	—	At 325
Ec 10		
Pleistocene deposits:		
Clay, sandy and gravelly, tan-brown; plant fragments	10	10
Patapsco formation:		
Clay, red and pink, lignitic; siderite pellets and spherules, abundant	10	20
Clay, pink and brown to gray; siderite nodules, common	10	30
Same as above, red-brown	10	40
Same as above	10	50
Same as above, streaked with gray clay	10	60
Same as above, pink-white and red	10	70
Same as above, darker red	10	80
Same as above	10	90
Same as above, with fragments of hematite	10	100
Same as above; spherules of siderite still common	10	110
Same as above, pink and gray mottled	10	120
Same as above, mostly reddish	10	130
Same as above; siderite spherules abundant	10	140
Same as above	10	150
Sand, medium-grained, red to pink; grains angular	10	160
Same as above, slightly clayey, well-sorted	10	170
Same as above, very clayey, red	10	180
Clay, red, with large pebbles; quartz, pink and clear; few plant fragments	10	190
Clay, as above, sandy, sideritic	10	200
Clay, sandy, red-ochre	10	210
Same as above; siderite nodules, abundant	10	220
Clay, tan, pink and white, mottled; siderite spherules, abundant; some sand grains	10	230
No samples	22	252
Ec 24		
Pliocene (?) deposits:		
Sand and gravel, very clayey, dark yellowish-orange	10	10
Sand and gravel, clayey, dark yellowish-orange	10	20
Calvert formation:		
Clay, greenish gray; some chert nodules	10	30
Clay, color as above, tough; some chert granules	10	40
Clay, color as above, tough; some chert granules	10	50
Clay, color as above, clay, light olive-gray, softer	10	60
Clay, greenish gray, streaked and mottled with clay, silty, light olive-gray; chert granules	10	70

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Ec 24—*Continued*		
Clay, greenish gray, streaked and mottled with clay, silty, light olive-gray; chert granules in clay matrix	10	80
Sand, very fine, clayey, light olive-gray	10	90
Sand, very fine, light olive-gray; a few chert granules	10	100
Clay, greenish gray, streaked and mottled with silt or fine sand, light olive-gray, slightly gravelly	10	110
Clay, light gray to greenish gray, fairly tough	10	120
Aquia greensand:		
Sand, clayey, grayish olive; megafossil fragments; glauconite; foraminifera, small	10	130
Sand, clayey, as above; glauconite; foraminifera, small	10	140
Brightseat formation and/or Monmouth formation:		
Sand, fine, clayey, dark greenish-gray, glauconitic; mica, fine, small amount; foraminifera	10	150
Sand, fine, clayey, dark greenish-gray, fossiliferous	10	160
Sand, fine, clayey, dark greenish-gray	10	170
Sand or silt, color as above, very clayey	10	180
Sand, very fine, or silt, color as above	10	190
Sand, fine, clayey, dark greenish-gray, glauconitic	10	200
Patapsco formation:		
Clay, light brownish-gray streaked with moderate red and pale red; few grains glauconite in clay matrix	10	210
Clay, as above, streaked and mottled red and grayish white	10	220
Ec 25		
Pliocene (?) deposits:		
Gravel, medium, sandy, pale yellowish-orange	20	20
Gravel and sand, slightly clayey, mottled pale yellowish-orange	10	30
Gravel, sandy, mottled pale yellowish-orange	10	40
Calvert formation:		
Clay, slightly sandy, light olive-gray	10	50
Clay, tough, light olive-gray	10	60
Aquia greensand (?):		
Sand, fine, clayey, dark greenish-gray	20	80
Sand, fine, silty, dark greenish-gray	10	90
Clay or silt, sandy, olive-gray, highly micaceous	10	100
Clay, silty, olive-gray, micaceous	10	110
Clay, sandy, silty, olive-gray to medium gray	10	120
Patapsco formation:		
Clay, slightly pebbly, streaked and mottled, yellowish brown and yellowish gray	10	130
Clay, light olive-gray, streaked with clay, dusky yellow	10	140
Clay, tough, pale yellowish-brown	10	150
Clay, pale yellowish-brown to grayish	10	160
Clay, mottled, pale yellowish-brown	20	180
Clay, pale reddish-brown	20	200

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Ec 25—*Continued*		
Clay, pale reddish-brown, streaked with clay, gray	50	250
Clay, slightly gravelly, dark yellowish-orange to moderate yellowish-brown	10	260
Clay, streaked, pale yellowish-brown	10	270
Clay, yellowish gray	10	280
Ed 4		
Pliocene (?) deposits:		
Sand and gravel, tan; mica, small amount	10	10
Same as above but poorly sorted	10	20
Clay, silty and gravelly, tan and buff streaked, finely micaceous	10	30
Calvert formation:		
Clay, gray, finely micaceous; few angular quartz grains	10	40
Same as above; diatoms common	10	50
Same as above, silty; diatoms abundant	20	70
Clay, silty, slightly sandy, gray, highly micaceous; diatoms common	10	80
Clay, gray-white, tough; one fossil fragment	10	90
Same as above, finely micaceous	20	110
Aquia greensand:		
Clay or marl, sandy, greenish gray, glauconitic; shell fragments	10	120
Clay or marl, silty, greenish gray; glauconite	10	130
Silt or fine sand, marly, dark greenish-gray, glauconitic	10	140
Sand, very fine, clayey, marly, medium greenish-gray, glauconitic	10	150
Silt or fine sand, clayey, marly, glauconitic	10	160
Clay, silty, marly, greenish gray; glauconite	10	170
Brightseat formation and/or Monmouth formation:		
Clay, silty, sandy, dark greenish-gray, slightly fossiliferous, micaceous	10	180
Silt or very fine sand, clayey, dark greenish-gray, micaceous	10	190
Sand, very fine, clayey, dark greenish-gray, micaceous	10	200
Silt or fine sand, clayey, dark greenish-gray, micaceous; glauconite	10	210
Same as above, color as above or darker	10	220
Magothy formation (?):		
Silt, clayey, sandy, medium dark-gray; few pieces clay, soft, whitish	10	230
Silt, clayey, medium gray; clay, soft, white	10	240
Sand, fine, clayey, dark gray, micaceous	10	250
Magothy formation:		
Sand, medium coarse, moderately clean, light gray to light olive-gray, well-sorted	10	260
Patapsco formation:		
Clay, pale reddish-brown and light brown, streaked and mottled	20	280
Clay, red and tan; one fossil plant impression	10	290
Clay, red and white, streaked	10	300
Same as above; fossil plant impressions	10	310
Same as above; streak of lavender-pink clay	10	320
Same as above; fragments of wood	10	330
Same as above; spherules of siderite or limonite	10	340

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Ed 4—*Continued*		
Same as above; siderite pellets abundant; some clay, white	10	350
Clay, sandy, gray-buff	10	360
Ed 8		
Pliocene (?) deposits:		
Silt or fine sand, tan, gravelly; plant fragments	10	10
Same as above, with glauconite, mica; no plant fragments	10	20
Calvert formation:		
Clay, silty, light gray; few small fragments phosphatic pebbles; diatoms	10	30
Clay, same as above; one grain glauconite; diatoms, abundant	10	40
Same as above, slightly sandy; diatoms, common	10	50
Nanjemoy formation:		
Silt, clayey, gray; fair amount glauconite; few shell fragments	10	60
Same as above, sandy, glauconitic	10	70
Silt, sandy, gray, glauconitic; sand grains mostly rounded clear quartz	10	80
Same as above, glauconite mostly black; few small grains pyrite	20	100
Sand, dark gray, clayey, glauconitic; shell fragments common	20	120
Clay, gray with pinkish tinge; few shell fragments	10	130
Clay, pink; one fish tooth fragment	10	140
Clay, silty and slightly sandy, dark gray	10	150
Clay, pink	10	160
Aquia greensand:		
Clay, pink grading to gray-green glauconitic sandy clay	10	170
Clay, pink, with streaks green-gray silty clay, glauconitic	10	180
Sand, very fine, clayey, gray-green, glauconitic	20	200
Same as above; a few large shell fragments	10	210
Silt, clayey, gray-green, with fragments of clay, tan	10	220
Same as above, highly glauconitic	10	230
Sand, fine, clayey, gray-green	20	250
Same as above, less clayey	10	260
Brightseat formation and/or Monmouth formation:		
Clay, silty, dark gray; glauconite less common; mica flakes more conspicuous	10	270
Same as above, glauconite rare; one foraminifer	10	280
Same as above; very large shell fragments	10	290
Same as above, sandy; sand grains consist of rounded blue-gray quartz in clay matrix	10	300
Same as above; shell fragments, common	10	310
Same as above; almost no shell fragments; no glauconite	10	320
Same as above; glauconite absent	10	330
Magothy formation:		
Sand, clean, coarse to medium-grained, angular to subangular, blue-gray	10	340
Same, coarser, color as above, with pyrite and marcasite	10	350

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Ed 9		
Pliocene (?) deposits:		
Clay, yellowish, and gravel	18	18
Calvert formation:		
Clay, micaceous, dark green, not limy	30	48
Sand, fine to coarse, grayish, with clay, yellow, red, and dark green; glauconite and shell fragments	60	108
Nanjemoy formation:		
Clay, micaceous, sandy, dark, not limy	12	120
Sand, medium to coarse, some clay, dark, bits of shells, glauconite plentiful	6	126
Clay, fine-textured, light red, with gray streaks, containing pebbles up to ½ inch in diameter	10	136
Aquia greensand:		
Sand, clayey, medium to fine, dark green, and clay, limy, containing glauconite, greensand marl	12	148
Clay, pebbly, red, and sand, medium to coarse, greenish, containing glauconite	11	159
Shell fragments, a small amount of coarse sand and glauconite	30	189
Rock and sand	3	192
Sand, fine to medium, greenish, gray, limy, glauconite plentiful, a few shell fragments	8	200
Rock, soft	2	202
Sand, clayey and limy, fine to medium, dark green, glauconite plentiful, a few shell fragments	18	220
Rock, hard	3	223
Brightseat formation (?) and/or Monmouth formation (?):		
Sand, coarse, gray and yellowish, with a little pink and dark greenish clay, some glauconite and shell fragments	40	263
Brightseat formation (?) and/or Monmouth formation (?) and Magothy formation (?):		
Sand, coarse, gray, and gravel, fine, with shell fragments and a small amount of glauconite	87	350
Magothy formation (?) and Potomac group:		
Clay, red, not limy, with gravel, fine, and a small amount of clay, dark gray	20	370
Sand, medium to coarse, grayish, with a small amount of clay, yellow to red, a small amount of glauconite	30	400
Gravel, yellowish, with a small amount of glauconite sand, dark, limy, some bits of shells, reptilian teeth	13	413
"Gumbo"	30	443
Gravel, yellowish, and sand, coarse, shell fragments, clayey nodules, red and brown, bits of lignite, few grains of glauconite	8	451
Gravel and sand, coarse, clay, brownish red, bits of glauconite marl	60	511
Clay, gritty, light brownish and gray, with bits of lignite	12	523
Rock	2	525

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Ed 9—*Continued*		
Clay, gritty, light grayish-brown	70	595
Rock	3	598
Clay, red, white, and gray	65	663
Rock	2	665
Clay, red, with fine gravel and lignite	130	795
Gravel and sand, coarse, grayish, a small amount of clay, red and dark, and lignite	60	855
Clay, brown, buff, red, and white	40	895
Sand, medium to coarse, brownish gray, a small amount of clay, red	85	980
Rock	2	982
Clay, pebbly, red and gray	20	1002
Sand, coarse, and gravel, with clay, red, brown, and gray	35	1037
Clay, red, and clay, stiff, gray to dark gray, with fine gravel	65	1102
Clay, gritty and stiff, unctuous, gray to dark gray, and clay, red	70	1172
Clay, red, and clay, stiff, gray, with fine gravel	18	1190
Clay, stiff, unctuous, gray and dark gray, and clay, sandy, reddish and gray	100	1290
Clay, unctuous or sometimes gritty, stiff, gray, dark gray, red and brownish, and gravel, fine (called shale by driller)	100	1390
Sandstone, fine, brownish gray and dark gray; conglomerate, fine, dark; clay, sandy, reddish, and lignite	6	1396
Clay, unctuous, gray, dark gray, and brown, with sand and gravel, coarse	115	1511
Ed 31		
Pliocene (?) deposits:		
Clay and silt, pebbly, dark yellowish-orange	10	10
Sand, clayey and gravelly, yellowish orange to yellowish brown	20	30
Calvert formation:		
Clay, pale olive-gray	10	40
Same as above, pebbly	10	50
Clay, yellowish gray, slightly pebbly	10	60
Clay, tougher than above, yellowish gray	20	80
Silt and clay, light olive-gray	20	100
Nanjemoy formation:		
Sand, very clayey, olive-gray	10	110
Sand, clayey, olive-gray	30	140
Sand, clayey, shelly, olive-gray	10	150
Sand, clayey, olive-gray	10	160
Clay, smooth, pale yellowish-brown	10	170
Clay, smooth, pale red to light brown	10	180
Clay, smooth, light brown	10	190
Aquia greensand:		
Sand, clayey, olive-gray	10	200
Sand, clayey, shelly, with rock fragments, light olive-gray	10	210
Sand, clayey, shelly, greenish gray	10	220

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Ed 31—*Continued*		
Sand, clayey, dark greenish-gray	10	230
Sand, clayey, dark greenish-gray to olive-gray	10	240
Sand, clayey, olive-gray	10	250
Sand, clayey, dark greenish-gray	10	260
Sand, fine, dark greenish-gray	10	270
Brightseat formation and/or Monmouth formation:		
Clay, sandy, olive-gray, micaceous	10	280
Sand, clayey, micaceous, olive-gray	10	290
Silt or clay, sandy, olive-gray to medium dark-gray	10	300
Clay, sandy, shelly, olive-gray to medium dark-gray	10	310
Clay, sandy, olive-gray to medium dark-gray	10	320
Sand, very clayey, olive-gray	10	330
Magothy formation:		
Sand, coarse, clean, mottled yellowish gray	10	340
Ee 3		
Pleistocene deposits:		
Sand, very fine, tan and buff; some dark glauconite; a few larger quartz fragments, white	20	20
Nanjemoy formation:		
Silt, sandy and clayey, dark green, highly glauconitic	10	30
Sand, fine, clayey, dark gray, glauconitic; sand grains mostly quartz, subrounded, clear	10	40
Same as above	10	50
Same as above, with a few grains quartz, green	10	60
Same as above	10	70
Clay, smooth, light gray, finely micaceous; glauconite	10	80
Clay, smooth, red-buff, slightly glauconitic	10	90
Clay, red and blue-gray	10	100
Aquia greensand:		
Sand, salt and pepper, medium-grained; glauconite; quartz grains, rounded to subangular, semi-frosted	10	110
Similar to above, finer, slightly clayey	10	120
Same as above	30	150
Same as above, two foraminifera fragments	10	160
Same as above	10	170
Similar to above, but clean; small foraminifera more common; glauconite lighter in color	10	180
Same as above	10	190
Same as above, finer-grained sand	10	200
Same as above	40	240
Brightseat formation and/or Monmouth formation:		
Clay, silty, gray, finely micaceous	10	250
Sand, slightly clayey, gray-green, glauconitic; clay of chocolate-brown hue	10	260
Same as above, with a few shell fragments	10	270

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Ee 3—*Continued*		
Same as above; glauconite, abundant; quartz grains generally tan to clear	10	280
Clay, dark gray, finely micaceous, slightly glauconitic	10	290
Same as above, with few calcite fragments	10	300
Magothy formation:		
Sand, clean, coarse to fine, angular to subangular; quartz, gray, dull to clear; glauconite, common	10	310
Same as above, sand mostly fine-grained; few plant fragments; glauconite, common	10	320
Ee 4		
Pleistocene deposits:		
Sand, clayey, tan, with some gravel, angular, and silt, gray	10	10
Pleistocene deposits and Nanjemoy formation:		
Sand, fine, silty, gray; glauconite, dark, abundant; pebbles of clay, sandy, tan	10	20
Nanjemoy formation:		
Clay, slightly sandy, dark gray, glauconitic	10	30
Same as above	20	50
Same as above, with shell fragments	10	60
Same as above, with a few foraminifera	10	70
Clay, light gray, finely micaceous; one plant fragment	10	80
Clay, red-buff, smooth	20	100
Aquia greensand:		
Clay, silty; glauconite; quartz grains, clear, rounded, in clay matrix	10	110
Sand, very fine, clayey, green; shell fragments	20	130
Sand, fine to medium, green; glauconite, botryoidal, about 50 percent of sample; a few foraminifera	10	140
Same as above, shell fragments abundant	30	170
Same as above, foraminifera	10	180
Same as above, finer grained	10	190
Same as above, very slightly clayey	10	200
Same as above, with clay, silty, finely micaceous, gray	10	210
Sand, fine to medium, highly glauconitic; foraminifera	20	230
Sand, fine, clayey, glauconitic	10	240
Brightseat formation and/or Monmouth formation:		
Clay, silty, dark gray; foraminifera	10	250
Silt, dark green, glauconitic	10	260
Clay, dark gray; very little glauconite	10	270
Silt, clayey, dark, glauconitic	30	300
Magothy formation:		
Sand, coarse, gray, with silt, gray; some pelecypod shells	10	310
Ee 6		
Pleistocene deposits:		
Clay, sandy, buff, few spots red, slightly ferruginous, slightly carbonaceous	10	10

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Ee 6—*Continued*		
Aquia greensand (?):		
Clay, silty, light gray, mottled red, overall color of brownish red, few pieces of clay, dark gray	10	20
Clay, slightly sandy, gray to dark gray, one piece slightly carbonaceous	10	30
Clay, slightly silty, gray, slightly carbonaceous; one plant stem observed; few thin seams of ferruginous material	10	40
Clay, slightly silty, carbonaceous; plant remains moderately abundant	10	50
Aquia greensand:		
Limestone, hard, light gray, composed of abundant foraminifera; quartz grains, angular; glauconite, abundant	2	52
Sand, very fine, clayey, gray; glauconite, fairly abundant	8	60
Sand, fine, clayey, gray; glauconite, as above	10	70
No sample	10	80
Sand, fine, gray, few quartz pebbles, few pieces clay, sandy, gray to light green; glauconite, moderately abundant	10	90
Sand, fine, clayey, gray, glauconite	20	110
Sand, fine, very clayey, gray; glauconite, small, black, moderately abundant, a few large pebbles	10	120
Sand, fine, clayey, gray; glauconite, as above; shell fragments	10	130
Same as above, with foraminifera	10	140
Brightseat formation and/or Monmouth formation:		
Clay, silty, and slightly sandy; glauconite; mica, moderately abundant; foraminifera, moderately abundant	10	150
Sand, very fine, very clayey, gray; glauconite, mica, and foraminifera, as above	10	160
Clay, silty, gray; glauconite; mica, moderately abundant; foraminifera, common	10	170
Clay, silty, gray; glauconite; foraminifera, common; mica	10	180
Clay, silty to fine sandy; glauconite; mica; foraminifera	20	200
Clay, fine sandy, gray; glauconite; foraminifera; mica	20	220
Same as above; ostracods noted	10	230
Clay, silty, gray, few larger grains of milky quartz	20	250
Magothy formation:		
Sand, medium, mostly milky quartz, some clear quartz, subangular and subrounded; pyrite	10	260
Ee 31		
Calvert formation:		
Clay, grayish yellow and mottled moderate yellow	10	10
Clay, grayish yellow as above, with mottled iron-oxide stained inclusions	10	20
Clay, silty, olive-gray to light olive-gray, with a few globs orange-colored clay in gray matrix	10	30
Clay, yellowish gray, even-textured; glauconite; mica, rare	10	40
Clay, silty, yellowish gray, even-textured; glauconite, rare	10	50
Sand, very fine, clayey, light olive-gray; glauconite, rare; mica, rare	10	60

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Ee 31—*Continued*		
Sand, very fine, clayey, light olive-gray; glauconite; mica	10	70
Nanjemoy formation:		
Clay, sandy, medium dark gray; glauconite, common; some small foraminifera; microgranular pyrite	10	80
Clay, silty, finely micaceous, olive-gray; glauconite, common; pyrite; foraminifera, rare	10	90
Clay, sandy, olive-gray, with globs of clay, dusky, yellow; glauconite; a few foraminifera	10	100
Clay, pale yellowish-brown, even-textured, dense; few pieces glauconite	10	110
Clay, pale yellowish-brown to light brown, smooth; less glauconite than above	10	120
Aquia greensand:		
Sand, fine, very clayey, light olive-gray; few pieces brown clay; glauconite	10	130
Sand, fine, clayey, grayish olive, with globs of clay, pale yellowish-brown; glauconite; foraminifera, small	10	140
Sand, fine, clayey, grayish green; glauconite; agglomerates of fine glauconite with calcareous cement; foraminifera, rare	10	150
Sand, fine, clayey, greenish gray; glauconite, common; agglomerates of fine glauconite with calcareous cement; shell fragments common	10	160
Sand, fine to medium, clean, dusky yellow-green; glauconite, abundant	10	170
Sand, fine, clayey, dusky yellow-green; glauconite; few agglomerates of glauconite with calcareous cement; shell fragments common; foraminifera, small, rare	10	180
Sand, fine, very clayey, dusky yellow-green; glauconite; foraminifera, small, rare	10	190
Sand, fine, clayey, dusky yellow-green; glauconite, common; foraminifera, very small, common	10	200
Sand, medium, less clayey, dusky yellow-green; glauconite, as above; foraminifera, very small, common	10	210
Sand, medium, clayey, dusky yellow-green; glauconite, common; calcite, pink, fine, moderately common	10	220
Sand, medium, clayey, dusky yellow-green; glauconite, as above; few pieces calcite; foraminifera, very small, rare	10	230
Sand, fine to medium, clean, dusky yellow-green; glauconite; few foraminifera	10	240
Sand, medium, dusky yellow-green; glauconite; mica, common	10	250
Sand, fine to medium, clayey, dusky yellow-green; glauconite; mica, common; few foraminifera	10	260
Brightseat formation and/or Monmouth formation:		
Clay, sandy, micaceous, olive-gray; glauconite, green, common; foraminifera, abundant; macrofossil fragments, common; mica, abundant	10	270
Clay, sandy, micaceous, olive-gray; glauconite, as above; foraminifera, abundant	10	280

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Ee 31—*Continued*		
Clay, very sandy, micaceous, olive-gray; glauconite, rarer than above; foraminifera, scarce; mica, common	10	290
Sand, very clayey, micaceous, olive-gray; glauconite, rare; foraminifera, rare; mica, common	10	300
Sand, very clayey, micaceous, olive-gray; glauconite, rare; foraminifera, small, rare; mica, common	10	310
Sand, very clayey, micaceous, olive-gray; glauconite, rare; mica, common; few grains pyrite	10	320
Sand, very clayey, olive-gray to medium dark-gray; glauconite, as above; pyrite, more common	10	330
Magothy formation:		
Sand, coarse, clayey, olive-gray; microgranular pyrite; few grains glauconite	10	340
Ee 32		
Calvert formation:		
Sand, fine, clayey, dark yellowish-orange	30	30
Nanjemoy formation:		
Sand, clayey, olive-gray to dark greenish-gray	60	90
Sand, clayey, dark greenish-gray	30	120
Clay and sandy clay, pale yellowish-brown	20	140
Clay, grayish orange-pink	10	150
Aquia greensand:		
Sand, clayey, light olive-gray	25	175
Sand, fine, clayey, light olive-gray to olive-gray	25	200
Sand, clayey, olive-gray	20	220
Sand, fine, very clayey, light olive-gray	10	230
Sand, clayey, olive-gray	30	260
Brightseat formation and/or Monmouth formation:		
Sand, clayey, micaceous, olive-gray	10	270
Clay, sandy, olive-gray to medium dark-gray	10	280
Sand, clayey, medium dark-gray	20	300
Sand, clayey, olive gray to medium dark-gray	10	310
Magothy formation:		
Clay, light gray to medium gray	10	320
Sand, dull gray	10	330
Ef 1		
Pleistocene deposits:		
Gravel and sand, tan; composed mostly of semi-frosted quartz and chert grains	10	10
Same as above, with gravel pebbles up to ½ inch in maximum diameter; few grains reworked glauconite	10	20
Aquia greensand:		
Silt, clayey and sandy, olive-green, glauconitic; some mica flakes	10	30
Same as above, with limonitic globs	10	40

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Ef 1—*Continued*		
Sand, fine to medium, glauconitic, clean, with shell fragments	20	60
Same as above, slightly coarser	10	70
Sand, medium-grained, slightly clayey, green-brown; shell fragments, common; glauconite, abundant	10	80
Same as above, clayey; tan quartz, common	10	90
Sand, finer grained than above; glauconite present but not common; tan quartz, common	10	100
Sand, very fine, clayey, glauconitic; quartz grains mostly clear, subrounded to angular	10	110
Same as above	10	120
Same as above, few small fragments pink clay (cavings ?)	10	130
Sand, as above, olive-green, glauconitic	10	140
Brightseat formation and/or Monmouth formation:		
Silt, dark gray, finely micaceous, with a few shell fragments; few grains dark glauconite; foraminifera	10	150
Same as above	10	160
Same as above, with dull blue-gray quartz sand grains	10	170
Same as above, with clay, dark gray; increase in sand content; finely micaceous	10	180
No sample	10	190
Clay, lighter gray, finely micaceous	10	200
Same as above	10	210
Magothy formation:		
Sand, coarse, well-sorted; consists of quartz, subangular, blue-gray and gray; few grains glauconite	10	220
Ef 3		
Pleistocene deposits:		
Sand, fine, and silt, clayey, tan; few pieces gravel; few pieces clay, white	10	10
Same as above, gravel more plentiful	10	20
Sand, fine, and silt, clayey, tan; one piece gravel	10	30
Sand, fine, and silt, clayey, tan	10	40
Calvert formation:		
Sand, fine, yellowish brownish-gray; glauconite, rare; diatoms	10	50
Nanjemoy formation:		
Clay, silty and sandy, grayish green; mica; glauconite	10	60
Silt, sandy, olive-gray; mica; glauconite, about 5–10 percent of sample	10	70
Sand, fine, silty, olive-gray, darker than above; glauconite, as above	10	80
Aquia greensand:		
Sand, fine, silty, yellowish green; glauconite, abundant; foraminifera, abundant; small shell fragments	10	90
Sand, fine and medium, grayish green, glauconitic; foraminifera, abundant; shell fragments	10	100
Sand, fine and medium, yellowish green, glauconitic; foraminifera, less abundant than above; shell fragments	10	110

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Ef 3—*Continued*		
Sand, fine and medium, yellowish green, glauconitic; foraminifera, abundant; shell fragments	10	120
Sand, fine and medium, grayish green, glauconitic; shell fragments, abundant; few globs of glauconite and quartz sand indurated by calcium carbonate	20	140
Sand, fine and medium, grayish green, glauconitic; shell fragments, less abundant than above; more indurated globs	10	150
Sand, fine and medium, slightly silty, green to olive-gray, glauconitic; shell fragments, scarce	10	160
Sand, fine and medium, silty, green to olive-gray, glauconitic; foraminifera, rare	10	170
Sand, fine and medium, silty, yellowish green; foraminifera, rare	10	180
Sand, fine and medium, silty, yellowish green, glauconitic; foraminifera, plentiful	10	190
Sand, fine and medium, silty, yellowish green; glauconite; foraminifera, rare	10	200
Sand, fine and medium, yellowish green, glauconitic; foraminifera, plentiful	10	210
Sand, fine, yellowish green, darker than above, glauconitic; foraminifera, small, rare; few flakes mica	10	220
Sand, fine, as above, glauconitic; few flakes mica	10	230
Sand, fine, grayish green, glauconitic; few flakes mica; few grains quartz, well-rounded, medium, light gray	10	240
Sand, fine, grayish green, glauconitic; few flakes mica	10	250
Brightseat formation and/or Monmouth formation:		
Clay, silty, gray; glauconite; few flakes mica; foraminifera, small, rare	10	260
Clay, silty, gray; glauconite, abundant, moderately micaceous; shell fragments; foraminifera, small, abundant	10	270
Clay, silty, gray; glauconite, abundant, moderately micaceous; shell fragments and bone (?); foraminifera, common	10	280
Silt, clayey, gray; some sand, fine; glauconite, abundant; foraminifera; shell material	10	290
Silt, clayey, gray; some sand, fine; glauconite, abundant; foraminifera, common; shell fragments and bone (?)	10	300
Silt, clayey, gray; some sand, fine; glauconite, abundant, micaceous; foraminifera, common	10	310
Silt, clayey, gray; some sand, fine; glauconite, less abundant than above; foraminifera, common	10	320
Magothy formation:		
Clay, light gray; one piece quartz, angular, gray, 4 mm. long	4	324
Sand, medium, light gray, fairly well sorted; pyrite, plentiful; glauconite, rare	10	334
No sample; driller's log reports brown clay for this interval	17	351
Sand, fine and medium, yellowish gray; quartz grains mostly translucent, gray, angular	15	366

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Fb 4		
Pleistocene deposits, Calvert and Nanjemoy formations (?), Aquia greensand, Brightseat formation and/or Monmouth formation:		
No samples; see driller's log	80	80
Sand, fine, green, highly glauconitic; abundant shell fragments	5	85
No samples; see driller's log	45	130
Clay, gray; glauconite, fine; pebbles of green rock, hard, rounded, in clay matrix	10(?)	140(?)
No samples; see driller's log	20	160
Patapsco formation:		
Clay, reddish gray; glauconite; pebbles of rock, green, and quartz, blue	10	170
Clay, silty, reddish buff; quartz grains, subrounded	10	180
Same as above, streaked with clay, white	10	190
Clay, tan and white streaked, slightly lignitic	10	200
Clay, gray and pink; siderite pellets; grains of quartz, blue-gray	10	210
Clay, tan and gray	10	220
Clay, red-buff, finely micaceous; plant fragments	10	230
Clay, as above; a few siderite pellets	10	240
Clay, as above, sandy; a few quartz pebbles	10	250
Sand, quartz grains, tan, yellow, blue; silty clay and silt; few grains glauconite or phosphatic material	10	260
Sand, clayey, red-tan; a dark mineral, fine, abundant; quartz grains, blue, white, clear	10	270
Clay, sandy, tan; sand grains; quartz, blue, tan	10	280
Clay, gray; quartz grains, tan, blue; finely micaceous	10	290
Clay, sandy, red; plates of a black mineral	10	300
Clay, sandy, pink and tan; a few siderite pellets	10	310
Clay, silty, tan and white streaked	10	320
Clay, silty, gray	10	330
Clay, silty, gray to buff-gray	10	340
Sand, fine-grained, light gray, noncoherent; a few coarse mica plates	5	345
Fb 17		
Pleistocene deposits:		
Clay, sandy, silty, red; a few angular quartz pebbles; plant material	10	10
Sand and gravel, clayey, red as above; few pieces lignitic material	10	20
Same as above, with plant fragments; a few pieces rock (schist ?), green, rounded	10	30
Pleistocene deposits and/or Patapsco formation:		
Gravel, clayey; quartz, tan and white, angular; pebbles dark rock; clay, gray to tan	10	40
Same as above; material is heterogeneous	10	50
Clay, tan, red, and gray, micaceous; fragments of chert, white, angular and subangular	10	60
Clay, tan and gray; few chert pebbles, rounded	10	70
Patapsco formation:		
Clay, as above; some mottled pink; plant remains	10	80
Same as above, with pebbles of siderite (?), rounded	10	90

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Fb 17—*Continued*		
Clay, sandy, red and gray, micaceous; quartz grains, subangular, abundant	10	100
Same as above; less sand	10	110
Same as above	10	120
Same as above; inclusions of clay, gray, soft, smooth	10	130
Clay, red, tan, and brown	10	140
Clay, sandy and silty, red-brown	10	150
Same as above, lignitic; one pellet marcasite	10	160
Clay, very sandy, gray and tan, lignitic	10	170
Clay, sandy, pink and gray; quartz grains, chiefly blue in color	20	190
Sand, fine to medium, slightly clayey, pink-red	10	200
Same as above, slightly micaceous	10	210
Same as above, coarser	10	220
Sand, medium to coarse, lighter in color than above; a few clay fragments	10	230
Same as above, less well-sorted	10	240
Sand, clayey, gray, micaceous	10	250
Sand, clayey, gray, micaceous	5	255
Fc 3		
Pleistocene deposits:		
Clay, slightly sandy, grayish yellowish-orange	13	13
Clay, light olive, sticky; a little glauconite; foraminifera	7	20
Nanjemoy formation (?):		
Clay, grayish orange, pale brown; glauconite; foraminifera and radiolaria, very rare	12	32
Aquia greensand:		
Clay, grayish olive; glauconite; mica; a few shell fragments; ostracods; radiolaria; foraminifera, rare; bone	5	37
Clay, brownish gray; glauconite, fairly abundant; shell fragments; foraminifera, rare	8	45
Clay, somewhat sandy, brownish gray, constituents as above	10	55
Clay, slightly sandy, light olive-gray; glauconite; ostracods; foraminifera, abundant	7	62
Clay, sandy, light olive-gray; glauconite; shell fragments; foraminifera, abundant	8	70
Clay, sandy, light olive-gray; glauconite; shell fragments; foraminifera	5	75
Clay, sandy, olive-gray; glauconite; foraminifera	5	80
Clay, sandy, grayish olive; glauconite; foraminifera	6	86
Clay, light olive-gray; much lime-cemented glauconite and quartz; foraminifera	8	94
Same as above; foraminifera absent	6	100
Clay, light olive-gray; glauconite; foraminifera	4	104
Clay, sandy, light brownish-gray; mica; shell fragments	5	109
Clay, sandy, light brownish-gray; glauconite, abundant; mica; foraminifera; shell fragments	4	113

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Fc 3—*Continued*		
Clay, slightly sandy, brownish-gray; glauconite; shell fragments; foraminifera	7	120
Aquia greensand (?):		
Clay, somewhat sandy, brownish gray; glauconite; mica	8	128
Brightseat formation and/or Monmouth formation:		
Clay, brownish gray; glauconite; mica; few shell fragments; foraminifera, scarce	9	137
Clay, somewhat sandy, brownish gray; glauconite; mica; a few shell fragments	14	151
Clay, somewhat sandy, brownish gray; glauconite; mica; a few shell fragments	7	158
Same as above; foraminifera, scarce	8	166
Magothy formation:		
Clay, sandy, brownish gray; wood	5	171
Gravel, coarse, gray	4	175
Fd 5		
Pliocene (?) deposits:		
Clay, sandy, dark yellowish-orange, with some small fragments plant remains	10	10
Sand and gravel, clayey, moderate yellowish-brown	10	20
Sand, fine, clayey and gravelly, dark yellowish-orange	10	30
Silt or fine sand, sandy, dark yellowish-orange to pale yellowish-orange	10	40
Silt or fine sand, clayey and gravelly, dark yellowish-orange and pale yellowish-orange (fragments of lighter sand or silt are not gravelly)	10	50
Calvert formation:		
Silt, clayey, slightly sandy, light olive-gray; diatoms, common	10	60
Silt or fine sand, grayish olive, some associated small pebbles; diatoms, common	10	70
Sand, very fine, clayey, grayish olive; some globs pale olive clay; diatoms, common	10	80
Clay and silt, slightly sandy, light olive-gray; diatoms, abundant	10	90
Clay and silt, light olive-gray as above; diatoms, common	10	100
Clay, silty, olive-gray; diatoms, abundant; some small foraminifera	10	110
Sand, very fine, clayey, grayish olive; diatoms, common; foraminifera, rare	10	120
Nanjemoy formation:		
Sand, medium, clayey, grayish olive to olive-gray; glauconite, green-black to black, medium, very abundant, and some pale green; foraminifera, rare or absent	10	130
Sand, medium, clayey, dark greenish-gray, glauconitic; crumbly shell fragments; few small foraminifera	10	140
Clay, sandy, dark greenish-gray, slightly micaceous, glauconitic, semi-indurated; foraminifera, extremely common, mostly small forms	10	150
Clay, finely micaceous, light olive-gray; some glauconite	10	160

TABLE 9—*Continued*

	Thickness (feet)	Depth (feet)
Fd 5—*Continued*		
Clay, pale yellowish-brown, even-textured, uniform	10	170
Clay, slightly sandy, pale red, mostly even-textured	10	180
Clay, pale red to pale yellowish-brown, even-textured	10	190
Aquia greensand:		
Sand or silt, fine, olive-gray, clayey, glauconitic	10	200
Sand, fine, very clayey, medium olive-gray, glauconitic; foraminifera, rare	10	210
Sand, medium to fine, clayey, dark greenish-gray, a few streaks reddish clay; glauconite, common; foraminifera, common	10	220
Sand, fine, very clayey, dark greenish-gray; indurated calcareous glauconitic sand fragments common; small foraminifera, common	10	230
Sand, fine, very clayey, grayish olive-green; glauconite; small foraminifera	10	240
Sand, fine, clayey, grayish olive-green; glauconite	10	250
Sand, clayey, as above, grayish olive-green; glauconite; mostly small foraminifera	10	260
Sand, as above, clayey, grayish olive to moderate olive-brown; glauconite, more common; foraminifera, common	10	270
Sand, clayey, grayish olive to moderate olive-brown, similar to above sample	10	280
Sand, fine, clayey, grayish olive-green; glauconite	10	290
Sand, as above, clayey; glauconite; few ostracods; few foraminifera	10	300
Sand, fine, slightly clayey, grayish olive; glauconite; foraminifera not common	10	310
Sand, fine, clayey, olive-gray; glauconite; foraminifera not common	10	320
Brightseat formation and/or Monmouth formation:		
Sand, fine, clayey, dark gray; glauconite; few ostracods; several large foraminifera	10	330
Sand, fine, clayey, dark gray; less glauconite than above; foraminifera rare; few ostracods	10	340
Sand, fine, clayey, dark greenish-gray to medium gray; glauconite; foraminifera noted	10	350
Sand, fine, clayey, partly micaceous, dark gray; glauconite, as above; small foraminifera	10	360
Sand, fine, clayey, dark gray; decrease in amount of glauconite; mica more common; foraminifera rare	10	370
Sand, fine to medium, micaceous, less clayey, dark gray; glauconite scarce	10	380
Sand, as above, clayey, dark gray; glauconite	10	390
Magothy formation (?):		
Clay, slightly sandy, medium light-gray; glauconite; pyrite	10	400
Sand, fine to medium, micaceous, clayey, dark gray; glauconite; pyrite	10	410
Sand, medium, micaceous, very clayey, dark gray; glauconite; pyrite	5	415
Magothy formation:		
Sand, coarse, clean, gray; glauconite; pyrite or marcasite	3	418
Sand, as above	20	438

TABLE 9—*Concluded*

	Thickness (feet)	Depth (feet)
Ff 16		
Calvert formation:		
Silt, sandy, moderate yellowish-brown	20	20
Nanjemoy formation:		
Sand, clayey, dark greenish-gray	80	100
Clay, sandy, greenish gray	20	120
Clay, very sandy, greenish gray to dark greenish	10	130
Sand, clayey, dark greenish-gray	40	170
Clay, sandy, light olive-gray to greenish gray	10	180
Sand, clayey, dark greenish-gray	10	190
Clay, sandy, greenish gray	10	200
Clay, very sandy, olive-gray	20	220
Clay, light olive-gray	20	240
Clay, light brown	10	250
Aquia greensand:		
Sand, very clayey, pale yellowish-brown, glauconitic	10	260
Sand, clayey, olive gray to dark greenish-gray	10	270
Sand, very clayey, dark greenish-gray	10	280
Sand, clayey, olive-gray	10	290
Clay, sandy, light olive-gray	10	300
Sand, clayey, dusky yellow-green	10	310
Sand, clayey, light olive-gray	10	320
Sand, clayey, dusky yellow-green	10	330
Sand, clayey, light olive-brown	10	340
Sand, clayey, light olive-gray	10	350
Sand, fine, grayish olive	20	370
Sand, medium, clean, shelly, moderate olive-brown	10	380

REFERENCES

ANDERSON, JUDSON L., 1948. Cretaceous and Tertiary subsurface geology. Md. Dept. Geol., Mines and Water Resources Bull. 2.

BASCOM, FLORENCE, 1924. The resuscitation of the term Bryn Mawr gravel. U. S. Geol. Survey Prof. Paper 132, pp. 117–119.

BENNETT, R. R., AND COLLINS, G. G., 1952. Brightseat formation, a new name for sediments of Paleocene age in Maryland. Washington Acad. Sci. Jour., vol. 42, pp. 114–116.

BENNETT, R. R., AND MEYER, R. R., 1952. Geology and ground-water resources of the Baltimore area, Md., Md. Dept. Geol., Mines and Water Resources Bull. 4.

BERRY, EDWARD WILBUR, 1910. The evidence of the flora regarding the age of the Raritan formation. Jour. Geol., vol. 18, pp. 252–258.

———, 1911. The correlation of the Potomac formations. Md. Geol. Survey, Lower Cretaceous, pp. 153–172.

———, 1924. The fossil swamp deposit at the Walker Hotel site, Connecticut Avenue and DeSales Street, Washington, D. C.; organic remains, other than diatoms, from the excavation. Washington Acad. Sci. Jour., vol. 14, pp. 12–24.

BROOKHART, J. W., 1949. The ground-water resources, *in* The water resources of Anne Arundel County. Md. Dept. Geol., Mines and Water Resources Bull. 5, pp. 28–143.

CAMPBELL, MARIUS ROBISON, 1931. Alluvial fan of Potomac River. Geol. Soc. Am. Bull., vol. 42, pp. 825–852.

CLARK, W. B., 1893. A preliminary report on the Cretaceous and Tertiary formations of New Jersey, *in* Ann. Rept., State Geologist, for 1892. Geological Survey of New Jersey, pp. 167–245.

———, 1894. Origin and classification of the greensands of New Jersey. Jour. Geol., vol. 2, pp. 161–177.

———, 1895. Description of the geological excursion made during the spring of 1895; Johns Hopkins Univ. Circ., vol. 15, pp. 1–3.

———, 1895. Contributions to the Eocene fauna of the Middle Atlantic Slope. Johns Hopkins Univ. Circ., vol. 15, pp. 3–6.

———, 1896. The Eocene deposits of the Middle Atlantic Slope in Delaware, Maryland, and Virginia: U. S. Geol. Survey Bull. 141.

———, 1897a. Outline of present knowledge of the physical features of Maryland . . .: Md. Geol. Survey, vol. 1, pp. 139–228.

———, 1897b. Upper Cretaceous formations of New Jersey, Delaware, and Maryland. Geol. Soc. Am. Bull., vol. 8, pp. 315–358.

———, 1915. The Brandywine formation of the Middle Atlantic Coastal Plain. Am. Jour. Sci., ser. 4, vol. 40, pp. 499–506.

———, 1916. The Upper Cretaceous deposits of Maryland. Maryland Geol. Survey, Upper Cretaceous, pp. 23–110.

CLARK, WILLIAM BULLOCK, AND BIBBINS, ARTHUR BARNEVELD, 1897. The stratigraphy of the Potomac group in Maryland. Jour. Geol. vol. 5, pp. 479–506.

CLARK, WILLIAM BULLOCK, BIBBINS, ARTHUR BARNEVELD, AND BERRY, EDWARD WILBUR, 1911. The Lower Cretaceous deposits of Maryland. Md. Geol. Survey, Lower Cretaceous, pp. 23–99.

CLARK, WILLIAM BULLOCK, AND MARTIN, GEORGE CURTIS, 1901. The Eocene deposits of Maryland. Md. Geol. Survey, Eocene.

CLARK, W. B., MATHEWS, E. B., AND BERRY, E. W., 1918. The surface and underground water resources of Maryland, including Delaware and the District of Columbia. Md. Geol. Survey, vol. 10, pt. 2.

CLARK, WILLIAM BULLOCK, AND MILLER, BENJAMIN LEROY, 1912. Physiography and geology of the Coastal Plain Province of Virginia. Virginia Geol. Survey Bull. 4.

CLARK, WILLIAM BULLOCK, SHATTUCK, GEORGE BURBANK, AND DALL, WILLIAM HEALEY, 1904. The Miocene deposits of Maryland. Md. Geol. Survey, Miocene.

COOKE, CHARLES WYTHE, 1930a. Correlation of coastal terraces. Jour. Geol., vol. 38, pp. 577–589.

———, 1930b. Pleistocene seashores: Washington Acad. Sci. Jour., vol. 20. pp. 389–395.

———, 1931. Seven coastal terraces in the southeastern States. Washington Acad. Sci. Jour., vol. 21, pp. 503–513.

———, 1932a. Pleistocene changes of sea level. Washington Acad. Sci. Jour., vol. 23, pp. 109–110.

———, 1932b. Southern Maryland. XVI International Geological Congress Guidebook 12.

———, 1935. Tentative ages of Pleistocene shore lines. Washington Acad. Sci. Jour., vol. 25, pp. 331–333.

———, 1936. Are the Maryland terraces warped? Am. Jour. Sci., ser. 5, vol. 32, pp. 306–309.

———, 1945. Geology of Florida. Florida Geol. Survey Bull. 29.

CUSHMAN, JOSEPH AUGUSTINE, 1948. Foraminifera from the Hammond well. Md. Dept. Geol., Mines and Water Resources Bull. 2, pp. 213–267.

DALL, WILLIAM HEALEY, AND HARRIS, GILBERT DENNISON, 1892. Correlation papers; Neocene. U. S. Geol. Survey Bull. 84.

DARTON, NELSON HORATIO, 1891. Mesozoic and Cenozoic formations of eastern Virginia and Maryland. Geol. Soc. Am. Bull., vol. 2, pp. 431–450.

———, 1893. The Magothy formation of northeastern Maryland. Am. Jour. Sci., 3rd ser., vol. 45, pp. 407–419.

———, 1896. Artesian-well prospects in the Atlantic Coastal Plain. U. S. Geol. Survey Bull. 138.

———, 1939. Gravel and sand deposits of eastern Maryland. U. S. Geol. Survey Bull. 906-A.

———, 1947. (Geologic map of the) Sedimentary formations of Washington, D. C., and vicinity: U. S. Geological Survey.

———, 1948. The Marlboro clay. Econ. Geol. vol. 43, pp. 154–155.

DARTON, NELSON HORATIO, AND KEITH, ARTHUR, 1901. Description of the Washington quadrangles. U. S. Geol. Survey Atlas No. 70.

DRYDEN, LINCOLN, 1935. Structure of the Coastal Plain of Southern Maryland. Am. Jour. Sci., ser. 5, vol. 30, pp. 321–342.

GARDNER, JULIA ANNA, 1916. Mollusca. Md. Geol. Survey, Upper Cretaceous, pp. 371–733.

GILMORE, CHARLES WHITNEY, 1921. The fauna of the Arundel formation of Maryland. U. S. Nat. Mus. Proc., vol. 59, pp. 581–594.

HATCHER, JOHN BELL, 1903. Discovery of remains of *Astrodon* (*Pleurocoelus*) in the *Atlantosaurus* beds of Wyoming. Carnegie Mus. Annals, vol. 2, pp. 9–14.

LAFORGE, LAURENCE, 1924. The fossil swamp deposit at the Walker Hotel site, Connecticut Avenue and DeSales Street, Washington, D. C., the geographic and historical evidence. Washington Acad. Sci. Jour., vol. 14, pp. 33–41.

LEWIS, HENRY CARVILL, 1880. The surface geology of Philadelphia and vicinity. Acad. Nat. Sci. Philadelphia Proc., vol. 32, pp. 258–272.

LEVERETT, FRANK, 1928. Results of glacial investigations in Pennsylvania and New Jersey in 1926 and 1927. Geol. Soc. Am. Bull., vol. 39, p. 151.

LITTLE, HOMER PAYSON, 1917. The geology of Anne Arundel County. Md. Geol. Survey, Anne Arundel County.

LOHMAN, S. W., 1938. Ground water in southcentral Pennsylvania. Pa. Geol. Survey, 4th ser., Bull. W-5.

LULL, RICHARD SWANN, 1911. The Reptilia of the Arundel formation. Md. Geol. Survey, Lower Cretaceous, pp. 173–211.

MANN, ALBERT, 1924. The fossil swamp deposit at the Walker Hotel site, Connecticut Avenue and DeSales Street, Washington, D. C.; diatom deposit found in the excavation. Washington Acad. Sci. Jour., vol. 14, pp. 26–32.

MARSH, OTHNIEL CHARLES, 1888. Notice of a new genus of Sauropoda and other dinosaurs from the Potomac formation. Am. Jour. Sci., ser. 3, vol. 35, pp. 89–94.

MCGEE, W. J., 1886. Geologic formations [of Washington, D. C., and vicinity]. District of Columbia Health Officer, Report for 1885, pp. 19–20, 23–25. Abstract, Am. Jour. Sci., ser. 3, vol. 31, pp. 473–474.

MILLER, BENJAMIN LEROY, 1911. The geology of Prince Georges County. Md. Geol. Survey, Prince Georges County, pp. 83–136.

MILLER, B. L., BIBBINS, A. B., AND KEITH, ARTHUR, 1911. Map of Prince Georges County and District of Columbia showing the geological formations. Md. Geol. Survey.

MONROE, WATSON HINER, 1936. Structure of the Coastal Plain of Southern Maryland, a discussion. Am. Jour. Sci., ser. 5, vol. 32, pp. 70–72.

OVERBECK, R. M., 1948. Ground-water resources, *in* Md. Dept. Geology, Mines and Water Resources, The physical features of Charles County, pp. 138–184.

———, 1951. The ground-water resources, *in* The water resources of Calvert County, Md. Dept. Geology, Mines and Water Resources Bull. 8, pp. 4–95.

SCHMIDT, RUTH A. M., 1948. Ostracoda from the Upper Cretaceous and lower Eocene of Maryland, Delaware, and Virginia. Jour. Paleon., vol. 22, pp. 389–431.

SHATTUCK, GEORGE BURBANK, 1901. The Pleistocene problem of the North Atlantic Coastal Plain. Johns Hopkins Univ. Circ., vol. 20, pp. 69–75; Am. Geol. vol. 28, pp. 87–107.

———, 1902. The Miocene problem of Maryland (abst.): Science, new ser., vol. 15, p. 906.

———, 1906. The Pliocene and Pleistocene deposits of Maryland. Md. Geol. Survey, Pliocene and Pleistocene, pp. 1–137.

SHATTUCK, GEORGE BURBANK, MILLER, BENJAMIN LEROY, AND BIBBINS, ARTHUR BARNEVELD, 1907. Description of the Patuxent quadrangle. U. S. Geol. Survey, Geologic Atlas No. 152.

SHIFFLETT, ELAINE, 1948. Eocene stratigraphy and Foraminifera of the Aquia formation: Md. Dept. Geology, Mines and Water Resources Bull. 3.

SINGEWALD, JOSEPH THEOPHILUS, JR., 1911. Report on the iron ores of Maryland. Md. Geol. Survey, vol. 9, pp. 123–337.

SPANGLER, WALTER BLUE, AND PETERSON, JAHN JEAN, 1950. Geology of Atlantic Coastal Plain in New Jersey, Delaware, Maryland, and Virginia. Am. Assoc. Pet. Geol. Bull., vol. 34, pp. 1–99.

STEPHENSON, LLOYD WILLIAM, 1912. Quaternary formations. North Carolina Geol. and Econ. Survey, vol. 3, pp. 266–290.

STEPHENSON, LLOYD WILLIAM, COOKE, CHARLES WYTHE, AND MANSFIELD, WENDELL CLAY, 1932. Chesapeake Bay region. XVI International Geol. Congress Guidebook 5.

SWAIN, FREDERICK MORRILL, 1948. Ostracoda from the Hammond well. Md. Dept. Geology, Mines and Water Resources Bull. 2, pp. 187–213.

VOKES, HAROLD E., 1948. Cretaceous Mollusca from depths of 1475 to 4885 feet in the Maryland Esso Well. Md. Dept. Geology, Mines and Water Resources Bull. 2, pp. 126–151.

WENTWORTH, CHESTER KEELER, 1924. The fossil swamp deposit at the Walker Hotel site, Connecticut Avenue and DeSales Street, Washington, D. C.: the formations exposed in the excavation. Washington Acad. Sci. Jour., vol. 14, pp. 1–11.

———, 1927. Striated boulders on the southern Coastal Plain of Virginia. Geol. Soc. Am. Bull., vol. 38, pp. 150–151.

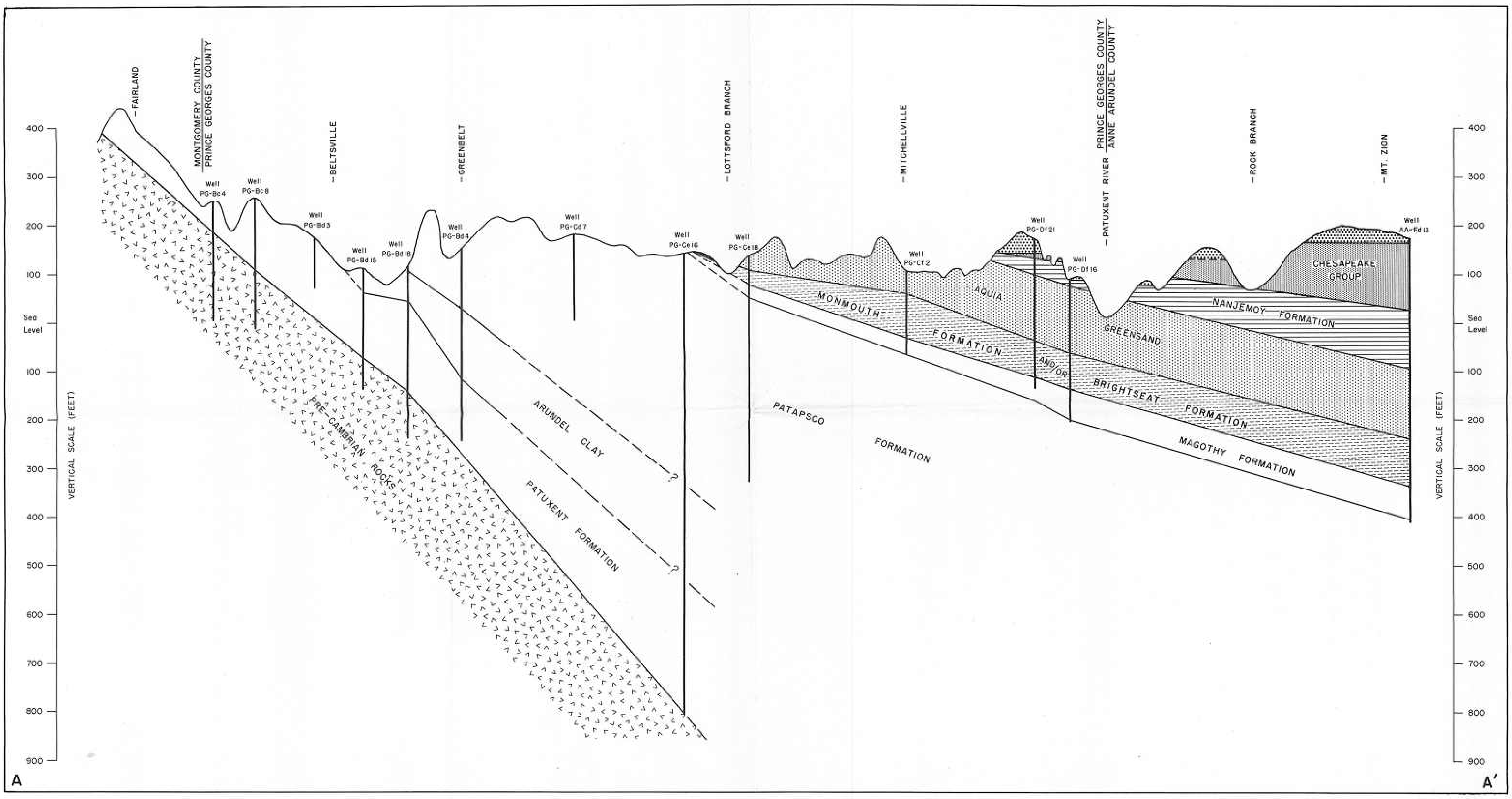
———, 1930. Sand and gravel resources of the Coastal Plain of Virginia. Virginia Geol. Survey Bull. 32.

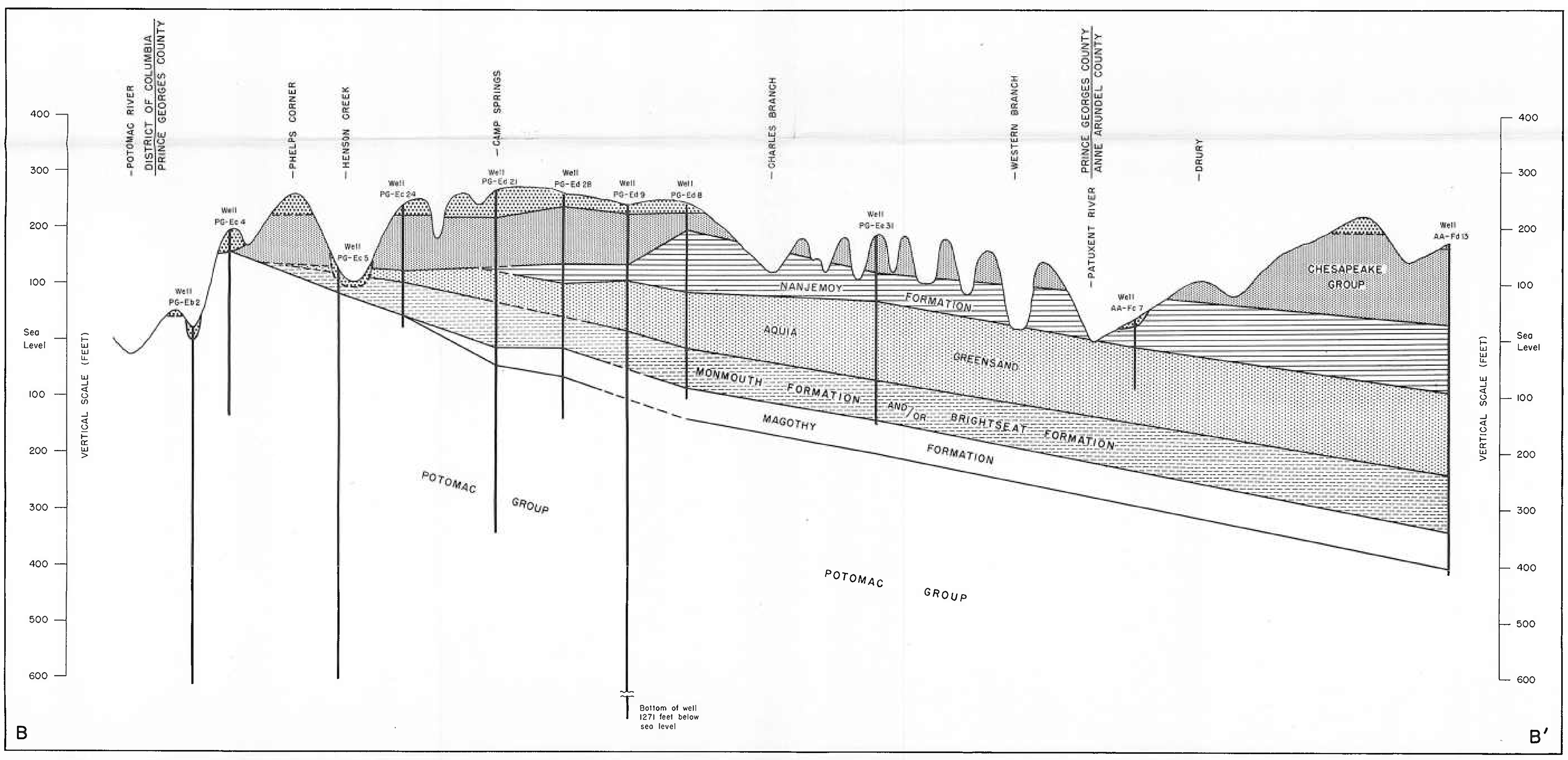
U. S. Dept. Commerce, Bur. Census, 1946. U. S. Census of Agriculture, 1945, vol. 1, pt. 14.

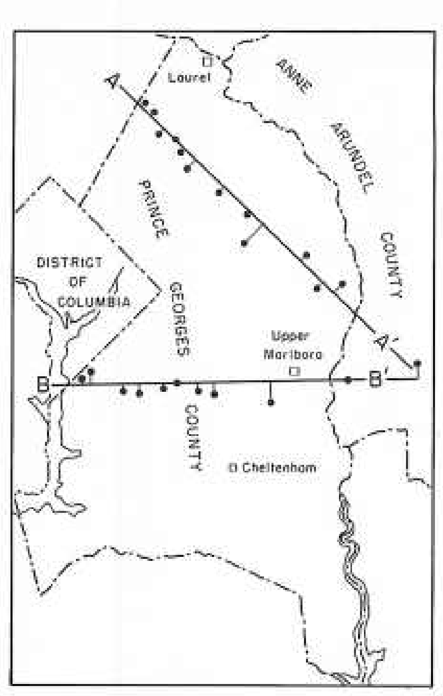
U. S. Public Health Service, 1946. Public Health Service drinking water standards. Public Health Reports, vol. 61, pp. 371–384.

INDEX*

* Page numbers in italics indicate detailed descriptions.







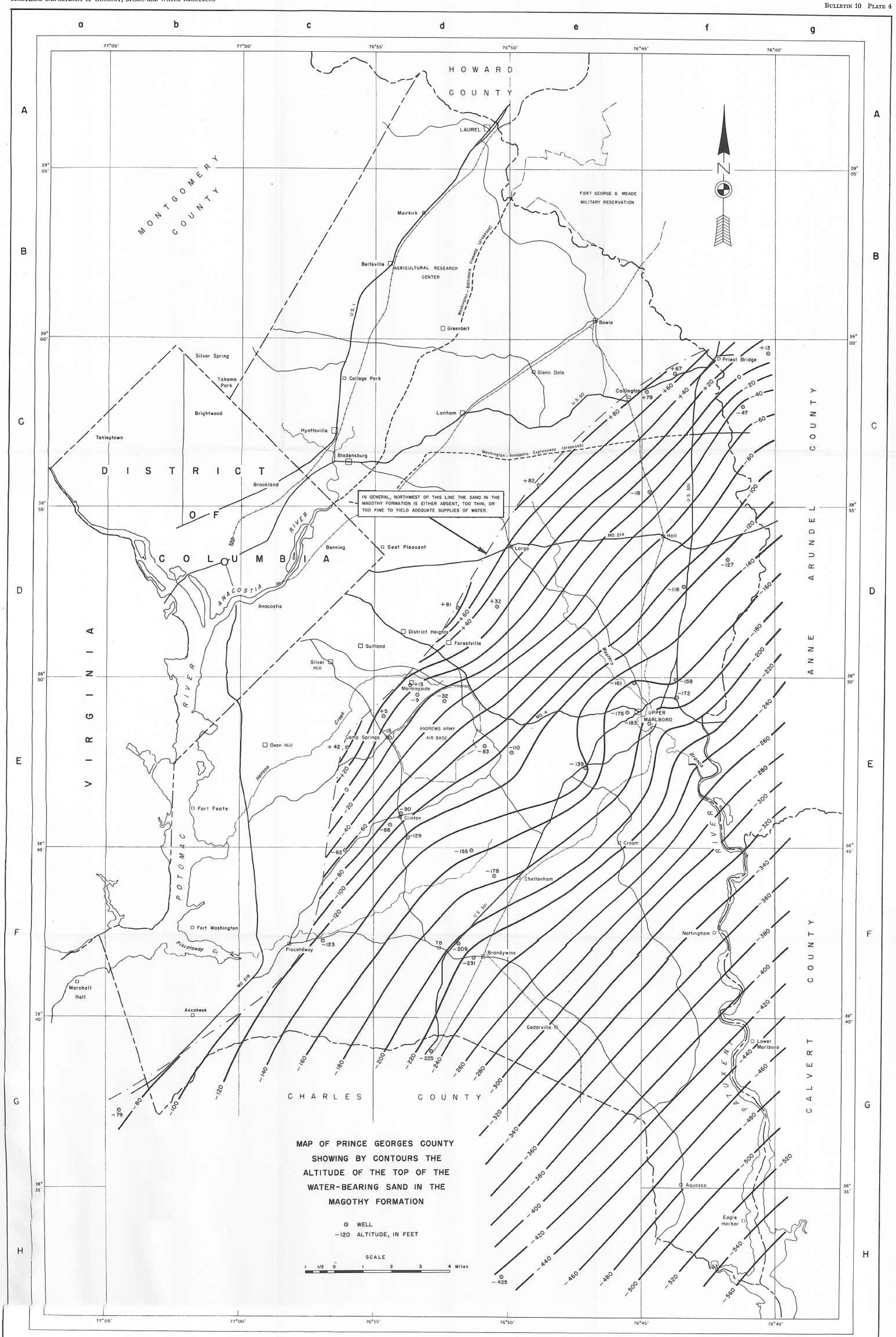
MAP SHOWING THE LOCATION OF WELLS USED IN CROSS SECTIONS A-A' AND B-B'

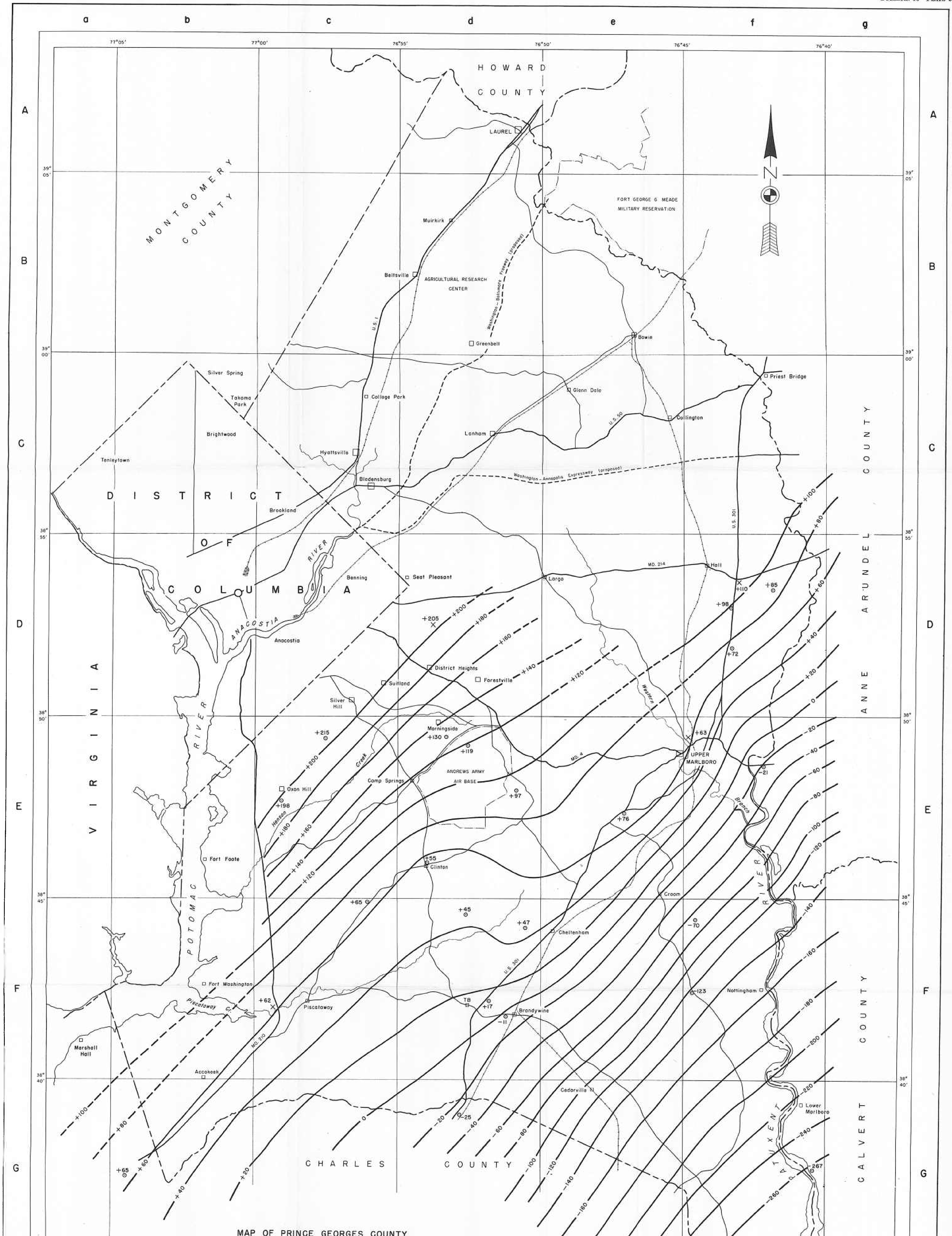
GEOLOGIC CROSS SECTIONS OF PRINCE GEORGES COUNTY

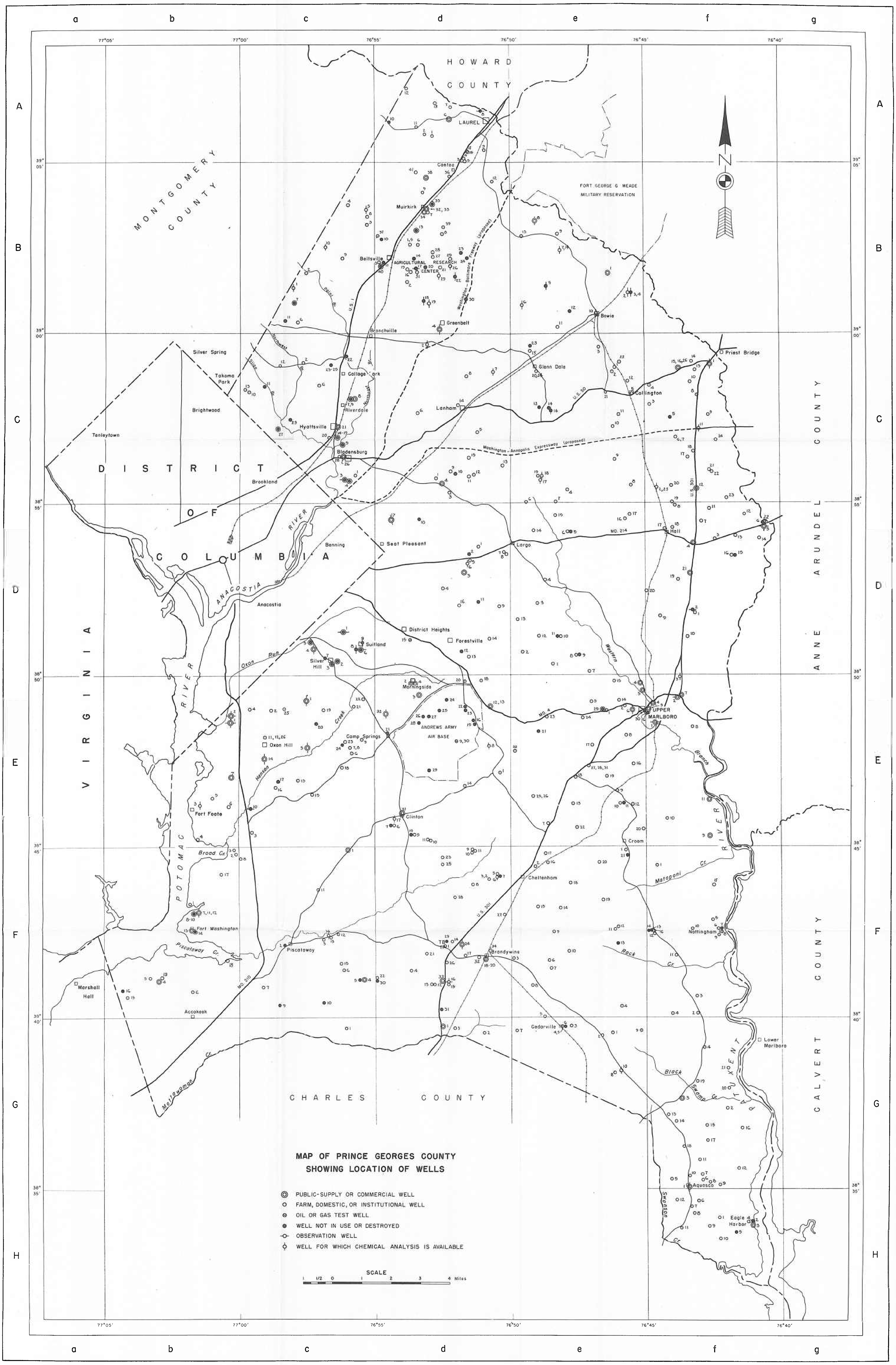
- Pliocene(?) and Pleistocene
- Miocene
- Eocene
- Eocene
- Upper Cretaceous and/or Paleocene
- Lower and Upper Cretaceous
- Pre-Cambrian

HORIZONTAL SCALE

1 1/2 0 1 2 3 Miles


HOWARD COUNTY
MONTGOMERY COUNTY
DISTRICT OF COLUMBIA
VIRGINIA
ANNE ARUNDEL COUNTY
CALVERT COUNTY
CHARLES COUNTY
POTOMAC RIVER
ANACOSTIA RIVER
PATUXENT RIVER
FORT GEORGE G. MEADE MILITARY RESERVATION
AGRICULTURAL RESEARCH CENTER
ANDREWS ARMY AIR BASE
Laurel
Muirkirk
Beltsville
Greenbelt
Bowie
Glenn Dale
Collington
Priest Bridge
Lanham
College Park
Hyattsville
Bladensburg
Silver Spring
Takoma Park
Brightwood
Tenleytown
Brookland
Benning
Seat Pleasant
Anacostia
Largo
Hall
District Heights
Forestville
Suitland
Silver Hill
Morningside
Camp Springs
Oxon Hill
Clinton
Fort Foote
Fort Washington
Piscataway
Marshall Hall
Accokeek
Cheltenham
Brandywine
Croom
Upper Marlboro
Nottingham
Cedarville
Lower Marlboro
Aquasco
Eagle Harbor
IN GENERAL, NORTHWEST OF THIS LINE THE SAND IN THE MAGOTHY FORMATION IS EITHER ABSENT, TOO THIN, OR TOO FINE TO YIELD ADEQUATE SUPPLIES OF WATER.
MAP OF PRINCE GEORGES COUNTY SHOWING BY CONTOURS THE ALTITUDE OF THE TOP OF THE WATER-BEARING SAND IN THE MAGOTHY FORMATION
WELL
-120 ALTITUDE, IN FEET
SCALE
1/2 0 1 2 3 4 Miles


MAP OF PRINCE GEORGES COUNTY
SHOWING BY CONTOURS THE
ALTITUDE OF THE TOP OF THE
AQUIA GREENSAND
WELL
OUTCROP
±120 ALTITUDE, IN FEET
SCALE
4 Miles
HOWARD COUNTY
MONTGOMERY COUNTY
DISTRICT OF COLUMBIA
VIRGINIA
ANNE ARUNDEL COUNTY
CALVERT COUNTY
CHARLES COUNTY
FORT GEORGE G. MEADE MILITARY RESERVATION
AGRICULTURAL RESEARCH CENTER
ANDREWS ARMY AIR BASE
Laurel
Muirkirk
Beltsville
Greenbelt
Bowie
Priest Bridge
Glenn Dale
Collington
College Park
Lanham
Hyattsville
Bladensburg
Silver Spring
Takoma Park
Brightwood
Tenleytown
Brookland
Benning
Seat Pleasant
Largo
Hall
Anacostia
District Heights
Forestville
Suitland
Silver Hill
Morningside
Camp Springs
Oxon Hill
Upper Marlboro
Fort Foote
Clinton
Croom
Cheltenham
Fort Washington
Piscataway
Brandywine
Nottingham
Marshall Hall
Accokeek
Cedarville
Lower Marlboro
Aquasco
Eagle Harbor
POTOMAC RIVER
ANACOSTIA RIVER
PATUXENT RIVER
Western Branch
Henson Creek
Piscataway Cr.
U.S. 1
U.S. 50
U.S. 301
MD. 214
MD. 4
MD. 210
Washington-Baltimore Freeway (proposed)
Washington-Annapolis Expressway (proposed)



MAP OF PRINCE GEORGES COUNTY SHOWING LOCATION OF WELLS

- ◎ PUBLIC-SUPPLY OR COMMERCIAL WELL
- ○ FARM, DOMESTIC, OR INSTITUTIONAL WELL
- ⊚ OIL OR GAS TEST WELL
- ● WELL NOT IN USE OR DESTROYED
- -○- OBSERVATION WELL
- ϙ WELL FOR WHICH CHEMICAL ANALYSIS IS AVAILABLE