GEOHYDROLOGY OF THE ENGLISHTOWN FORMATION IN THE NORTHERN COASTAL PLAIN OF NEW JERSEY

By W. D. Nichols

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CONVERSION FACTORS

Factors for converting English units to the International System of Units (SI) are given below to four significant figures. However, in the text the metric equivalents are shown only to the number of significant figures consistent with the values for the English units.

English	Multiply by	Metric (SI)
ft (feet)	0.3048	m (meters)
ft/s (feet per second)	30.48	cm/s (centimeters per second)
ft/mi (feet per mile)	0.1894	m/km (meters per kilometer)
ft^2/day (square feet per day)	0.0929	m^2/day (square meters per day)
ft^2/s (square feet per second)	929	cm^2/s (square centimeters per second)
gal/min (gallons per minute)	0.06309	l/s (liters per second)
Mgal/d (million gallons per day)	0.04381	m^3/s (cubic meters per second)
mi^2 (square miles)	2.590	km^2 (square kilometers)
psi (pounds per square inch)	.07031	kg/cm^2 (kilograms per square centimeter)

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ABSTRACT

The Englishtown Formation of the Matawan Group of Late Cretaceous age is exposed in the western part of the New Jersey Coastal Plain along a northeast-southwest trending zone extending from Raritan Bay to Delaware Bay. In outcrop, in the northern part of the Coastal Plain, the Englishtown typically consists of a series of thin, cross-stratified, fine- to medium-grained lignitic quartz sand beds intercalated with thin beds of sandy silty clay and clayey silt, ranging in total thickness from about 140 feet (43 meters) near Raritan Bay to about 50 feet (15 meters) near Trenton. In the subsurface of the northern part of the Coastal Plain, the formation retains most of the lithologic characteristics displayed in outcrop. In northern and eastern Ocean County the Englishtown can be subdivided into three distinct lithologic units; upper and lower units of quartz sand with thin interbeds of dark sandy silt, separated by a thick sequence of sandy and clayey lignitic silt.

The confined part of the aquifer in the Englishtown Formation is utilized as a source of water over an area of about 1,100 square miles (2,849 square kilometers) of the New Jersey Coastal Plain and is an important source of supply in Monmouth and northern Ocean Counties. The annual average rate of withdrawal from the aquifer in the two-county area increased from 5.5 million gallons per day (0.24 cubic meters per second) in 1959 to 9.5 million gallons per day (0.4 cubic meters per second) in 1970. Water levels in parts of this area were declining 8 to 12 feet (2.4 to 3.6 meters) per year as of 1970 and they declined as much as 140 feet (43 meters) between 1959 and 1970 near pumping centers. The aquifer transmissivity ranges from 2,400 square feet per day to 650 square feet per day (223 square meters per day to 60 square meters per day); the estimated hydraulic conductivity ranges from about 11 feet per day to 20 feet per day (3.3 meters per day to 6.1 meters per day); and the storage coefficient ranges from 8×10^{-5} to 3×10^{-4}. The underlying and overlying confining beds, which have an average thickness of 200 feet (61 meters) and 40 feet (12 meters), respectively, have vertical hydraulic conductivities on the order of 1×10^{-5} feet per day (3×10^{-6} meters per day) and specific storage on the order of 8×10^{-5} ft^{-1} (2.4×10^{-5} m^{-1}).

The Englishtown aquifer is an integral part of the complex multi-aquifer system of the New Jersey Coastal Plain. The withdrawal of water from the Englishtown aquifer has had a marked effect on the water level in the overlying Mount Laurel aquifer, and these effects will continue so long as the water level in the Englishtown continues to decline. Any increase in the development of the Mount Laurel aquifer that reduces the volume of leakage to the Englishtown will cause an increase in the rate of water-level decline in the Englishtown even with no increase in direct withdrawals. The interrelationship and interdependency between pumping stresses in individual aquifers within the complex Coastal Plain aquifer system must be recognized and appreciated, and the hydrodynamics of all parts of the system must be considered if reliable predictions of aquifer response to these stresses are to be made. Such predictions generally require a simulation model analysis of the system.

INTRODUCTION

The aquifer in the Englishtown Formation of the Matawan Group of Late Cretaceous age is one of the more important sources of ground-water supplies in the northern part of the New Jersey Coastal Plain. Total ground-water withdrawals for public supply in Monmouth and northern Ocean Counties increased from 5.5 Mgal/d (million gallons per day) [0.24 m^3/s (cubic meters per second)] in 1959 to 9.5 Mgal/d (0.4 m^3/s) in 1970. Although these withdrawals may seem small in comparison with withdrawals from ground-water sources in other areas, they have placed a considerable stress on the Englishtown aquifer. Water levels in the aquifer have been declining at the rate of 8 to 12 ft (feet) [2.4 to 3.6 m (meters)] per year over large areas since 1959. The rate of decline has accelerated during the past several years in some areas, near pumping centers, in response to increased withdrawals.

Recognizing the need for quantitative solutions to the questions arising from the demands for continued increased development of the ground-water resources of the New Jersey Coastal Plain, the U.S. Geological Survey began a program of regional geohydrologic studies of the aquifers in the Coastal Plain aquifer system in cooperation with the Division of Water Resources of the New Jersey Department of Environmental Protection. These studies, in addition to utilizing the applicable analytical techniques needed to define system parameters, include simulation modeling of individual aquifers. The models in most, if not all, cases are to be digital computer simulation models and will serve three specific purposes. First, the modeling effort will identify those data that are essential to a quantitative study of the hydraulics of the aquifer and the areas where such data are most needed. Second, the model will provide a tool for the investigator to test and evaluate different concepts of the functioning of the ground-water system. Third, when completed and calibrated, the model will be a tool that can be used by the water-resource planner and manager to predict the effects of alternative schemes of resource development.

Purpose and Scope

The purpose of this first report is to define the geohydrologic parameters required for a quantitative analysis of the aquifer system. The geologic framework of the Englishtown Formation is briefly discussed. The lithologic character of the formation is described, and the geometry of the aquifer and adjacent confining beds is defined. The hydraulic parameters that control the movement of water in the aquifer system are given. These parameters have been computed from field and laboratory test data. The data presented and the concepts of the response of the aquifer system to stress provide the basis for the concurrent construction and development of a digital computer simulation model of the Englishtown aquifer system.

The investigation covers an area of about 1,450 mi^2 (square miles) [3,755 km^2 (square kilometers)] of the northern Coastal Plain of New Jersey and includes Monmouth and parts of Ocean and Burlington Counties (fig. 1). The simulation model of the Englishtown aquifer covers about 750 mi^2 (1,942 km^2) within the area of study and includes Monmouth County, northern Ocean County, and extreme northeastern Burlington County (fig. 1).

Most of the geologic and hydrologic data for the Englishtown aquifer system are presented in a series of tables. Stratigraphic control data used in constructing the various isopach maps and the structure contour map of the Englishtown Formation are given in table 2. The altitude and thickness data are based on interpretation of geophysical logs, most of which were collected by the U.S. Geological Survey. The stratigraphic control well locations are shown on figure 3. Water-level data used in constructing the "pre-pumping" potentiometric surface map (fig. 13) are given in table 5, and the approximate locations of the wells from which the measurements were obtained are shown on figure 13. Well-yield characteristics and well construction characteristics for all Englishtown wells are given in tables 6 and 7, respectively. Water-level data collected in 1959 and 1970 are also given in table 6. The locations of all wells given in tables 6 and 7 are shown on figure 19. The average annual rate of withdrawal for public supply from the Englishtown aquifer for the years 1959 through 1970 is given in table 8. The results of soil consolidation tests conducted on undisturbed core samples of confining layers in the New Jersey Coastal Plain are presented in table 9.

Previous Investigations

The geology of the Coastal Plain of New Jersey and of the Englishtown Formation has been discussed by several authors. Among the more recent studies are those by Owens and others (1970), Minard (1969), Minard and others (1969), Owens and Sohl (1969), Owens and Minard (1966, 1970), and Minard (1964). A more extensive list of references to the geologic literature of the New Jersey Coastal Plain and the Englishtown and adjacent formations can be found in the articles cited above.

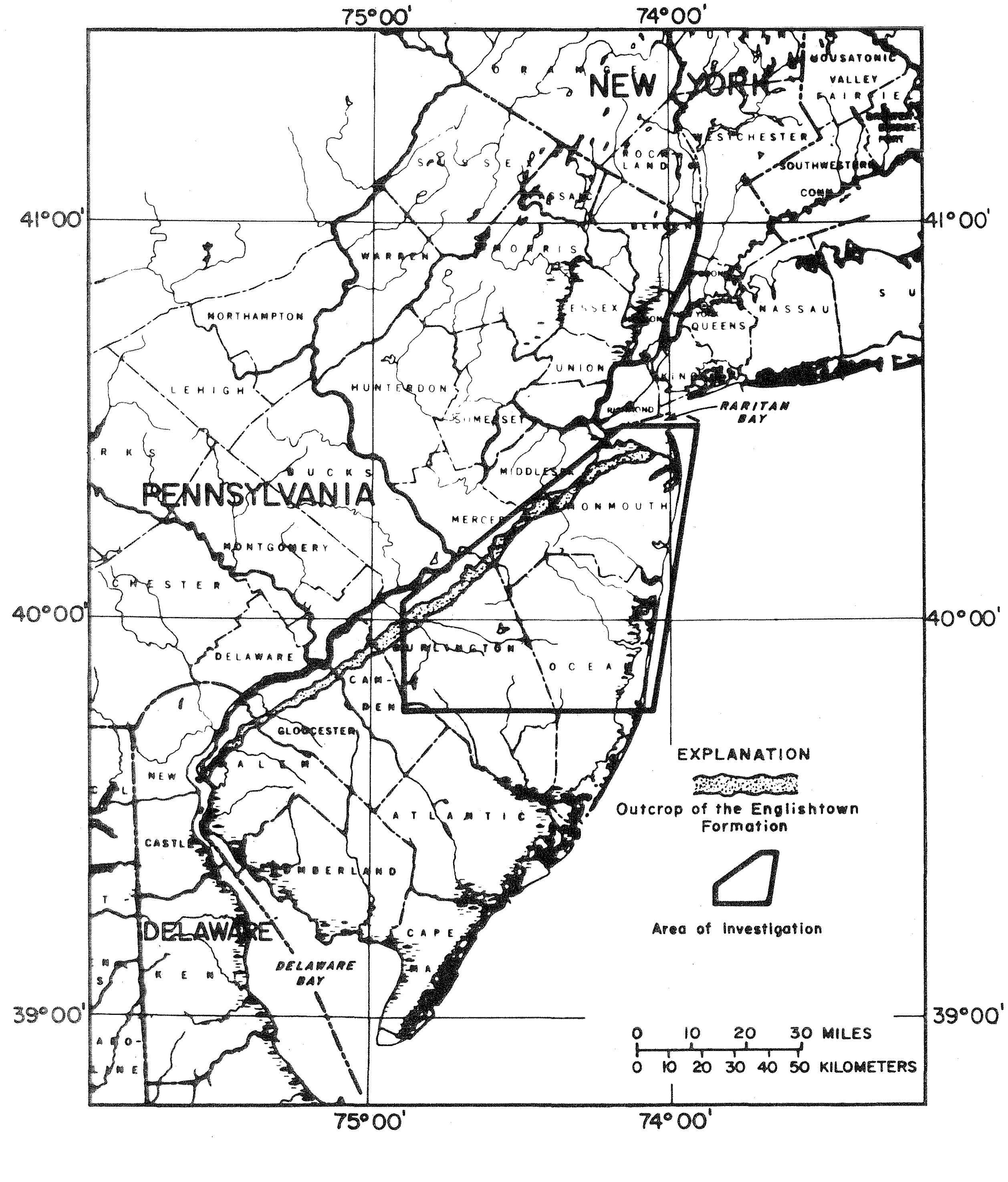


FIGURE 1. --INDEX MAP OF NEW JERSEY SHOWING AREA OF INVESTIGATION.

The regional hydrology of the Englishtown Formation is discussed briefly by Barksdale and others (1958) and by Parker and others (1964). Reports by Jablonski (1959, 1960, 1968) on Monmouth County; Rush (1962, 1968) on Burlington County; Anderson and Appel (1969) on Ocean County; Donsky (1963) and Farlekas and others (1974) on Camden County; Vecchioli and Palmer (1962) on Mercer County; Hardt (1963) and Hardt and Hilton (1969) on Gloucester County; and Rosenau and others (1969) on Salem County contain well records, logs, chemical analyses, and brief descriptions of the geology, hydrology, and water quality of the Englishtown Formation in these counties. Seaber (1965) has given a short discussion of the geology and geohydrology of the Englishtown Formation and a more extensive discussion of the chemical quality of the water in the Englishtown throughout much of the formation in the New Jersey Coastal Plain.

Acknowledgments

This investigation was conducted by the U.S. Geological Survey in cooperation with the Division of Water Resources of the New Jersey Department of Environmental Protection. Bronius Nemickas, Richard E. Hodges, Harry Farsett, William Cushing, and Floyd Price assisted the author in the collection, compilation, and analysis of basic data. Harold E. Gill provided invaluable guidance and assistance in the interpretation of geophysical logs during the early stages of the investigation.

STRATIGRAPHIC SUMMARY OF THE CRETACEOUS FORMATIONS OF THE NORTHERN COASTAL PLAIN OF NEW JERSEY

The New Jersey Coastal Plain is underlain by a wedge-shaped mass of unconsolidated and partly consolidated marine, marginal marine, and nonmarine deposits of clay, silt, sand, and gravel. The sediments range in age from Cretaceous to Holocene (table 1) and lie unconformably on the pre-Cretaceous basement. The total thickness of the sedimentary sequence in outcrop ranges from 500 to 1,000 ft (152 to 305 m); the sequence thickens downdip, toward the southeast, and attains a maximum aggregate thickness of about 6,500 ft (1,980 m) at the extreme southern tip of New Jersey.

The geology of the pre-Quaternary Coastal Plain formations of New Jersey has been discussed by several investigators and was recently summarized by Owens and Minard (1970) and Owens and Sohl (1969). These studies, especially the more recent ones, have shown that there are significant differences in the character and occurrence of these formations between Raritan Bay in the northeast and Delaware Bay to the southwest. The differences reflect the varying patterns and environments of sedimentation that existed throughout the region, especially during Late Cretaceous time. Depositional patterns in the northern Coastal Plain of New Jersey seem to have been controlled largely by two basement tectonic elements; a trough or small basin centering in the vicinity of Raritan Bay and a northwest-southeast trending high in southern New Jersey.

Table 1.--Stratigraphic units of the northern Atlantic Coastal Plain of New Jersey[1]

System	Series	Group	Formation	Lithology
Quaternary	Holocene		Alluvium	Sand, silt, and black mud.
			Beach sand and gravel	Sand, quartz, light-colored, medium-grained, pebbly.
	Pleistocene		Cape May Formation	Sand, quartz, light-colored, heterogeneous, clayey, pebbly, glauconitic.
			Pensauken Formation[2]	
			Bridgeton Formation	
Tertiary	Pliocene(?)		Beacon Hill Gravel	Gravel, quartz, light-colored, sandy.
	Pliocene(?) and Miocene(?)		Cohansey Sand	Sand, quartz, light-colored, medium- to coarse-grained, pebbly; local clay beds.
	Miocene		Kirkwood Formation	Sand, quartz, gray to tan, very fine to medium-grained, micaceous, and dark-colored diatomaceous clay.
	Eocene		Shark River Marl	Sand, quartz and glauconite, gray, brown, and green, fine- to coarse-grained, clayey, and green silty and sandy clay.
		Rancocas Group	Manasquan Formation	
	Paleocene		Vincentown Formation	Sand, quartz, gray and green, fine- to coarse-grained, glauconitic, and brown clayey, very fossiliferous, glauconite and quartz calcarenite.
			Hornerstown Sand	Sand, glauconite, green, medium- to coarse-grained, clayey.
Cretaceous	Upper Cretaceous	Monmouth Group	Tinton Sand and Red Bank Sand undivided	Sand, quartz and glauconite, brown and gray, fine- to coarse-grained, clayey, micaceous
			Navesink Formation	Sand, glauconite and quartz, green, black, and brown, medium- to coarse-grained, clayey.
			Mount Laurel Sand	Sand, quartz, brown and gray, fine- to coarse-grained, glauconitic.
		Matawan Group	Wenonah Formation	Sand, quartz, gray and brown, very fine to fine-grained, glauconitic, micaceous.
			Marshalltown Formation	Sand, quartz and glauconite, gray and black, very fine to medium-grained, very clayey.
			Englishtown Formation	Sand, quartz, tan and gray, fine- to medium-grained; local clay beds.
			Woodbury Clay	Clay, gray and black, micaceous.
			Merchantville Formation	Clay, gray and black, micaceous, glauconitic, silty; locally very fine grained quartz and glauconite sand.
			Magothy Formation	Sand, quartz, light-gray, fine-grained, and dark-gray lignitic clay.
			Raritan Formation	Sand, quartz, light-colored, fine- to coarse-grained, pebbly, arkosic, and red, white, and variegated clay.
Pre-Cretaceous				Precambrian and early Paleozoic crystalline rocks - metamorphic schist and gneiss; locally Triassic basalt, sandstone, and shale.

[1] Modified after Seaber, 1965, table 3.

[2] Age of Pensauken Formation now considered late Miocene.

Raritan and Magothy Formations

The Raritan Formation is the oldest stratigraphic unit in the northern Coastal Plain of New Jersey. This formation, which lies unconformably on the pre-Cretaceous basement, consists chiefly of interstratified light-colored sands and dark or variegated silty clays and clayey silts. Depositional environments ranging from marine and marginal marine to those of a subaerial and subaqueous deltaic plain (Owens and others, 1968) are represented in the various beds of this formation. The Raritan has a maximum thickness, in outcrop, of about 500 ft (152 m) in the northern New Jersey Coastal Plain.

The Magothy Formation overlies the Raritan Formation throughout New Jersey. In the Raritan Bay area the Magothy consists of three units; a basal unit of massive to laminated dark micaceous silt, a middle unit of thin-bedded dark clays and silts and light-colored sand, and an upper unit of cross-bedded sand (Owens and Sohl, 1969). Farther south, near Trenton, the Magothy consists of a unit of light-colored cross-bedded sand, which has been correlated (Berry, 1906) with the uppermost unit of the Magothy at Raritan Bay. Along its outcrop, the Magothy ranges in thickness from about 175 ft (53 m) near Raritan Bay to about 500 ft (152 m) near Trenton.

Matawan Group

The Matawan Group is divided into five formations; ascending they are the Merchantville Formation, Woodbury Clay, Englishtown Formation, Marshalltown Formation, and Wenonah Formation. The Merchantville Formation disconformably overlies the Magothy throughout the New Jersey Coastal Plain. It consists primarily of an interbedded marine sequence of dark-colored thin micaceous clayey silt and very fine silty sand with massive thick beds of silty glauconite sand in the Raritan Bay area. The formation becomes thicker bedded toward the southwest.

The Woodbury Clay overlies the Merchantville Formation in the northern and central part of the New Jersey Coastal Plain. It pinches out in the area just north of Swedesboro in southwestern New Jersey and is not seen in outcrop south of that point. The contact between the two formations is gradational. The Woodbury is a massive-bedded dark-gray to grayish-black lignitic sandy to clayey silt and silty clay of marine origin.

The Merchantville Formation and Woodbury Clay are both about 50 ft (15 m) thick along their outcrop between Trenton and Raritan Bay. South and southeast from the outcrop area, the combined thickness of the Merchantville Formation and Woodbury Clay gradually increases to about 200 ft (61 m). The total thickness of the two units then increases sharply to more than 300 ft (91 m) over a roughly elliptically shaped area of southeastern Monmouth County. An isopach map of the combined thickness of the two formations is shown in figure 2. The thickness data used in constructing the map is given in table 2. The location of stratigraphic control wells are shown on figure 3.

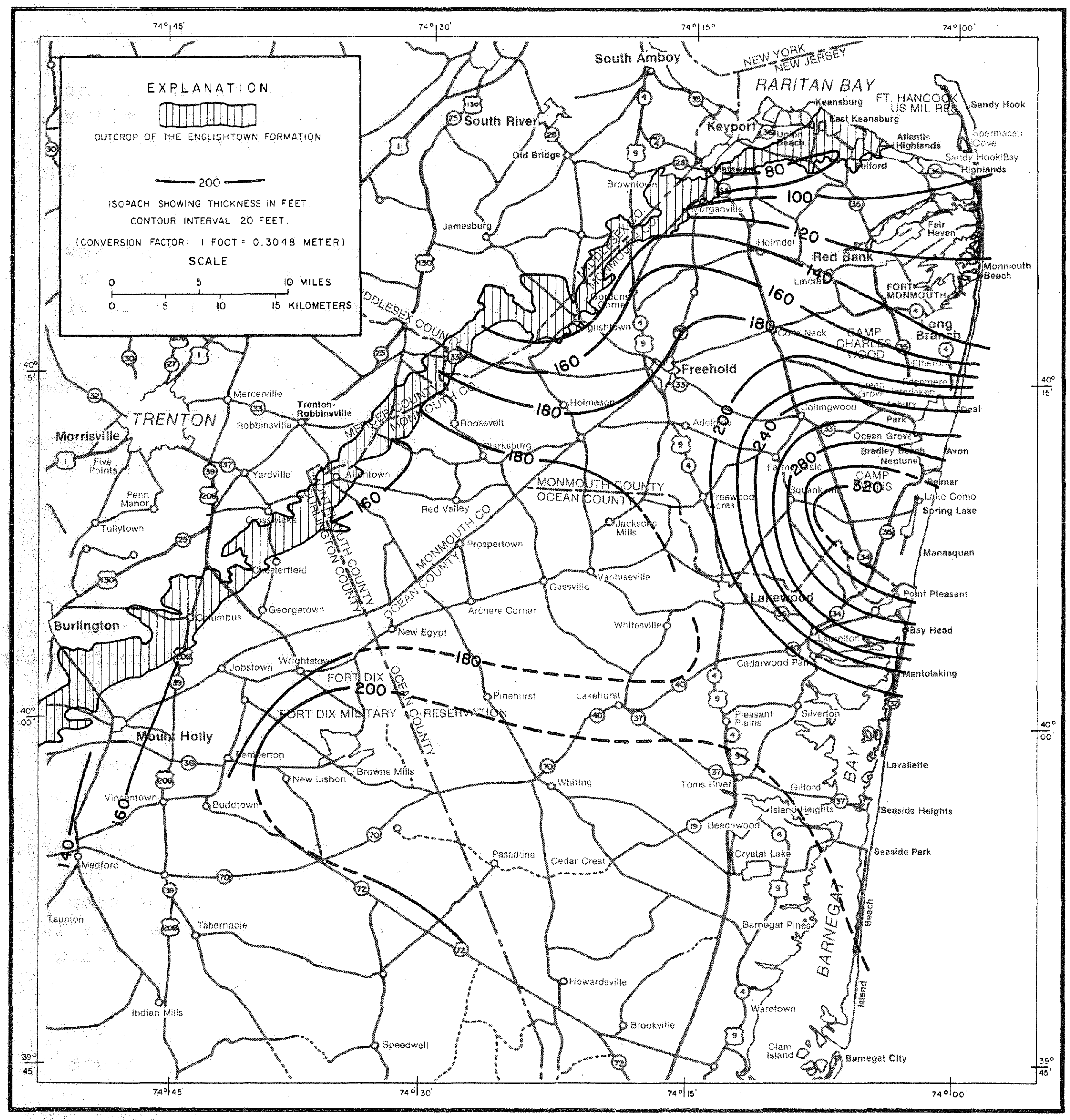


FIGURE 2. --COMBINED THICKNESS OF THE MERCHANTVILLE FORMATION AND WOODBURY CLAY IN MONMOUTH AND NORTHERN OCEAN AND BURLINGTON COUNTIES, N.J.

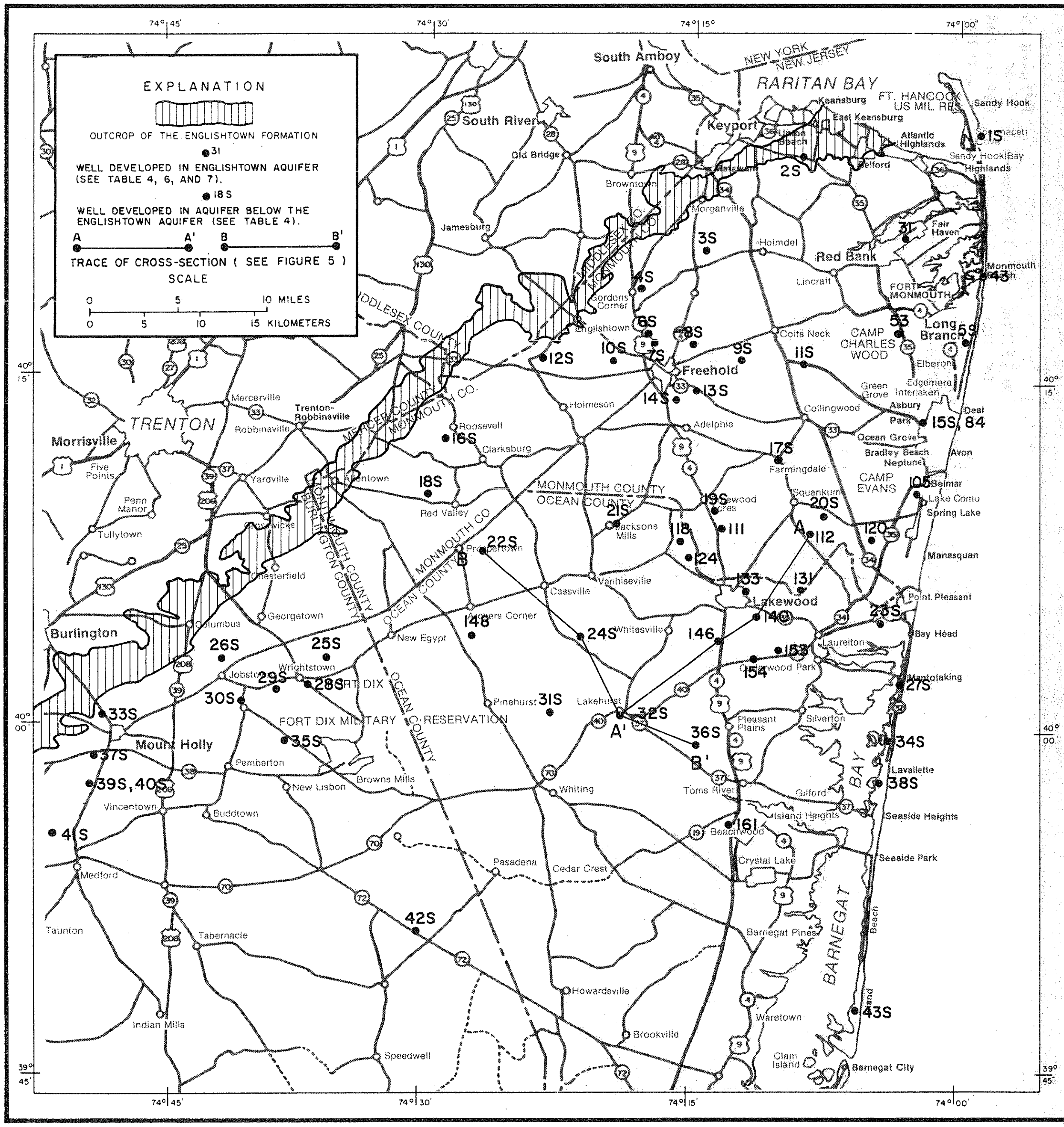


FIGURE 3. --LOCATION OF WELLS USED FOR STRATIGRAPHIC CONTROL DATA.

Table 2.--Stratigraphic control data

MAP NO	LOCATION	OWNER	LOCAL WELL NUMBER	ALTITUDE OF LSD (FT)	DATE DRILLED (YEAR)	WELL DEPTH (FT)	ALTITUDE OF TOP OF ENGLISHTOWN FORMATION	THICKNESS OF ENGLISHTOWN FORMATION (FT)	THICKNESS OF OVERLYING CONFINING LAYER (FT)	THICKNESS OF UNDERLYING CONFINING LAYER (FT)
31	402114N0740315.1	RED BANK W D	RBWD 2	30	1956	300	-112	138	42	--
43	401927N0735842.1	MON BCH CLD STR	MBCS 2	10	1961	430	-286	136	42	--
53	401720N0740315.1	R H MACY & CO	BAMBERGER TEST	70	1957	430	-280	116	42	144
84	401322N0740155.1	MONMOUTH CON WC	WHITESVILLE 3	10	1954	566	-436	104	40	--
105	401025N0740212.1	WALL TWP W D	WEST BELMAR	25	1959	575	-541	80+	35	--
111	400908N0741330.1	ALDRICH W CO	ALDRICH W CO 4	130	1967	550	-380	56+	40	--
112	400832N0740821.1	US GEOL SURVEY	ALLAIRE S P C	96	1963	633	-469	108	40	--
118	400823N0741520.1	JACKSON TWP MUA	JACKSON 2	156	1962	577	-330	118+	40	--
120	400824N0740508.1	WALL TWP W D	ALLENWOOD 2	80	1959	710	-524	74	44	--
124	400742N0741639.1	JACKSON TWP MUA	JACKSON 4	80	1965	500	-366	138+	50	--
133	400614N0741157.1	LAKEWOOD W C	LAKEWOOD 9	55	1968	698	-478	170	54	--
131	400555N0740851.1	PARKWAY W C	PARKWAY 1	45	1958	646	-558	124+	50	--
140	400500N0741108.1	LAKEWOOD W C	LAKEWOOD	30	1966	736	-552	170	94	--
146	400443N0741352.1	LAKEWOOD W C	LAKEWOOD 8	78	1965	758	-520	160	100	--
148	400416N0742701.1	US GEOL SURVEY	COLL MILLS TW1	137	1964	427	-249	96+	44	--
153	400358N0740812.1	BRADLEES CORP	BRADLEES WELL	10	1969	710	-640	62+	48	
154	400312N0741123.1	S LAKEWOOD W C	S LAKEWOOD 3	45	1966	741	-616	54+	62	--
161	395609N0741240.1	US GEOL SURVEY	TOMS RIVER TW2	15	1965	1146	-886	222	46	--
1S	402536N0735905.1	STATE OF NJ	SANDY HOOK SP1	10	1965	397	-55	146	10	94
2S	402449N0740910.1	LILY TULIP CUP	DEEP TEST WELL	60	1969	799	--	122+	--	80
3S	402102N0741353.1	MARLBORO S HOSP	STATE HOSP 15	135	1966	810	+17	70	14	148
4S	401902N0741811.4	GORDONS W C	GORDONS 4	150	1968	810	+38	80	18	164
5S	401639N0735936.1	MONMOUTH CONSOL	MCWC 1	10	1956	981	-384	122	42	140
6S	401633N0741728.1	FREEHOLD W D	FREEHOLD 3	120	1964	567	+16	108	36	160
7S	401633N0741726.2	FREEHOLD W D	TOP.LAKE TEST	110	1967	585	+34	100	24	178
8S	401625N0741501.2	SO GULF UTIL	SO GULF 2	195	1966	656	-66	92	36	190
9S	401609N0741206.1	HARMONY GOLF CL	HARMON GOLF 1	135	1963	712	-137	98	12	186
10S	401607N0742014.1	BATTLEGROUND CC	IRRIGATION	125	1967	569	+6	100	26	174
11S	401558N0740908.1	NAD EARLE	NAD EARLE 2	135	1944	836	-202	98	22	210
12S	401557N0742318.1	BOY SCOUTS AMER	QUAIL HILL 2	250	1967	527	+62	62	16	152
13S	401510N0741604.1	NESTLE CO	3 SUPPLY	155	1970	650	-71	104	28	186
14S	401412N0741606.1	FREEHOLD TWP WD	KOENIG LANE 1	130	1957	670	-92	100	32	172
15S	401322N0740202.1	MONMOUTH CON WC	WHITESVILLE 4	25	1956	957	-421	100	44	242
16S	401223N0742847.1	WILLIAM LEE	--	175	1960	456	+50	76	32	165
17S	401134N0741014.1	ROKEACH SONS	ROKEACH 1	80	1961	885	-302	102	52	261
18S	401005N0742939.1	PUNK BROS	PUNK DEEP WELL	140	1964	952	-4	84	28	176
19S	400957N0741317.1	ALDRICH W CO	ALDRICH W CO 2	150	1960	440	-320	124	34	--
20S	400921N0740743.1	STATE OF N J	ALLAIRE S P G2	30	1967	1029	-482	90	44	326
21S	400853N0741925.1		OIL TEST WELL	110	--	5000	-250	156	24	172
22S	400733N0742635.1	S. SWITLICK	TEST WELL 68-1	120	1968	404	-172	100	40	--

Table 2.--Stratigraphic control data--Continued

MAP NO	LOCATION	OWNER	LOCAL WELL NUMBER	ALTI-TUDE- OF LSD (FT)	DATE DRILLED (YEAR)	WELL DEPTH (FT)	ALTITUDE OF TOP OF ENGLISHTOWN FORMATION	THICKNESS OF ENGLISHTOWN FORMATION (FT)	THICKNESS OF OVERLYING CONFINING LAYER (FT)	THICKNESS OF UNDERLYING CONFINING LAYER (FT)
23S	400454N0740414.1	PT PLEASANT W D	PPWD 5	18	1960	1342	-705	158+	42	188
24S	400319N0741957.1	GLIDDEN-DURKEE	SCM 3	105	1962	1728	-402	166	62	162
25S	400300N0743517.1	US AIR FORCE	MCGUIRE B	126	1960	835	-112	50	80	178
26S	400256N0744111.1	WM G HELIS	STOCK FARM 3	70	1962	372	+2	50	35	172
27S	400210N0740310.2	OCEAN CO W C	MANTOLOKING 7	10	1960	1369	-854	180	38	202
28S	400138N0743753.1	US ARMY	FORT DIX 3	172	--	869	-130	54	58	230
29S	400129N0743656.1	US ARMY	FORT DIX 2	131	1941	1051	-155	70	58	162
30S	400115N0744009.1	WM G HELIS	STOCK FARM SO	90	--	498	-96	52	56	170
31S	400105N0742244.1	US NAVY	LAKE NAS 32	100	1964	1583	-418	152	56	170
32S	400046N0741838.1	LAKEHURST WD	1	65	1928	1035	-559	148	96	190
33S	400021N0744737.1	ACME FOOD STORE	1	62	1956	545	+2	74	34	142
34S	400009N0740337.1	OCEAN CO W C	NORMANDY 4	8	1967	1500	-924	176	180	--
35S	395938N0743742.1	US ARMY FT DIX	FORT DIX 6	160	1970	1140	-232	28	40	214
36S	395930N0741421.1	TOMS R CHEM CO	TOMS R 84	66	1968	1480	-711	148	66	196
37S	395830N0744803.1	BROWN CO	TEST 1	40	1961	355	-41	60	25	180
38S	395808N0740416.1	LAVALLETTE W D	LAVALLETTE 4	5	1960	1515	-946	178	190	--
39S	395721N0744821.1	LUMBERTON L W S	LLWS 3	10	1960	400	-90	80	28	152
40S	395720N0744822.1	LUMBERTON L W S	LLWS 2	10	1960	359	-90	80	28	152
41S	395524N0745025.1	US GEOL SURVEY	MEDFORD 1	70	1963	410	-112	84	28	128
42S	395122N0743017.1	US GEOL SURVEY	BUTLER PLACE 1	130	1964	2117	-684	68	18	294
43S	394829N0740535.3	US GEOL SURVEY	IS BEACH 3	8	1962	2756	-1390	152	--	--

The Englishtown Formation is exposed in the western part of the New Jersey Coastal Plain along a northeast-southwest trending zone extending from Raritan Bay to Delaware Bay (fig. 1). The formation dips gently from 30 to 50 ft/mi (feet per mile) [5.7 to 9.5 m/km (meters per kilometer)] toward the southeast. The top of the formation is 700 to 800 ft (213 to 243 m) below sea level in northeastern Ocean County (fig. 4, table 2).

The Englishtown conformably overlies the Woodbury Clay in the northern part of the New Jersey Coastal Plain and the Merchantville Formation farther to the south (Owens and Minard, 1970). The transitional contact between the Woodbury and the Englishtown "is characterized by a gradual increase in sand-sized quartz and a decrease in silt and clay" (Owens and Sohl, 1969, p. 244). The Englishtown Formation along its outcrop in the northern part of the Coastal Plain is typically a series of light-gray to white thin cross-stratified fine- to medium-grained lignitic quartz sand beds intercalated with thin beds of dark-gray sandy silty clay and clayey silt. A marine and marginal marine origin has been established for parts of the Englishtown, especially along its outcrop south of Trenton. The internal structure of the Englishtown indicates an alluvial origin for the formation exposed between Trenton and Raritan Bay (Owens and Sohl, 1969, p. 245); in the vicinity of Raritan Bay a shallow-water to beach-complex environment of deposition is suggested by Minard (1969) and Seaber (1965).

The formation in the subsurface in northern, northwestern, and western Monmouth County seems to retain most of the lithologic characteristics displayed in outcrop. However, along a line extending roughly from Long Branch westward to the Freehold area and then southwest through extreme northwestern Ocean County, the Englishtown can be subdivided into two or three ill-defined thick dominantly sandy zones separated by one or two indistinct silty zones, which range in thickness from about 5 to 15 ft (1.5 to 4.6 m). This lithologic subdivision can be traced downdip into southeastern Monmouth County and northern and eastern Ocean County, where the formation can be subdivided into three distinct lithologic units over an area extending from north of Lakewood east to Point Pleasant, south to Toms River, and southwest into east-central Burlington County (fig. 5). The upper and lower units consist of light-colored fine- to very fine-grained silty lignitic quartz sand with thin interbeds of dark sandy silt. These units are separated by a thick sequence of dark-gray sandy and clayey lignitic silt beds. The uppermost sand pinches out, apparently grading laterally into the silty lithofacies somewhere between Mantoloking and Normandy Beach and between Toms River and Lavallette. Farther southeast at Island Beach State Park the very fine-grained silty sand to sandy lithofacies predominates.

Seaber (1965) restricted the name Englishtown Formation to the quartz sand lithofacies, as described in outcrop, limiting the name Englishtown to a distinctive water-bearing rock-stratigraphic unit. However, Owens and Sohl (1969) and Owens, Minard, Sohl, and Mello (1970) include more than one

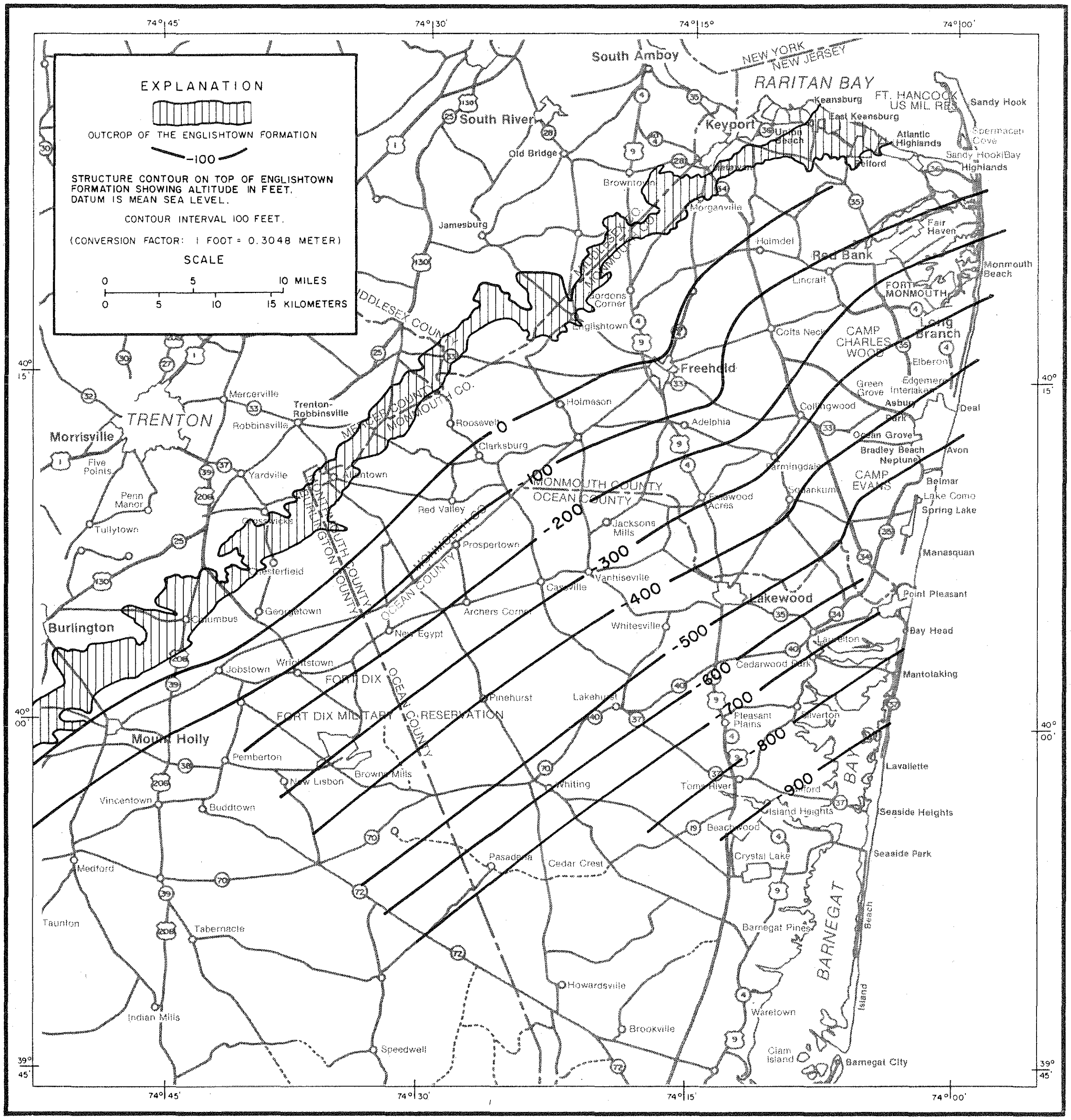


FIGURE 4. --STRUCTURE CONTOURS OF THE TOP OF THE ENGLISHTOWN FORMATION IN MONMOUTH AND NORTHERN OCEAN COUNTIES, N.J.

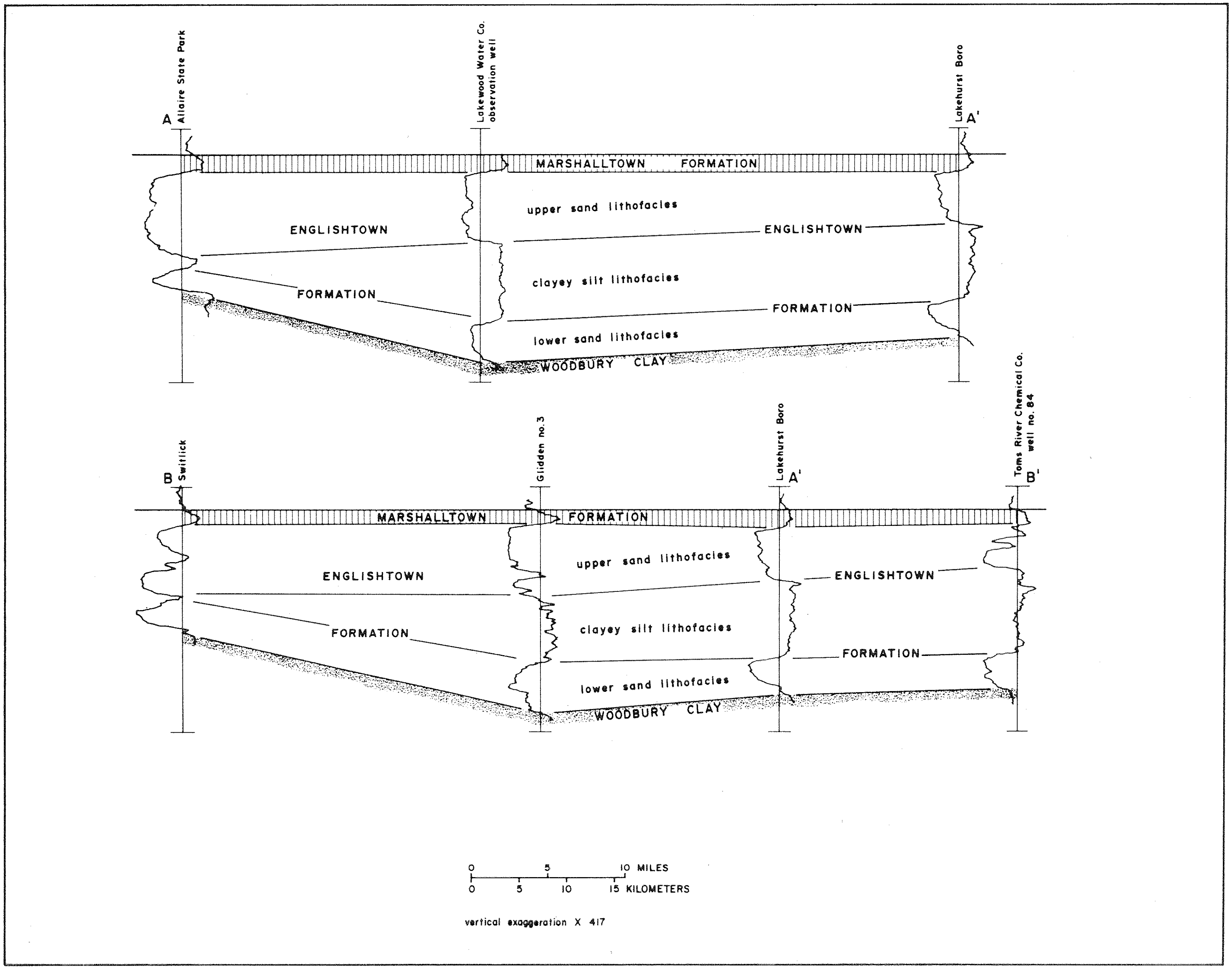


FIGURE 5. --CROSS SECTIONS A-A' AND B-B' SHOWING THE SAND AND CLAYEY SILT LITHOFACIES ON NATURAL GAMMA RADIATION LOGS OF THE ENGLISHTOWN FORMATION IN NORTHERN OCEAN COUNTY, N.J. (LOCATION OF CROSS-SECTION SHOWN ON FIGURE 3.)

lithofacies in the formation. This report follows the usage of Owens and Sohl and includes more than one lithofacies in the Englishtown. The lowermost sand in the subsurface of Ocean County, previously not recognized as part of the Englishtown, can be traced northward into the more typical Englishtown sequence in Monmouth County. The middle silty sequence is included in the formation because of its stratigraphic position between the two sand units; it is probably continuous with one of the silty zones observed in the subsurface of central Monmouth County.

The thickness of the Englishtown along its outcrop in the northern New Jersey Coastal Plain ranges from about 140 ft (43 m) near Raritan Bay to about 50 ft (15 m) near Trenton. The formation averages about 100 ft (30 m) thick in the subsurface throughout most of central Monmouth County. It gradually thickens to about 160 ft (49 m) in northern Ocean County and attains a maximum thickness of more than 200 ft (61 m) in the Toms River area of east-central Ocean County (fig. 6, table 2). Figures 7, 8, and 9 show the thickness of each of the three units into which the Englishtown can be subdivided in southeastern Monmouth County and northern Ocean County. Figure 5 shows these units in cross section. The upper sand unit thins southeastward from a maximum thickness of more than 80 ft (24 m) in northern Ocean County to less than 40 ft (12 m) near Toms River and about 20 ft (6 m) at Mantoloking. This lithofacies is absent from the section at Island Beach. The middle silt sequence thickens southeastward from about 20 ft (6 m), where it can be clearly identified in northern Ocean County and southeastern Monmouth County, to more than 130 ft (39 m) in the Toms River-Lavallette area. The lower sand had an average thickness of between 30 and 40 ft (9 and 12 m) in north-central Ocean County. The unit thickens slightly toward the southeast to a maximum of about 50 ft (15 m) at Toms River and Lavallette. It cannot readily be recognized in the section at Island Beach State Park.

The Marshalltown Formation, which overlies the Englishtown throughout the New Jersey Coastal Plain is a massive dark-greenish-black fine- to very fine-grained clayey glauconite-quartz sand and silt. The abrupt contact between the Marshalltown and Englishtown and the presence of reworked Englishtown material in the basal few feet of the Marshalltown suggest a disconformable relationship (Owens and Sohl, 1969). The formation is remarkably uniform in thickness along its entire outcrop in New Jersey, ranging from 10 to 20 ft (3 to 6 m). The same uniformity is observed everywhere in the subsurface of the northern Coastal Plain of New Jersey.

The overlying Wenonah Formation is a poorly sorted dark silty very fine to fine sand. The contact with the underlying Marshalltown is gradational. The Wenonah obtains a maximum thickness in outcrop of about 70 ft (21 m) in the vicinity of Mount Holly, N.J. (Minard and others, 1964). It thins along the outcrop both to the northeast and southwest. Minard (1969, 1965) reports a thickness of 25 to 30 ft (7.6 to 9 m) near Raritan Bay and 15 to 25 ft (4.5 to 7.6 m) in extreme southwestern New Jersey. A similar range in thickness is observed in the subsurface of the northern Coastal Plain of New Jersey, although accurate identification of the formation on geophysical logs is difficult.

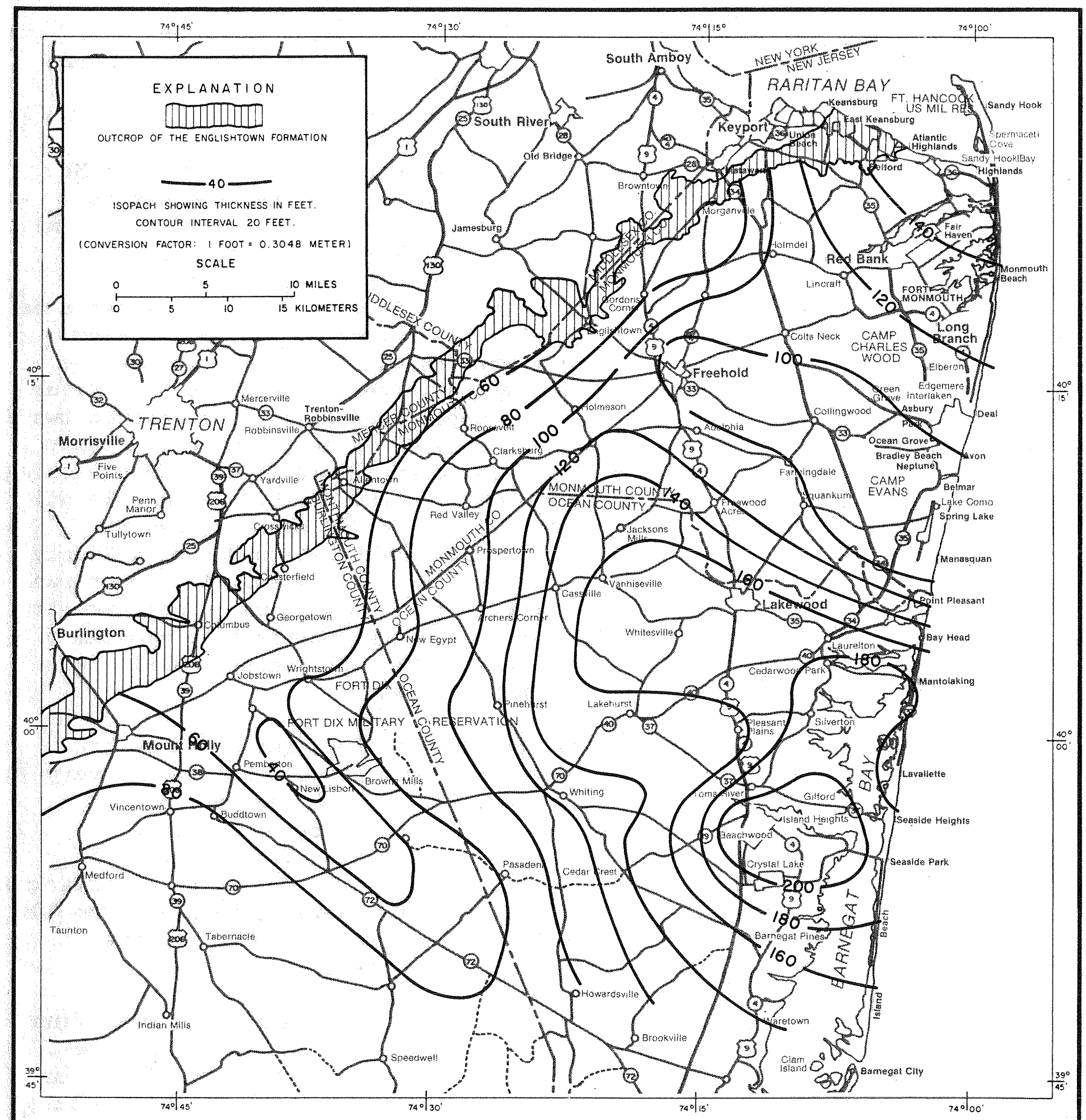


FIGURE 6. --THICKNESS OF THE ENGLISHTOWN FORMATION IN MONMOUTH AND NORTHERN OCEAN AND BURLINGTON COUNTIES, N.J.

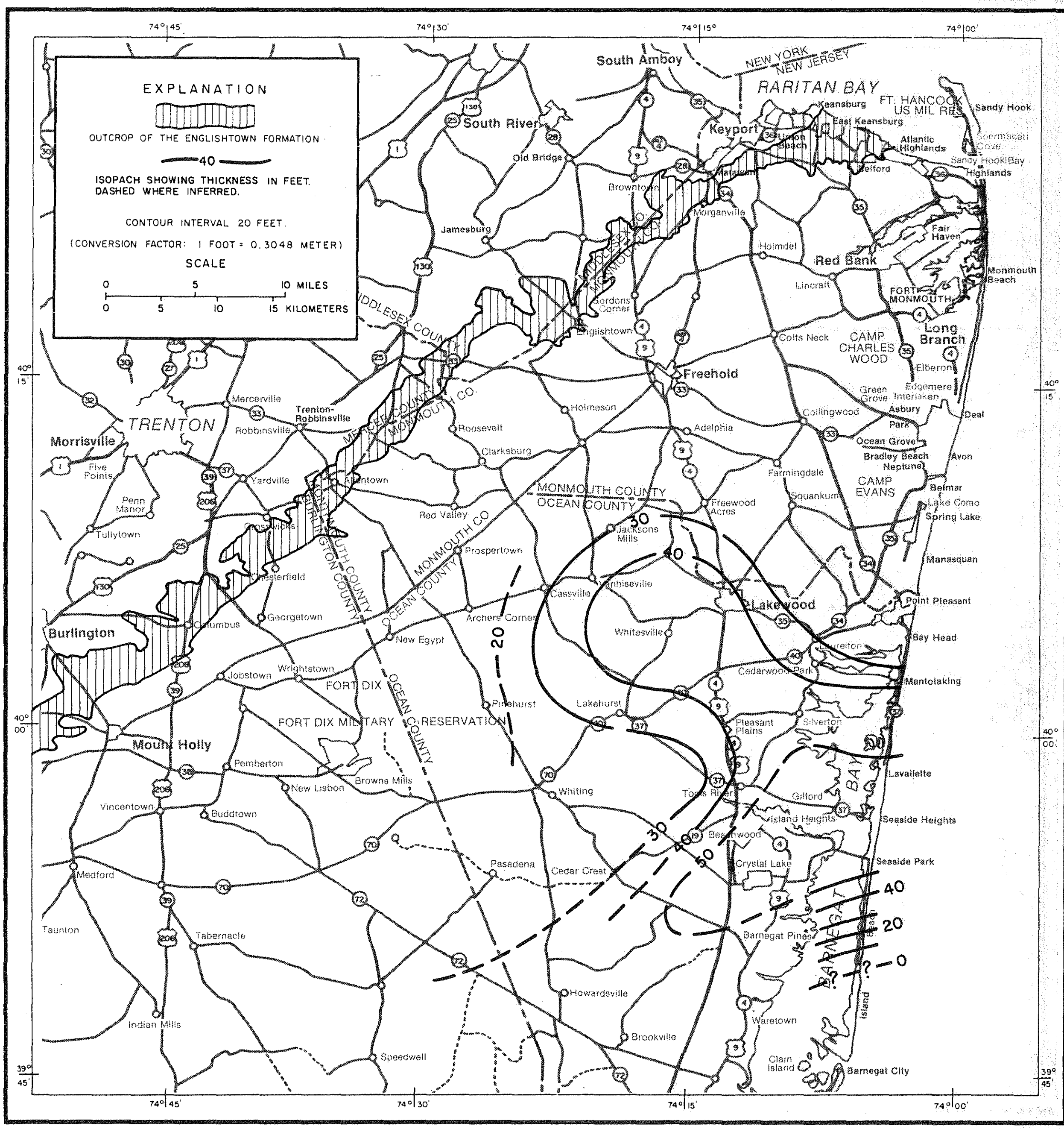


FIGURE 7. --THICKNESS OF THE LOWER SAND LITHOFACIES OF THE ENGLISHTOWN FORMATION IN NORTHERN OCEAN COUNTY, N.J.

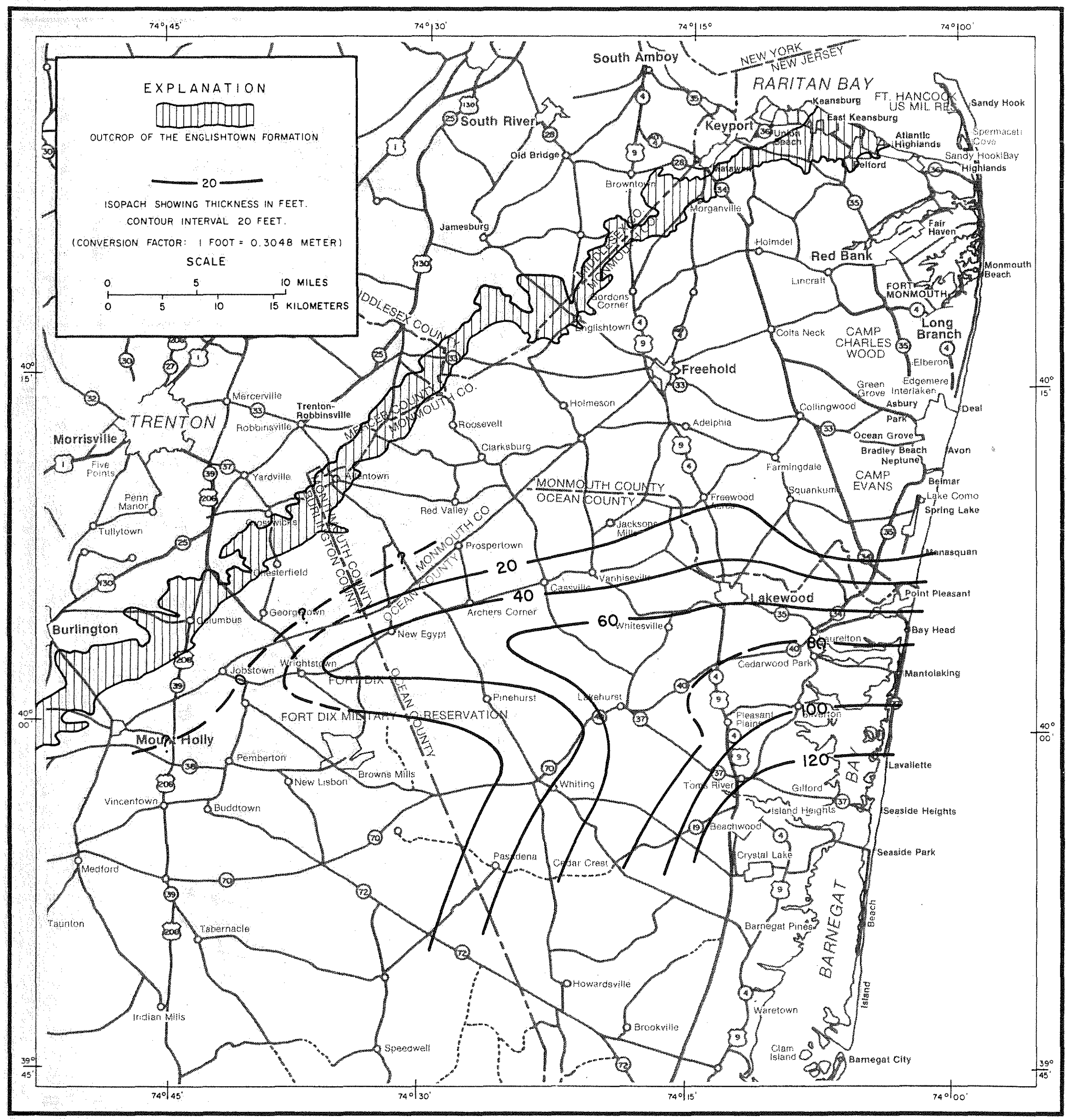


FIGURE 8. --THICKNESS OF THE CLAYEY SILT LITHOFACIES OF THE ENGLISHTOWN FORMATION IN NORTHERN OCEAN COUNTY, N.J.

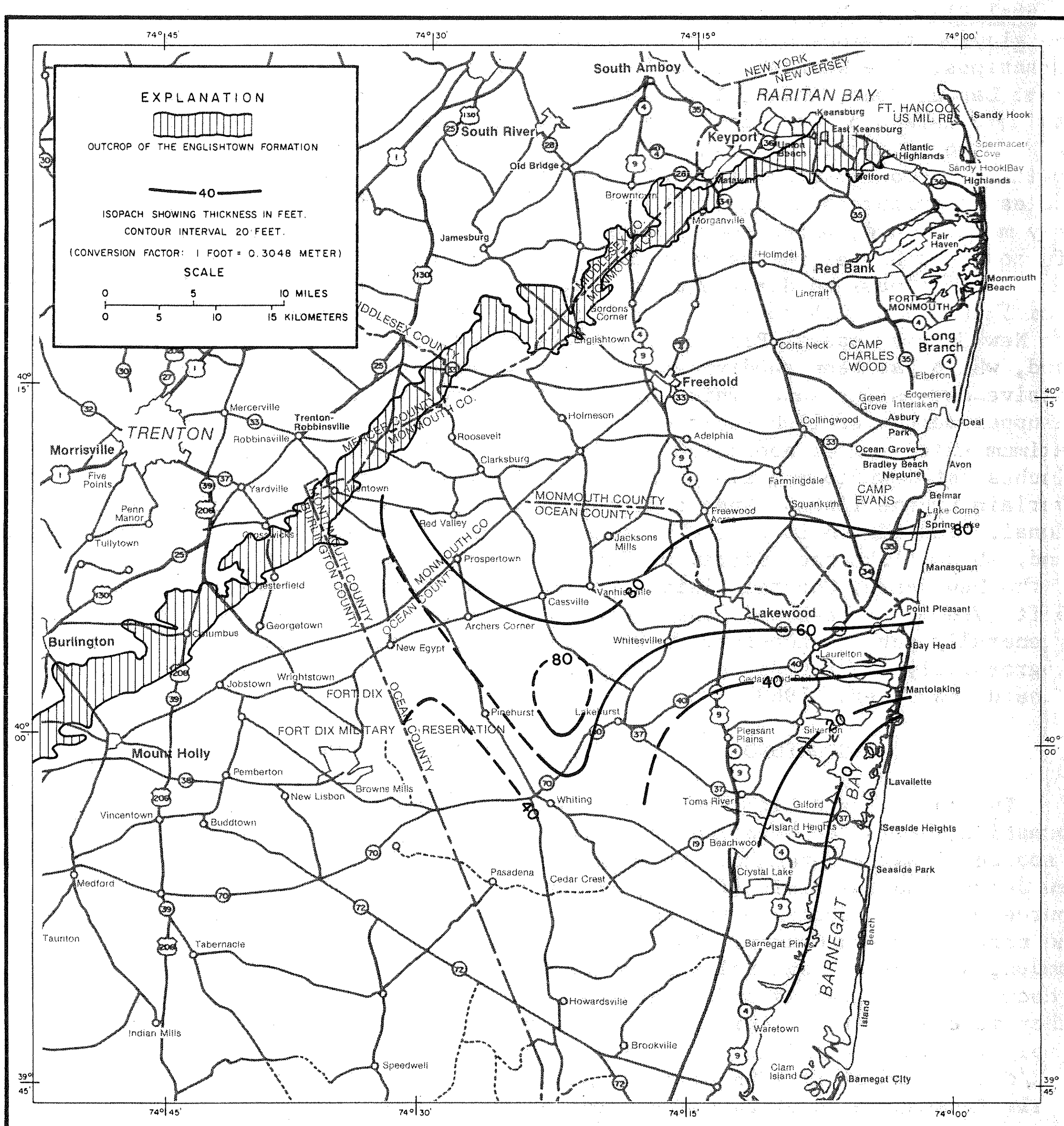


FIGURE 9. --THICKNESS OF THE UPPER SAND LITHOFACIES OF THE ENGLISHTOWN FORMATION IN NORTHERN OCEAN COUNTY, N.J.

Monmouth Group

Overlying the Wenonah Formation of the Matawan Group in the northern Coastal Plain of New Jersey is a sequence of medium- to coarse-grained quartz and glauconite sands named the Monmouth Group which is divided into four formations. The Wenonah Formation is the oldest and grades upward into the Mount Laurel Sand, which, like other coarse clastic units in the Coastal Plain, consists of more than one lithofacies along its outcrop. Near Raritan Bay the Mount Laurel consists of light-colored thin-bedded fine- to medium-grained glauconite sand with thin interbeds of dark clay and silt. This facies interfingers along strike to the southwest with a massive-bedded dark-gray medium sand, which constitutes the formation near Trenton. The thickness of the Mount Laurel ranges from 20 to 70 ft (6 to 21 m). The Navesink Formation, a massive dark-colored clayey glauconite sand ranging in thickness from 5 to 35 ft (1.5 to 10.6 m), abruptly overlies the Mount Laurel throughout the New Jersey Coastal Plain. The Navesink grades upward into the Red Bank Sand, which has been subdivided into two members; a lower member of dominantly massive dark silty sand, which grades laterally into a glauconitic sand, and an upper member of light-colored fine to coarse sand. The Red Bank has a maximum thickness of about 130 ft (39.6 m) in the Raritan Bay area, but pinches out downdip and along strike to the southwest. The Red Bank is overlain by the Tinton Sand; the contact between the two formations is gradational. The Tinton is a fine to medium glauconite-quartz to quartz-glauconite sand, which, like the underlying Red Bank, occurs only in the northern part of the New Jersey Coastal Plain. Its maximum thickness in outcrop is about 25 ft (7.6 m). The top of the Cretaceous section in New Jersey is marked by a generally subtle unconformity with the basal Tertiary sediments overlapping progressively lower beds in the Cretaceous section from northeast to southwest (Minard and others, 1969).

GEOHYDROLOGY OF THE ENGLISHTOWN AQUIFER SYSTEM

The quartz sand lithofacies (two units shown on fig. 5) of the Englishtown Formation, hereafter referred to as the Englishtown aquifer, are utilized as a source of water throughout an area of about 1,100 mi^2 (2,849 km^2) of the New Jersey Coastal Plain (fig. 1) (Seaber, 1965, p. B16). It is an important source of water supply in the northeastern Coastal Plain in Monmouth County and northern Ocean County. The aquifer is less developed in Burlington, Camden, Gloucester, and Salem Counties to the southwest, largely because of a decrease in thickness and water-yield capabilities, and the presence of other more productive aquifers. Total ground-water withdrawals for public supply in Monmouth and northern Ocean Counties increased from about 5.5 Mgal/d (0.24 m^3/s) in 1959 to about 9.5 Mgal/d (0.4 m^3/s) in 1970. Water levels in some parts of this area are declining 8 to 12 ft (2.4 to 3.6 m) per year and have declined more than 100 ft (30 m) near centers of pumping between 1959 and 1970 (fig. 10).

The Englishtown aquifer, together with the underlying and overlying confining beds, constitute the Englishtown aquifer system. This system is,

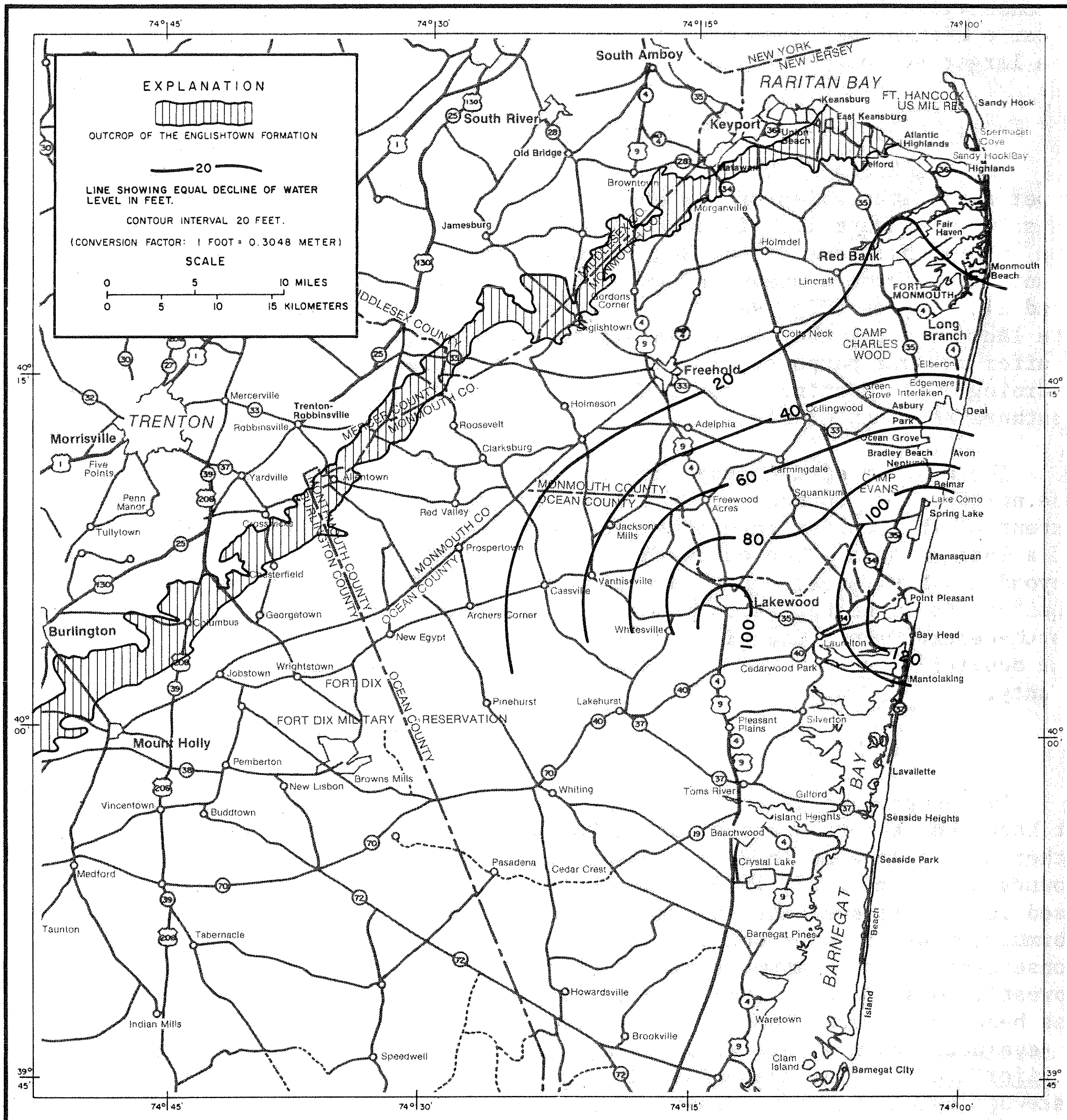


FIGURE 10. --DECLINE IN WATER LEVEL BETWEEN JANUARY 1959 AND NOVEMBER 1970 IN THE ENGLISHTOWN AQUIFER IN MONMOUTH AND NORTHERN OCEAN COUNTIES, N.J.

in turn, a subsystem of the larger Coastal Plain aquifer system of New Jersey. The overlying confining bed, which includes the Marshalltown Formation and part of the Wenonah Formation, provides the interconnection between the Englishtown subsystem and the overlying part of the larger system. The Merchantville Formation and Woodbury Clay, which together constitute the lower confining bed, perform the same function with respect to that part of the larger system underlying the Englishtown.

Aquifer Geometry and Boundaries

The thickness of the Englishtown aquifer in Monmouth County and the upper sand lithofacies of the aquifer in northern Ocean and Burlington Counties is shown in figure 11. Throughout most of Monmouth County the aquifer includes the entire thickness of the Englishtown Formation. In southeastern Monmouth County and northern Ocean and Burlington Counties, however, only the upper sand lithofacies (fig. 9) is included as part of the aquifer. Because of the lack of data, the lower sand lithofacies (fig. 7) is not included in the aquifer for the purposes of this study, even though it is lithologically and hydrologically continuous with the aquifer over some undefined area across southern Monmouth County.

The outcrop of the upper contact of the Englishtown Formation marks the northwestern boundary of the confined part of the aquifer. The southward extent of the aquifer into southern Ocean County cannot be determined because of a lack of data. The eastward extent and thickness trends of the aquifer, beyond the New Jersey coast, are also unknown. The thickest parts of the aquifer are in northeastern Monmouth County and south-central Monmouth and north-central Ocean Counties, where it is more than 120 ft (36 m) thick. The aquifer generally thins toward the south into central and eastern Ocean County.

Aquifer Coefficients

Two pumping tests of the Englishtown aquifer have been conducted; one at Lakewood in north-central Ocean County on May 14 and 15, 1959, and the other near Allenwood in Wall Township in extreme southeastern Monmouth County on November 28, 1959. The Theis (1935) nonequilibrium formula was used in 1959 to evaluate the data collected during both of these tests. This formula, however, does not take into account the leaky nature of the aquifer. Consequently, the transmissivity ascribed to the Englishtown by previous investigators (Seaber, 1965; Rush, 1968; Anderson and Appel, 1969) generally has been too large. The data collected during the two pumping tests were re-evaluated during this study using the Hantush (1960) modified leaky aquifer theory. The transmissivity computed from the drawdown data at Lakewood using the Theis equation was 1,300 ft^2/day (square feet per day) [121 m^2/day (square meters per day)]. This compares with a transmissivity of 1,100 ft^2/day (102 m^2/day) computed from drawdown data with the Hantush modified equations. The storage coefficients computed with the Theis equation were 2.7×10^{-4}. These compare with a storage coefficient of 2.2×10^{-4} computed with the modified leaky aquifer equations.

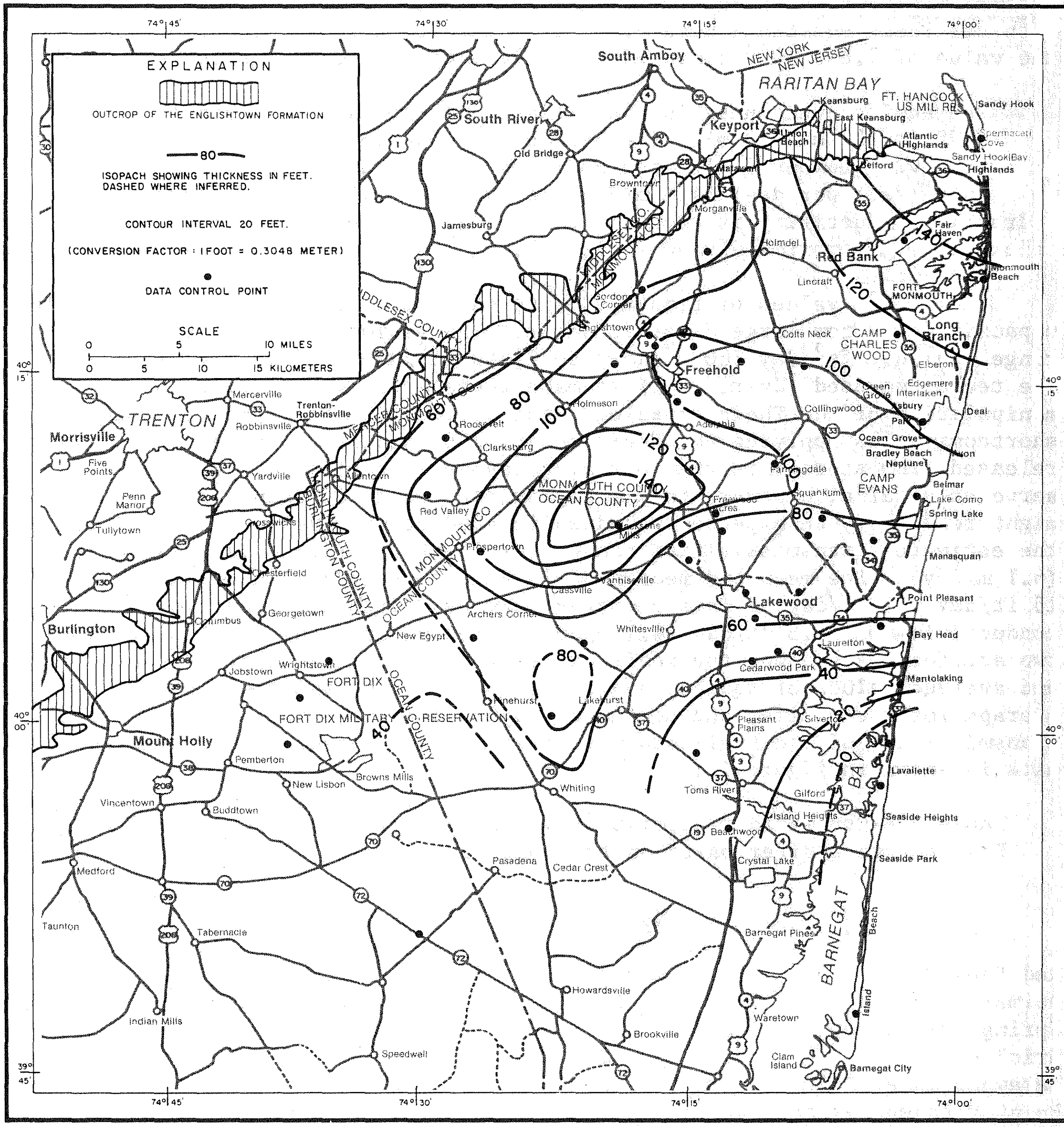


FIGURE 11. --THICKNESS OF THE ENGLISHTOWN AQUIFER IN MONMOUTH COUNTY AND OF THE UPPER SAND LITHOFACIES OF THE ENGLISHTOWN AQUIFER IN NORTHERN OCEAN AND BURLINGTON COUNTIES, N.J.

The drawdown and recovery data obtained during the test at Allenwood were used in the Theis equation to compute transmissivities of 1,200 ft^2/day (111 m^2/day) and 1,300 ft^2/day (121 m^2/day). These same drawdown data were used to compute a transmissivity of 1,100 ft^2/day (102 m^2/day) with the Hantush modified leaky aquifer equations. The storage coefficients computed with the Theis equations were 8.8×10^{-5} and 8.3×10^{-5} which are close to the value of 7.6×10^{-5} computed with the modified leaky aquifer equations.

The aquifer thickness in the vicinity of the Lakewood test is between 70 and 75 ft (21 and 23 m). The hydraulic conductivity, using the value of transmissivity computed with the modified leaky aquifer equations, is about 15 ft/day (feet per day) [4.6 m/day (meters per day)]. At Allenwood the hydraulic conductivity is about 12 ft/day (4.6 m/day) based on an aquifer thickness of approximately 90 ft (27 m).

Additional values of transmissivity have been estimated using specific capacity data from large diameter wells. The estimated transmissivities range from 650 ft^2/day (60 m^2/day) to 2,400 ft^2/day (223 m^2/day) (table 3). The technique used (Hurr, 1966) to make these estimates is based on a manipulation of the Theis equation. The approach suffers from the same shortcomings as applying the Theis equation to aquifer test data since water released from storage in the confining layers is neglected. The estimates serve as a guide, however, to the approximate range of transmissivity that might reasonably be expected. Hydraulic conductivity values obtained from the estimated transmissivities range from 11 ft/day (3.3 m/day) to 20 ft/day (6.1 m/day). The mean and median of 15 values of hydraulic conductivity is 15 ft/day (4.5 m/day). This compares very well with the mean hydraulic conductivity of 13.5 ft/day (4.1 m/day) computed from the results of the two aquifer tests using the modified leaky aquifer equations. The extreme and average values of aquifer hydraulic conductivity and specific storage for the aquifer and confining layers are given in table 4. The transmissivity of the Englishtown aquifer which is based on all available data is shown in figure 12.

Table 3.--Estimated transmissivity and hydraulic conductivity of the Englishtown aquifer based on the specific capacity of selected wells

		T		K	
	Well No.	(ft^2/day)	(m^2/day)	(ft/day)	(m/day)
Red Bank Boro	2	2,400	223	17	5.2
Belmar Boro	11	1,400	130	16	4.9
Spring Lake Boro	3	960	99	12	3.6
Brielle Boro	2	1,100	102	14	4.2
Lakewood Water Co.	6	1,100	102	16	4.9
Point Pleasant Water Dept.	1	740	69	12	3.6
do.	2	900	84	15	4.6
do.	3	750	70	12	3.6
Central RR of New Jersey	-	1,100	102	19	5.8
Ocean County Water Co.	Bay Head 6	650	60	13	3.9
Lavoie Labs	-	1,600	149	20	6.1
Frank Gumina	-	1,900	176	17	5.2
Anthony Verange	-	2,000	186	20	6.1
Laura Harding	-	1,200	111	12	3.6
U.S. Army, Camp Evans	Bldg. 82	1,000	93	11	3.3

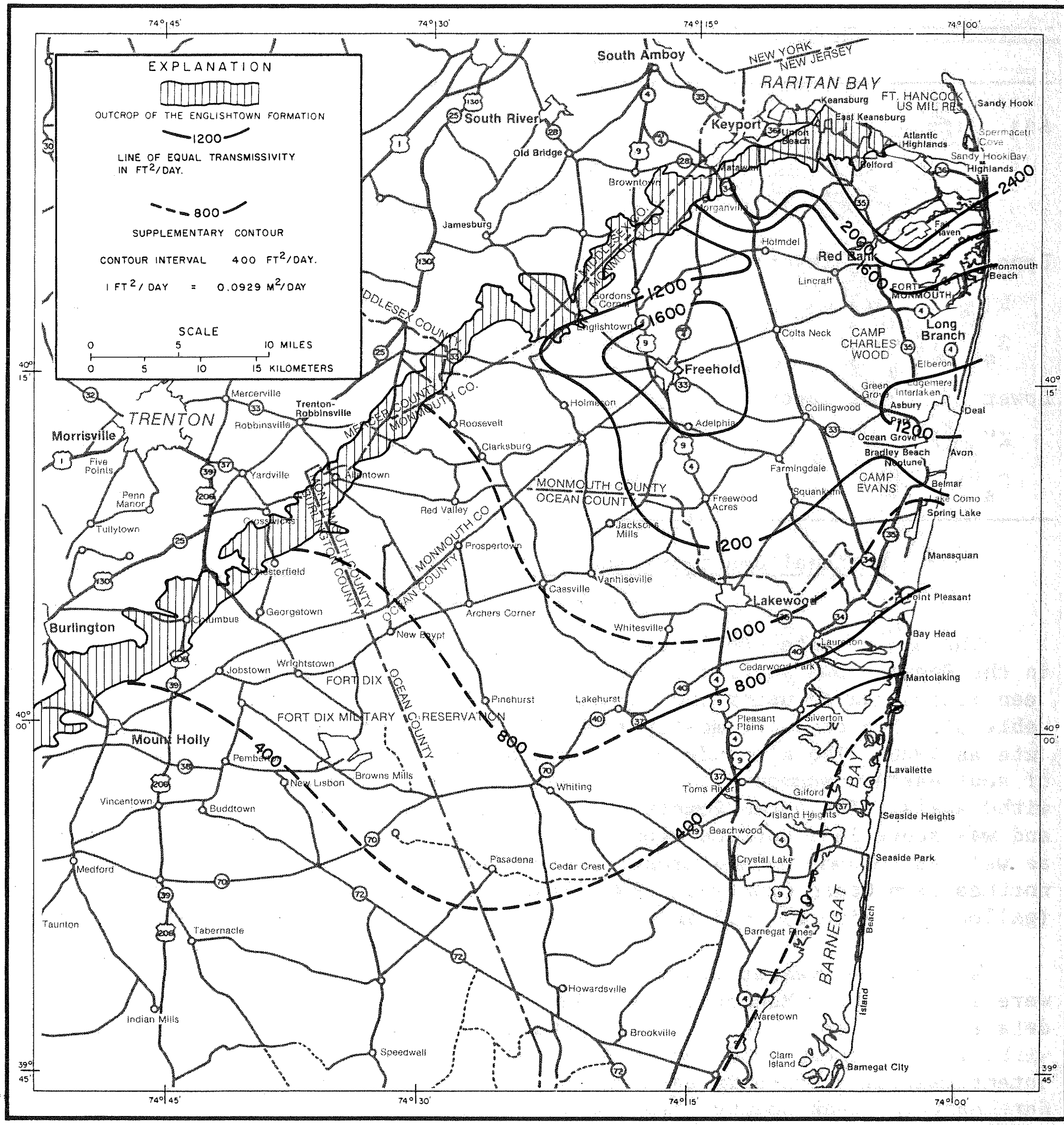


FIGURE 12. --TRANSMISSIVITY OF THE ENGLISHTOWN AQUIFER IN MONMOUTH AND NORTHERN OCEAN COUNTIES, N.J.

Table 4.--Extreme and average values of hydraulic coefficients of the aquifer and confining layer
(K - hydraulic conductivity)
(S_s - specific storage)

	Maximum	Minimum	Average[3/]
Aquifer:[1/]			
K (ft/sec)	2.31×10^{-4}	1.29×10^{-4}	1.65×10^{-4}
S_s (1/ft)	2.98×10^{-6}	8.48×10^{-7}	-- [2/]
Upper confining layer:			
K' (ft/sec)	5.7×10^{-9}	6.5×10^{-11}	1.7×10^{-10}
S_s' (1/ft)	9.2×10^{-5}	5.1×10^{-5}	7.1×10^{-5}
Lower confining layer:			
K" (ft/sec)	6.9×10^{-10}	4.2×10^{-11}	7.6×10^{-11}
S_s'' (1/ft)	4.6×10^{-4}	9.6×10^{-5}	8.8×10^{-5}

Regional Configuration of the Potentiometric Surface and Water-level Trends

The approximate configuration of the prepumping potentiometric surface in the Englishtown aquifer in Monmouth, Ocean, and Burlington Counties has been reconstructed using the earliest available water-level data (fig. 13, table 5). The data are mostly from the period 1890-1900, but some are as late as 1920. The altitude of the surface in the Belmar-Spring Lake area of southeastern Monmouth County probably reflects the effects of pre-1900 withdrawals. The potentiometric surface was everywhere above sea level and was above land surface along the coastal areas south of Long Branch as well as in some inland areas. Several wells drilled at Lakewood in northeastern Ocean County in 1899 flowed between 100 and 150 gal/min (gallons per minute) [6.3 and 9.4 l/s (liters per second)] at land surface.

Water-level measurements obtained in December 1958 and January 1959 were available for Monmouth and Ocean Counties (table 6). Well construction data are shown on table 7. It is apparent from these data that ground-water withdrawals between 1900 and 1959 caused a significant lowering of the potentiometric surface in eastern and southeastern Monmouth County and northeastern Ocean County (fig. 14). A decline of 40 ft (12 m) or more occurred over a wide area, and a decline of more than 100 ft (30 m) occurred

[1/] Calculated from aquifer test data

[2/] Insufficient field data

[3/] Harmonic mean values.

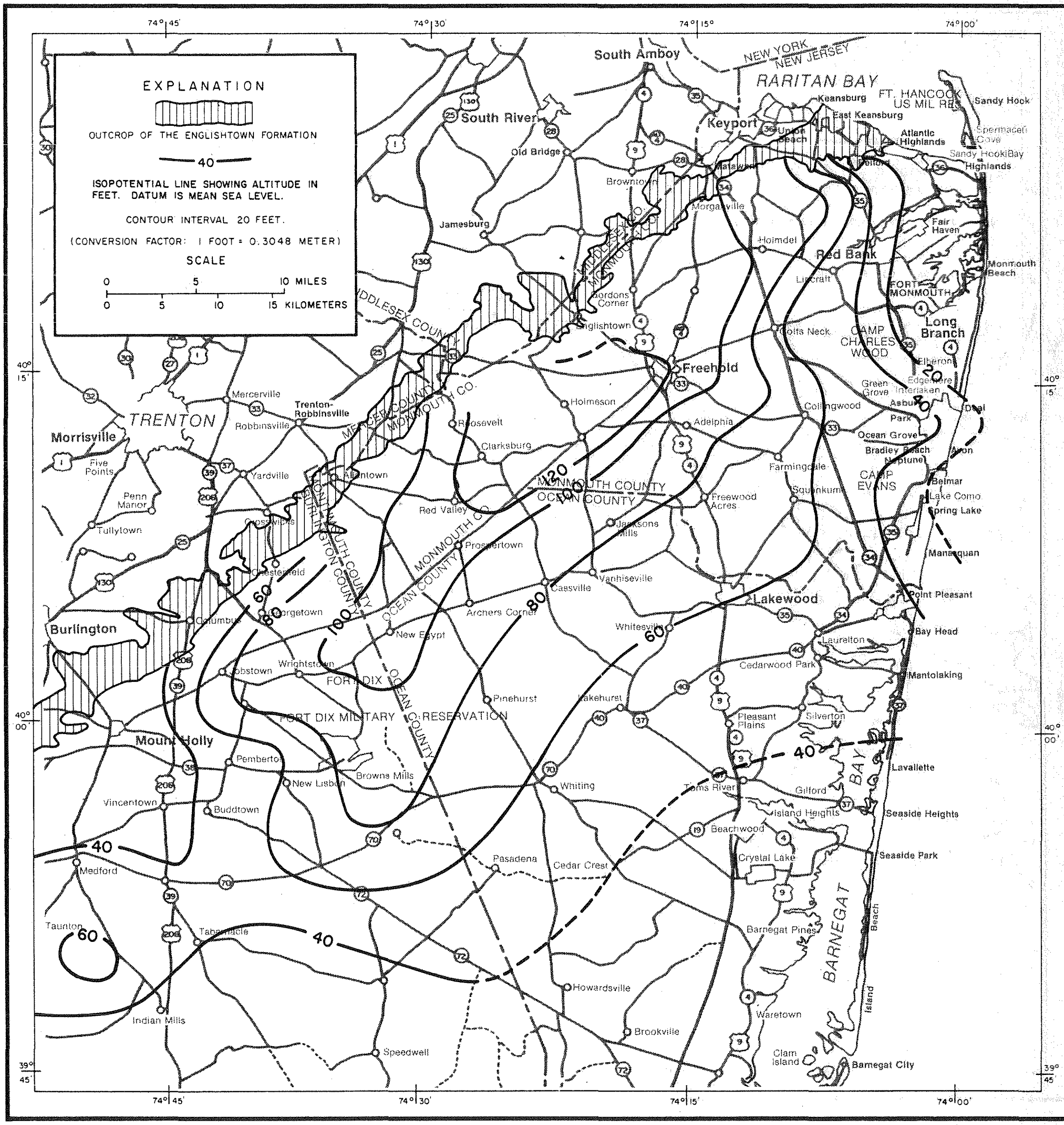


FIGURE 13. --ALTITUDE OF THE POTENTIOMETRIC SURFACE IN THE ENGLISHTOWN AQUIFER ABOUT 1900 IN MONMOUTH AND NORTHERN OCEAN AND BURLINGTON COUNTIES, N.J.

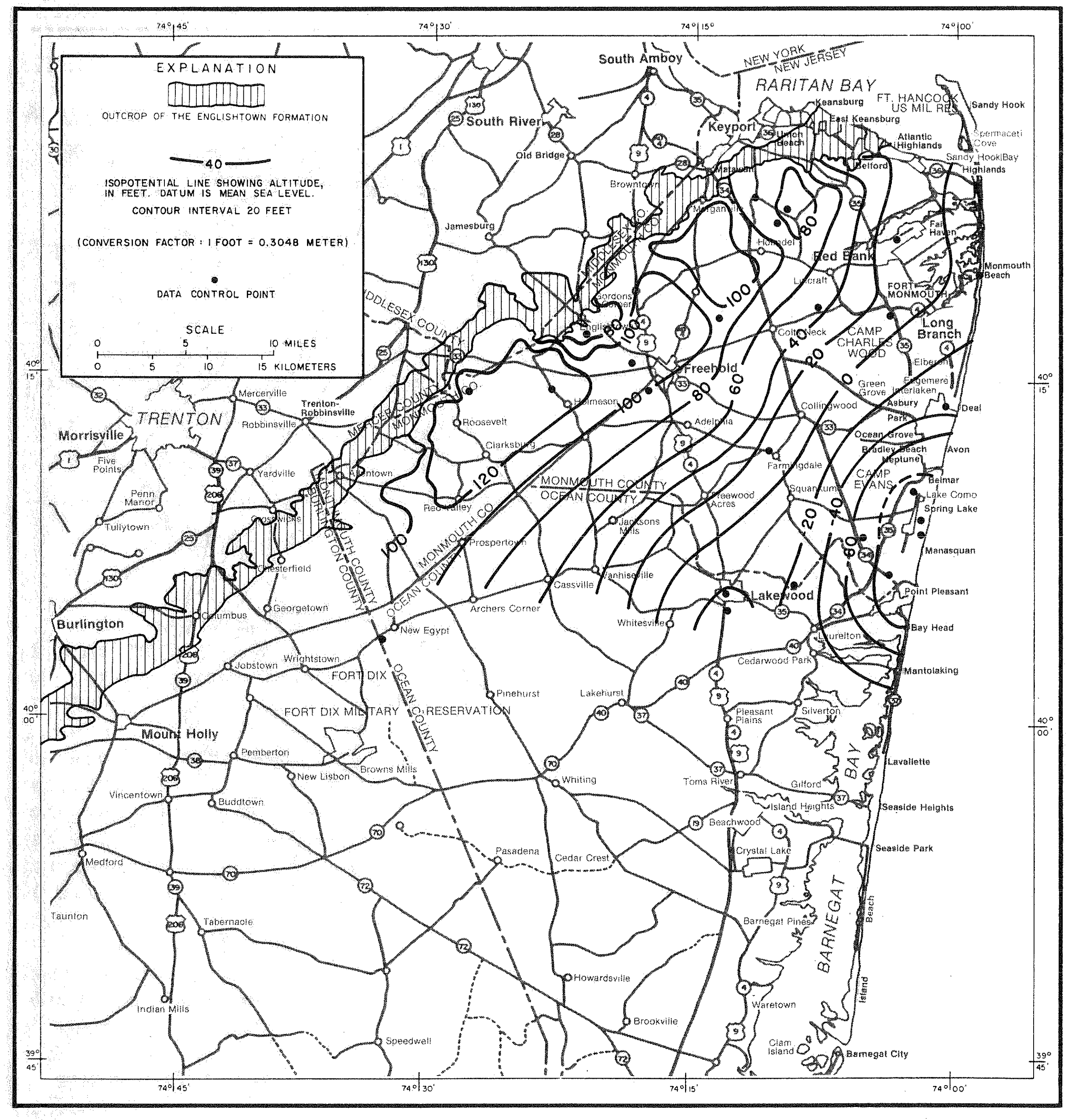


FIGURE 14. --ALTITUDE OF THE POTENTIOMETRIC SURFACE IN THE ENGLISHTOWN AQUIFER IN JANUARY 1959 IN MONMOUTH AND NORTHERN OCEAN COUNTIES, N.J.

Table 5.--Water-level data used in constructing 1900 potentiometric surface map for the Englishtown aquifer

Map no.	Location	Owner	Local well designation	Altitude of LSD (ft) (mean sea level datum)	Water level (ft) (depth below lsd)	Date water level meas.	Remarks
1	402450N0740233.1	Charles Leonard	Leonard	30	28	1897	
2	402024N0741009.1	Unknown	Owner Unknown	160	146	1900	
3	402328N0740055.1	Vincent Lamarch	Lamarch	4	0	1898	
4	402226N0740028.1	M C D Borden	Borden	16	12	1897	
5	402201N0740152.1	Rumson Improvmt	Rumson Imprvmt	10	6	1904	
6	402124N0735917.1	Dr Kimball	Kimball	12	9	1897	
7	402111N0740055.1	Mr Lobb	Lobb	45	38	1898	
8	401959N0740440.1	Town W Comm	Town W Commsrs	18	15	1900	
9	401942N0740230.1	Mcmahon & Dean	Mcmahon & Dean	38	2	1899	
10	401653N0741721.1	Freehold W&U Au	Freehold W&U	120	16	1890	
11	401316N0740142.1	Ocean Grove AS	Ocean Grove AS	20	+28	1883	
12	400817N0740223.1	Beach H Sea Grt	Beach House SG	11	+13	1895	
13	400547N0741329.1	Laurel Hotel	Laurel Hotel	50	+17	1884	
14	400507N0741247.1	Lakewood W Co	Lakewood W Co	30	+20	1899	
15	400434N0740241.1	Beacon-by-Sea	Beacon-by-Sea	10	+36	1896	
16	400233N0740300.1	Mantoloking	Mantoloking	10	+42	1896	
17	395814N0743438.1	Mr Reilly	Reilly	20	F	--	Flowing
18	395749N0743100.1	J J White Co	J J White Co	95	5	1914	

Table 6.--Yield and water-level data for wells developed in the Englishtown aquifer in Monmouth and Ocean Counties

MAP NO	OWNER	LOCAL WELL NUMBER	ALTITUDE OF LSD (FT)	YIELD (GAL/MIN)	DRAW DOWN (FT)	PUMPING PERIOD (HOURS)	SPECIFIC CAPACITY	WATER LEVEL (FT)	DATE WATER LEVEL MEASURED	WATER LEVEL (FT)	DATE WATER LEVEL MEASURED	WATER LEVEL (FT)	DATE WATER LEVEL MEASURED
1	L W BAHRENBURG	BAHRENBURG 1	60	--	6	8	--	13	1-52	--	--	--	--
2	EDWARD LESKE	LESKE 3	25	5	6	--	0.8	10	11-52	--	--	--	--
3	ATLAN HIGH W D	AHWD 2	15	--	--	--	--	16	-23	40	1-59	14	11-70
4	A W ZELINSKI	1	80	60	14	4	4.3	26	8-63	--	--	--	--
5	LILY TULIP CUP	LILY STAND BY	65	--	32	4	--	19	1-62	--	--	--	--
6	LILY TULIP CUP	LILY TULIP 1	65	500	44	8	11.4	25	2-62	--	--	--	--
7	LILY TULIP CUP	LILY TULIP 2	55	--	32	8	--	26	2-62	--	--	--	--
8	LAVOIE LAB	LAVOIE LAB 1	180	170	30	19	5.7	85	10-48	--	--	--	--
9	B EDUC MARLBORO	BOARD OF ED 1	180	60	18	--	3.3	70	7-48	--	--	--	--
10	B EDUC MARLBORO	BOARD OF ED 2	--	150	28	--	5.4	64	9-67	--	--	--	--
11	DONALD AHLERS	--	121	10	--	--	--	40	5-64	--	--	--	--
12	L F GRANDINETTI	--	70	30	28	--	1.1	35	12-55	--	--	--	--
13	JOSEPH STAVELA	--	180	12	11	12	1.1	178	5-51	--	--	--	--
14	GARDEN ST PKWY	TELEGRAPH HILL	234	--	--	--	--	--	--	--	--	--	--
15	RICHARD CARROLL	--	95	15	6	--	2.5	22	12-53	--	--	--	--
16	JOHN GARRISON	--	100	10	13	4	0.8	17	1-54	--	--	--	--
17	U S ARMY	NIKE BASE	305	30	58	--	0.5	215	12-57	--	--	--	--
18	NEIL BRY	--	210	10	20	--	0.5	221	4-63	--	--	--	--
19	F & F NURSERIES	FF NURSERIES 1	135	60	90	6	0.7	60	2-54	--	--	--	--
20	G HUBENY	--	250	10	30	--	0.3	180	1-54	--	--	--	--
21	ANTHONY VERANGE	VERANGE 1	250	30	4	4	7.5	174	-54	--	--	--	--
22	HARMYK AND SONS	HARMYK 1	205	350	56	9	6.2	174	1-56	--	--	--	--
23	W J DUNCAN	--	145	20	23	--	0.9	75	8-54	--	--	--	--
24	BELL TELE CO	BELL LAB 3	120	300	--	--	--	40	10-66	--	--	--	--
25	BELL TELE CO	BELL LAB 2	120	300	--	--	--	51	10-60	66	11-70	--	--
26	BELL TELE CO	BELL LAB 1	120	300	--	--	--	54	12-66	--	--	--	--
27	JOSEPH MORREL	MORREL	76	--	--	--	--	5	9-55	2	-59	--	--
28	ROY DENSON	DENSON 1	100	15	5	--	3.0	5	10-64	--	--	--	--
29	MRS HARDING	HARDING 1	120	35	8	--	4.4	50	1-49	--	--	--	--
30	NICK PETRUZELLA	--	130	25	62	4	0.4	43	10-49	--	--	--	--
31	RED BANK W D	RBWD 2	30	525	53	--	9.9	27	4-56	13	-59	--	--
32	NOVAK	HULSART	110	--	--	--	--	16	1-58	34	11-70	--	--
33	RUMSON C CLUB	RUMSON C C 1	7	--	--	--	--	--	--	12	11-70	--	--
34	JOHN LEMLI	--	160	10	20	--	0.5	70	5-54	--	--	--	--
35	MARLBORO S HOSP	STATE HOSP 6	140	200	92	--	2.2	57	10-69	--	--	--	--
36	MARLBORO S HOSP	STATE HOSP 13	140	370	54	--	6.9	62	11-53	59	11-70	--	--
37	MARLBORO S HOSP	STATE HOSP 14	125	300	--	--	--	--	--	--	--	--	--
38	MRS A ONORATO	--	120	9	38	--	0.2	35	7-53	--	--	--	--
39	RED BANK W D	RBWD 3	35	421	159	--	2.6	25	6-46	39	11-70	--	--
40	W SCHIEMEYER	--	80	15	--	--	--	18	9-53	--	--	--	--

Table 6.--Yield and water-level data for wells developed in the Englishtown aquifer in Monmouth and Ocean Counties--Continued

MAP NO	OWNER	LOCAL WELL NUMBER	ALTI-TUDE-OF LSD (FT)	YIELD (GAL/MIN)	DRAW DOWN (FT)	PUMPING PERIOD (HOURS)	SPECIFIC CAPACITY	WATER LEVEL (FT)	DATE WATER LEVEL MEASURED	WATER LEVEL (FT)	DATE WATER LEVEL MEASURED	WATER LEVEL (FT)	DATE WATER LEVEL MEASURED
41	MARLBORO S HOSP	STATE HOSP 4	125	100	--	--	--	--	--	--	--	--	--
42	MARLBORO S HOSP	STATE HOSP 5	135	100	--	--	--	--	--	--	--	--	--
43	MON BCH CLD STR	MBCS 2	10	480	136	8	3.5	12	4-61	--	--	--	--
44	H&L FARMS	--	160	55	85	6	0.6	62	8-51	--	--	--	--
45	R E MORGAN	--	140	20	70	6	0.3	50	12-47	--	--	--	--
46	HENRY HIGGINS	--	170	12	27	--	0.4	73	7-54	--	--	--	--
47	M ROSENBERG	ROSENBERG 1	80	100	40	8	2.5	35	1-57	43	11-70	--	--
48	J P FOCARILE	FOCARILE	95	10	30	--	0.3	28	1-64	--	--	--	--
49	VILLAGE WC	VILLAGE 215	120	292	110	48	2.7	44	9-64	--	--	--	--
50	OLD ORCHARD C C	OLD ORCHARD 1	40	200	180	10	1.1	20	4-52	--	--	--	--
51	CEDAR DR EL SCH	--	122	75	100	8	0.7	45	12-63	--	--	--	--
52	GEORGE THOMPSON	--	100	10	8	--	1.2	12	10-54	--	--	--	--
53	R H MACY & CO	BAMBERGER TEST	70	123	63	24	2.0	67	9-57	--	--	--	--
54	E R DURAND	--	180	15	30	--	0.5	80	3-60	--	--	--	--
55	TAYLOR PALMER	1	90	15	13	--	1.2	22	12-55	--	--	--	--
56	TENNENT ORCH I	--	130	12	70	--	0.2	35	10-54	--	--	--	--
57	SO GULF UTIL	SO GULF 1	200	80	140	8	0.6	110	8-64	--	--	--	--
58	ATLANTIC TWP SC	ATLANTIC SCH 1	86	25	30	--	0.8	30	10-54	109	11-70	--	--
59	K A JADASSOHN	--	120	10	30	--	0.3	30	1-56	--	--	--	--
60	ROY H KIRSHNER	--	95	10	27	--	0.4	20	10-53	--	--	--	--
61	FREEHOLD TWP WD	POINT IVY 1	130	1486	159	72	9.3	16	9-67	17	11-70	--	--
62	ABE COHEN	--	84	12	--	--	--	37	8-53	--	--	--	--
63	FRANK GUMINA	GUMINA 1	190	200	30	8	6.7	75	11-53	--	--	--	--
64	MONMOUTH COUNTY	MO CO C H 2	170	275	140	12	2.0	81	9-54	--	--	--	--
65	AM KARAGHEUSIAN	1	150	240	88	--	2.7	87	1-48	--	--	--	--
66	BOY SCOUTS AMER	QUAIL HILL 1	250	65	--	--	--	140	8-67	--	--	--	--
67	MR SCATUORCHIO	SCATUORCHIO 1	140	30	60	8	0.5	60	8-50	--	--	--	--
68	F J MOREAU	--	185	--	--	--	--	--	--	72	1-59	--	--
69	GEORGE MOUNT	MOUNT 2	135	12	25	6	0.5	10	10-53	--	--	--	--
70	MANALAPAN W C	MANALAPAN 1	122	240	154	6	1.6	2	4-67	4	11-70	--	--
71	S WURTZEL	--	180	10	7	--	1.4	40	10-53	--	--	--	--
72	C BORDUNOVICH	--	160	10	40	--	0.2	42	3-54	--	--	--	--
73	BROCKWAY GLASS	BROCKWAY 1	130	220	56	--	3.9	44	--	47	11-70	--	--
74	SEASIDE INVEST	--	160	20	62	8	0.3	58	9-63	--	--	--	--
75	LEON VASSEUR	--	140	10	3	--	3.3	9	6-52	9	12-58	--	--
76	ABE KUHL	--	230	10	34	--	0.3	50	12-56	--	--	--	--
77	CLAYTON WM D	CLAYTON 2	180	530	154	9	3.4	56	3-55	79	1-59	--	--
78	D MAYK	--	145	12	35	4	0.3	65	10-49	--	--	--	--
79	HENRY WIKOFF	--	115	14	15	--	0.9	10	7-53	--	--	--	--
80	FREEHOLD TWP WD	KOENIG LANE 2	130	130	160	6	0.8	40	10-66	42	11-70	--	--

Table 6.--Yield and water-level data for wells developed in the Englishtown aquifer in Monmouth and Ocean Counties--Continued

MAP NO	OWNER	LOCAL WELL NUMBER	ALTITUDE OF LSD (FT)	YIELD (GAL/MIN)	DRAW DOWN (FT)	PUMPING PERIOD (HOURS)	SPECIFIC CAPACITY	WATER LEVEL (FT)	DATE WATER LEVEL MEASURED	WATER LEVEL (FT)	DATE WATER LEVEL MEASURED	WATER LEVEL (FT)	DATE WATER LEVEL MEASURED
81	ALLENHURST W D	AWD 2	10	525	169	--	3.1	45	7-50	--	--	--	--
82	ALLENHURST W D	AWD 4	10	524	123	8	4.3	90	7-50	44	1-59	84	11-70
83	ASBURY PARK W D	APWD 4	10	500	160	8	3.1	--	5-63	--	--	--	--
84	MONMOUTH CON WC	WHITESVILLE 3	10	465	162	4	2.9	50	3-54	108	11-70	--	--
85	MONMOUTH CON WC	OCEAN GROVE 20	20	300	134	--	2.2	61	6-49	141	11-70	--	--
86	FARMINGDALE W D	FARMINGDALE 1	80	300	--	--	--	--	--	71	1-59	--	--
87	FARMINGDALE W D	FARMINGDALE 2	80	90	155	--	0.6	45	1-49	--	--	--	--
88	FARMINGDALE W D	FARMINGDALE 4	85	302	118	8	2.6	130	12-70	--	--	--	--
89	FARMINGDALE W D	FARMINGDALE 3	80	300	146	8	2.1	86	8-64	--	--	--	--
90	MRS ERRICKSON	--	130	5	93	--	0.1	37	9-54	--	--	--	--
91	MR VANHISE	--	145	10	85	--	0.1	35	7-54	--	--	--	--
92	BELMAR BORO WD	BWD 4 ELEC	15	630	103	--	6.1	62	7-41	151	11-70	--	--
93	DEPT OF ARMY	IMPERIAL PARK2	100	302	73	--	4.1	87	4-43	206	11-70	--	--
94	DUNCAN THECKER	D T ASSOC 1	100	80	48	--	1.7	7	6-69	7	11-70	--	--
95	BELMAR BORO WD	BWD 8 SUB	20	--	--	--	--	--	--	--	--	--	--
96	BELMAR BORO WD	BWD 5 SUB	20	--	--	--	--	--	--	--	--	--	--
97	BELMAR BORO WD	BWD 1 ELEC	20	--	--	--	--	--	--	173	11-70	--	--
98	BELMAR BORO WD	BWD 3 SUB	20	--	--	--	--	--	--	--	--	--	--
99	BELMAR BORO WD	BWD 6 SUB	20	--	--	--	--	--	--	--	--	--	--
100	BELMAR BORO WD	BWD 1 SUB	20	--	--	--	--	--	--	--	--	--	--
101	BELMAR BORO WD	BWD 4 SUB	20	--	--	--	--	--	--	--	--	--	--
102	BELMAR BORO WD	BWD 2 ELEC	20	--	--	--	--	20	--	--	--	--	--
103	BELMAR BORO WD	BWD 3 ELEC	20	305	162	--	1.9	100	10-49	--	--	--	--
104	BELMAR BORO WD	BWD 7 SUB	20	--	--	--	--	--	--	--	--	--	--
105	WALL TWP W D	WEST BELMAR	25	400	225	10	1.8	112	9-59	--	--	--	--
106	WALL TWP W D	RT 34 WELL	80	402	116	8	3.5	206	1-68	242	11-70	--	--
107	C I SMITH	--	130	20	57	--	0.4	25	8-53	--	--	--	--
108	U FREEHOLD B ED	BOARD ED 1	135	15	121	6	0.1	24	2-51	--	--	--	--
109	SPRING LAKE W D	SLWD 4	10	608	115	--	5.3	145	8-65	172	11-70	--	--
110	SPRING LAKE W D	SLWD 3	20	545	128	--	4.3	62	6-41	120	12-58	--	--
111	ALDRICH W CO	ALDRICH W CO 4	130	1100	149	8	7.4	165	8-67	185	11-70	--	--
112	US GEOL SURVEY	ALLAIRE S P C	96	--	--	--	--	100	12-63	205	11-70	--	--
113	SPRING LK HT WD	SPRING LK HGT2	60	510	118	8	4.3	125	5-53	--	--	--	--
114	SPRING LK HT WD	SPRING LK HGT3	25	457	115	8	4.0	180	11-66	206	11-70	--	--
115	SPRING LAKE W D	SLWD 1	15	600	57	--	10.5	97	8-40	145	12-58	196	11-70
116	SPRING LAKE W D	SLWD 2	15	535	103	11	5.2	91	7-41	--	--	--	--
117	E W HARVEY	--	115	100	10	--	10.0	10	8-50	--	--	--	--
118	JACKSON TWP MUA	JACKSON 2	156	412	109	8	3.8	144	11-62	231	11-70	--	--
119	WALL TWP W D	ALLENWOOD 1	100	400	100	10	4.0	185	10-59	--	--	--	--
120	WALL TWP W D	ALLENWOOD 2	80	400	98	10	4.1	167	11-59	256	11-70	--	--

Table 6.--Yield and water-level data for wells developed in the Englishtown aquifer in Monmouth and Ocean Counties--Continued

MAP NO	OWNER	LOCAL WELL NUMBER	ALTITUDE OF LSD (FT)	YIELD (GAL/MIN)	DRAW DOWN (FT)	PUMPING PERIOD (HOURS)	SPECIFIC CAPACITY	WATER LEVEL (FT)	DATE WATER LEVEL MEASURED	WATER LEVEL (FT)	DATE WATER LEVEL MEASURED	WATER LEVEL (FT)	DATE WATER LEVEL MEASURED
121	SEA GIRT W D	SGWD 5	20	400	62	8	6.5	178	11-63	188	11-70	--	--
122	SEA GIRT W D	SGWD 4	18	310	157	24	2.0	103	7-49	--	--	--	--
123	ATLEE ZURLO	--	90	20	--	4	--	30	9-52	--	--	--	--
124	JACKSON TWP MUA	JACKSON 4	80	520	150	8	3.5	90	7-65	133	11-70	--	--
125	HOWELL TWP BD	KENT RD	110	120	49	8	2.4	96	2-55	--	--	--	--
126	SEA GIRT W D	SGWD 3	20	300	54	--	5.6	47	--	--	--	--	--
127	JACKSON TWP MUA	JACKSON 3	140	421	76	8	5.5	119	5-62	193	11-70	--	--
128	JACKSON TWP MUA	JACKSON 1	110	415	111	8	3.7	101	7-61	201	11-70	--	--
129	BRIELLE WATER D	BWD 2	33	510	110	--	4.6	75	2-50	110	12-58	212	11-70
130	ST GABRIELS COL	ST GABRIELS 1	70	130	166	--	0.8	34	-57	149	11-70	--	--
131	PARKWAY W C	PARKWAY 1	45	179	85	5	2.1	81	8-58	--	--	--	--
132	BRIELLE WATER D	BWD 3	90	400	95	--	4.2	225	--	268	11-70	--	--
133	LAKEWOOD W C	LAKEWOOD 9	55	412	147	24	2.8	126	5-68	170	11-70	--	--
134	LAKEWOOD W C	LAKEWOOD 6	70	503	109	8	4.6	93	11-60	180	11-70	--	--
135	LAKESORE LAUNDR	LAKESHORE LA 1	50	70	135	--	0.5	50	--	--	--	--	--
136	LAKEWOOD W C	LAKEWOOD W C	35	--	--	--	--	--	--	--	--	--	--
137	LAKEWOOD W C	LAKEWOOD 2	60	300	--	--	--	20	--	--	--	--	--
138	LAKEWOOD W C	LAKEWOOD W C	30	--	--	--	--	+20	--	--	--	--	--
139	LAKEWOOD W C	LAKEWOOD 5	40	215	91	2	2.4	67	5-57	--	--	--	--
140	LAKEWOOD W C	LAKEWOOD	30	--	--	--	--	46	--	124	11-70	--	--
141	PT PLEASANT W D	PPWD 3	15	300	117	48	2.6	56	4-46	224	11-70	--	--
142	PT PLEASANT W D	PPWD 6	20	517	225	8	2.3	146	5-65	--	--	--	--
143	PT PLEASANT W D	PPWD 2	15	265	83	21	3.2	34	9-36	--	--	--	--
144	PT PLEASANT W D	PPWD 1	20	277	57	4	4.9	30	6-36	--	--	--	--
145	PT PLEASANT W D	PPWD	10	--	--	--	--	+35	--	--	--	--	--
146	LAKEWOOD W C	LAKEWOOD 8	78	500	230	8	2.2	84	12-65	194	11-70	--	--
147	CENTRAL RR NJ	CENTRAL RR NJ	9	250	65	--	3.8	20	--	--	--	--	--
148	US GEOL SURVEY	COLL MILLS TW1	137	--	--	--	--	56	1-64	57	11-70	--	--
149	LAKEWOOD W C	LAKEWOOD 7	85	350	115	8	3.0	176	5-64	--	--	--	--
150	NEW EGYPT WC	1	75	70	--	--	--	+15	1-59	--	--	--	--
151	OCEAN CO W C	BAY HEAD 6	10	338	139	24	2.4	104	9-50	--	--	--	--
152	OCEAN CO W C	BAY HEAD 5	10	220	75	1	2.9	64	3-47	202	11-70	--	--
153	BRADLEES CORP	BRADLEES WELL	10	300	177	12	1.7	138	9-69	--	--	--	--
154	S LAKEWOOD W C	S LAKEWOOD 3	45	508	176	8	2.9	143	8-66	--	--	--	--
155	S LAKEWOOD W C	S LAKEWOOD 2	40	400	--	--	--	--	--	204	11-70	--	--
156	S LAKEWOOD W C	S LAKEWOOD 1	90	500	--	--	--	--	--	245	11-70	--	--
157	OCEAN CO W C	MANTOLOKING 4	5	--	--	--	--	42	--	--	--	--	--
158	OCEAN CO W C	MANTOLOKING 6	5	239	224	4	1.1	58	--	149	11-70	--	--
159	LAVALLETTE W D	LWD 2	5	512	50	4	10.2	20	4-31	--	--	--	--
160	LAVALLETTE W D	LWD 3	7	500	240	3	2.1	58	7-48	--	--	--	--
161	US GEOL SURVEY	TOMS RIVER TW2	15	--	--	--	--	54	12-65	--	--	--	--

Table 7.--Construction data for wells developed in the Englishtown aquifer in Monmouth and Ocean Counties

MAP NO	LOCATION	OWNER	LOCAL WELL NUMBER	MUNICIPALITY	DATE DRILLED (YEAR)	ALTI-TUDE-OF LSD (FT)	WELL DEPTH (FT)	CASING DEPTH (FT)	CASING DIAM-ETER (IN)	LENGTH OF WELL OPEN TO AQUIFER (FEET)
1	402454N0741130.1	L W BAHRENBURG	BAHRENBURG 1	HAZLET TWP	1952	60	31	27	4	4
2	402525N0740802.1	EDWARD LESKE	LESKE 3	MIDDLETOWN TWP	1952	25	20	16	4	4
3	402441N0740234.1	ATLAN HIGH W D	AHWD 2	ATLANTIC HIGHLAND	1923	15	200	--	--	--
4	402446N0740909.1	A W ZELINSKI	1	HOLMDEL TWP	1963	80	71	65	--	6
5	402441N0740846.1	LILY TULIP CUP	LILY STAND BY	HOLMDEL TWP	1962	65	102	82	6	21
6	402441N0740843.1	LILY TULIP CUP	LILY TULIP 1	HOLMDEL TWP	1962	65	126	101	12	25
7	402438N0740842.1	LILY TULIP CUP	LILY TULIP 2	HOLMDEL TWP	1962	55	122	97	12	25
8	402239N0741434.1	LAVOIE LAB	LAVOIE LAB 1	MARLBORO TWP	1948	180	152	140	8	12
9	402232N0741441.1	B EDUC MARLBORO	BOARD OF ED 1	MARLBORO TWP	1948	180	103	93	6	10
10	402238N0741410.1	B EDUC MARLBORO	BOARD OF ED 2	MARLBORO TWP	1967	--	144	123	8	22
11	402405N0741145.1	DONALD AHLERS	--	HOLMDEL TWP	1964	121	108	102	4	6
12	402354N0740134.1	L F GRANDINETTI	--	MIDDLETOWN TWP	1955	70	74	64	6	10
13	402323N0740307.1	JOSEPH STAVELA	--	MIDDLETOWN TWP	1951	180	248	248	6	--
14	402325N0741040.1	GARDEN ST PKWY	TELEGRAPH HILL	HOLMDEL TWP	--	234	1044	--	--	--
15	402238N0741506.1	RICHARD CARROLL	--	MARLBORO TWP	1953	95	44	35	4	9
16	402238N0741539.1	JOHN GARRISON	--	MARLBORO TWP	1954	100	52	50	4	2
17	402235N0741125.1	U S ARMY	NIKE BASE	HOLMDEL TWP	1957	305	318	298	10	--
18	402311N0741249.1	NEIL BRY	--	MATAWAN TWP	1963	210	254	243	6	11
19	402223N0741024.1	F & F NURSERIES	FF NURSERIES 1	HOLMDEL TWP	1954	135	200	190	6	10
20	402210N0741127.1	G HUBENY	--	HOLMDEL TWP	1954	250	228	223	6	5
21	402210N0741127.2	ANTHONY VERANGE	VERANGE 1	HOLMDEL TWP	1954	250	225	215	4	10
22	402222N0740832.1	HARMYK AND SONS	HARMYK 1	MIDDLETOWN TWP	1956	205	343	317	8	26
23	402208N0741059.1	W J DUNCAN	--	HOLMDEL TWP	1954	145	176	172	6	4
24	402256N0740950.1	BELL TELE CO	BELL LAB 3	HOLMDEL TWP	1960	120	154	--	10	--
25	402208N0740952.1	BELL TELE CO	BELL LAB 2	HOLMDEL TWP	1960	120	221	191	10	30
26	402157N0741003.1	BELL TELE CO	BELL LAB 1	HOLMDEL TWP	1960	120	214	173	10	41
27	402143N0741852.1	JOSEPH MORREL	MORREL	MADISON TWP	1923	76	11	11	17	--
28	402138N0741532.1	ROY DENSON	DENSON 1	MARLBORO TWP	1964	100	33	30	--	3
29	402121N0740942.1	MRS HARDING	HARDING 1	HOLMDEL TWP	1949	120	210	200	6	10
30	402120N0740919.1	NICK PETRUZELLA	--	HOLMDEL TWP	1949	130	143	138	6	5
31	402114N0740315.1	RED BANK W D	RBWD 2	RED BANK BORO	1956	30	300	225	24	--
32	402122N0741846.1	NOVAK	HULSART	MARLBORO TWP	--	110	19	--	54	--
33	402046N0740105.1	RUMSON C CLUB	RUMSON C C 1	RUMSON BORO	1966	7	332	--	--	--
34	402035N0741615.1	JOHN LEMLI	--	MARLBORO TWP	1954	160	100	96	4	4
35	402103N0741357.1	MARLBORO S HOSP	STATE HOSP 6	MARLBORO TWP	1936	140	184	162	8	12
36	402103N0741351.1	MARLBORO S HOSP	STATE HOSP 13	MARLBORO TWP	1953	140	168	120	--	26
37	402109N0741346.1	MARLBORO S HOSP	STATE HOSP 14	MARLBORO TWP	1955	125	205	--	--	--
38	402020N0741804.1	MRS A ONORATO	--	MARLBORO TWP	1953	120	81	78	4	--
39	402020N0740411.1	RED BANK W D	RBWD 3	RED BANK BORO	1946	35	268	228	10	40
40	401921N0742100.1	W SCHIEMEYER	--	MANALAPAN TWP	1953	80	52	47	4	5

Table 7.--Construction data for wells developed in the Englishtown aquifer in Monmouth and Ocean Counties--Continued

MAP NO	LOCATION	OWNER	LOCAL WELL NUMBER	MUNICIPALITY	DATE DRILLED (YEAR)	ALTI-TUDE- OF LSD (FT)	WELL DEPTH (FT)	CASING DEPTH (FT)	CASING DIAM-ETER (IN)	LENGTH OF WELL OPEN TO AQUIFER (FEET)
41	401937N0741428.1	MARLBORO S HOSP	STATE HOSP 4	MARLBORO TWP	--	125	124	90	6	1
42	401933N0741336.1	MARLBORO S HOSP	STATE HOSP 5	MARLBORO TWP	1935	135	144	110	6	30
43	401927N0735842.1	MON BCH CLD STR	MBCS 2	MONMOUTH BCH BORO	1961	10	430	390	10	40
44	401948N0741541.1	H&L FARMS	--	MARLBORO TWP	1951	160	206	197	6	9
45	401918N0741507.1	R E MORGAN	--	MARLBORO TWP	1947	140	175	160	6	15
46	401858N0741506.1	HENRY HIGGINS	--	MARLBORO TWP	1954	170	176	171	4	5
47	401803N0740814.1	M ROSENBERG	ROSENBERG 1	COLTS NECK TWP	1957	80	342	322	8	20
48	401710N0741925.1	J P FOCARILE	FOCARILE	MANALAPAN TWP	1964	95	116	100	4	6
49	401906N0741514.1	VILLAGE WC	VILLAGE 215	MARLBORO TWP	1964	120	215	186	8	29
50	401742N0740201.1	OLD ORCHARD C C	OLD ORCHARD 1	WEST LONG BRANCH	1952	40	425	360	8	20
51	401747N0741221.1	CEDAR DR EL SCH	--	COLTS NECK TWP	1963	122	233	213	--	20
52	401657N0741944.1	GEORGE THOMPSON	--	MANALAPAN TWP	1954	100	86	83	4	3
53	401720N0740315.1	R H MACY & CO	BAMBERGER TEST	EATONTOWN BORO	1957	70	430	416	6	14
54	401712N0741428.1	E R DURAND	--	FREEHOLD TWP	1960	180	257	249	6	8
55	401718N0742217.1	TAYLOR PALMER	1	MANALAPAN TWP	1955	90	60	53	4	--
56	401644N0741929.1	TENNENT ORCH I	--	MANALAPAN TWP	1954	130	167	157	6	10
57	401624N0741502.1	SO GULF UTIL	SO GULF 1	FREEHOLD TWP	1964	200	356	327	8	29
58	401719N0741016.1	ATLANTIC TWP SC	ATLANTIC SCH 1	COLTS NECK TWP	1954	86	280	270	6	10
59	401628N0742026.1	K A JADASSOHN	--	MANALAPAN TWP	1956	120	115	110	4	5
60	401710N0742220.1	ROY H KIRSHNER	--	MANALAPAN TWP	1953	95	84	80	4	4
61	401654N0741736.1	FREEHOLD TWP WD	POINT IVY 1	FREEHOLD TWP	1967	130	212	150	12	50
62	401710N0742147.1	ABE COHEN	--	MANALAPAN TWP	1953	84	78	73	6	5
63	401618N0741452.1	FRANK GUMINA	GUMINA 1	FREEHOLD TWP	1953	190	324	304	6	20
64	401547N0741640.1	MONMOUTH COUNTY	MO CO C H 2	FREEHOLD BORO	1954	170	323	307	8	16
65	401545N0741603.1	AM KARAGHEUSIAN	1	FREEHOLD BORO	1948	150	323	303	8	20
66	401557N0742318.2	BOY SCOUTS AMER	QUAIL HILL 1	MANALAPAN TWP	1967	250	241	231	6	--
67	401600N0741204.1	MR SCATUORCHIO	SCATUORCHIO 1	COLTS NECK TWP	1950	140	250	238	6	12
68	401505N0741710.1	F J MOREAU	--	FREEHOLD BORO	--	185	300	--	--	--
69	401545N0742536.1	GEORGE MOUNT	MOUNT 2	MILLSTONE TWP	1953	135	52	46	--	6
70	401518N0742230.1	MANALAPAN W C	MANALAPAN 1	MANALAPAN TWP	1967	122	185	125	10	60
71	401443N0742320.1	S WURTZEL	--	MILLSTONE TWP	1953	180	178	174	6	4
72	401511N0742021.1	C BORDUNOVICH	--	MANALAPAN TWP	1954	160	170	166	4	4
73	401500N0741514.1	BROCKWAY GLASS	BROCKWAY 1	FREEHOLD TWP	1956	130	260	240	8	20
74	401429N0741254.1	SEASIDE INVEST	--	HOWELL TWP	1963	160	380	364	4	16
75	401323N0742824.1	LEON VASSEUR	--	ROOSEVELT BORO	1952	140	96	92	4	4
76	401333N0742640.1	ABE KUHL	--	MILLSTONE TWP	1956	230	160	154	4	6
77	401331N0741944.1	CLAYTON WM D	CLAYTON 2	MANALAPAN TWP	1955	180	333	304	10	29
78	401426N0741631.1	D MAYK	--	FREEHOLD TWP	1949	145	310	300	6	10
79	401323N0743118.1	HENRY WIKOFF	--	MILLSTONE TWP	1953	115	50	47	4	3
80	401412N0741606.2	FREEHOLD TWP WD	KOENIG LANE 2	FREEHOLD TWP	1966	130	307	262	6	45

Table 7.--Construction data for wells developed in the Englishtown aquifer in Monmouth and Ocean Counties--Continued

MAP NO	LOCATION	OWNER	LOCAL WELL NUMBER	MUNICIPALITY	DATE DRILLED (YEAR)	ALTITUDE OF LSD (FT)	WELL DEPTH (FT)	CASING DEPTH (FT)	CASING DIAMETER (IN)	LENGTH OF WELL OPEN TO AQUIFER (FEET)
81	401401N0740026.1	ALLENHURST W D	AWD 2	ALLENHURST BORO	1950	10	570	525	24	--
82	401401N0740025.1	ALLENHURST W D	AWD 4	ALLENHURST BORO	1950	10	570	525	12	45
83	401346N0740034.1	ASBURY PARK W D	APWD 4	ASBURY PARK	1963	10	580	540	10	40
84	401322N0740155.1	MONMOUTH CON WC	WHITESVILLE 3	ASBURY PARK	1954	10	566	498	8	68
85	401223N0740104.1	MONMOUTH CON WC	OCEAN GROVE 20	NEPTUNE TWP	1949	20	605	570	18	35
86	401154N0741018.1	FARMINGDALE W D	FARMINGDALE 1	FARMINGDALE BORO	1926	80	480	--	--	--
87	401154N0741018.2	FARMINGDALE W D	FARMINGDALE 2	FARMINGDALE BORO	1949	80	480	450	8	30
88	401153N0741012.1	FARMINGDALE W D	FARMINGDALE 4	FARMINGDALE BORO	1970	85	470	410	16	60
89	401143N0741018.1	FARMINGDALE W D	FARMINGDALE 3	FARMINGDALE BORO	1964	80	460	420	10	40
90	401104N0743146.1	MRS ERRICKSON	--	U FREEHOLD TWP	1954	130	134	128	4	6
91	401107N0743052.1	MR VANHISE	--	U FREEHOLD TWP	1954	145	131	126	6	5
92	401102N0740045.1	BELMAR BORO WD	BWD 4 ELEC	BELMAR BORO	1941	15	679	601	28	78
93	401053N0740341.1	DEPT OF ARMY	IMPERIAL PARK2	WALL TWP	1943	100	662	616	12	--
94	401005N0743200.1	DUNCAN THECKER	D T ASSOC 1	U FREEHOLD TWP	1969	100	119	96	10	23
95	401042N0740150.1	BELMAR BORO WD	BWD 8 SUB	BELMAR BORO	--	20	640	640	8	--
96	401042N0740143.1	BELMAR BORO WD	BWD 5 SUB	BELMAR BORO	1900	20	515	--	6	--
97	401040N0740145.1	BELMAR BORO WD	BWD 1 ELEC	BELMAR BORO	1900	20	545	--	--	--
98	401039N0740144.1	BELMAR BORO WD	BWD 3 SUB	BELMAR BORO	1900	20	518	--	6	--
99	401039N0740141.1	BELMAR BORO WD	BWD 6 SUB	BELMAR BORO	--	20	--	--	--	--
100	401038N0740147.1	BELMAR BORO WD	BWD 1 SUB	BELMAR BORO	1900	20	600	--	06	--
101	401038N0740146.1	BELMAR BORO WD	BWD 4 SUB	BELMAR BORO	--	20	524	--	6	--
102	401038N0740146.2	BELMAR BORO WD	BWD 2 ELEC	BELMAR BORO	1938	20	581	581	18	--
103	401037N0740148.1	BELMAR BORO WD	BWD 3 ELEC	BELMAR BORO	1949	20	594	563	--	31
104	401036N0740146.1	BELMAR BORO WD	BWD 7 SUB	BELMAR BORO	--	20	648	--	8	--
105	401025N0740212.1	WALL TWP W D	WEST BELMAR	WALL TWP	1959	25	575	440	10	40
106	401028N0740638.1	WALL TWP W D	RT 34 WELL	WALL TWP	1968	80	649	549	10	100
107	400949N0743142.1	C I SMITH	--	U FREEHOLD TWP	1953	130	139	134	6	5
108	400942N0743052.1	U FREEHOLD B ED	BOARD ED 1	U FREEHOLD TWP	1951	135	157	148	6	9
109	400952N0740149.1	SPRING LAKE W D	SLWD 4	SPRING LAKE BORO	1967	10	670	600	10	70
110	400915N0740146.1	SPRING LAKE W D	SLWD 3	SPRING LAKE BORO	1941	20	705	640	8	65
111	400908N0741330.1	ALDRICH W CO	ALDRICH W CO 4	HOWELL TWP	1967	130	550	363	12	40
112	400832N0740821.1	US GEOL SURVEY	ALLAIRE S P C	WALL TWP	1963	96	633	623	6	10
113	400859N0740308.2	SPRING LK HT WD	SPRING LK HGT2	SPRNG LK HGTS BO	1953	60	711	660	8	51
114	400845N0740312.1	SPRING LK HT WD	SPRING LK HGT3	SPRNG LK HGTS BO	1966	25	680	630	10	50
115	400849N0740207.1	SPRING LAKE W D	SLWD 1	SPRING LAKE BORO	1940	15	698	631	6	--
116	400849N0740207.2	SPRING LAKE W D	SLWD 2	SPRING LAKE BORO	1941	15	707	640	8	--
117	400824N0743121.1	E W HARVEY	--	U FREEHOLD TWP	1950	115	150	96	6	--
118	400823N0741520.1	JACKSON TWP MUA	JACKSON 2	JACKSON TWP	1962	156	577	541	8	36
119	400825N0740502.1	WALL TWP W D	ALLENWOOD 1	WALL TWP	1959	100	740	689	10	50
120	400824N0740508.1	WALL TWP W D	ALLENWOOD 2	WALL TWP	1959	80	710	658	10	50

Table 7.--Construction data for wells developed in the Englishtown aquifer in Monmouth and Ocean Counties--Continued

MAP NO	LOCATION	OWNER	LOCAL WELL NUMBER	MUNICIPALITY	DATE DRILLED (YEAR)	ALTI-TUDE-OF LSD (FT)	WELL DEPTH (FT)	CASING DEPTH (FT)	CASING DIAM-ETER (IN)	LENGTH OF WELL OPEN TO AQUIFER (FEET)
121	400804N0740227.1	SEA GIRT W D	SGWD 5	SEA GIRT BORO	1963	20	710	660	10	55
122	400800N0740231.1	SEA GIRT W D	SGWD 4	SEA GIRT BORO	1949	18	715	685	10	--
123	400752N0743454.1	ATLEE ZURLO	--	U FREEHOLD TWP	1952	90	109	99	4	10
124	400742N0741639.1	JACKSON TWP MUA	JACKSON 4	JACKSON TWP	1965	80	500	448	8	52
125	400745N0741333.1	HOWELL TWP BD	KENT RD	HOWELL TWP	1955	110	582	558	6	--
126	400803N0740229.1	SEA GIRT W D	SGWD 3	SEA GIRT BORO	1921	20	760	730	8	--
127	400657N0741715.1	JACKSON TWP MUA	JACKSON 3	JACKSON TWP	1962	140	559	513	10	46
128	400712N0741512.1	JACKSON TWP MUA	JACKSON 1	JACKSON TWP	1961	110	557	511	8	46
129	400645N0740345.1	BRIELLE WATER D	BWD 2	BRIELLE BORO	1950	33	750	690	12	60
130	400636N0741515.1	ST GABRIELS COL	ST GABRIELS 1	LAKEWOOD TWP	1957	70	530	--	8	--
131	400555N0740851.1	PARKWAY W C	PARKWAY 1	HOWELL TWP	1958	45	646	605	8	41
132	400623N0740429.1	BRIELLE WATER D	BWD 3	BRIELLE BORO	1967	90	820	770	10	50
133	400614N0741157.1	LAKEWOOD W C	LAKEWOOD 9	LAKEWOOD TWP	1968	55	698	569	8	65
134	400622N0741349.1	LAKEWOOD W C	LAKEWOOD 6	LAKEWOOD TWP	1960	70	582	521	8	61
135	400540N0741230.1	LAKESORE LAUNDR	LAKESHORE LA 1	LAKEWOOD TWP	1950	50	612	596	6	16
136	400516N0741255.1	LAKEWOOD W C	LAKEWOOD W C	LAKEWOOD TWP	1900	35	621	--	6	--
137	400516N0741255.2	LAKEWOOD W C	LAKEWOOD 2	LAKEWOOD TWP	1921	60	625	575	8	50
138	400515N0741251.2	LAKEWOOD W C	LAKEWOOD W C	LAKEWOOD TWP	1899	30	600	--	6	--
139	400515N0741251.1	LAKEWOOD W C	LAKEWOOD 5	LAKEWOOD TWP	1957	40	604	547	8	57
140	400500N0741108.1	LAKEWOOD W C	LAKEWOOD	LAKEWOOD TWP	1966	30	736	725	4	--
141	400459N0740359.1	PT PLEASANT W D	PPWD 3	PT PLSNT BORO	1946	15	798	748	10	50
142	400454N0740413.1	PT PLEASANT W D	PPWD 6	PT PLSNT BORO	1965	20	790	730	8	68
143	400450N0740410.1	PT PLEASANT W D	PPWD 2	PT PLSNT BORO	1936	15	745	715	6	30
144	400450N0740410.2	PT PLEASANT W D	PPWD 1	PT PLSNT BORO	1936	20	825	745	8	--
145	400450N0740410.3	PT PLEASANT W D	PPWD	PT PLSNT BORO	1893	10	806	746	--	--
146	400443N0741352.1	LAKEWOOD W C	LAKEWOOD 8	LAKEWOOD TWP	1965	78	758	600	8	88
147	400435N0740257.1	CENTRAL RR NJ	CENTRAL RR NJ	BAY HEAD BORO	1930	9	813	793	5	20
148	400416N0742701.1	US GEOL SURVEY	COLL MILLS TW1	JACKSON TWP	1964	137	427	417	6	--
149	400354N0741310.1	LAKEWOOD W C	LAKEWOOD 7	LAKEWOOD TWP	1964	85	757	697	8	--
150	400401N0743200.2	NEW EGYPT WC	1	PLUMSTED TWP	1907	75	239	214	6	25
151	400405N0740244.1	OCEAN CO W C	BAY HEAD 6	BAY HEAD BORO	1950	10	818	778	8	--
152	400405N0740242.1	OCEAN CO W C	BAY HEAD 5	BAY HEAD BORO	1947	10	834	775	8	--
153	400358N0740812.1	BRADLEES CORP	BRADLEES WELL	BRICK TWP	1969	10	710	670	12	40
154	400312N0741123.1	S LAKEWOOD W C	S LAKEWOOD 3	LAKEWOOD TWP	1966	45	741	673	8	68
155	400250N0741044.1	S LAKEWOOD W C	S LAKEWOOD 2	LAKEWOOD TWP	1963	40	762	680	8	62
156	400220N0741154.1	S LAKEWOOD W C	S LAKEWOOD 1	LAKEWOOD TWP	1969	90	817	748	8	65
157	400211N0740311.1	OCEAN CO W C	MANTOLOKING 4	MANTOLOKING BORO	1924	5	922	900	6	22
158	400210N0740310.1	OCEAN CO W C	MANTOLOKING 6	MANTOLOKING BORO	1955	5	906	845	8	--
159	395808N0740421.1	LAVALLETTE W D	LWD 2	LAVALLETTE BORO	1931	5	1136	1009	6	127
160	395741N0740437.1	LAVALLETTE W D	LWD 3	LAVALLETTE BORO	1948	7	1180	1120	8	60
161	395609N0741240.1	US GEOL SURVEY	TOMS RIVER TW2	S TOMS RIVER BORO	1965	15	1146	1080	3	66

along the shore area of southeastern Monmouth County (fig. 15). The altitude of the potentiometric surface was below sea level throughout eastern Monmouth County and northeastern Ocean County; the potentiometric surface in the Belmar-Spring Lake area was more than 80 ft (24 m) below sea level and in the vicinity of Lakewood was more than 20 ft (6 m) below sea level.

A second series of water-level measurements in the Englishtown aquifer in Monmouth, Ocean, and Burlington Counties was made in November 1970 (table 6). The altitude and configuration of this potentiometric surface is shown in figure 16. The regional decline of the potentiometric surface between 1959 and 1970 (fig. 10) was greater than the decline from 1900 to 1959. The heavy ground-water withdrawals along the coastal areas of southern Monmouth County and northern Ocean County and in the Lakewood area caused decline of 100 ft (30 m) or more during this period. The effects of the pumping in these areas extended as far west as Freehold, where 12 to 15 ft (3.6 to 4.6 m) of decline occurred.

Continuous records of water-level changes in the confined part of the Englishtown aquifer became available in 1964, when the U.S. Geological Survey installed two observation wells as part of the cooperative statewide observation well network. One well was installed at Allaire State Park in southeastern Monmouth County and the other at Colliers Mills Hunting and Fishing Grounds in northwestern Ocean County. The well at Allaire State Park is situated approximately midway between the two main centers of pumpage; one near Lakewood and the other along the coast in southern Monmouth County. The water level in this well declined 50 ft (15 m) between February 1964 and February 1970 at an average annual rate of decline of 8 ft (2.4 m) per year (fig. 17). The net decline between February 1969 and February 1970 was 12 ft (3.6 m). As the observation well at Colliers Mills is considerably west of the Lakewood area, water-level declines recorded in this well (fig. 17) are considerably less than those seen at Allaire State Park. The water-level at Colliers Mills declined only about 8 ft (2.4 m) between February 1964 and February 1970; the average rate of decline over this period was 1.3 ft (0.4 m) per year. The water level declined 1.2 ft (0.37 m) between February 1969 and February 1970.

The Lakewood Water Company installed an observation well southeast of Lakewood in late 1966. Continuous records of water levels in this well have been kept by the company since that time (fig. 17). The measurements show an almost continuous water-level decline of 81 ft (24.7 m) from January 1967 to September 1970.

Ground-water Withdrawals

Ground-water withdrawals from the Englishtown aquifer in Monmouth and Ocean Counties are dominantly for public supply (fig. 18). Domestic pumpage is not known but is probably small. Because shallower aquifers are capable of yielding quantities of water suitable for domestic purposes, it is not

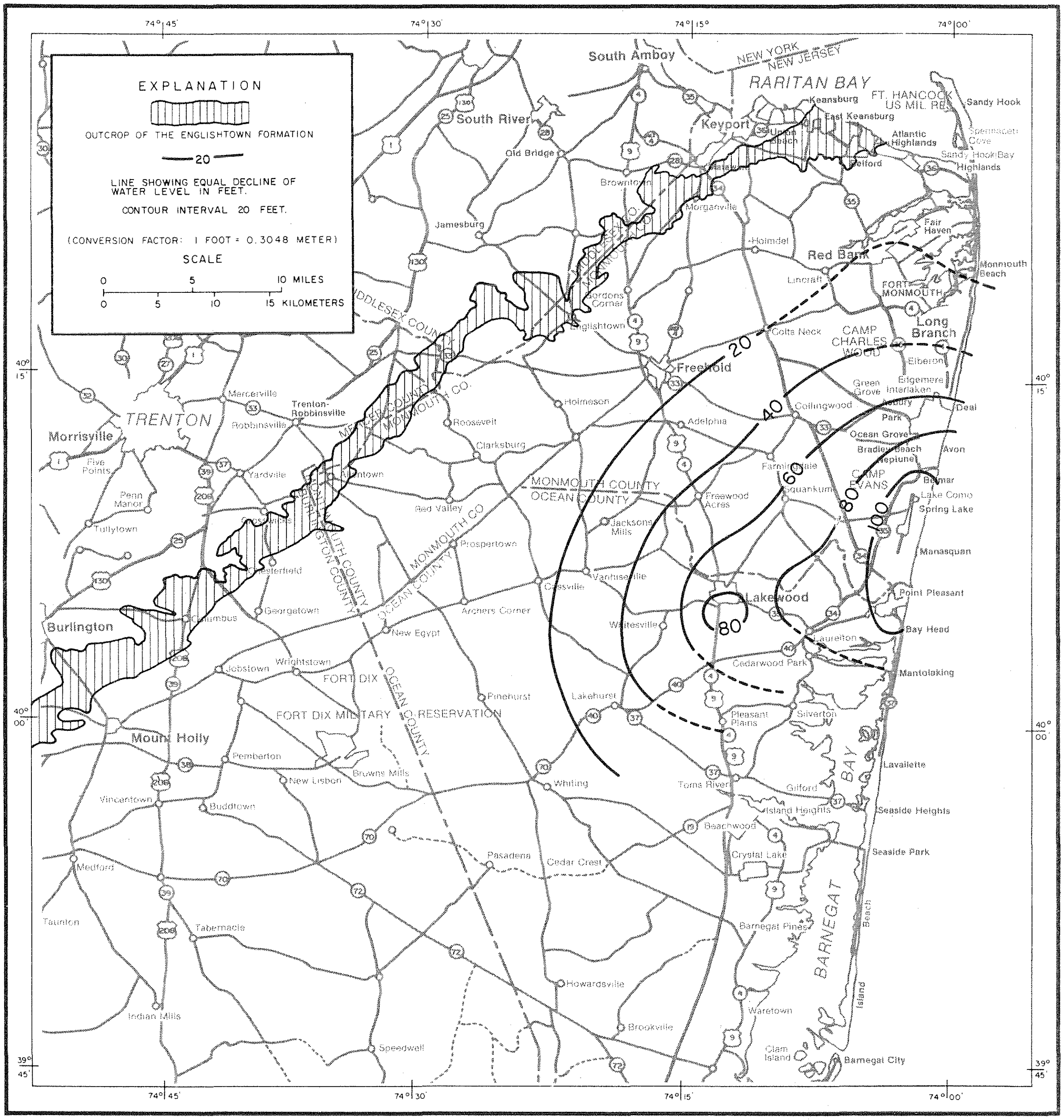


FIGURE 15. --WATER-LEVEL DECLINE BETWEEN ABOUT 1900 AND JANUARY 1959 IN THE ENGLISHTOWN AQUIFER IN MONMOUTH AND NORTHERN OCEAN COUNTIES, N.J.

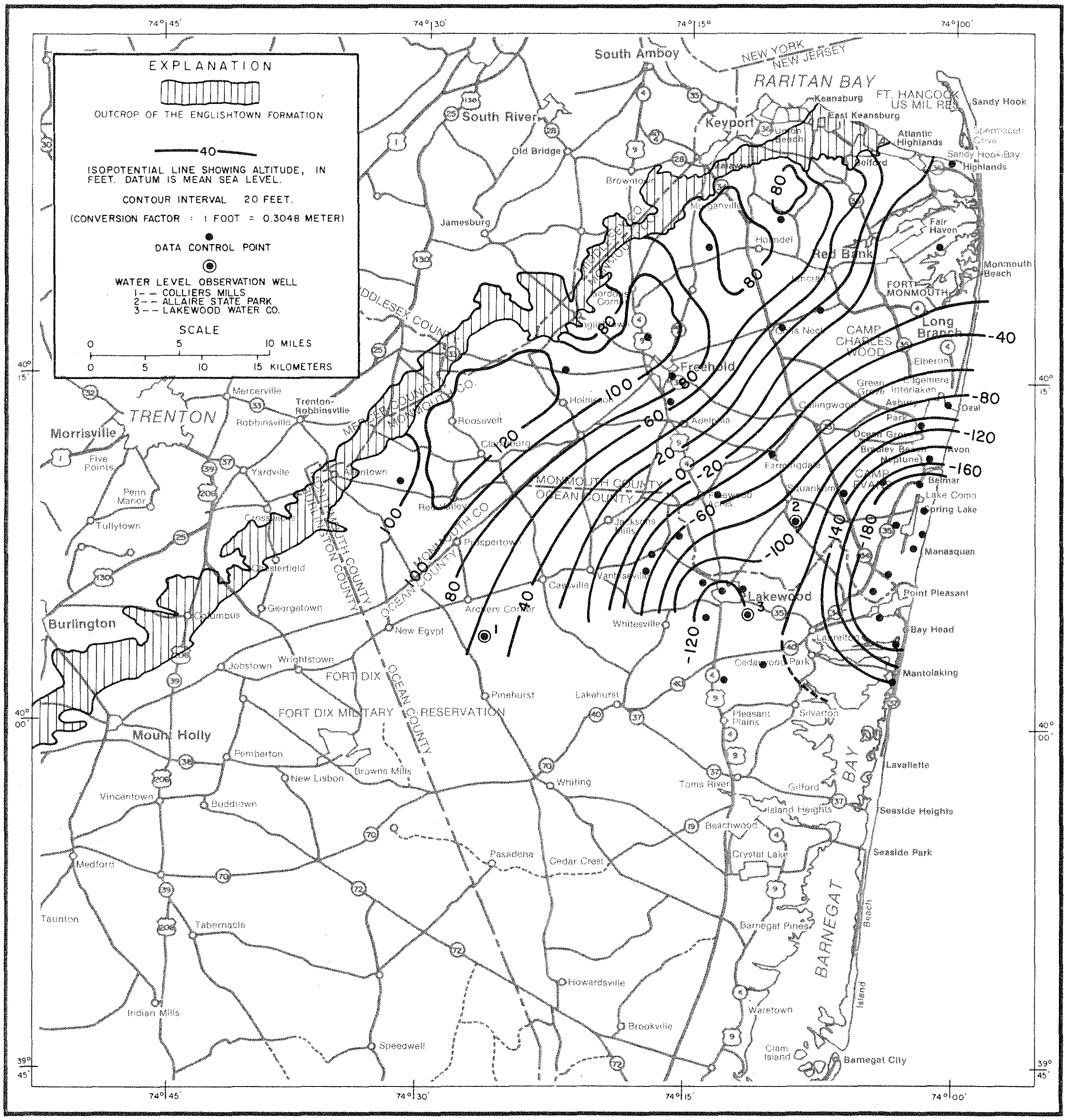
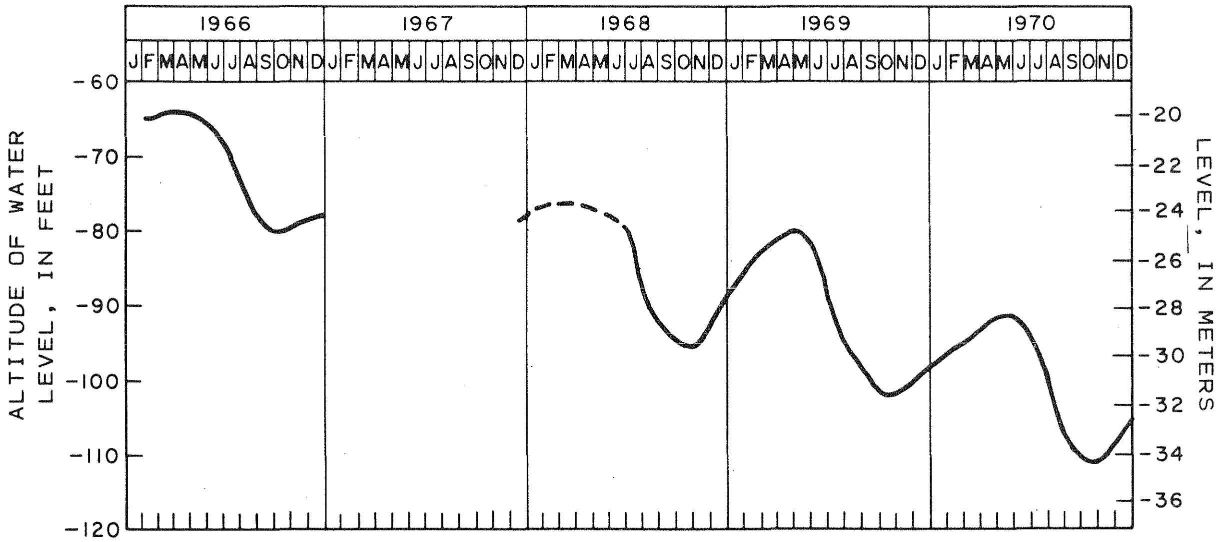
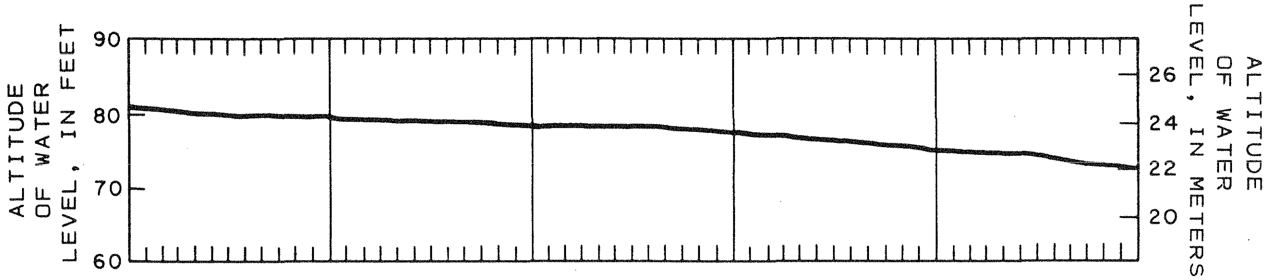


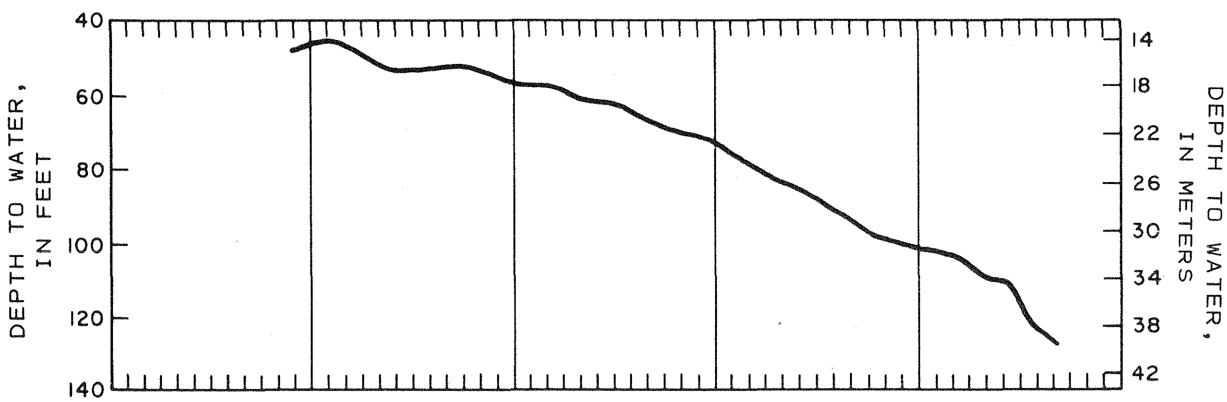
FIGURE 16. --ALTITUDE OF THE POTENTIOMETRIC SURFACE IN THE ENGLISHTOWN AQUIFER IN NOVEMBER 1970 IN MONMOUTH AND NORTHERN OCEAN COUNTIES, N.J.



A. ALLAIRE STATE PARK, U.S.G.S. OBSERVATION WELL, MONMOUTH COUNTY, N.J.



B. COLLIERS MILLS, U.S.G.S. OBSERVATION WELL TW 1, OCEAN COUNTY, N.J.



C. LAKEWOOD WATER COMPANY OBSERVATION WELL, LAKEWOOD, OCEAN COUNTY, N.J.

FIGURE 17. --HYDROGRAPHS OF OBSERVATION WELLS TAPPING THE ENGLISHTOWN AQUIFER IN MONMOUTH AND NORTHERN OCEAN COUNTIES, N.J.

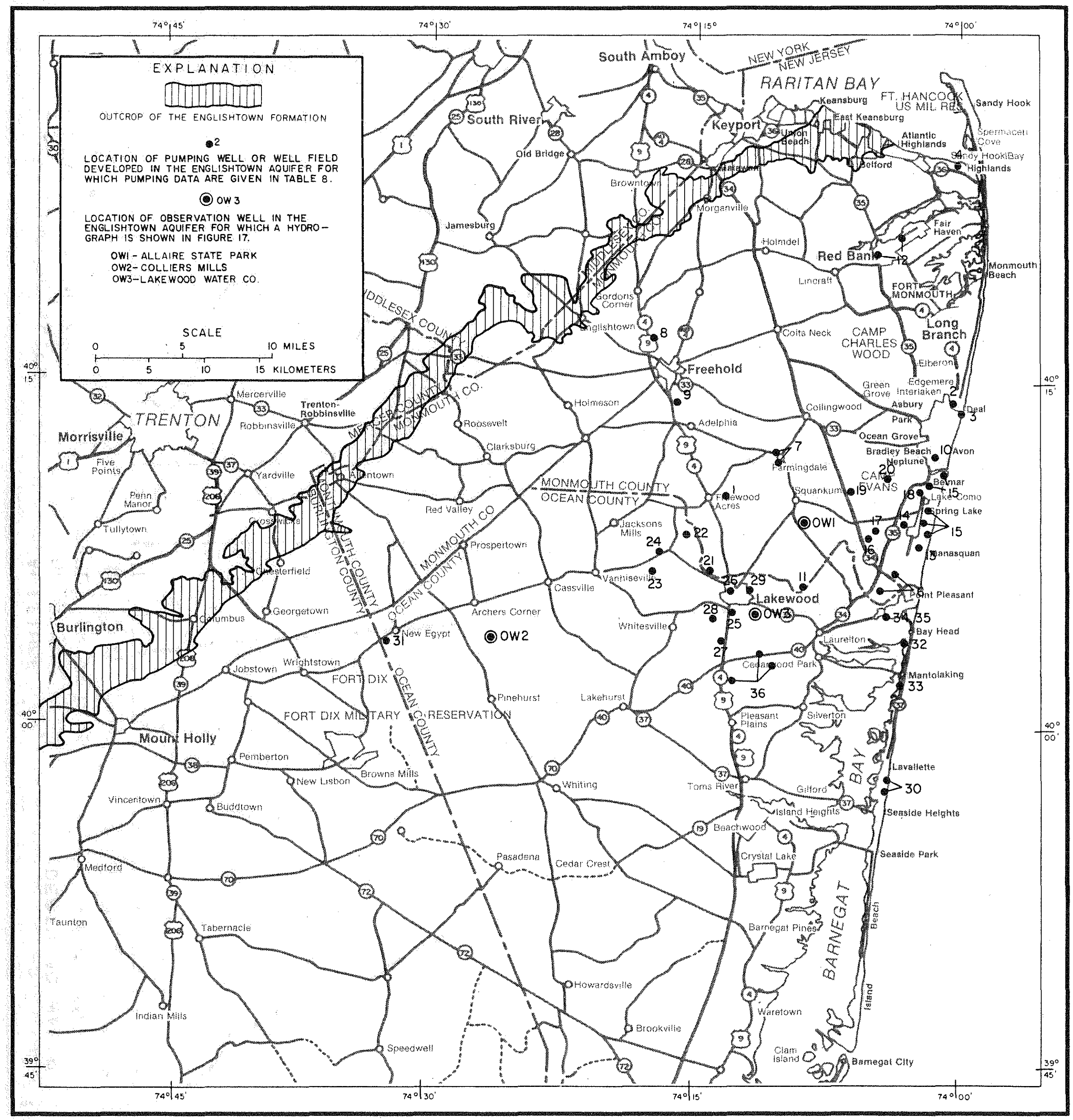


FIGURE 18. --LOCATION OF PUMPING WELLS LISTED IN TABLE 8 AND OBSERVATION WELLS DESCRIBED IN FIGURE 17.

necessary for these users to tap the Englishtown. Total withdrawals from the Englishtown in the area of investigation for industrial, irrigation, commercial and institutional uses are also minor and in most cases have not been considered (figure 19).

Water for public supply was pumped from the Englishtown aquifer in the two-county area at an average rate of about 5.5 Mgal/d (0.24 m^3/s) in 1959 (table 8). By 1970 the rate of withdrawal had increased by approximately 80 percent, to about 9.5 Mgal/d (0.4 m^3/s). Nearly 80 percent of the withdrawals was from an area of roughly 100 mi^2 (259 km^2), extending from Asbury Park southwest to the vicinity of Lakewood and south to the Point Pleasant area. This is about one-seventh of the total area covered by this study.

The greatest increase in the rate of withdrawal from the Englishtown between 1959 and 1970 occurred in Ocean County. The average annual rate of pumping in 1959 was about 1.75 Mgal/d (0.07 m^3/s). The 1970 rate of withdrawal was 4.67 Mgal/d (0.20 m^3/s), an increase of almost 268 percent of the 1959 rate. Nearly all of the increase in withdrawals from the Englishtown aquifer in Ocean County has been from the area around Lakewood in Jackson and Lakewood Townships (table 8). In Monmouth County, the average annual rate of withdrawal for public supply increased only about 34 percent from 3.46 Mgal/d (0.15 m^3/s) in 1959 to 4.67 (0.20 m^3/s) in 1970 (table 8). Nearly 60 percent [about 0.7 Mgal/d (0.03 m^3/s)] of the rate increase occurred in Wall Township in the southeastern part of the county. The remainder of the increased rate of pumping reflects increases throughout the rest of the county.

Confining Layer Geometry

The Englishtown Formation is bounded above and below by sequences of sandy to clayey silts and silty clays. The underlying sequence of sediments, which form the lower confining bed of the Englishtown aquifer, includes the Merchantville Formation and the Woodbury Clay. The combined thickness of the two formations ranges from less than 100 ft (30 m) in northern Monmouth County to more than 300 ft (91 m) in southeastern Monmouth County (fig. 2). It has an average thickness of about 180 ft (55 m) throughout most of northern Ocean County.

The sequence of fine-grained sediments above the Englishtown in the study area includes the Marshalltown Formation and the finer grained lower part of the Wenonah Formation. These sediments act as the upper confining bed of the aquifer. The thickness of the Marshalltown is relatively uniform throughout the area of investigation, ranging from 10 to 20 ft (3 to 6 m). As much as 80 ft (24 m) of the Wenonah is included in the thickness of the upper confining bed. The total thickness of this confining layer ranges from about 12 ft (6 m) in northern Monmouth County to 100 ft (30 m) in central Ocean County (fig. 20).

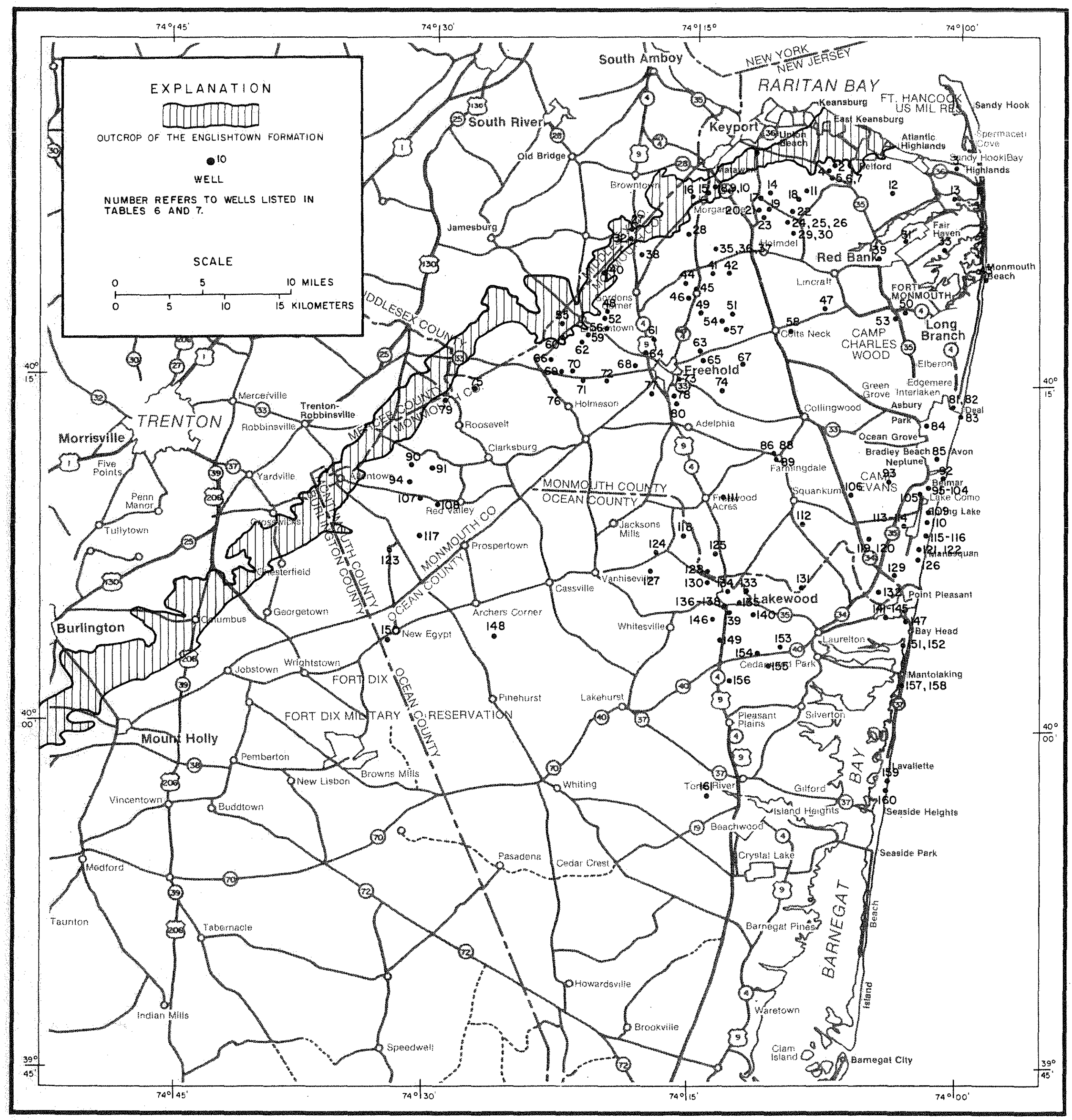


FIGURE 19. --LOCATION OF WELLS DEVELOPED IN THE ENGLISHTOWN AQUIFER IN MONMOUTH AND OCEAN COUNTIES.

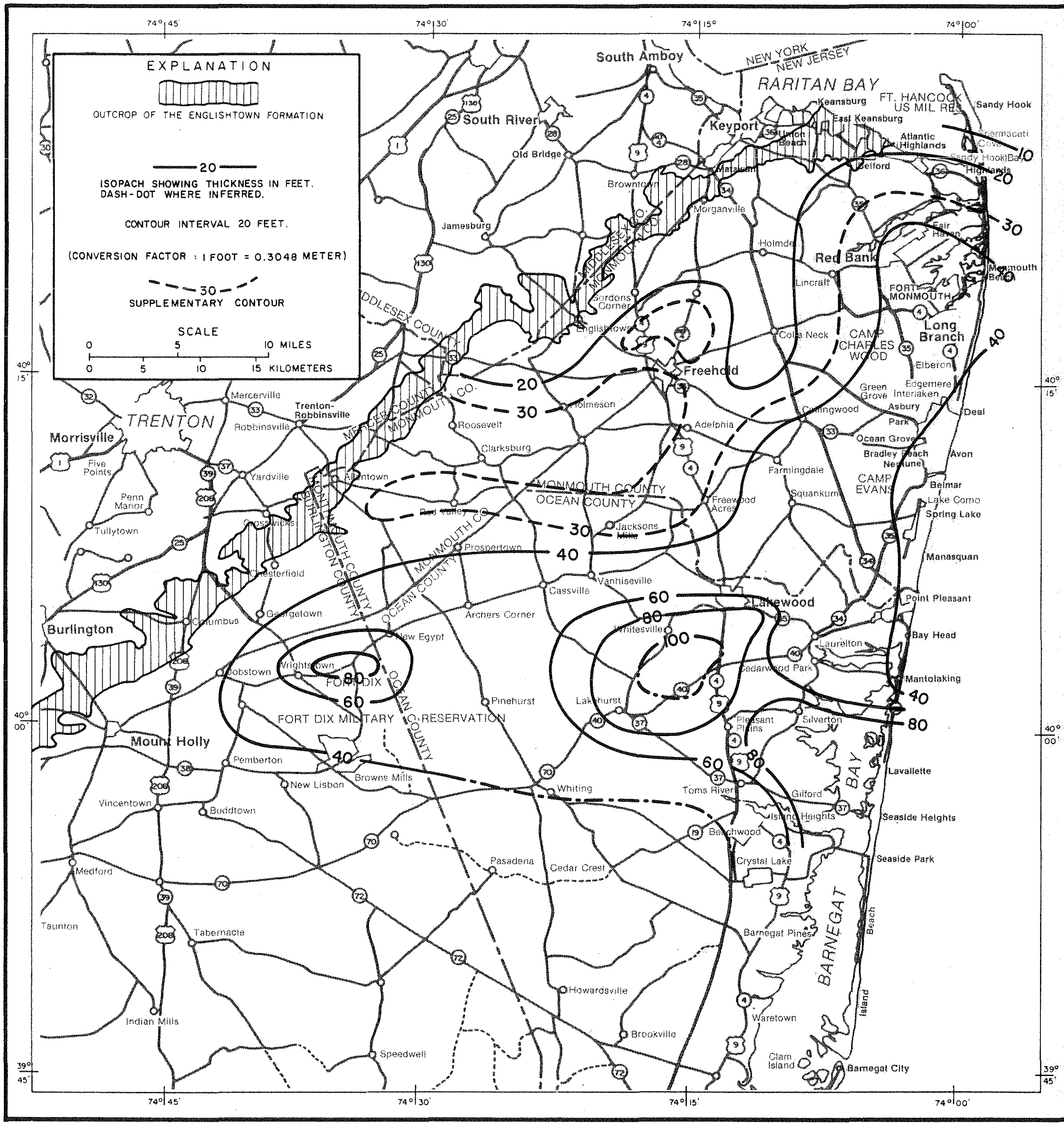


FIGURE 20. --THICKNESS OF THE CONFINING LAYER OVERLYING THE ENGLISHTOWN AQUIFER IN MONMOUTH AND NORTHERN OCEAN AND BURLINGTON COUNTIES, N.J.

Table 8.--Rate of ground-water withdrawal for public supply from the Englishtown aquifer in Monmouth and Ocean Counties

Map No.	Water department or company	Owner well number (see fig. 18 for locations)	Average annual rate of withdrawal (Mgal/d) Year 1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
1	Aldrich Water Co.	#4	--	--	--	--	--	--	--	--	--	.04	.11	.17
2	Allenhurst Water Co.	#4	.13	.14	.14	.14	.15	.14	.14	.15	.15	.17	.15	.15
3	Asbury Park Water Dept.	#4	.10	.10	.10	.10	.10	.10	.10	.10	.10	.10	.10	.10*
4	Atlantic Highlands Water Dept.	#2	.23	.25	.27	.29	.30	.20	.13	.15	.13	.17	.19	.19
5	Belmar Water Dept.	10 wells	.93	.70	.68	.72	.83	.83	.79	.80	.84	.93	.92	.91
6	Brielle Water Dept.	#2-3	.17	.18	.15	.16	.16	.16	.16	.21	.20	.32	.34	.32
7	Farmingdale Water Dept.	All wells	.04	.04	.05	.05	.06	.07	.09	.14	.15	.09	.10	.09
8	Freehold Water & Util.	Point Ivy #1	--	--	--	--	--	--	--	--	--	--	.02	.04*
9	Freehold Twp. Water Dept.	Koenig Lane #2	--	--	--	--	--	--	--	--	--	--	--	.60
10	Monmouth Consolidated Water Co.	Ocean Grove Sta. #20	.33	.07	.60	.71	.04	.05	.02	.08	--	--	--	.01
11	Parkway Water Co.		.02	.03	.04	.07	.07	.10	.08	.08	.08	.09	.09	.10
12	Red Bank Water Dept.	#2-3	.64	.68	.69	.67	.67	.67	.65	.67	.64	.77	.72	.62*
13	Sea Girt Water Dept.	#4-5	.19	.19	.19	.20	.23	.21	.21	.21	.18	.19	.19	.05
14	Spring Lake Heights Water Dept.	#2-3	.20	.23	.24	.23	.30	.33	.28	.29	.32	.42	.44	.53*
15	Spring Lake Water Dept.	#1-4	.48	.52	.45	.47	.49	.52	.45	.49	.46	.53	.55	.63
16	Wall Twp. Water Dept.	Allenwood #1	--	--	--	.11	.13	.16	.17	.19	.19	.18	.15	.18
17	Wall Twp. Water Dept.	Allenwood #2	--	--	--	.10	.12	.14	.16	.18	.20	.20	.19	.20
18	Wall Twp. Water Dept.	West Belmar	--	--	--	.09	.10	.11	.12	.14	.13	.13	.13	.15
19	Wall Twp. Water Dept.	Route 34 well	--	--	--	--	--	--	--	--	--	.08	.16	.18
20	Wall Twp. Water Dept.	Imperial Park #2	--	--	--	--	--	--	--	--	--	--	--	.06

Table 8.--Rate of ground-water withdrawal for public supply from the Englishtown aquifer in Monmouth and Ocean Counties--Continued

Map No.	Water department or company	Owner well number (see fig. 18 for locations)	Average annual rate of withdrawal (Mgal/d) Year 1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
21	Jackson Twp. MUA	#1	--	--	--	.09	.19	.17	.17	.13	.13	.11	.13	.19
22	Jackson Twp. MUA	#2	--	--	--	--	.07	.21	.17	.17	.15	.18	.19	.28
23	Jackson Twp. MUA	#3	--	--	--	--	.01	.02	.01	.11	.12	.14	.17	.17
24	Jackson Twp. MUA	#4	--	--	--	--	--	--	--	.16	.16	.18	.14	.11
25	Lakewood Water Co.	#5	.75	.77	.78	.75	.65	.50	.22	.20	.17	.10	.08	.10*
26	Lakewood Water Co.	#6	--	--	--	.12	.27	.42	.56	.53	.47	.47	.32	.33*
27	Lakewood Water Co.	#7	--	--	--	--	--	.24	.44	.53	.45	.63	.60	.63*
28	Lakewood Water Co.	#8	--	--	--	--	--	--	--	.06	.29	.30	.32	.29*
29	Lakewood Water Co.	#9	--	--	--	--	--	--	--	--	--	.01	.25	.40*
30	Lavallette Water Dept.	#2-3	.32	.31	.30	.29	.30	.32	.33	.25	.19	.37	.40	.35*
31	New Egypt Water Co.		.10	.11	.11	.10	.12	.11	.12	.14	.11	.11	.11	.12*
32	Ocean County Water Co.	Bay Head #5-6	.38	.39	.41	.44	.45	.47	.47	.47	.51	.63	.60	.65
33	Ocean County Water Co.	Mantoloking #6	--	--	--	--	--	--	--	--	.01	.00	.03	.04
34	Point Pleasant Water Dept.	#3	.20	.09	.12	.25	.26	.45	.40	.21	.03	.05	--	--
35	Point Pleasant Water Dept.	#6	--	--	--	--	--	--	.33	.72	.32	.54	.47	.39
36	South Lakewood Water Co.	#1-3 (#1 drilled 69)	--	--	--	--	--	--	.05	.06	.18	.38	.56	.73

*Estimated

Confining Layer Coefficients

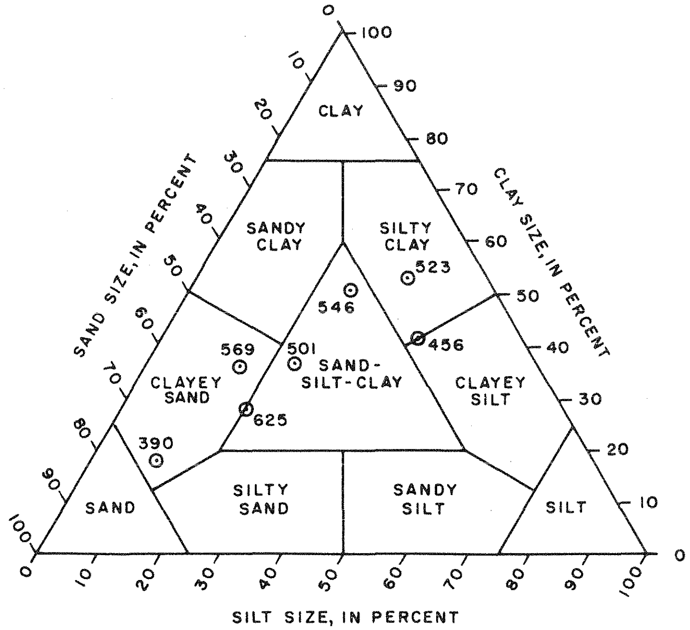
The quantitative analysis of ground-water flow in complex aquifer systems requires reliable values of hydraulic conductivity and specific storage for the confining layers which separate the individual aquifers. These values can be computed from the results of standard soil consolidation tests performed in the laboratory on undisturbed samples (Lambe, 1951; Domenico and Mifflin, 1965). Subsurface core samples were obtained at three sites for laboratory analysis. In all 58 samples were collected and tested; 16 of the samples are from confining beds of the Englishtown aquifer system.

Samples were collected with an 18-inch (0.45-m) split barrel sampler with three 6-inch (0.15-m) brass liner inserts. The liner segment containing the sample to be tested was capped at each end, sealed with wax, and stored in a controlled temperature and humidity environment. Consolidation tests were performed by the Hydrologic Laboratory of the U.S. Geological Survey and by the Division of Materials of the New Jersey Department of Transportation. The results of these tests are shown in table 9.

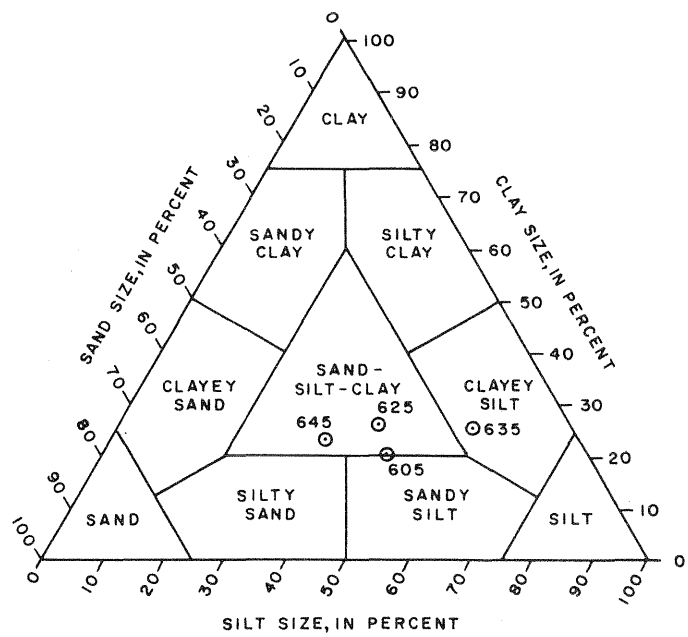
The upper confining bed of the Englishtown aquifer system was penetrated by the Bradlees Corporation well located in Brick Township in northeastern Ocean County. The samples obtained at depths of 605 ft (184 m) and 625 ft (190 m) are from the Wenonah Formation; those from 635 ft (193 m) and 645 ft (196 m) are from the Marshalltown Formation. The sediments recovered are of the sand-silt-clay and clayey silt types according to the Shepard (1954) classification system (fig. 21B).

Hydraulic conductivity values computed from consolidation test data range from 2.79×10^{-10} ft/s (feet per second) [8.5×10^{-9} cm/s (centimeters per second)] to 6.57×10^{-11} ft/s (2.0×10^{-9} cm/s). These values were calculated from data at the load increment nearest the approximate computed overburden pressure of 480 psi (pounds per square inch) [33.7 kg/cm^2 (kilograms per square centimeter)]. Computed values of specific storage range from 1.37×10^{-4} ft^{-1} (4.49×10^{-6} cm^{-1}) to 5.14×10^{-5} ft^{-1} (6.07×10^{-6} cm^{-1}) for the same samples (table 9). The hydraulic diffusivity of the four samples ranges from 1.27×10^{-6} ft^2/s (square feet per second) [1.18×10^{-3} cm^2/s (square centimeters per second)] to 2.29×10^{-6} ft^2/s (2.13×10^{-3} cm^2/s).

Samples of both confining layers were obtained from a well drilled by the U.S. Army at Fort Dix, New Jersey. One sample was taken of the Marshalltown Formation at a depth of 390 ft (119 m) and five samples were collected from the Merchantville-Woodbury Formations between depths of 456 ft (139 m) and 625 ft (190 m). The Marshalltown sample is a silty sand according to the Shepard classification. A variety of sediment types were recovered from the Merchantville-Woodbury sequence. They ranged from clayey sand to silty clay according to Shepard's classification system (fig. 21A).



A. FORT DIX TEST WELL 'A'.



B. BRADLEES CORP. WELL.

FIGURE 21. --SEDIMENT CLASSIFICATION DIAGRAMS FOR SELECTED SAMPLES FROM TEST HOLES PENETRATING THE CONFINING LAYERS OF THE ENGLISHTOWN AQUIFER SYSTEM. NUMBERS INDICATE DEPTH OF SAMPLE. TRIANGULAR PARTICLE-SIZE DIAGRAMS ARE SUBDIVIDED ACCORDING TO THE SYSTEM PROPOSED BY SHEPARD (1954).

Table 9.--Consolidation Test Data

U.S. Army, Fort Dix Well 6
New Hanover Twp., Burlington Co., N.J.

Sample depth	Consolidation load		Consolidation coefficient-C_v			Hydraulic conductivity-K		Specific storage-S_s		Specific gravity	Void ratio	Porosity (percent)	Geol. Fm.*
(ft)	(psi)	(g/cm^2)	(in^2/s)	(ft^2/s)	(cm^2/s)	(ft/s)	(cm/s)	(1/ft)	(1/cm)				
116.0	111.1	7.81×10^3	5.74×10^{-5}	3.99×10^{-7}	3.70×10^{-4}	1.80×10^{-10}	5.49×10^{-9}	4.52×10^{-4}	1.48×10^{-5}	2.84	0.580	36.7	
	222.2	1.56×10^4	3.26×10^{-5}	2.26×10^{-7}	2.10×10^{-4}	6.42×10^{-11}	1.96×10^{-9}	2.84×10^{-4}	9.31×10^{-6}	2.84	0.473	32.1	
116.5	97.2	6.84×10^3	3.26×10^{-3}	2.26×10^{-5}	2.10×10^{-2}	7.97×10^{-9}	2.43×10^{-7}	3.52×10^{-4}	1.15×10^{-5}	2.88	0.650	39.4	
	125.0	8.79×10^3	9.54×10^{-4}	6.62×10^{-6}	6.15×10^{-3}	1.83×10^{-10}	5.59×10^{-9}	2.77×10^{-5}	9.08×10^{-7}	2.88	0.620	38.3	
	222.2	1.56×10^4	4.32×10^{-3}	3.00×10^{-5}	2.79×10^{-2}	8.75×10^{-9}	2.67×10^{-7}	2.92×10^{-4}	9.57×10^{-6}	2.88	0.522	34.3	
117.0	111.1	7.81×10^3	1.15×10^{-4}	7.99×10^{-7}	7.42×10^{-4}	2.92×10^{-10}	8.89×10^{-9}	3.65×10^{-4}	1.20×10^{-5}	2.76	0.523	34.3	
	222.2	1.56×10^4	1.79×10^{-5}	1.24×10^{-7}	1.15×10^{-4}	3.09×10^{-11}	9.42×10^{-10}	2.49×10^{-4}	8.16×10^{-6}	2.76	0.432	30.2	
	444.4	3.12×10^4	2.75×10^{-5}	1.91×10^{-7}	1.77×10^{-4}	2.07×10^{-11}	6.30×10^{-10}	1.08×10^{-4}	3.55×10^{-6}	2.76	0.357	26.3	
139.0	55.6	3.91×10^3	2.79×10^{-4}	1.94×10^{-6}	1.80×10^{-3}	3.70×10^{-10}	1.13×10^{-8}	1.91×10^{-4}	6.27×10^{-6}	2.67	1.130	53.1	
	55.6	3.91×10^3	2.12×10^{-4}	1.47×10^{-6}	1.37×10^{-3}	2.89×10^{-10}	8.81×10^{-9}	1.96×10^{-4}	6.44×10^{-6}	2.67	1.130	53.1	
	111.1	7.81×10^3	8.52×10^{-5}	5.92×10^{-7}	5.50×10^{-4}	1.70×10^{-10}	5.18×10^{-9}	2.87×10^{-4}	9.43×10^{-6}	2.67	1.054	51.3	
	111.1	7.81×10^3	5.48×10^{-4}	3.18×10^{-6}	2.95×10^{-3}	9.17×10^{-10}	2.79×10^{-8}	2.88×10^{-4}	9.46×10^{-6}	2.67	1.054	51.3	
	166.7	1.17×10^4	2.60×10^{-5}	1.81×10^{-7}	1.68×10^{-4}	4.37×10^{-11}	1.33×10^{-9}	2.42×10^{-4}	7.93×10^{-6}	2.67	0.992	49.8	
	222.2	1.56×10^4	4.50×10^{-5}	3.12×10^{-7}	2.90×10^{-4}	6.10×10^{-11}	1.86×10^{-9}	1.95×10^{-4}	6.40×10^{-6}	2.67	0.943	48.5	
162.0	125.0	8.79×10^3	3.07×10^{-3}	2.13×10^{-5}	1.98×10^{-2}	3.00×10^{-9}	9.14×10^{-8}	1.41×10^{-4}	4.62×10^{-6}	2.44	0.469	31.9	
	166.7	1.17×10^4	7.75×10^{-4}	5.38×10^{-6}	5.00×10^{-3}	5.41×10^{-10}	1.65×10^{-8}	1.00×10^{-4}	3.30×10^{-6}	2.44	0.455	31.3	
	222.2	1.56×10^4	1.94×10^{-4}	1.35×10^{-6}	1.25×10^{-3}	1.10×10^{-10}	3.35×10^{-9}	8.16×10^{-5}	2.68×10^{-6}	2.44	0.440	30.6	
207.0	111.1	7.81×10^3	3.77×10^{-3}	2.62×10^{-5}	2.43×10^{-2}	3.12×10^{-9}	9.50×10^{-8}	1.19×10^{-4}	3.91×10^{-6}	2.92	0.508	33.7	
	166.7	1.17×10^4	1.84×10^{-3}	1.28×10^{-5}	1.19×10^{-2}	9.33×10^{-10}	2.84×10^{-8}	7.30×10^{-5}	2.40×10^{-6}	2.92	0.494	33.1	
	222.2	1.56×10^4	3.76×10^{-4}	2.61×10^{-6}	2.43×10^{-3}	1.22×10^{-10}	3.73×10^{-9}	4.69×10^{-5}	1.54×10^{-6}	2.92	0.485	32.7	

Table 9.--Consolidation Test Data--Continued

U.S. Army, Fort Dix Well 6--Continued
New Hanover Twp., Burlington Co., N.J.

Sample depth (ft)	Consolidation load (psi)	Consolidation load (g/cm^2)	Consolidation coefficient-C_v (in^2/s)	Consolidation coefficient-C_v (ft^2/s)	Consolidation coefficient-C_v (cm^2/s)	Hydraulic conductivity-K (ft/s)	Hydraulic conductivity-K (cm/s)	Specific storage-S_s (1/ft)	Specific storage-S_s (1/cm)	Specific gravity	Void ratio	Porosity (percent)	Geol. Fm.*
390.0	222.2	1.56×10^{4}	3.92×10^{-3}	2.72×10^{-5}	2.53×10^{-2}	3.00×10^{-9}	9.14×10^{-8}	1.10×10^{-4}	3.62×10^{-6}	2.77	0.551	35.5	Kmt
	444.4	3.12×10^{4}	2.88×10^{-3}	2.00×10^{-5}	1.86×10^{-2}	1.55×10^{-9}	4.72×10^{-8}	7.75×10^{-5}	2.54×10^{-6}	2.77	0.488	32.8	
456.0	222.2	1.56×10^{4}	8.44×10^{-4}	5.86×10^{-6}	5.45×10^{-3}	6.87×10^{-10}	2.09×10^{-8}	1.17×10^{-4}	3.84×10^{-6}	2.67	0.636	38.9	Kw
	361.1	2.54×10^{4}	9.53×10^{-4}	6.62×10^{-6}	6.15×10^{-3}	6.92×10^{-10}	2.11×10^{-8}	1.05×10^{-4}	3.43×10^{-6}	2.67	0.583	36.8	
	444.4	3.12×10^{4}	8.90×10^{-4}	6.18×10^{-6}	5.74×10^{-3}	4.33×10^{-10}	1.32×10^{-8}	7.01×10^{-5}	2.30×10^{-6}	2.67	0.562	36.0	
523.0	111.1	7.81×10^{3}	1.15×10^{-4}	7.99×10^{-7}	7.42×10^{-4}	1.44×10^{-10}	4.39×10^{-9}	1.81×10^{-4}	5.92×10^{-6}	2.68	0.686	40.7	Kwb
	222.2	1.56×10^{4}	5.25×10^{-5}	3.65×10^{-7}	3.39×10^{-4}	8.83×10^{-11}	2.69×10^{-9}	2.42×10^{-4}	7.95×10^{-6}	2.68	0.588	37.0	Kmv
	402.8	2.83×10^{4}	4.30×10^{-5}	2.99×10^{-7}	2.77×10^{-4}	1.39×10^{-10}	4.24×10^{-9}	4.66×10^{-4}	1.53×10^{-5}	2.68	0.558	35.8	
546.0	111.1	7.81×10^{3}	7.39×10^{-5}	5.13×10^{-7}	4.77×10^{-4}	7.62×10^{-11}	2.32×10^{-9}	1.48×10^{-4}	4.87×10^{-6}	2.58	0.739	42.5	Kwb
	222.2	1.56×10^{4}	9.04×10^{-5}	6.28×10^{-7}	5.83×10^{-4}	6.07×10^{-11}	1.85×10^{-9}	9.68×10^{-5}	3.17×10^{-6}	2.58	0.697	41.1	Kmv
	444.4	3.12×10^{4}	6.59×10^{-5}	4.58×10^{-7}	4.25×10^{-4}	4.25×10^{-11}	1.30×10^{-9}	9.29×10^{-5}	3.05×10^{-6}	2.58	0.620	38.3	
	888.9	6.25×10^{4}	2.46×10^{-5}	1.71×10^{-7}	1.59×10^{-4}	3.20×10^{-11}	9.75×10^{-10}	1.87×10^{-4}	6.15×10^{-6}	2.58	0.360	26.5	
569.0	111.1	7.81×10^{3}	2.48×10^{-4}	1.72×10^{-6}	1.60×10^{-3}	2.70×10^{-10}	8.23×10^{-9}	1.57×10^{-4}	5.14×10^{-6}	2.77	0.640	39.0	Kmb
	222.2	1.56×10^{4}	1.70×10^{-4}	1.18×10^{-6}	1.10×10^{-3}	1.42×10^{-10}	4.32×10^{-9}	1.20×10^{-4}	3.94×10^{-6}	2.77	0.591	37.1	Kmv
	444.4	3.12×10^{4}	1.40×10^{-4}	9.72×10^{-7}	9.03×10^{-4}	9.33×10^{-11}	2.84×10^{-9}	9.60×10^{-5}	3.15×10^{-6}	2.77	0.517	34.1	
	888.9	6.25×10^{4}	1.50×10^{-4}	1.04×10^{-6}	9.68×10^{-4}	8.67×10^{-11}	2.64×10^{-9}	8.32×10^{-5}	2.73×10^{-6}	2.77	0.398	28.5	
625.0	111.1	7.81×10^{3}	8.79×10^{-4}	6.10×10^{-6}	5.67×10^{-3}	1.22×10^{-9}	3.71×10^{-8}	1.99×10^{-4}	6.54×10^{-6}	2.69	0.522	34.3	Kmv
	222.2	1.56×10^{4}	8.97×10^{-4}	6.23×10^{-6}	5.79×10^{-3}	6.39×10^{-10}	1.95×10^{-8}	1.03×10^{-4}	3.37×10^{-6}	2.69	0.483	32.6	
	444.4	3.12×10^{4}	7.61×10^{-4}	5.28×10^{-6}	4.91×10^{-3}	3.46×10^{-10}	1.05×10^{-8}	6.54×10^{-5}	2.15×10^{-6}	2.69	0.435	30.3	
	888.9	6.25×10^{4}	7.08×10^{-4}	4.92×10^{-6}	4.57×10^{-3}	1.92×10^{-10}	5.84×10^{-9}	3.90×10^{-5}	1.28×10^{-6}	2.69	0.380	27.5	

Table 9.--Consolidation Test Data--Continued

U.S. Army, Fort Dix Well 6--Continued
New Hanover Twp., Burlington Co., N.J.

Sample depth	Consolidation load		Consolidation coefficient-C_v			Hydraulic conductivity-K		Specific storage-S_s		Specific gravity	Void ratio	Porosity (percent)	Geol. Fm.*
(ft)	(psi)	(g/cm^2)	(in^2/s)	(ft^2/s)	(cm^2/s)	(ft/s)	(cm/s)	(1/ft)	(1/cm)				
660.0	55.6	3.91×10^{3}	2.51×10^{-4}	1.74×10^{-6}	1.62×10^{-3}	3.38×10^{-10}	1.03×10^{-8}	1.94×10^{-4}	6.37×10^{-6}	2.67	0.356	26.3	
	111.1	7.81×10^{3}	4.42×10^{-4}	3.07×10^{-6}	2.85×10^{-3}	6.78×10^{-10}	2.07×10^{-8}	2.21×10^{-4}	7.25×10^{-6}	2.67	0.312	23.8	
	222.2	1.56×10^{4}	3.55×10^{-4}	2.47×10^{-6}	2.29×10^{-3}	2.79×10^{-10}	8.51×10^{-9}	1.13×10^{-4}	3.72×10^{-6}	2.67	0.274	21.5	
	444.4	3.12×10^{4}	5.42×10^{-4}	3.76×10^{-6}	3.50×10^{-3}	2.83×10^{-10}	8.64×10^{-9}	7.53×10^{-5}	2.47×10^{-6}	2.67	0.159	13.7	
	888.9	6.25×10^{4}	8.60×10^{-4}	5.97×10^{-6}	5.55×10^{-3}	3.09×10^{-10}	9.42×10^{-9}	5.18×10^{-5}	1.70×10^{-6}	2.67	0.159	13.7	
772.0	111.1	7.81×10^{3}	4.96×10^{-4}	3.44×10^{-6}	3.20×10^{-3}	6.97×10^{-10}	2.13×10^{-8}	2.02×10^{-4}	6.64×10^{-6}	2.74	0.453	31.2	
	222.2	1.56×10^{4}	5.33×10^{-4}	3.70×10^{-6}	3.44×10^{-3}	4.09×10^{-10}	1.25×10^{-8}	1.11×10^{-4}	3.63×10^{-6}	2.74	0.413	29.2	
	444.4	3.12×10^{4}	5.64×10^{-4}	3.92×10^{-6}	3.64×10^{-3}	2.58×10^{-10}	7.87×10^{-9}	6.60×10^{-5}	2.16×10^{-6}	2.74	0.367	26.8	
	888.9	6.25×10^{4}	4.99×10^{-4}	3.47×10^{-6}	3.22×10^{-3}	1.42×10^{-10}	4.32×10^{-9}	4.09×10^{-5}	1.34×10^{-6}	2.74	0.312	23.8	
795.0	111.1	7.81×10^{3}	5.25×10^{-4}	3.65×10^{-6}	3.39×10^{-3}	8.05×10^{-10}	2.45×10^{-8}	2.21×10^{-4}	7.24×10^{-6}	2.58	0.413	29.2	
	222.2	1.56×10^{4}	5.76×10^{-4}	4.00×10^{-6}	3.72×10^{-3}	5.17×10^{-10}	1.57×10^{-8}	1.29×10^{-4}	4.24×10^{-6}	2.58	0.366	26.8	
	444.4	3.12×10^{4}	7.30×10^{-4}	5.07×10^{-6}	4.71×10^{-3}	4.63×10^{-10}	1.41×10^{-8}	9.14×10^{-5}	3.00×10^{-6}	2.58	0.305	23.4	
	888.9	6.25×10^{4}	1.00×10^{-3}	6.94×10^{-6}	6.45×10^{-3}	3.28×10^{-10}	1.00×10^{-8}	4.73×10^{-5}	1.55×10^{-6}	2.58	0.245	19.7	
844.0	111.1	7.81×10^{3}	1.27×10^{-3}	8.82×10^{-6}	8.19×10^{-3}	1.44×10^{-9}	4.39×10^{-8}	1.63×10^{-4}	5.36×10^{-6}	2.72	0.389	28.0	
	222.2	1.56×10^{4}	2.18×10^{-3}	1.51×10^{-5}	1.41×10^{-2}	6.41×10^{-10}	1.95×10^{-8}	4.23×10^{-5}	1.39×10^{-6}	2.72	0.374	27.2	
	444.4	3.12×10^{4}	2.13×10^{-3}	1.48×10^{-5}	1.37×10^{-2}	4.41×10^{-10}	1.34×10^{-8}	2.98×10^{-5}	9.78×10^{-7}	2.72	0.352	26.0	
866.0	444.4	3.12×10^{4}	1.51×10^{-3}	1.05×10^{-5}	9.74×10^{-3}	5.67×10^{-10}	1.73×10^{-8}	5.41×10^{-5}	1.78×10^{-6}	2.74	0.311	23.7	
889.0	111.1	7.81×10^{3}	1.73×10^{-3}	1.20×10^{-5}	1.12×10^{-2}	4.14×10^{-9}	1.26×10^{-7}	3.45×10^{-4}	1.13×10^{-5}	2.61	0.284	22.1	
	222.2	1.56×10^{4}	6.72×10^{-3}	4.67×10^{-5}	4.34×10^{-2}	3.92×10^{-9}	1.20×10^{-7}	8.41×10^{-5}	2.76×10^{-6}	2.61	0.257	20.4	
	444.4	3.12×10^{4}	7.61×10^{-3}	5.28×10^{-5}	4.91×10^{-2}	2.61×10^{-9}	7.95×10^{-8}	4.94×10^{-5}	1.62×10^{-6}	2.61	0.226	18.4	
	611.1	4.30×10^{4}	2.74×10^{-4}	1.90×10^{-6}	1.77×10^{-3}	4.89×10^{-11}	1.49×10^{-9}	2.57×10^{-5}	8.43×10^{-7}	2.61	0.214	17.6	

Table 9.--Consolidation Test Data--Continued

U.S. Army, Fort Dix Well 6--Continued
New Hanover Twp., Burlington Co., N.J.

Sample depth (ft)	Consolidation load (psi)	Consolidation load (g/cm^2)	Consolidation coefficient-C_v (in^2/s)	Consolidation coefficient-C_v (ft^2/s)	Consolidation coefficient-C_v (cm^2/s)	Hydraulic conductivity-K (ft/s)	Hydraulic conductivity-K (cm/s)	Specific storage-S_s (1/ft)	Specific storage-S_s (1/cm)	Specific gravity	Void ratio	Porosity (percent)	Geol. Fm.*
889.0	694.4	4.88×10^{4}	1.45×10^{-3}	1.01×10^{-5}	9.35×10^{-3}	2.62×10^{-10}	7.98×10^{-9}	2.60×10^{-5}	8.53×10^{-7}	2.61	0.208	17.2	
	833.3	5.86×10^{4}	1.46×10^{-3}	1.01×10^{-5}	9.42×10^{-3}	1.05×10^{-10}	3.20×10^{-9}	1.04×10^{-5}	3.40×10^{-7}	2.61	0.204	16.9	
935.0	111.1	7.81×10^{3}	2.38×10^{-4}	1.65×10^{-6}	1.54×10^{-3}	2.78×10^{-10}	8.48×10^{-9}	1.68×10^{-4}	5.53×10^{-6}	2.66	0.299	23.0	
	222.2	1.56×10^{4}	3.92×10^{-4}	2.72×10^{-6}	2.53×10^{-3}	7.73×10^{-10}	2.36×10^{-8}	2.84×10^{-4}	9.32×10^{-6}	2.66	0.211	17.4	
	444.4	3.12×10^{4}	5.84×10^{-4}	4.06×10^{-6}	3.77×10^{-3}	3.34×10^{-10}	1.02×10^{-8}	8.24×10^{-5}	2.70×10^{-6}	2.66	0.162	13.9	
	888.9	6.25×10^{4}	6.44×10^{-4}	4.47×10^{-6}	4.15×10^{-3}	1.88×10^{-10}	5.74×10^{-9}	4.21×10^{-5}	1.38×10^{-6}	2.66	0.114	10.2	
956.0	222.2	1.56×10^{4}	4.17×10^{-4}	2.90×10^{-6}	2.69×10^{-3}	3.54×10^{-10}	1.08×10^{-8}	1.22×10^{-4}	4.01×10^{-6}	2.73	0.281	21.9	
	444.4	3.12×10^{4}	3.23×10^{-4}	2.24×10^{-6}	2.08×10^{-3}	1.90×10^{-10}	5.79×10^{-9}	8.47×10^{-5}	2.78×10^{-6}	2.73	0.228	18.6	
	888.9	6.25×10^{4}	3.94×10^{-4}	2.74×10^{-6}	2.54×10^{-3}	8.75×10^{-11}	2.67×10^{-9}	3.20×10^{-5}	1.05×10^{-6}	2.73	0.172	14.7	
979.0	222.2	1.56×10^{4}	4.63×10^{-4}	3.22×10^{-6}	2.99×10^{-3}	2.18×10^{-10}	6.65×10^{-9}	6.79×10^{-5}	2.23×10^{-6}	2.72	0.323	24.4	
	444.4	3.12×10^{4}	8.04×10^{-4}	5.58×10^{-6}	5.19×10^{-3}	2.28×10^{-10}	6.96×10^{-9}	4.09×10^{-5}	1.34×10^{-6}	2.72	0.296	22.8	
	888.9	6.25×10^{4}	5.90×10^{-4}	4.10×10^{-6}	3.81×10^{-3}	1.02×10^{-10}	3.10×10^{-9}	2.48×10^{-5}	8.14×10^{-7}	2.72	0.264	20.9	
1000.0	666.7	4.69×10^{4}	3.51×10^{-4}	2.44×10^{-6}	2.26×10^{-3}	7.22×10^{-11}	2.20×10^{-9}	2.96×10^{-5}	9.71×10^{-7}	2.69	0.188	15.8	
	888.9	6.25×10^{4}	2.51×10^{-4}	1.74×10^{-6}	1.62×10^{-3}	3.48×10^{-11}	1.06×10^{-9}	2.00×10^{-5}	6.56×10^{-7}	2.69	0.176	15.0	
					Bradless Corp. Well Brick Township, Ocean County, N.J.								
225.0	222.2	1.56×10^{4}	3.42×10^{-3}	2.37×10^{-5}	2.21×10^{-2}	2.63×10^{-10}	8.03×10^{-9}	1.11×10^{-5}	3.64×10^{-7}	2.67	--	--	
	81.0	5.69×10^{3}	4.17×10^{-5}	2.90×10^{-7}	2.69×10^{-4}	2.66×10^{-10}	8.10×10^{-9}	9.18×10^{-4}	3.01×10^{-5}	--	0.930	48.2	
255.0	222.2	1.56×10^{4}	1.60×10^{-3}	1.11×10^{-5}	1.03×10^{-2}	1.68×10^{-7}	5.13×10^{-6}	1.51×10^{-2}	4.97×10^{-4}	2.60	--	--	
	92.2	6.48×10^{3}	3.43×10^{-3}	2.38×10^{-5}	2.21×10^{-2}	1.70×10^{-8}	5.18×10^{-7}	7.14×10^{-4}	2.34×10^{-5}	--	0.725	42.0	

Table 9.--Consolidated Test Data--Continued

Bradlees Corp Well--Continued
Brick Township, Ocean County, N.J.

Sample depth	Consolidation load		Consolidation coefficient-C_v			Hydraulic conductivity-K		Specific storage-S_s		Specific gravity	Void ratio	Porosity (percent)	Geol. Fm.*
(ft)	(psi)	(g/cm^2)	(in^2/s)	(ft^2/s)	(cm^2/s)	(ft/s)	(cm/s)	(1/ft)	(1/cm)				
270.0	222.2	1.56×10^{4}	6.51×10^{-3}	4.52×10^{-5}	4.20×10^{-2}	1.29×10^{-10}	3.94×10^{-9}	2.86×10^{-6}	9.37×10^{-8}	2.70	--	--	
	98.2	6.90×10^{3}	9.25×10^{-5}	6.42×10^{-7}	5.97×10^{-4}	6.89×10^{-10}	2.10×10^{-8}	1.07×10^{-3}	3.52×10^{-5}	--	0.890	47.1	
300.0	222.2	1.56×10^{4}	6.95×10^{-3}	4.83×10^{-5}	4.48×10^{-2}	5.83×10^{-9}	1.78×10^{-7}	1.21×10^{-4}	3.97×10^{-6}	2.54	--	--	
322.0	222.2	1.56×10^{4}	1.70×10^{-3}	1.18×10^{-5}	1.10×10^{-2}	7.52×10^{-10}	2.29×10^{-8}	6.37×10^{-5}	2.09×10^{-6}	2.56	--	--	
352.0	222.2	1.56×10^{4}	1.86×10^{-3}	1.29×10^{-5}	1.20×10^{-2}	2.32×10^{-10}	7.06×10^{-9}	1.79×10^{-5}	5.88×10^{-7}	2.77	--	--	
370.0	222.2	1.56×10^{4}	4.27×10^{-3}	2.97×10^{-5}	2.75×10^{-2}	6.11×10^{-11}	1.86×10^{-9}	2.06×10^{-6}	6.76×10^{-8}	2.61	--	--	
400.0	222.2	1.56×10^{4}	8.60×10^{-4}	5.97×10^{-6}	5.55×10^{-3}	7.96×10^{-9}	2.43×10^{-7}	1.33×10^{-3}	4.37×10^{-5}	2.64	--	--	
432.0	222.2	1.56×10^{4}	1.71×10^{-4}	1.19×10^{-6}	1.10×10^{-3}	--	--	--	--	2.68	--	--	
489.0	115.0	8.09×10^{3}	5.49×10^{-5}	3.81×10^{-7}	3.54×10^{-4}	2.13×10^{-10}	6.50×10^{-9}	5.60×10^{-4}	1.84×10^{-5}	--	1.270	55.9	
	230.0	1.62×10^{4}	2.37×10^{-5}	1.65×10^{-7}	1.53×10^{-4}	4.92×10^{-11}	1.50×10^{-9}	2.99×10^{-4}	9.80×10^{-6}	--	1.180	54.1	
	460.0	3.23×10^{4}	1.45×10^{-5}	1.01×10^{-7}	9.35×10^{-5}	1.54×10^{-11}	4.70×10^{-10}	1.53×10^{-4}	5.02×10^{-6}	--	1.070	51.7	
550.0	126.0	8.86×10^{3}	3.84×10^{-3}	2.67×10^{-5}	2.48×10^{-2}	5.25×10^{-9}	1.60×10^{-7}	1.97×10^{-4}	6.46×10^{-6}	--	1.380	58.0	
	252.0	1.77×10^{4}	2.82×10^{-3}	1.96×10^{-5}	1.82×10^{-2}	1.90×10^{-9}	5.79×10^{-8}	9.70×10^{-5}	3.18×10^{-6}	--	1.330	57.1	
	504.0	3.54×10^{4}	1.36×10^{-3}	9.44×10^{-6}	8.77×10^{-3}	8.83×10^{-10}	2.69×10^{-8}	9.35×10^{-5}	3.07×10^{-6}	--	1.290	56.3	
605.0	138.0	9.70×10^{3}	8.39×10^{-4}	5.83×10^{-6}	5.41×10^{-3}	1.97×10^{-9}	5.99×10^{-8}	3.38×10^{-4}	1.11×10^{-5}	--	0.920	47.9	Kw
	276.0	1.94×10^{4}	5.36×10^{-4}	3.72×10^{-6}	3.46×10^{-3}	6.88×10^{-10}	2.10×10^{-8}	1.85×10^{-4}	6.07×10^{-6}	--	0.860	46.2	
	551.0	3.87×10^{4}	3.30×10^{-4}	2.29×10^{-6}	2.13×10^{-3}	2.10×10^{-10}	6.40×10^{-9}	9.16×10^{-5}	3.01×10^{-6}	--	0.780	43.8	
625.0	141.0	9.91×10^{3}	5.40×10^{-4}	3.75×10^{-6}	3.48×10^{-3}	6.88×10^{-10}	2.10×10^{-8}	1.84×10^{-4}	6.02×10^{-6}	--	1.130	53.1	Kw
	282.0	1.98×10^{4}	6.00×10^{-4}	4.17×10^{-6}	3.87×10^{-3}	4.27×10^{-10}	1.30×10^{-8}	1.02×10^{-4}	3.36×10^{-6}	--	1.100	52.4	
	564.0	3.97×10^{4}	1.84×10^{-4}	1.28×10^{-6}	1.19×10^{-3}	6.57×10^{-11}	2.00×10^{-9}	5.14×10^{-5}	1.69×10^{-6}	--	1.020	50.5	

Table 9.--Consolidation Test Data--Continued

Bradlees Corp. Well--Continued
Brick Township, Ocean County, N.J.

Sample depth	Consolidation load		Consolidation coefficient-C_v			Hydraulic conductivity-K		Specific storage-S_s		Specific gravity	Void ratio	Porosity (percent)	Geol. Fm.*
(ft)	(psi)	(g/cm^2)	(in^2/s)	(ft^2/s)	(cm^2/s)	(ft/s)	(cm/s)	(1/ft)	(1/cm)				
635.0	133.0	9.35×10^{3}	3.01×10^{-4}	2.09×10^{-6}	1.94×10^{-3}	6.57×10^{-10}	2.00×10^{-8}	3.14×10^{-4}	1.03×10^{-5}	--	0.920	47.9	Kmt
	265.0	1.86×10^{4}	2.46×10^{-4}	1.71×10^{-6}	1.59×10^{-3}	2.76×10^{-10}	8.41×10^{-9}	1.61×10^{-4}	5.30×10^{-6}	--	0.860	46.2	
	531.0	3.73×10^{4}	2.23×10^{-4}	1.55×10^{-6}	1.44×10^{-3}	1.28×10^{-10}	3.91×10^{-9}	8.29×10^{-5}	2.72×10^{-6}	--	0.790	44.1	
645.0	151.0	1.06×10^{4}	6.75×10^{-4}	4.69×10^{-6}	4.35×10^{-3}	1.28×10^{-9}	3.91×10^{-8}	2.74×10^{-4}	8.98×10^{-6}	--	0.870	46.5	Kmt
	302.0	2.12×10^{4}	2.94×10^{-4}	2.04×10^{-6}	1.90×10^{-3}	2.79×10^{-10}	8.51×10^{-9}	1.37×10^{-4}	4.49×10^{-6}	--	0.860	46.2	
Toms River Water Company Test Well Step 5, Dover Township, Ocean Co., N.J.													
465.0	222.2	1.56×10^{4}	4.17×10^{-3}	2.90×10^{-5}	2.69×10^{-2}	5.81×10^{-9}	1.77×10^{-7}	2.01×10^{-4}	6.58×10^{-6}	--	--	--	
	444.4	3.12×10^{4}	3.12×10^{-3}	2.17×10^{-5}	2.01×10^{-2}	5.81×10^{-9}	1.77×10^{-7}	2.68×10^{-4}	8.80×10^{-6}	--	--	--	
485.0	222.2	1.56×10^{4}	4.59×10^{-4}	3.19×10^{-6}	2.96×10^{-3}	1.07×10^{-8}	3.25×10^{-7}	3.35×10^{-3}	1.10×10^{-4}	2.68	--	--	
	444.4	3.12×10^{4}	4.81×10^{-4}	3.34×10^{-6}	3.10×10^{-3}	1.07×10^{-8}	3.25×10^{-7}	3.19×10^{-3}	1.05×10^{-4}	2.68	--	--	
525.0	222.2	1.56×10^{4}	5.28×10^{-5}	3.67×10^{-7}	3.41×10^{-4}	--	--	--	--	2.73	--	--	
	444.4	3.12×10^{4}	1.15×10^{-4}	7.99×10^{-7}	7.42×10^{-4}	--	--	--	--	2.73	--	--	
545.0	222.2	1.56×10^{4}	1.19×10^{-4}	8.26×10^{-7}	7.68×10^{-4}	9.08×10^{-8}	2.77×10^{-6}	1.10×10^{-1}	3.61×10^{-3}	2.73	--	--	
	444.4	3.12×10^{4}	1.06×10^{-4}	7.36×10^{-7}	6.84×10^{-4}	9.08×10^{-8}	2.77×10^{-6}	1.23×10^{-1}	4.05×10^{-3}	2.73	--	--	
645.0	222.2	1.56×10^{4}	2.94×10^{-4}	2.04×10^{-6}	1.90×10^{-3}	4.88×10^{-9}	1.49×10^{-7}	2.39×10^{-3}	7.85×10^{-5}	2.77	--	--	
	444.4	3.12×10^{4}	4.25×10^{-4}	2.95×10^{-6}	2.74×10^{-3}	4.88×10^{-9}	1.49×10^{-7}	1.65×10^{-3}	5.43×10^{-5}	2.77	--	--	
685.0	222.2	1.56×10^{4}	1.06×10^{-3}	7.36×10^{-6}	6.84×10^{-3}	5.58×10^{-9}	1.70×10^{-7}	7.58×10^{-4}	2.49×10^{-5}	2.63	--	--	
	444.4	3.12×10^{4}	2.52×10^{-3}	1.75×10^{-5}	1.63×10^{-2}	5.58×10^{-9}	1.70×10^{-7}	3.19×10^{-4}	1.05×10^{-5}	2.63	--	--	

Table 9.--Consolidation Test Data--Continued

Toms River Water Company Test Well Step 5--Continued
Dover Township, Ocean Co., N.J.

Sample depth	Consolidation load		Consolidation coefficient-C_v			Hydraulic conductivity-K		Specific storage-S_s		Specific gravity	Void ratio	Porosity (percent)	Geol. Fm.*
(ft)	(psi)	(g/cm^2)	(in^2/s)	(ft^2/s)	(cm^2/s)	(ft/s)	(cm/s)	(1/ft)	(1/cm)				
765.0	222.2	1.56×10^4	1.72×10^{-3}	1.19×10^{-5}	1.11×10^{-2}	7.35×10^{-8}	2.24×10^{-6}	6.15×10^{-3}	2.02×10^{-4}	2.75	--	--	
	444.4	3.12×10^4	1.61×10^{-3}	1.12×10^{-5}	1.04×10^{-2}	7.35×10^{-8}	2.24×10^{-6}	6.57×10^{-3}	2.16×10^{-4}	2.75	--	--	
775.0	222.2	1.56×10^4	5.79×10^{-4}	4.02×10^{-6}	3.74×10^{-3}	--	--	--	--	2.66	--	--	
	444.4	3.12×10^4	1.02×10^{-4}	7.08×10^{-7}	6.58×10^{-4}	--	--	--	--	2.66	--	--	
785.0	222.2	1.56×10^4	3.59×10^{-4}	2.49×10^{-6}	2.32×10^{-3}	--	--	--	--	2.73	--	--	
	444.4	3.12×10^4	4.91×10^{-4}	3.41×10^{-6}	3.17×10^{-3}	--	--	--	--	2.73	--	--	
795.0	222.2	1.56×10^4	2.11×10^{-4}	1.47×10^{-6}	1.36×10^{-3}	--	--	--	--	2.82	--	--	
	444.4	3.12×10^4	1.95×10^{-4}	1.35×10^{-6}	1.26×10^{-3}	--	--	--	--	2.82	--	--	
805.0	222.2	1.56×10^4	1.41×10^{-3}	9.79×10^{-6}	9.10×10^{-3}	1.73×10^{-9}	5.28×10^{-8}	1.77×10^{-4}	5.81×10^{-6}	2.66	--	--	
	444.4	3.12×10^4	7.92×10^{-4}	5.50×10^{-6}	5.11×10^{-3}	1.73×10^{-9}	5.28×10^{-8}	3.15×10^{-4}	1.03×10^{-5}	2.66	--	--	
New Jersey Water Co. Well 10 Lakewood Township, Ocean County, N.J.													
566.0	100.0	7.03×10^3	--	--	--	1.29×10^{-8}	3.93×10^{-7}	--	--	--	--	--	Kmt
	275.0	1.93×10^4	1.33×10^{-2}	9.21×10^{-5}	8.56×10^{-2}	6.45×10^{-9}	1.96×10^{-7}	7.0×10^{-5}	2.29×10^{-6}	--	--	--	
	435.0	3.06×10^4	1.51×10^{-2}	1.05×10^{-4}	9.75×10^{-2}	5.69×10^{-9}	1.73×10^{-7}	5.4×10^{-5}	1.77×10^{-6}	--	--	--	
	685.0	4.82×10^4	1.48×10^{-2}	1.03×10^{-4}	9.57×10^{-2}	4.55×10^{-9}	1.39×10^{-7}	4.4×10^{-5}	1.44×10^{-6}	--	--	--	
692.0	100.0	7.03×10^3	1.02×10^{-4}	7.08×10^{-7}	6.58×10^{-4}	1.63×10^{-10}	4.96×10^{-9}	2.3×10^{-4}	7.55×10^{-6}	--	--	--	Ket
	275.0	1.93×10^4	6.72×10^{-5}	4.67×10^{-7}	4.34×10^{-4}	6.07×10^{-11}	1.85×10^{-9}	1.3×10^{-4}	4.27×10^{-6}	--	--	--	
	435.0	3.06×10^4	5.41×10^{-5}	3.76×10^{-7}	3.49×10^{-4}	3.42×10^{-11}	1.04×10^{-9}	9.1×10^{-5}	2.99×10^{-6}	--	--	--	
	530.0	3.73×10^4	3.74×10^{-5}	2.60×10^{-7}	2.41×10^{-4}	2.24×10^{-11}	6.83×10^{-10}	8.6×10^{-5}	2.82×10^{-6}	--	--	--	

Table 9.--Consolidation Test Data--Continued

New Jersey Water Co. Well 10--Continued
Lakewood Township, Ocean County, N.J.

Sample depth	Consolidation load		Consolidation coefficient-C_v			Hydraulic conductivity-K		Specific storage-S_s		Specific gravity	Void ratio	Porosity (percent)	Geol. Fm.*
(ft)	(psi)	(g/cm^2)	(in^2/s)	(ft^2/s)	(cm^2/s)	(ft/s)	(cm/s)	(1/ft)	(1/cm)				
795.0	100.0	7.03×10^{3}	7.89×10^{-4}	5.48×10^{-6}	5.09×10^{-3}	4.93×10^{-10}	1.50×10^{-9}	9.0×10^{-5}	2.95×10^{-6}	--	--	--	Kwb
	610.0	4.29×10^{4}	8.37×10^{-5}	5.81×10^{-7}	5.40×10^{-4}	4.18×10^{-11}	1.27×10^{-9}	7.2×10^{-5}	2.36×10^{-6}	--	--	--	
	1150.0	8.09×10^{4}	4.00×10^{-5}	2.78×10^{-7}	2.58×10^{-4}	1.67×10^{-11}	5.09×10^{-10}	6.0×10^{-5}	1.97×10^{-6}	--	--	--	
845.0	115.0	8.09×10^{4}	3.61×10^{-3}	2.51×10^{-5}	2.33×10^{-2}	1.63×10^{-9}	4.97×10^{-8}	6.5×10^{-5}	2.13×10^{-6}	--	--	--	Kwb
	645.0	4.53×10^{4}	1.23×10^{-4}	8.58×10^{-7}	7.97×10^{-4}	5.32×10^{-11}	1.62×10^{-9}	6.2×10^{-5}	2.03×10^{-6}	--	--	--	
	1190.0	8.37×10^{4}	2.10×10^{-5}	1.46×10^{-7}	1.35×10^{-4}	8.35×10^{-12}	2.54×10^{-10}	5.7×10^{-5}	1.87×10^{-6}	--	--	--	
896.0	145.0	1.02×10^{4}	6.47×10^{-4}	4.49×10^{-6}	4.17×10^{-3}	4.94×10^{-10}	1.51×10^{-9}	1.1×10^{-4}	3.61×10^{-6}	--	--	--	Kmv
	690.0	4.85×10^{4}	1.32×10^{-4}	9.18×10^{-7}	8.53×10^{-4}	5.69×10^{-11}	1.73×10^{-9}	6.2×10^{-5}	2.03×10^{-6}	--	--	--	
	1225.0	8.61×10^{4}	5.05×10^{-5}	3.51×10^{-7}	3.26×10^{-4}	1.44×10^{-11}	4.39×10^{-10}	4.1×10^{-5}	1.35×10^{-6}	--	--	--	
928.0	180.0	1.27×10^{4}	--	--	--	5.69×10^{-10}	1.73×10^{-8}	--	--	--	--	--	Kmv
	715.0	5.03×10^{4}	--	--	--	1.63×10^{-10}	4.97×10^{-9}	--	--	--	--	--	
	1245.0	8.75×10^{4}	--	--	--	1.18×10^{-10}	3.59×10^{-9}	--	--	--	--	--	

*Ket - Englishtown Formation, clayey silt lithofacies
Kmt - Marshalltown Formation
Kmv - Merchantville Formation
Kw - Wenonah Formation
Kwb - Woodbury Clay

The approximate computed overburden pressure is 300 psi (21.1 kg/cm^2) for the Marshalltown sample and ranges from 360 psi (25.3 kg/cm^2) to 480 psi (33.8 kg/cm^2) for the Merchantville-Woodbury samples. The hydraulic conductivity calculated for the Marshalltown for the load increment closest to overburden pressure is 3.0×10^{-9} ft/s (9.1×10^{-8} cm/s); the specific storage is 1.1×10^{-4} ft^{-1} (3.62×10^{-6} cm^{-1}); and the hydraulic diffusivity is 2.72×10^{-5} ft^2/s (2.53×10^{-2} cm^2/s). Hydraulic conductivity values of the Merchantville-Woodbury samples computed for load increments nearest the approximate overburden pressures range from 4.25×10^{-11} ft/s (1.29×10^{-9} cm/s) to 6.92×10^{-10} ft/s (2.11×10^{-8} cm/s). Specific storage values range from 6.54×10^{-5} ft^{-1} (2.14×10^{-6} cm^{-1}) to 4.66×10^{-4} ft^{-1} (1.53×10^{-5} cm^{-1}). The hydraulic diffusivity of these samples varies from 2.97×10^{-7} ft^2/s (2.76×10^{-4} cm^2/s) to 6.59×10^{-6} ft^2/s (6.12×10^{-3} cm^2/s) (table 9).

Samples of the Marshalltown Formation, the clayey silt lithofacies of the Englishtown Formation, and the Woodbury and Merchantville Formations were obtained from a well drilled by the New Jersey Water Company near Lakewood, N.J. The Marshalltown Formation sample, collected at a depth of 566 ft (172 m), is in the sand-silt-clay category of the Shepard classification. A sample of the clayey silt lithofacies of the Englishtown Formation was taken at a depth of 692 ft (211 m) and is a silty clay in Shepard's classification system. Four samples of the Merchantville and Woodbury Formations were obtained between depths of 795 ft (242 m) and 928 ft (283 m). The sediments recovered fall in the clayey silt and sand-silt-clay categories of the Shepard classification system.

The approximate computed overburden pressure is 440 psi (30.9 kg/cm^2) for the Marshalltown sample, 540 psi (38 kg/cm^2) for the clayey silt lithofacies sample of the Englishtown, and ranges from 620 psi (43.6 kg/cm^2) to 710 psi (50 kg/cm^2) for the Merchantville-Woodbury samples. The hydraulic conductivity calculated for the Marshalltown for the consolidation load closest to overburden pressure is 5.69×10^{-9} ft/s (1.73×10^{-7} cm/s) and the specific storage is 5.45×10^{-5} ft^{-1} (1.77×10^{-6} cm^{-1}). The hydraulic conductivity calculated for the clayey silt lithofacies of the Englishtown Formation is 2.24×10^{-11} ft/s (6.83×10^{-10} cm/s), and the specific storage is 8.6×10^{-5} ft^{-1} (2.82×10^{-6} cm^{-1}). Hydraulic conductivity values of the Merchantville and Woodbury Formation samples calculated for load increments nearest the approximate overburden pressures range from 4.18×10^{-11} ft/s (1.27×10^{-9} cm/s) to 1.63×10^{-10} ft/s (4.97×10^{-9} cm/s). Specific storage values range from 6.2×10^{-5} ft^{-1} (2.03×10^{-6} cm^{-1}) to 7.2×10^{-5} ft^{-1} (2.36×10^{-6} cm^{-1}). The hydraulic diffusivity of these samples varies from 5.81×10^{-7} ft^2/s (5.40×10^{-4} cm^2/s) to 9.18×10^{-7} ft^2/s (8.53×10^{-4} cm^2/s). The average and extreme values of the hydraulic conductivity of the confining layers of the Englishtown aquifer system are given in table 4.

CONCLUSIONS

The geohydrologic data contained in this report are the basic requirements needed in the development of a computer simulation model of the most developed part of the Englishtown aquifer in the northern Coastal Plain of New Jersey. The Englishtown aquifer, which has an average thickness of about 100 feet (30 m) throughout Monmouth and northern Ocean Counties, is sandwiched between overlying and underlying confining beds that have an average thickness of 40 ft (12 m) and 200 ft (61 m) respectively.

The transmissivity of the aquifer is relatively low, ranging from 2,400 ft^2/d (223 m^2/d) to 650 ft^2/d (60 m^2/d); the hydraulic conductivity averages about 15 ft/d (3.3 m/d); and the storage coefficient ranges from 8×10^{-5} to 3×10^{-4}. The confining beds have vertical hydraulic conductivities on the order of 1×10^{-5} ft/d (3×10^{-6} m/d) and specific storage of 8×10^{-5}/ft (2.4×10^{-5}/m).

The average rate of withdrawal from the Englishtown aquifer, within the area of study increased from 5.5 Mgal/d (.24 m^3/s) in 1959 to about 9.5 Mgal/d (0.4 m^3/s) in 1970. The effect of this withdrawal rate was a decline in head as of 1970 at a rate of 8 to 12 ft (2.4 to 3.6 m) per year over large areas. As a consequence of this change in head, large quantities of water have apparently leaked from and through the confining layers into the Englishtown aquifer. The quantity of leakage and the effects of future stresses on the aquifer can best be estimated by simulation modeling.

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