

EXPLANATION

- AM12**
Nonplastic gravelly and sandy soil derived from fluvial deposits of Pleistocene age
- AM24**
Nonplastic to slightly plastic sandy and silty soil derived from fluvial deposits of Pleistocene age
- AM4**
Slightly plastic silty and clayey soil derived from fluvial deposits of Pleistocene age
- M3**
Nonplastic sandy soil derived from marine sediments
- Fill**
Fill
- MTM**
Marine tidal-marsh deposits
- U**
Urban areas where soil has been altered by man
- Z**
Poorly drained organic swamp soil
- AR/Z**
Flood-plain deposits associated with swamp deposits
- AM24/A**
AM24 soil associated with diminutive amounts of AM4 soil
- AM24/A46**
AM24 soil associated with diminutive amounts of A46 soil
- AM4/A4**
AM4 soil associated with diminutive amounts of AM24 soil
- F/AM24**
Fill associated with diminutive amounts of AM24 soil
- F/AM4**
Fill associated with diminutive amounts of AM4 soil
- F/Z**
Fill associated with swamp deposits
- MM4/24**
Slightly plastic silty and clayey soil associated with nonplastic to slightly plastic sandy and silty soil derived from gneiss
- Z/MTM**
Swamp deposits associated with marine tidal marshes
- AM24**
AM24 soil underlain by AM12 soil
- AM4**
AM4 soil underlain by AM12 soil
- 38**
Soil sample pit
- 5A**
Soil sample site
- 4**
Primary observation well
- 29**
Domestic or farm well
- Water-table contour**
Number shows altitude of water table in feet above mean sea level. Contour interval 10 feet. Relative position of water table in September 1955 is shown in hydrograph (Figure 2)
- Perennial stream**
Bottom of stream channel almost always below water table
- Intermittent stream**
Bottom of stream channel above water table part of the time and below water table part of the time

Location and number of pit from which soil samples were obtained for laboratory analyses (see table 3). General characteristics are summarized in table 1.

Location and number of secondary soil sample sites. Samples were collected with a one-inch-diameter long-core soil sampler. For results of laboratory analyses see table 2; for general characteristics see table 1.

Primary observation well
Numerator is altitude of water table in September 1958. Denominator shows measured range in altitude of water table during 1950-61.

Domestic or farm well
Numerator is the altitude of the water table in September 1955. Denominator, where given, shows estimated range in altitude of water table during 1950-61, based on 2 or 3 measurements and comparison with primary and secondary observation-well records.

Water-table contour
Number shows altitude of water table in feet above mean sea level. Contour interval 10 feet. Relative position of water table in September 1955 is shown in hydrograph (Figure 2).

Perennial stream
Bottom of stream channel almost always below water table

Intermittent stream
Bottom of stream channel above water table part of the time and below water table part of the time

TABLE 1.—Explanation of letter symbols

Symbol	Explanation
A	Alluvial deposit, Cretaceous age.
AM	Surficial alluvial mantle, Pleistocene age.
AR	Recent alluvial deposit.
M	Marine deposit.
MMg	Gneiss.
F	Fill.
MTM	Marine tidal marsh.
U	Urban area.
Z	Swamp deposit.

SOIL SYMBOLS

The map symbols used in this report to designate the various types of soils are a modification of the system used in the engineering soil survey of New Jersey (Rogers, 1955). The first part of the symbol is a letter, or group of letters, which identifies the parent material according to the classification developed by Lueder (1950) (see table 1). The second part of the symbol is a number which identifies the soil group according to the classification system adopted by the Highway Research Board (Allen and others, 1945) and used with some modifications by the Delaware State Highway Department (see table 2). A two-digit number indicates that two soil types are present within the same soil profile; for example, the symbol AM24 implies that both A-2 and A-4 soils are present in the same soil profile, but usually in different horizons.

Two different soil symbols may be combined by either a horizontal bar ($\frac{A-2}{A-4}$) or a diagonal bar ($\frac{A-2}{A-4}$). A horizontal bar indicates that the soil designated by the denominator underlies the soil designated by the numerator within a depth of 20 to 72 inches. If the letter symbol is omitted from the denominator, the parent material is the same as that shown for the numerator. A diagonal bar indicates that two soils are interpersed within the area so designated, but they are not present in the same soil profile. The predominant soil type is identified by the symbol that precedes the diagonal bar.

REFERENCES

Allen, Harold, and others, 1945, Report of committee on classification of materials for subgrades and granular type roads: Highway Research Board, 25th Ann. Mtg., Oklahoma City, 1946, Highway Research Board Proc., v. 25, p. 375-388.

Lueder, D. R., 1950, A system for designating map-units on engineering soil-maps in soil exploration and mapping: Highway Research Board Bull. 28, p. 17-35.

Rogers, P. C., 1955, Engineering soil survey of New Jersey, Report No. 1: Rutgers Univ. Eng. Research Bull. 15, 114 p.

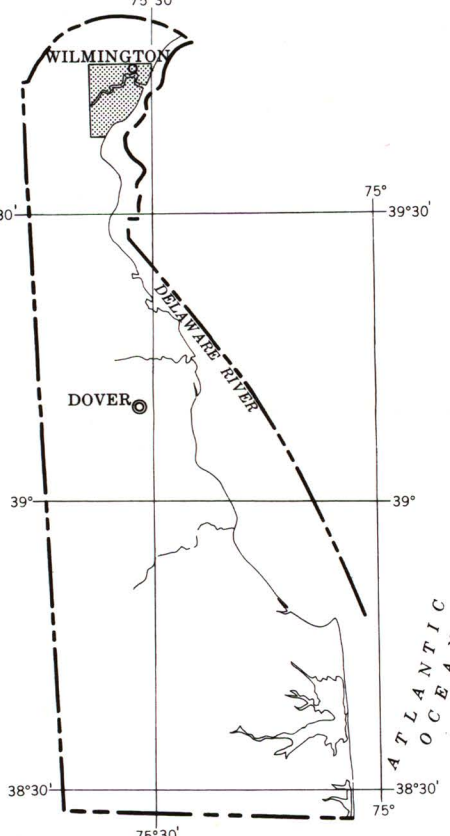


FIGURE 1.—Index map of Delaware showing location of the Wilmington Area.

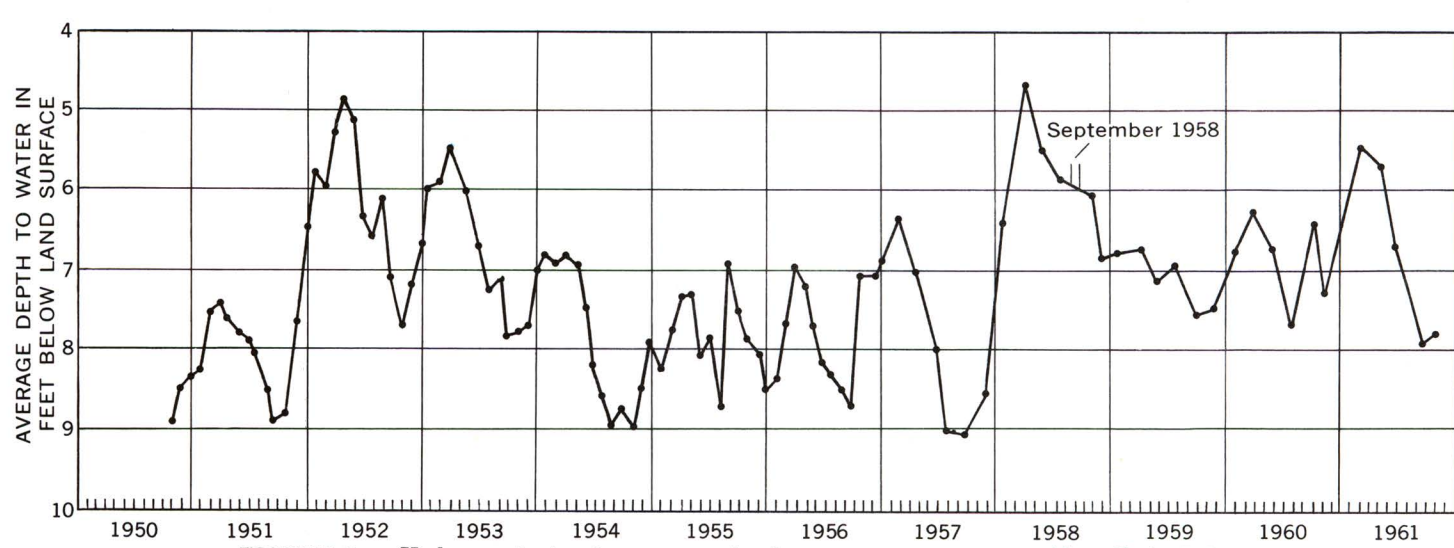


FIGURE 2.—Hydrograph showing average depth to water in 13 water-table wells in Delaware.

TABLE 2.—Soils classification

General classification	Granular materials (35 percent or less passing a No. 200 sieve)							Silt-clay materials (more than 35 percent passing a No. 200 sieve)					
Group classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7		A-8
	a	b		4	5	6	7				I _p	U _p	
Sieve analysis													
Percent passing													
No. 10 sieve	50 max.	50 max.											
No. 40 sieve	30 max.	30 max.	51 min.	35 max.	35 max.	35 max.	35 max.	36 min.	36 min.	36 min.	36 min.	36 min.	36 min.
No. 200 sieve	15 max.	15 max.	10 max.	10 max.	10 max.	10 max.	10 max.	10 max.	10 max.	10 max.	10 max.	10 max.	10 max.
Characteristics of fraction passing No. 40 sieve													
Liquid limit	6 max.	6 max.	Nonplastic	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.	41 min.	42-400
Plasticity index	6 max.	6 max.	Nonplastic	10 max.	10 max.	11 min.	11 min.	10 max.	10 max.	11 min.	11 min.	11 min.	0-60
Group index	0	0	0	0	4 max.			8 max.	12 max.	16 max.	20 max.		
General subgrade rating	Excellent	Good	Good	Good	Fair	Fair	Fair	Poor	Poor	Poor	Very poor	Unsuitable	Unsuitable
Material	Well-graded gravel and sand	Clean sand and gravelly sand	Poorly graded, silty of clayey sand and gravel	Poorly graded, silty of clayey sand and gravel	Poorly graded, silty of clayey sand and gravel	Poorly graded, silty of clayey sand and gravel	Poorly graded, silty of clayey sand and gravel	Silty soil	Plastic silt	Plastic clay	Expansive plastic clay	Muck-peat	

¹Plasticity index of A-7-3 subgroup is equal to or less than the liquid limit minus 30.

²Plasticity index of A-7-6 subgroup is greater than the liquid limit minus 30.

TABLE 3.—Results of laboratory analyses of soil samples

Liquid limit: NL, nonliquid													Plasticity index: NP, nonplastic						
Sample pit and site nos.	Depth of interval sampled (inches)	Soil horizon	Mechanical analyses										Liquid limit index ¹	Plasticity index ²	Moisture-density		Classification		Map symbol
			Cumulative percent passing sieve—Percent by weight												Maximum density ³ (lb./cu. ft.)	Optimum moisture ⁴ (percent)	HB ⁵	Unified ⁶	
			No. 4 (mm.)	No. 10 (mm.)	No. 40 (mm.)	No. 200 (mm.)	Silt	Clay											
38	0-6	A	100	100	99.8	94.4	60.5					NL	NP	121.1	10.5	A-4 (5)	ML		
	6-27	B	100	100	100	96.2	56.2					NL	NP	126.3	11.0	A-4 (4)	ML		
	27-66	C	100	99.9	99.7	94.7	55.3					NL	NP	123.8	9.5	A-4 (4)	ML		
	0-7	A	100	99.5	99.1	90.5	64.9					19	NP	121.0	12.0	A-4 (7)	ML		
	7-39	B	100	99.9	99.3	93.3	77.8					18	NP	123.5	11.7	A-4 (8)	ML	AM24	
	42-72	C	99.5	97.7	95.3	74.4	54.1					NL	NP	124.0	9.8	A-2-4 (2)	SM		
	0-4	A	98.0	96.2	95.8	83.4	72.0					NL	NP	113.0	8.8	A-2-4 (2)	SM		
	4-27	B	78.8	73.0	72.4	56.3	46.5	33	12	26	7	NL	NP			A-4 (2)	GM-CG	ML	
	27-66	C	98.6	98.1	90.7	56.5	14.9					NL	NP	113.0	8.8	A-2-4 (4)	GP	12	
	66-96	D	68.0	56.5	48.6	12.1	4.0					NL	NP			A-2-4 (4)	GP		
	0-1	A	100	99.9	99.6	93.6	83.0					32	NP	110.0	10.1	A-4 (6)	ML		
	1-5	B	100	100	100	93.5	74.5	49	21	23	10	NL	NP	110.0	10.1	A-4 (6)	ML		
	5-35	C	100	100	100	99.6	97.8	87	27	28	9	NL	NP	108.0	9.9	A-4 (6)	ML		
	47-63	D	86.6	83.3	81.2	64.2	29.0					28	NP			A-4 (6)	CL	AM24	
	63-74	D	100	100	98.7	90.7	22.3					21	3			A-2-4 (4)	SM		
	0-11	A	100	99.7	99.0	91.3	79.8					28	NP	110.0	10.1	A-4 (6)	ML		
	11-43	B	100	99.2	98.6	92.4	84.9	56	25	28	6	NL	NP	110.0	10.1	A-4 (6)	ML	AM24	
	43-75	C	97.1	96.3	95.8	85.8	16.9					28	NP	108.0	9.9	A-4 (6)	ML		
	75-84	D	81.7	39.6	35.9	28.0	9.4					28	NP	108.0	9.9	A-2-4 (4)	GP	12	
	0-1	A	100	99.7	99.0	91.3	79.8					NL	NP	110.0	10.1	A-4 (6)	ML		
	1-5	B	100	99.2	98.6	92.4	84.9	56	25	28	6	NL	NP	110.0	10.1	A-4 (6)	ML		
	5-35	C	97.1	96.3	95.8	85.8	16.9					NL	NP	108.0	9.9	A-4 (6)	ML		
	47-63	D	81.7	39.6	35.9	28.0	9.4					<40	<40			A-1-3 (6)	SM		
	63-74	D	100	100	98.7	90.7	22.3					<40	<40			A-1-3 (6)	SM		
3C	7-34	B	99.3	98.3	95.3	85.9	9.9					<40	<40			A-4 (8)	ML	AM24	
	34-72	C	99.3	98.3	95.3	85.9	9.9					<40	<40			A-4 (8)	ML		
	0-10	A	100	99.8	98.2	83.0	40.0					<40	<40			A-4 (8)	ML		
	10-57	B	99.4	97.4	94.4	87.4	47.4					<40	<40			A-4 (8)	ML	Hm14	
	57-72	C	83.8	59.7	38.8							<40	<40			A-4 (8)	SM		
	0-1	A	99.7	97.5	91.8	81.0						<40	<40			A-4 (8)	ML		
	1-24	B	99.7	99.0	96.9	89.0						<40	<40			A-4 (8)	ML		
	24-35	C	99.6	97.4	90.6							<40	<40			A-4 (8)	ML	AM4	
	35-57	D	99.6	98.2	88.6	63.2	4.4					<40	<40			A-4 (8)	ML		
	0-10	A	95.1	91.5	78.9	63.3						<40	<40			A-4 (6)	ML		
	10-42	D	96.6	93.2	84.6	63.3						<40	<40			A-4 (6)	ML		
	42-72	C	96.6	93.7	85.7	28.0						<40	<40			A-2-4 (2)	SM		