

**UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF CHEMISTRY AND SOILS**

In cooperation with the Department of Conservation and Development of New Jersey

**SOIL SURVEY
OF
THE BERGEN AREA, NEW JERSEY**

BY

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Conservation and Development of New Jersey
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of Agriculture**

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SOIL SURVEY

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AREA SURVEYED

The Bergen area is in the extreme northeastern part of New Jersey, adjoining the State of New York on the north and east. It includes all of Bergen and Hudson Counties, nearly all of Essex County, about three-fifths of both Passaic and Union Counties, and a small part of Morris and Middlesex Counties. The area has a maximum length of slightly more than 49 miles, and its greatest width is nearly 23 miles. It contains 640 square miles or 409,600 acres.

Three distinct physiographic belts, known as the highlands, the piedmont belt, and the coastal plain, cross the Bergen area, which ranges in elevation from sea level to more than 1,200 feet above. The region of greatest elevation is in the northwestern part of the area.

The highlands belt crossing the western part of the Bergen area is part of the northeastern extension of the Blue Ridge. In New Jersey this ridge, which constitutes one of the important belts of the Appalachian Mountain system, consists of a comparatively even plateau, ranging from a little less than 1,000 feet to a little more than 1,200 feet in elevation. It is dissected by numerous streams and certain long lowland belts ranging up to about 5 miles in width and trending in the same direction as the ridge.

The piedmont belt lies south and east of the highland area and comprises about six-sevenths of the land covered by the survey. In this region the elevation ranges from nearly 900 feet above sea level to sea level. The region in general is gently rolling, with comparatively wide valleys and some ridges and isolated hills rising conspicuously above the general surface. These elevations are locally known as mountains and constitute the ridge fronting on Hudson River, First Watchung Mountain, and Second Watchung Mountain. The terminal moraine crosses the piedmont belt in the extreme western part of the area near Perth Amboy and gives rise to a comparatively small area of typical rolling moraine topography.

The coastal plain region lies in the extreme southeastern part of the area. It is a level or gently rolling plain ranging in elevation

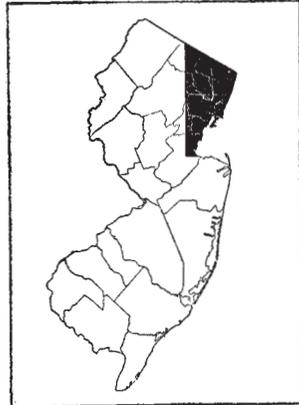


FIGURE 1.—Sketch map showing location of the Bergen area, New Jersey.

from sea level to about 130 feet above. It is of very small extent and importance in the Bergen area.

The drainage of the area is effected by several large streams, all of which flow either into Newark Bay or Raritan Bay and thence to the Atlantic Ocean.

The settlement of the Bergen area dates back to 1658, when the part along Hudson River was incorporated as the town of Bergen. From the time of early settlement the proximity of the area to New York City had considerable influence on its development. This influence has become increasingly important with the rapid development of this city and the surrounding territory. The natural effect of such a condition has been the utilization of more and more farm land for building sites. The area is now dotted with cities, towns, and villages, and is one of the most thickly populated districts in the United States, the population in 1920 being more than 1,500,000. A large proportion of the inhabitants commute daily to business in New York.

Excellent railroad facilities are afforded all parts of the area by the main lines of the Pennsylvania, Lackawanna, Erie, Lehigh Valley of New Jersey, and Central of New Jersey railroads, together with many branch lines of these systems and of the New York Central Railroad Co. Highways also are exceptionally good. All the main highways and many of the county roads are improved, paved, and graded. Even during the heavy snows of winter the snowplows of the State highway department keep the main highways open for traffic. Telephone service is available to practically every farm. Probably no locality in the United States is better supplied with large near-by markets. The large local population insures ready local markets, and New York City absorbs large quantities of farm products.

CLIMATE

The climate of the Bergen area is typical of the latitude. The winter months are usually cold, with considerable snowfall, and the summers are moderately warm. Extreme temperatures occur very rarely and endure only a short time. In all parts of the area, however, the mean temperature during winter is below freezing.

In the northern part of the area it is somewhat colder than in the southern half. There is also considerable variation in the length of the frost-free season. In the northern half the average date of the first killing frost is September 26 and of the last is May 7. This gives an average frost-free season of 142 days. In the southern half of the area the average date of the first killing frost is October 24 and of the last is April 18, resulting in a frost-free season of 189 days. Farmers in the southern half of the area, therefore, have the advantage of 41 days to mature growing crops.

The mean annual rainfall is greatest in the northern half of the area. Precipitation is usually well distributed throughout the year, but occasional summer droughts seriously damage growing crops.

Tables 1 and 2 give the most important climatic data in the Bergen area, as recorded by the Weather Bureau at Charlotteburg in Passaic County, about 5 miles west of the northern part of the area, and at Elizabeth, in the southern half of the surveyed area.

TABLE 1.—Normal monthly, seasonal, and annual temperature and precipitation at Charlotteburg, Passaic County

[Elevation, 719 feet]

| Month | Temperature | | | Precipitation | | | |
|----------------|-------------|------------------|------------------|---------------|---|--|---------------------|
| | Mean | Absolute maximum | Absolute minimum | Mean | Total amount for the driest year (1916) | Total amount for the wettest year (1901) | Snow, average depth |
| | ° F. | ° F. | ° F. | Inches | Inches | Inches | Inches |
| December..... | 29.8 | 62 | -19 | 4.33 | 4.61 | 9.45 | 8.5 |
| January..... | 26.9 | 67 | -26 | 3.55 | 1.02 | 1.96 | 9.3 |
| February..... | 25.6 | 62 | -23 | 4.16 | 3.52 | .80 | 12.0 |
| Winter..... | 27.4 | 67 | -26 | 12.04 | 9.15 | 12.21 | 29.8 |
| March..... | 35.8 | 82 | -7 | 4.20 | 2.49 | 8.07 | 7.0 |
| April..... | 46.8 | 91 | 10 | 4.32 | 3.08 | 10.22 | 1.7 |
| May..... | 57.5 | 94 | 26 | 4.20 | 3.55 | 6.57 | .0 |
| Spring..... | 46.7 | 94 | -7 | 12.72 | 9.12 | 24.86 | 8.7 |
| June..... | 64.8 | 96 | 31 | 4.12 | 4.66 | 2.89 | .0 |
| July..... | 70.0 | 99 | 36 | 4.83 | 5.08 | 7.32 | .0 |
| August..... | 67.9 | 98 | 34 | 4.62 | 1.06 | 12.11 | .0 |
| Summer..... | 67.6 | 99 | 31 | 13.57 | 10.80 | 22.32 | .0 |
| September..... | 61.9 | 96 | 23 | 4.42 | 3.77 | 3.94 | .0 |
| October..... | 51.6 | 88 | 17 | 4.47 | 1.61 | 1.66 | .0 |
| November..... | 40.1 | 74 | 4 | 3.52 | 3.81 | 1.83 | 2.1 |
| Fall..... | 51.2 | 96 | 4 | 12.41 | 9.19 | 7.43 | 2.1 |
| Year..... | 48.2 | 99 | -26 | 50.74 | 38.26 | 66.82 | 40.6 |

TABLE 2.—Normal monthly, seasonal, and annual temperature and precipitation at Elizabeth

[Elevation, 45 feet]

| Month | Temperature | | | Precipitation | | | |
|----------------|-------------|------------------|------------------|---------------|---|--|---------------------|
| | Mean | Absolute maximum | Absolute minimum | Mean | Total amount for the driest year (1909) | Total amount for the wettest year (1897) | Snow, average depth |
| | ° F. | ° F. | ° F. | Inches | Inches | Inches | Inches |
| December..... | 33.3 | 64 | -15 | 3.96 | 3.76 | 5.47 | 7.2 |
| January..... | 30.2 | 72 | -16 | 4.04 | 2.77 | 3.67 | 8.1 |
| February..... | 30.5 | 66 | -10 | 4.32 | 4.63 | 2.98 | 12.4 |
| Winter..... | 31.3 | 72 | -16 | 12.32 | 11.16 | 12.12 | 27.7 |
| March..... | 38.8 | 83 | 4 | 4.22 | 2.88 | 3.08 | 7.5 |
| April..... | 50.8 | 96 | 20 | 3.68 | 5.81 | 3.54 | 2.0 |
| May..... | 62.0 | 98 | 31 | 3.82 | 1.50 | 6.37 | .0 |
| Spring..... | 50.5 | 98 | 4 | 11.72 | 10.19 | 12.99 | 9.5 |
| June..... | 70.5 | 103 | 38 | 3.62 | 2.78 | 2.71 | .0 |
| July..... | 75.3 | 105 | 44 | 5.16 | 1.66 | 20.80 | .6 |
| August..... | 73.4 | 105 | 44 | 4.29 | 5.87 | 6.15 | .0 |
| Summer..... | 73.1 | 105 | 38 | 13.07 | 10.31 | 29.66 | .0 |
| September..... | 66.7 | 100 | 32 | 3.77 | 2.08 | 1.50 | .0 |
| October..... | 55.4 | 89 | 25 | 3.89 | .40 | 1.33 | .0 |
| November..... | 43.5 | 79 | 10 | 3.25 | 1.73 | 5.03 | 1.5 |
| Fall..... | 55.2 | 100 | 10 | 10.91 | 4.21 | 7.86 | 1.5 |
| Year..... | 52.5 | 105 | -16 | 48.02 | 35.87 | 62.63 | 38.7 |

AGRICULTURE

The agricultural development of the Bergen area differs radically from that of any other area in New Jersey, owing primarily to the constant increase in the population of the many cities and towns and the resultant rapid expansion of city boundaries at the expense of the rural districts. Each year finds many additional acres of farm land taken over for building sites. Under such circumstances it is natural that an intensive type of agriculture should prevail, an effort being made to obtain the largest possible cash return from each available acre. Agriculture is particularly intensive close to the thickly populated districts, and farther away intensive methods give way to more varied and general farm practices.

Hence the Bergen area is, largely by necessity, devoted to two general types of agriculture. Close to the cities small market-garden and poultry farms prevail, and in the outlying districts dairying and fruit growing, in conjunction with vegetable production, are common. Two types of dairy farming are important, although neither is very extensive. The first type prevails on farms devoted exclusively to dairy farming and the production of market milk. Most dairy farms of this kind are near cities which furnish a market. The dairy-men either maintain their own city milk route or sell their entire milk output to some local distributor. In a system of this kind, it is rarely possible to produce all feed needed, owing to the smallness of the acreage available for crops and to the size of the herds. Some feeds, however, are usually produced. On such dairy farms the herds usually are large, on some farms numbering more than 100 producing cows. Only good grade or purebred cows are kept, and the bulls are all registered. The Holstein is the favorite breed.

Dairying on farms farther from the populated areas is usually conducted in conjunction with the production of fruit and vegetables. On farms of this type most of the feed is grown. The herds, consisting largely of Holsteins, range from about 5 to 30 cows.

Next to trucking, poultry raising is the most important type of farming in the Bergen area. It is especially extensive in Bergen County. Some farmers specialize in poultry raising, especially near the cities. The flocks are largely of White Leghorns, with some Rhode Island Reds and Barred Plymouth Rocks. The average flock consists of about 500 chickens, but on some specialized poultry farms flocks may number 3,000. Some truck farmers raise poultry as a side line, and many workers in the cities have small flocks. Most farmers purchase New Jersey baby chicks and concentrate their efforts on the production of eggs, which are practically all sold locally either to special customers or dealers.

Apples are the most important fruit grown, followed by peaches. Fruit growing is carried on mainly in the outlying districts, especially in the northeastern part of the area where some farms are devoted exclusively to fruit. On most farms, however, the production of fruit is carried on in conjunction with the growing of truck crops. Fruit trees for planting come from almost all parts of the United States. Modern methods of cultivation and spraying are in use. Most growers plant and plow under cover crops. Inter-cropping is not common. The chief variety of apples grown is

the Baldwin; the Delicious, Paragon, Rhode Island Greening, Stayman Winesap, King David, Rome Beauty, McIntosh, Grimes Golden, Newtown Spitzenburg, Northern Spy, Opalescent, Winter Banana, Stark, York Imperial, Fallawater, Northwestern Greening, and Ben Davis are of minor importance.

The growing of truck crops is the most important agricultural industry. These crops are grown throughout the entire area but especially near the cities. Two forms of truck farming are practiced. The first consists of the exclusive production of market-garden crops and the second of the growing of truck in conjunction with some other crop, especially fruit. The first form requires special skill in intensive methods and is practiced on tracts of land averaging about 10 acres. The average size of combined truck and fruit farms is about 50 acres.

Plowing land for market-garden crops is done in all months of the year except January. Frozen ground is frequently plowed and seeded to carrots or spinach. Only high-grade fertilizers, analyzing about 5-8-7,¹ are used. The amount and time of application vary with the crop under cultivation, but from 1,000 to 2,000 pounds are applied on most crops in the course of a growing season. Market-garden crops are grown either from seed or greenhouse and coldframe plants. Practically every market gardener has from one-eighth to one-tenth acre of coldframes. Some practice overhead irrigation. The necessary organic matter is obtained largely from stable manure, but manure is expensive and is the source of troublesome weeds. Applications of commercial mixtures are liberal. The chief market-garden crops are lettuce, celery, spinach, carrots, and beets, and some strawberries are grown. As a new crop is planted as soon as a crop is harvested, three or four crops are produced on the same ground in the course of a single growing season. One-horse plows or tractors are used for breaking the ground. Cultivation is usually done by hand, as are also weeding and thinning.

Sweet corn is the most important and extensively grown truck crop. Yields average about 8,000 ears to the acre. The chief varieties grown are Early Monmouth, Long Island Beauty, White-cob Cory, Howling Mob, and Golden Bantam. Tomatoes rank second in importance among the truck crops. Yields vary with the variety grown and with the season but average from 10 to 20 tons to the acre. Earliana, Jewell, Matchless, and Stone are the principal varieties grown. Cabbage is also an important truck crop. The varieties grown, in the order of their importance, are Copenhagen Market, Succession, Red Danish, and Savoy.

Although equipment on farms in the Bergen area varies considerably with the type of farming practiced, generally it is modern and well kept. Practically every farm is equipped with running water and electricity for light and power. Farm buildings and houses are well kept and in good repair.

On farms where agriculture is more extensive, systematic crop rotations are not extensively followed, although some effort is made to avoid growing the same crop in the same field in successive seasons. On most truck farms, however, when it is at all possible cover crops are grown and plowed under the following spring, and on the few

¹ Percentages, respectively, of nitrogen, phosphoric acid, and potash.

specialized dairy farms where general farm crops are produced definite rotations are followed.

The shortage of efficient farm labor is one of the most important agricultural problems of the Bergen area. This shortage is caused largely by the competition of the many near-by factories where high wages are paid even for unskilled labor. Some farmers are fortunate enough to obtain laborers by the year at wages ranging from \$75 to \$100 or more a month, with either free house rent or board. Day labor is very hard to obtain and commands not less than \$5. Most of the farm laborers are white persons of foreign parentage.

Probably 75 per cent of the farms of the Bergen area are operated by the owners, 20 per cent by tenants, and 5 per cent by farm managers. Cash rents are usually paid, although various crop-share arrangements are made. Land rents are comparatively high, as is to be expected in a region of high land values.

The price of farm land in the Bergen area depends largely on location but, in general, is very high. Practically every farm is considered either as having present or potential value as a real-estate development and is priced more for its real estate than for its agricultural value. Probably no land in the area can be bought for less than \$200 an acre, and the average is \$250 or more an acre.

SOILS

The soils of the Bergen area owe their outstanding physical properties to two principal agents, namely, character of the parent material and kind and degree of weathering. The parent material, particularly on the sloping areas where erosion has kept more or less close pace with rock decay and on the coarser-textured sands of the coastal-plain region, has exerted a powerful influence on the texture. In flat areas where it has been possible for percolating water to move considerable fine material out of the upper soil zone down into lower layers some areas have developed comparatively heavy-textured subsoils. Probably this process, known as illuviation, has effected to some extent textural differences between the surface and upper subsoil layers of such soils as Holyoke loam. Illuviation has not been so active in this region as farther south in the coastal-plain section. Elutriation—that is, a washing by rain water of part of the fine material which eventually is carried down the slopes to the streams—is effective on sloping areas and probably has altered the soils more than has illuviation.

The most extensive soils are comparatively young; that is, they have not developed the definite layers which would characterize soils in this region had they lain long on smooth areas undisturbed by erosion. Some of the soils on flat areas differ markedly from soils derived from similar material but occupying sloping positions. This condition is illustrated by the difference between Croton silt loam and the Dunellen soils, which were derived from the same kind of rock. The Croton soil occupies flat positions, and definite horizons have been developed in it. Some of the soil layers are very impervious and have so intensified poor underdrainage that the entire soil is feebly oxidized, as is shown by its light and mottled color. Profiles of Whitman silty clay loam and of the Whippany soils are somewhat similar to that of the Croton soil.

On sloping areas erosion is always more or less active, and conditions are not favorable to strong zonation. Some zonation, however, is nearly everywhere present. The surface layer in virgin areas has been somewhat stained or darkened by organic matter to a slight depth. In the more eroded positions, the present material shows strongly the influence of the parent rock. Not only has the peculiar chocolate-red or Indian-red color of the rocks of the region been retained in the soil, but the texture of the parent rock and soil correspond, the fine-grained rocks having given rise to fine-grained soils and the coarser-grained rocks to soils of corresponding or approximately corresponding texture.

This area was originally timbered with hardwood, and many patches of the virgin forest are still to be found. The soil in these areas is not so rich in organic matter as is commonly believed. Where fires have not recently destroyed them a layer of loose leaves and twigs and a more compact layer of forest mold are over the surface. Beneath the forest mold the soil is brown or yellowish-brown to a depth ranging from about one-half inch to 3 or 4 inches. In many places humus has accumulated in the soil only to about this depth.

The alluvial soils of the overflowed stream bottoms are very young and are still being added to in many places by additions of sediments from the overflow water. Here there is less uniformity through the profile than characterizes the upland soils. Textural changes and in many places color changes are common not only through the vertical section but in the surface soil within narrow limits.

Practically no lime carbonate is contained in the parent rocks, with the exception of traces in some of the chocolate-red sedimentations, and there is very little or none of this material in the soils. The humid climate is not favorable to the preservation of soil lime or other readily soluble constituents.

The materials from which the soils of the Bergen area are derived consist of glacial till, usually closely related to the underlying rock; reworked stratified glacial materials; water-laid deposits chiefly of marine origin; or recent alluvial deposits of the present streams.

In classifying the soils of the area those of similar outstanding physical and chemical characteristics such as color, drainage conditions, and structure, and of related parent material have been grouped in a series. A soil type is a member of a series differentiated from other members on the basis of the relative percentages of stone, gravel, sand, silt, and clay constituting the surface soil. Each soil series may, therefore, contain several soil types.

Among the soils of the Bergen area derived from glacial material those of the Gloucester series are of great importance. They are derived from the glaciation of gneiss and have light-brown surface soils over yellow subsoils. Gloucester stony loam, Gloucester gravelly loam, with a compact-subsoil phase, and Gloucester loam are mapped.

The Wethersfield soils are derived from glacial material coming from the Triassic chocolate-red sandstones and shales. The surface soils are brownish red, chocolate red, or Indian red and are underlain by friable or moderately friable material of the same color. In the Bergen area, Wethersfield loam, with a light-colored phase, Wethersfield gravelly loam, and Wethersfield silt loam are mapped.

The soils of the Holyoke series have light-brown surface soils overlying brownish-yellow or reddish-yellow rather friable subsoils. They are derived from glacial material from basic igneous rocks. Some fragments of the parent rock are present in most places through the soil. The gravelly loam, stony loam, and loam of this series are mapped.

Of the soils from glacial material those of the Merrimac series are the most extensive. They are derived from reworked gneissic material and have brown surface soils and brownish-yellow or orange-yellow friable subsoils. The loam, with an imperfectly drained phase, gravelly loam, with a rolling phase, sandy loam, with an imperfectly drained phase, gravelly sandy loam, with a rolling phase, and loamy sand members of this series are mapped.

The Dunellen soils are derived from glacial material of the Triassic rocks. The surface soils are brown, and the subsoils are red or reddish yellow and are friable. These soils occur only as stratified glacial drift. Dunellen loam is mapped.

The Whippany soils are among the most important of the imperfectly and poorly drained soil types. The surface soils are gray and the subsoils are mottled bluish gray, greenish yellow, and yellow and typically are not very friable. An impervious claypan layer lies at a depth of about 20 inches. The material consists of old glacial-lake sediments. Whippany silty clay loam and Whippany loam, sandy-subsoil phase, are mapped.

The Croton soils are also poorly drained. They are derived from Triassic sandstones and shales and have brown or gray surface soils overlying mottled yellow, gray, and red subsoils. A compact, red claypan layer lies at or below a depth of 20 inches. Only Croton silt loam is mapped.

The surface layers of the Whitman soils are gray or grayish brown. The subsoils are mottled bluish gray and pale yellow, becoming reddish and compact below a depth of about 28 inches. These soils are derived from the breaking down of glacial igneous rock materials. Whitman silty clay loam is mapped.

Soils of the Podunk series consist of the better-drained brown first-bottom alluvium along streams in the glacial gneissic rock region. The surface soils are brown. The subsoils are yellow or brownish, are friable, and in places are sandy at a depth below 24 inches. Podunk loam is mapped.

The Papakating soils are poorly drained. The surface soils are dark brown or dark gray, and the subsoils are mottled bluish gray, gray, and pale yellow. The material is derived from wash, chiefly from glaciated gneissic rock uplands. Papakating silt loam is mapped.

The Wehadkee soils have light-brown or grayish surface soils, underlain by grayish, pale-yellow, and yellow, mottled, plastic or compact subsoils. They are poorly drained. The material has been washed from adjacent glaciated soils of the Triassic rocks. Wehadkee silt loam occurs in the Bergen area.

The Bermudian soils, of which only the loam is mapped, have chocolate-red or dark reddish-brown surface soils underlain by subsoils of much the same color. These soils occupy the first bottoms of

streams flowing out of or through areas of Triassic sandstones and shale soils.

Muck is a black organic accumulation of varying thickness. It consists chiefly of well-decomposed organic matter, with some mineral soil material. The black color persists throughout the soil.

Miscellaneous classes of material occurring in the Bergen area include tidal marsh, which consists of level depressed areas adjacent to tidewater and subject to tidal inundation; meadow, including low areas where drainage is poor and the diverse soils are not fitted for agriculture unless drained; rough stony land, consisting of rugged, steep, stony areas not suited to agricultural practices; made land; unclassified city land; and clay pits.

In the following pages the soils are discussed in full. Their distribution is shown on the accompanying soil map, and their acreage and proportionate extent are listed in Table 3.

TABLE 3.—*Acreage and proportionate extent of the soils mapped in the Bergen area, N. J.*

| Type of soil | Aces | Per cent | Type of soil | Aces | Per cent |
|-----------------------------------|--------|----------|---|---------|----------|
| Sassafras loamy coarse sand..... | 512 | 0.1 | Holyoke loam..... | 1,344 | 0.3 |
| Sassafras loam..... | 576 | .1 | Dunellen loam..... | 13,760 | 3.4 |
| Sassafras sand..... | 960 | .2 | Whippany silty clay loam..... | 6,592 | 1.6 |
| Sassafras sandy loam..... | 1,216 | .3 | Whippany loam, sandy-subsoil phase..... | 3,904 | 1.0 |
| Gloucester gravelly loam..... | 14,080 | 5.9 | Croton silt loam..... | 8,640 | 2.1 |
| Compact-subsoil phase..... | 10,048 | | Whitman silty clay loam..... | 1,216 | .3 |
| Gloucester stony loam..... | 16,576 | 4.1 | Podunk loam..... | 6,336 | 1.5 |
| Gloucester loam..... | 128 | .1 | Papakating silt loam..... | 18,176 | 4.4 |
| Merrimac loam..... | 13,568 | 4.4 | Wekahkee silt loam..... | 320 | .1 |
| Imperfectly drained phase..... | 4,672 | | Bermudian loam..... | 4,992 | 1.2 |
| Merrimac gravelly loam..... | 14,528 | 5.1 | Muck..... | 2,624 | |
| Rolling phase..... | 6,208 | | Intermediate phase..... | 1,152 | 1.2 |
| Merrimac sandy loam..... | 10,816 | 2.7 | Shallow phase..... | 1,088 | |
| Imperfectly drained phase..... | 128 | | Tidal marsh..... | 31,296 | 7.6 |
| Merrimac loamy sand..... | 3,328 | .8 | Meadow..... | 6,528 | 1.6 |
| Merrimac gravelly sandy loam..... | 5,312 | 2.5 | Rough stony land..... | 36,736 | 9.0 |
| Rolling phase..... | 4,928 | | Unclassified city land..... | 90,688 | 22.1 |
| Wethersfield loam..... | 11,776 | 7.2 | Swamp..... | 2,368 | .6 |
| Light-colored phase..... | 17,600 | | Made land..... | 1,792 | .4 |
| Wethersfield gravelly loam..... | 3,840 | .9 | Clay pits..... | 1,472 | .4 |
| Wethersfield loam..... | 5,760 | 1.4 | | | |
| Holyoke gravelly loam..... | 9,920 | 2.4 | | | |
| Holyoke stony loam..... | 12,096 | 3.0 | | | |
| | | | Total..... | 409,600 | |

SASSAFRAS LOAMY COARSE SAND

The surface soil of typical Sassafras loamy coarse sand consists of grayish-brown loamy coarse sand about 10 inches thick. This is underlain by reddish-yellow loamy coarse sand which becomes coarser and more reddish with depth.

Sassafras loamy coarse sand is inextensive and occurs only in the extreme southern part of the surveyed area. Areas are gently rolling or nearly flat, and drainage is adequate. Most of the soil supports a forest growth of scrub oak and pine.

SASSAFRAS LOAM

Sassafras loam consists of brown or slightly yellowish-brown loam from 9 to 12 inches thick, underlain by reddish-yellow or yellowish-brown loam which commonly becomes more sandy and gravelly at a depth of about 30 inches.

Owing to their small extent, some areas of Keyport loam are included with this soil as mapped. This included soil consists of grayish-brown loam, 8 or 10 inches thick, underlain by pale-yellow heavy clay loam or clay which, at a depth ranging from about 15 to 24 inches, becomes more plastic and mottled with gray, drab, and yellow. The deeper part of the subsoil is very heavy and rather impervious to water. Some small flat or slightly depressed imperfectly drained areas of Woodstown loam are also included in mapping. This included soil differs from Sassafras loam in that the subsoil is mottled with gray and reddish yellow.

This soil occurs only in the extreme southern part of the area in close association with Sassafras sandy loam. Areas are level or gently rolling, are well drained, and are easily cultivated. Most of the land is cleared and utilized in the production of potatoes and other truck crops.

SASSAFRAS SAND

Typical Sassafras sand consists of grayish-brown sand, about 10 inches thick, underlain by yellowish-brown loose sand. In many places the lower part of the subsoil is slightly loamy.

Sassafras sand occurs only in the southern part of the surveyed area. Most of it is forested with scrub oak and some pine. Where cleared it is utilized in the production of truck crops, it being especially suited to the early varieties.

SASSAFRAS SANDY LOAM

The surface soil of Sassafras sandy loam consists of light-brown sandy loam from 9 to 11 inches thick. This is underlain by friable reddish-yellow or dark-yellow sandy loam which becomes more sandy and in places gravelly below a depth of about 30 inches.

Some patches of Sassafras gravelly sandy loam were included with this soil in mapping. This included soil closely resembles typical Sassafras sandy loam but contains considerable rounded quartz gravel, both in the surface soil and subsoil.

Sassafras sandy loam occurs only in the southern part of the surveyed area. Areas are well drained. Some of the land is cleared and utilized in the production of potatoes and truck crops, and the remainder is in forest.

GLOUCESTER GRAVELLY LOAM

Gloucester gravelly loam consists of light-brown or brown gritty loam from 6 to 10 inches thick, underlain by brownish-yellow or yellow gritty loam or clay loam. In places a sandy layer occurs in the deep subsoil, but such areas represent pockets of sand and gravel rather than true stratification. Gneiss, quartzite, sandstone, and trap gravel are everywhere abundant, both on the surface and throughout the subsoil. Some small areas of Gloucester loam and Gloucester gravelly sandy loam have been included in mapping.

Gloucester gravelly loam occurs principally in the northern part of the surveyed area. Large areas are near Allendale, northeast of Franklin Lake, and north of Wortendyke. The soil occupies the

more gentle slopes at the lower levels of ridges. Drainage is naturally good.

This soil produces good yields of corn and other general farm crops. It is well suited to fruit, especially apples. Crop yields are largely dependent on the proportion of gravel present. Cultivation is made rather difficult in places and yields are impaired by the presence of excessive quantities of gravel.

Gloucester gravelly loam, compact-subsoil phase.—The compact-subsoil phase of Gloucester gravelly loam differs from the typical soil in that the subsoil below a depth of about 20 inches consists of compact gravelly loam and sand feebly cemented by ferruginous material into a heterogeneous substance closely resembling conglomerate. This compact layer acts as a hardpan and is more or less impervious to water. Its color is yellow or yellowish brown, with streaks, splotches, and specks of rust brown. In places the compact layer is not well developed. In many places gravelly sand occurs below the compact or cemented layer, which is about 1 foot thick.

This soil occurs in the north-central part of the area and is especially prominent just south of the New York State line at Chestnut Ridge, Park Ridge, east of Saddle River, and east of Glenrock. Its topographic position is similar to that of typical Gloucester gravelly loam, although on the whole it occurs at lower levels and in somewhat less rugged country. Drainage is somewhat imperfect, owing to the presence of the hardpan layer which in places appears to retard the seepage of surface water.

Most of this phase of soil is cleared and utilized in the production of general farm crops and fruit. Dairying is practiced on four or five rather extensive farms. Good yields of general farm crops are reported, and the soil is especially suited to the production of apples.

A rather large proportion of this land is now in country estates maintained by people from near-by cities. Other areas remain idle, awaiting real-estate development. Land values are therefore exceedingly high, areas commanding from \$500 to \$800 an acre. Such figures are of course based on real-estate rather than actual agricultural value.

Table 4 gives the results of mechanical analyses of samples of the surface soil, subsurface soil, and several layers of the subsoil of Gloucester gravelly loam, compact-subsoil phase.

TABLE 4.—*Mechanical analysis of Gloucester gravelly loam, compact-subsoil phase*¹

| No. | Description | Fine gravel | Coarse sand | Medium sand | Fine sand | Very fine sand | Silt | Clay |
|--------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | | <i>Per cent</i> |
| 171211 | Surface soil, 0 to 1 inch..... | 3.3 | 9.2 | 8.5 | 19.3 | 14.4 | 31.9 | 13.4 |
| 171212 | Subsurface soil, 1 to 7 inches..... | 4.0 | 8.7 | 9.6 | 20.9 | 16.3 | 25.8 | 14.5 |
| 171213 | Subsoil, 7 to 42 inches..... | 4.6 | 8.6 | 9.9 | 21.4 | 15.0 | 27.5 | 13.0 |
| 171214 | Subsoil, 42 to 50 inches..... | 7.4 | 13.0 | 12.0 | 20.9 | 14.9 | 22.8 | 8.9 |
| 171215 | Subsoil, 50 to 80 inches..... | 9.3 | 15.2 | 12.2 | 21.4 | 13.4 | 22.9 | 5.7 |
| 171216 | Subsoil, 80 to 104 inches..... | 8.6 | 14.6 | 11.9 | 20.1 | 12.9 | 23.4 | 8.7 |

¹ After treatment with hydrogen peroxide.

GLOUCESTER STONY LOAM

Typical Gloucester stony loam consists of yellowish-brown gritty loam from 4 to 8 inches thick, underlain by brownish-yellow gritty loam. Gravel and large boulders of gneiss occur on the surface and throughout the soil. Some gravel and boulders of sandstone, quartzite, and trap are also present. In places a compact yellowish-brown, mottled with rust brown, stratum of partly cemented concretionary material consisting of mixed gravel, sand, and cobbles and closely resembling a hardpan occurs at a depth of about 20 inches. Such areas represent pockets of slightly cemented sand and gravel rather than true stratification.

This soil is extensive in the northwestern part of the area, especially near Mountain View, Ringwood, Ramseys, and Mahwah. It occupies the summits and more gentle slopes of the gneiss ridges and in most places is covered with a forest growth of maple, hickory, oak, ash, tulip poplar, and other hardwoods.

None of the Gloucester stony loam is cultivated, owing to the abundance of boulders and rocks present and to its unfavorable topographic position. In its present condition it can best be used for forest and pasture land, but some areas, especially on the more gentle slopes, can be reclaimed for agricultural purposes by clearing the timber and removing the larger stones.

GLOUCESTER LOAM

Typical Gloucester loam consists of light-brown or brown gritty loam from 8 to 10 inches thick, underlain by heavy brownish-yellow or yellow loam. In many places the subsoil is heavy. It may contain some gravel. Gloucester loam is well drained and occupies somewhat more level positions than Gloucester gravelly loam.

This soil occurs in the northwestern part of the Bergen area in close association with the gravelly loam of the same series. The material is mellow and easily worked. It produces good crops of corn and other general farm crops and is well suited to the production of fruits, especially apples. Greatest care, however, must be exercised in locating orchard sites in order that air drainage be efficient.

MERRIMAC LOAM

Typical Merrimac loam consists of brown mellow loam or gritty loam, from 10 to 12 inches thick, grading into brownish-yellow or orange-yellow friable loam or gritty loam. Below a depth of 20 inches gravel and sand are present in varying proportions. This stratified condition extends into the deeper subsoil. The surface soil commonly contains a small amount of gravel, chiefly rounded waterworn gneiss fragments together with some sandstone, quartzite, and trap.

In places, as in Pompton Valley, the surface material is somewhat more gritty than typical and considerable gravel and sand are present nearer the surface. In this valley and extending southward to the vicinity of Caldwell this soil as mapped contains sufficient trap material to impart to it the reddish-brown or orange color characteristic of soils derived from the trap rocks of the region. In other

places, as in Hackensack Valley, especially near Harrington Park, the subsoil is more yellow and contains less gravel than the typical material. Locally, whitish feldspathic material is noticeable in the subsoil. Some small areas of Merrimac fine sandy loam were also included in mapping.

Merrimac loam occurs mainly in the northeastern quarter of the surveyed area. The largest areas are mapped in the Pompton Valley south of Riverdale, north of Hawthorne, and near Harrington Park. Areas occupy terrace positions and, though nearly flat or gently rolling, are well drained. The material is friable and mellow.

This is one of the most productive soils of the Bergen area. The mellow surface soil is easily worked into an excellent seed bed, and the gravel in the subsoil insures good drainage. Excellent yields of corn and general farm crops are obtained. This soil is also utilized in the production of potatoes and truck crops, which return excellent yields. Commercial fertilizers and manures are used in abundance, and modern cultural methods are practiced.

The value of this soil is greatly enhanced by its proximity to real-estate developments. The soil is not extensively cultivated, the owners preferring to utilize it as country homes or to allow it to remain idle awaiting real estate development.

Merrimac loam, imperfectly drained phase.—The imperfectly drained phase of Merrimac loam consists of brown or yellowish-brown mellow loam, 10 or 12 inches thick, underlain by reddish-yellow or yellow friable fine sandy loam or sandy loam which, at a depth of about 18 or 20 inches, becomes more sandy and mottled yellow and bluish gray with slight mottles of reddish yellow. In most places the subsoil is compact below a depth of about 20 inches. Included within this soil as mapped are some minor areas of Merrimac sandy loam, imperfectly drained phase.

This soil occurs chiefly in the west-central part of the area. It occupies nearly flat or slightly rolling positions where drainage is slightly imperfect. Practically all the soil is cleared and under cultivation, chiefly to truck crops. Intensive cultural methods are used, and liberal applications of manure and commercial fertilizers are made. Excellent crop yields are obtained. This soil should produce excellent yields of strawberries, but at present it is not extensively used for this crop.

Owing to its proximity to cities values on this land are exceedingly high.

MERRIMAC GRAVELLY LOAM

Merrimac gravelly loam consists of brown gravelly loam underlain at a depth of about 10 inches by brownish-yellow or orange-yellow gravelly loam which becomes more gravelly and sandy below a depth of 20 inches. In the northern part of the surveyed area the gravel consists chiefly of rounded waterworn gneiss, quartzite, sandstone, and trap. The percentage of trap increases in the eastern and central parts of the area. Near Caldwell much of both the surface soil and gravel material is derived from trap.

This soil occurs mainly on the river terraces in the Ramapo and Wanaque Valleys, especially near Mahwah, at Oakland, and near

Midvale and Wanaque. Areas are level or nearly level and are very well drained. A few areas occupy slightly rolling positions.

Much of the Merrimac gravelly loam of the Bergen area is either in towns or is allowed to remain idle awaiting real-estate development. When this soil is farmed, excellent yields are obtained. Sweet and field corn, fruit, and late truck crops do well. Owing to the proportion of gravel present the potato yield is not so heavy as on the more mellow Merrimac loam. Near Caldwell much of this soil is wooded with hardwoods such as oak, hickory, maple, and elm.

The value of this land is difficult to estimate but depends more on location than on agricultural worth.

Merrimac gravelly loam, rolling phase.—The surface soil of Merrimac gravelly loam, rolling phase, consists of brown gravelly loam. This is underlain at a depth of 6 or 8 inches by brownish-yellow gravelly loam which becomes more yellow with depth. The lower part of the subsoil usually contains more gravel mixed with some sand, indicating stratification. The gravel both on the surface and throughout the soil consists of waterworn rounded fragments of gneiss, quartzite, and trap, with some sandstone. In places some of it is more than 3 inches in diameter but most of it is much smaller.

Included in mapping are some areas of Merrimac gravelly sandy loam, rolling phase. This soil differs from typical Merrimac gravelly loam, rolling phase, in containing, both in the surface soil and subsoil, considerable sand and gravel. Such areas occur in small patches in the Ramapo and Wanaque Valleys, near Campgaw, southwest of Pompton, and north of Wyckoff.

This soil is not extensive. It occurs in small areas in the Ramapo and Wanaque Valleys and in larger areas near Mahwah, Ramseys, Crystal Lake, and Saddle River, and north of Franklin Lake. It occupies hillocks and rather steep slopes, as well as rolling topographic positions. Drainage is good and in many places excessive.

This soil is not important agriculturally. Owing to its topographic position, excessive drainage, and high gravel content it is droughty and difficult to till. It is suited to practically the same crops as Merrimac gravelly loam, but its agricultural value is inferior to that of the typical soil. Many areas are utilized for gravel pits.

Table 5 gives the results of mechanical analyses of samples of the surface soil, subsurface soil, and several layers of the subsoil of typical Merrimac gravelly loam.

TABLE 5.—*Mechanical analysis of Merrimac gravelly loam*¹

| No. | Description | Fine gravel | Coarse sand | Medium sand | Fine sand | Very fine sand | Silt | Clay |
|--------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | | <i>Per cent</i> |
| 171206 | Surface soil, 0 to ½ inch..... | 9.5 | 13.9 | 6.6 | 9.4 | 9.8 | 35.0 | 15.8 |
| 171207 | Subsurface soil, ½ to 6 inches..... | 11.6 | 16.2 | 7.5 | 8.3 | 5.8 | 29.3 | 21.2 |
| 171208 | Subsoil, 6 to 26 inches..... | 14.5 | 17.4 | 7.4 | 7.2 | 4.8 | 27.0 | 21.6 |
| 171209 | Subsoil, 26 to 36 inches..... | 35.7 | 33.5 | 6.9 | 3.6 | 1.9 | 7.1 | 11.4 |
| 171210 | Subsoil, 36 to 70 inches..... | 30.0 | 31.6 | 10.2 | 7.2 | 2.6 | 9.0 | 9.5 |

¹ After treatment with hydrogen peroxide.

MERRIMAC SANDY LOAM

Typical Merrimac sandy loam consists of brown sandy loam about 10 inches thick, underlain by yellowish-brown or yellow friable sandy loam which grades abruptly into brownish-yellow sandy loam at a depth of 20 or 22 inches. The subsoil below this depth commonly contains some gravel and coarse sand and in places has a faint-reddish color.

This soil occurs principally in the northern half of the surveyed area. It is rather extensive between Hackensack and Passaic Rivers, near Westwood and Tenafly, and northeast of Ridgewood. Areas occupy level or very gently rolling positions and are well drained.

Although not extensive, this soil is locally important in the production of market-garden crops. Practically all of it is cleared and farmed very intensively, being utilized almost exclusively in the production of early and late truck crops such as peas, sweet corn, lettuce, celery, onions, carrots, cabbage, spinach, tomatoes, and soup greens. A few strawberries and some cauliflower are also grown. Under skillful care and cultivation, excellent yields are obtained.

It is difficult to estimate the value of Merrimac sandy loam, as it is based on both real estate and agricultural worth. Few tracts can be bought at this time for less than \$500 an acre, and the average price is much higher.

The productivity of this soil is dependent largely on the maintenance of the supply of organic matter. Its fertility and physical condition can be improved by the systematic growing and plowing under of legumes and other cover crops, supplemented by the yearly heavy application of manure. Deeper plowing would no doubt prove beneficial, the depth being increased not more than one-half or 1 inch a year until a maximum of 12 inches is reached.

Merrimac sandy loam, imperfectly drained phase.—Merrimac sandy loam, imperfectly drained phase, consists of brown or yellowish-brown sandy loam from 9 to 12 inches thick, underlain by reddish-yellow or yellow sandy loam becoming more sandy and mottled with yellow, reddish yellow, and bluish gray in the deep subsoil. Considerable fine sand occurs throughout the soil. The mottling is the result of poor aeration and the lack of good subsoil drainage.

This soil is very inextensive, occurring chiefly west of Singac. It is utilized principally in the production of truck crops. The cultural practices and soil treatment are practically the same as for the imperfectly drained phase of Merrimac loam, with which this soil is closely associated.

MERRIMAC LOAMY SAND

Typical Merrimac loamy sand consists of yellowish-brown loamy sand 2 or 3 inches thick, overlying yellow or slightly reddish-yellow loamy sand which contains more gravel and coarse sand in the subsoil. In places, such as 1½ miles northeast of Paterson, some included patches of Merrimac fine sand consist of light-brown fine sand 1 or 2 inches thick, underlain by yellow loose fine sand which becomes rather pale yellow at a depth of 30 inches. There are also included some small areas of Merrimac sand and of Merrimac gravelly sand.

Merrimac loamy sand occurs most extensively in scattered areas between Hackensack and Passaic Rivers. The more important areas are near Dundee Lake, west of Mountain View, one-half mile south of Totowa, and one-half mile south of Little Falls. Typically this soil occupies level or very gently rolling positions and is well drained.

This is not an extensive soil, but it is practically all cleared and under cultivation. Crops are practically the same as on Merrimac sandy loam, and the two soils are managed in much the same manner. Crop yields are slightly lower on Merrimac loamy sand than on Merrimac sandy loam, but this disadvantage is offset somewhat by the early maturing qualities of crops grown on the loamy sand.

Land values at present are exceedingly variable and depend more on location in respect to real-estate development than on actual agricultural worth.

MERRIMAC GRAVELLY SANDY LOAM

The surface soil of Merrimac gravelly sandy loam is brown sandy loam. It is underlain at a depth of about 10 or 12 inches by yellowish-brown or yellow sandy loam which becomes more yellowish brown and contains more sand and gravel in the lower part of the subsoil, below a depth of 28 or 30 inches. Abundant rounded water-worn gravel, consisting chiefly of gneiss, with some quartzite, sandstone, and trap, is present throughout the entire soil. In the vicinity of Caldwell this gravel consists almost exclusively of trap material, as does also the soil mass itself.

Merrimac gravelly sandy loam occurs in the northern half of the area, chiefly near Glenrock, one-quarter mile northwest of Spring Valley, 1 mile northeast of Preakness, and west of Caldwell. Areas are flat or gently rolling, and drainage is good.

This is not an important agricultural soil, although considerably more than 50 per cent of it is cleared and under cultivation to general farm crops and some truck and fruit. Its high content of gravel somewhat restricts its use for crops. Crops on extremely gravelly areas are affected by excessive drought.

Present values of this soil range from \$150 to as much as \$1,000 an acre, depending largely on location in respect to real-estate development.

Merrimac gravelly sandy loam, rolling phase.—The rolling phase of Merrimac gravelly sandy loam differs from the typical soil principally in having a higher content of gravel and in occurring on rather steep slopes and rolling hilly situations subject to erosion and excessive drainage.

This phase of soil is mapped principally east of Campgaw and in areas of less importance one-quarter mile northeast of Demarest, one-half mile northwest of Hillsdale, 1 mile southeast of Boardville, and elsewhere throughout the northern half of the area.

Very little attempt is made to farm this soil, as its extreme droughtiness and steep relief render cultivation difficult and unprofitable.

WETHERSFIELD LOAM

Wethersfield loam typically consists of brownish-red, chocolate-red, or dark reddish-brown loam 8 or 10 inches thick and in many

places containing considerable grit, underlain by Indian-red or chocolate-red friable loam continuous to a depth of 36 or more inches. In places considerable sandy material occurs in the lower part of the subsoil and in other places the material is sandy loam. Both these variations are inextensive and unimportant.

Wethersfield loam occurs in the southern half of the area, largely within the corporate limits of cities and towns. It occupies nearly level or gently rolling topographic positions and is well drained. The soil is mellow and easily cultivated. It is suited to general farm crops, fruit, and late truck crops.

Owing to its location in cities and towns this soil commands a very high price.

Wethersfield loam, light-colored phase.—The surface soil of Wethersfield loam, light-colored phase, consists of brown or slightly reddish-brown loam grading at a depth of 6 or 8 inches into yellowish-brown loam which, below a depth of 18 or 20 inches, becomes reddish yellow. The reddish shade increases with depth, and in many places Indian-red and chocolate-red loam are found in the deeper subsoil.

In places, as $1\frac{1}{2}$ miles east of Rivervale, this soil consists of slightly reddish-brown sandy loam containing considerable fine sand, which passes into yellowish-brown sandy loam with a reddish cast, underlain at a depth of 12 or 14 inches by light-red or red sandy loam. Such areas represent inclusions of Wethersfield sandy loam, light-colored phase, which because of their small extent are not shown separately on the map. Some areas of Wethersfield fine sandy loam, light-colored phase, are also included with this soil as mapped. In many areas, shown by gravel symbols on the map, gravel consisting of gneiss, sandstone, quartzite, and trap is present. Other areas, such as that 1 mile southeast of Pleasantdale, contain numerous large trap boulders or outcrops of the trap bedrock.

This soil is mapped in the northeastern and southern parts of the area. It is most extensive near Brookdale in the central part. It occupies level or rolling positions and the tops of hills and ridges underlain by red sandstone. Drainage is good.

Much of this soil is utilized for building sites, although in the northeastern part of the area some of it is farmed, principally to fruit and general farm crops. On other areas more favorably situated in respect to markets it is utilized in the intensive cultivation of market-garden and truck crops.

Land values depend largely on location and are unusually high.

WETHERSFIELD GRAVELLY LOAM

Typical Wethersfield gravelly loam consists of dark-brown, reddish-brown, Indian-red, or chocolate-red loam 6 or 8 inches thick, underlain by reddish-brown, Indian-red, or chocolate-red loam which becomes more reddish with depth. Gravel, consisting of red sandstone together with considerable trap, gneiss, and quartzite, is found in varying quantities both on the surface and throughout the soil.

This soil occurs principally near Iselin and north of Fords in the southern part of the area and near Avondale and west of Hack-

ensack. It occupies rather hummocky or rolling areas and is well drained.

Although practically all this soil is cleared, it is not extensively cultivated as much of the land is either developed as real estate or awaits early development. Land values are very high.

WETHERSFIELD SILT LOAM

Wethersfield silt loam consists of brown mellow loam 8 or 10 inches thick underlain by yellow, brownish-yellow, or slightly reddish-yellow silt loam which at a depth of about 18 or 20 inches grades into light chocolate-red silt loam or silty clay loam underlain by chocolate-red or Indian-red friable silty clay or silty clay loam below a depth of 30 inches. In places the lower part of the subsoil is sandy, suggesting stratification, but such areas represent pockets of sand rather than true layers. In slight depressions where drainage is rather imperfect this soil is slightly mottled with gray and reddish yellow.

This soil occurs only in the southern part of the area south of Newark. It is extensive in the vicinity of Perth Amboy, Woodbridge, Roselle, and Union. It occupies level or gently rolling areas, and drainage ranges from good to slightly imperfect.

Wethersfield silt loam is a strong agricultural soil especially suited to corn, grass, and other general farm crops. It is not extensively utilized for farming, as much of the land is held for real-estate development.

HOLYOKE GRAVELLY LOAM

Typical Holyoke gravelly loam is light-brown gritty loam grading at a depth between 3 and 5 inches into yellowish, slightly reddish-brown, or orange gritty loam underlain at a depth of about 8 or 10 inches by brownish-yellow or reddish-yellow gritty loam which grades below a depth of 20 inches into reddish-brown gritty loam. This soil is derived from trap rocks which have been subject to glacial action. Fragments of trap rock with some gneiss, red sandstone, and quartzite occur in abundance in both surface soil and subsoil. In places small included areas are gravelly silt loam and gravelly sandy loam.

Holyoke gravelly loam occurs scattered throughout the northern half of the area, especially in the vicinity of Caldwell, east of Roseland, west and north of St. Cloud, southeast of Leonia, and 1 mile east of Norwood near the New York State line. Areas occupy the lower, more gentle slopes of glaciated trap ridges. Drainage is good.

This is not an extensive soil, nor is it extensively cultivated except in the extreme northeastern part of the Bergen area. In this region it is utilized in the production of fruit in conjunction with truck crops. Modern methods of cultivation are practiced and these, together with the liberal application of fertilizer, produce good results. Areas of this soil occurring farther south are utilized to a small extent in producing general farm crops but are mainly held as prospective building sites or as timberlands.

Land values, which depend largely on location in respect to real-estate development, probably range at the present time from \$300 to \$700 or more an acre.

HOLYOKE STONY LOAM

Holyoke stony loam consists of yellowish-brown loam or silty loam 5 or 6 inches thick, underlain by yellow or pale-yellow gritty loam which, at a depth of about 12 inches, grades abruptly into yellow gritty loam, becoming reddish yellow and more reddish with depth. In places the lower part of the subsoil is reddish. Small fragments of trap rock together with some gneiss, quartzite, and red sandstone occur in abundance both on the surface and throughout the soil. Larger boulders and fragments of trap are also present, together with outcrops of the underlying trap bedrock. Some areas of Holyoke stony silt loam have been included in mapping along the west side of the ridge fronting Hudson River between Englewood and the New York State line.

Holyoke stony loam is rather extensive, especially in the north-eastern part of the area along the ridge fronting Hudson River and topping the summits of the trap ridges between Caldwell and Short Hills. Other areas occur north of Totowa and 1 mile south of Paterson. Areas occupy the tops and steeper slopes of ridges where drainage is good. Some areas are subject to erosion.

This soil is prevailingly too stony for economic cultivation. If cleared and freed of the larger stones by blasting or otherwise, the more level areas would no doubt prove productive, especially where the bedrock lies several feet below the surface. Much of this soil is at present utilized as building sites within the metropolitan district and has not been mapped as a soil type.

Land values depend entirely on location and are usually high.

HOLYOKE LOAM

Holyoke loam consists of yellowish-brown or brown loam or silty loam which at a depth of 4 or 5 inches passes into yellowish or slightly reddish-yellow silty loam underlain at a depth of 10 or 12 inches by reddish-yellow silty clay loam below which is reddish-brown or reddish-yellow loam. In most places some gneiss, trap, and sandstone are found below a depth of 20 inches. Near Pleasantdale some included areas consist of brown mellow loam overlying brownish-yellow or yellowish-brown loam containing considerable reddish material in the subsoil. Two miles east of Northfield some small included areas consist of brown silt loam 10 inches thick underlain by yellow silty clay loam grading into yellow silty clay mottled with bluish gray and rust brown near a depth of 3 feet. In places, especially on level areas, the subsoil is sandy, suggesting stratification. Some areas of Holyoke silt loam have also been included in mapping.

This soil occurs principally at Pleasantdale and north of Richfield in gently rolling or level positions. Drainage is good, except in extremely flat areas where it is slightly imperfect.

Holyoke loam is practically all cleared but only a little of it is cultivated. This lack of utilization is due to the lack of agricultural

interest in this soil in the Bergen area, rather than to limitations of the soil. Where farmed, the land produces good yields of general crops and truck. It is also especially suited to fruit.

Land values are entirely dependent on location.

DUNELLEN LOAM

Typical Dunellen loam has a brown loam surface layer about 8 inches thick underlain by yellowish-brown or reddish-yellow friable loam which grades, at a depth ranging from 18 to 24 inches, into reddish-yellow heavy sandy loam becoming more reddish and sandier with depth. The reddish color in the subsoil is variable but generally is more in evidence in the southern half of the area than elsewhere.

In places chocolate-red or chocolate reddish-brown compact loam occurs at a depth between 18 and 24 inches. This contains some rust-brown material. In a few places there is a little grayish mottling in the subsoil, but as a rule the subsoil is even more reddish in the lower part. In places considerable gravel, consisting of waterworn more or less rounded fragments of trap, sandstone, and gneiss, occurs both on the surface and throughout the soil to a depth of 3 feet. Such areas are indicated on the soil map by gravel symbols. Some areas of Dunellen sandy loam and fine sandy loam are also included.

This soil is rather extensive in the vicinity of Springfield and Rahway, north of Englewood, north and east of Hackensack, and south and west of Rochelle Park. It is well drained, although areas are flat or nearly level.

This is a strong agricultural soil and produces good yields. As with most of the soils of the area, however, much of this land is at present utilized as building sites or remains idle awaiting real-estate development. Its levelness and mellowness make it ideal for cultivation, and the porosity of the sandy subsoil insures good drainage.

WHIPPANY SILTY CLAY LOAM

The surface soil of Whippany silty clay loam is gray silty loam or silt loam. It grades at a depth of 5 or 6 inches into bluish-gray silty clay loam underlain by light-bluish silty clay or sandy clay mottled with yellow. Below a depth of 20 or 24 inches is a plastic claypan of bluish gray mottled with yellow. This grades into greenish-yellow plastic heavy clay mottled with bluish gray.

Included in this soil as mapped are some unimportant areas of Whippany loam. About 1 mile east of Northfield an included area consists of grayish-brown silt loam 8 inches thick overlying reddish-brown silt loam mottled with gray. The grayish color increases with depth until at a depth of about 30 inches a grayish claypan layer mottled with reddish brown and dark brown is reached. Numerous waterworn gravel fragments consisting chiefly of gneiss and trap are present on the surface of this area, which has been indicated on the map by gravel symbols. Some areas of the better-drained phases of Whippany loam and Whippany silt loam have also been included. These areas occur principally northwest of Roseland and scattered between Northfield and Pompton Plains. These areas differ from the typical Whippany silty clay loam in that they occupy higher

positions and are imperfectly rather than poorly drained. The surface soil is brown; less mottling is seen in the subsoil, and the areas are better suited to cultivation.

Whippany silty clay loam occurs only in the old lake bottom of the now extinct glacial Lake Passaic in the west-central part of the area. The largest tracts are northwest of Roseland and south of Lincoln Park. Areas occupy low depressions and are poorly drained.

Agriculturally Whippany silty clay loam is important only as pasture and hay land. Virgin timber, consisting chiefly of pin oak and maple, covers much of the land.

Land values are low, as this soil is generally recognized as unproductive and unsuited for agriculture. Owing to its location, its real-estate value is also low.

Before this soil could be brought under cultivation, it would be necessary to provide some comprehensive system of drainage.

WHIPPANY LOAM, SANDY-SUBSOIL PHASE

The sandy-subsoil phase of Whippany loam consists of grayish-brown or bluish-gray loam grading at a depth of about 10 inches into pale-yellow loam mottled with gray or bluish gray which at a depth of 12 or 15 inches is underlain by pale-yellow sandy loam or sandy clay passing below into yellow sandy loam or loamy sand with bluish-gray and rust-brown mottles.

One mile southeast of Mountain View an included area consists of bluish-gray silt loam 3 inches thick overlying gray silty loam or silty clay loam which grades, at a depth of 10 inches, into mottled bluish-gray and yellow or yellowish-brown plastic clay which becomes less yellow with depth and passes at a depth of about 20 inches into bluish-gray sandy clay slightly mottled with yellow. Below about 26 inches the material is mottled bluish-gray and yellow sandy clay loam. The lower sand stratum is saturated with water and varies considerably in color and texture, although it is everywhere sandy. Similar areas are mapped at Clinton and 1 mile west of Two Bridges. These represent inclusions of the sandy-subsoil phase of Whippany silty clay loam.

This soil occurs principally in the bed of the extinct Lake Passaic. It has its greatest development near Two Bridges, south of Wayne, and southeast of Mountain View. Areas occupy low depressions adjacent to streams and are poorly drained. Like Whippany silty clay loam this soil is utilized only for pasture and hay land.

Reclamation by drainage is necessary if this soil is to be brought under cultivation. The sandy texture of the subsoil tends to make drainage easier than on typical Whippany loam which has a stiff clayey substratum.

Most of this land is at present covered with timber such as oak, maple, birch, sweetgum, and hickory, together with an abundance of weeds, grasses, and sedges.

The agricultural value of this class of land is low, and land values depend entirely on location.

CROTON SILT LOAM

Croton silt loam consists of brown or grayish-brown silt loam from 6 to 10 inches thick, underlain by yellow silt loam which grades

abruptly into yellowish-brown silt loam. This becomes mottled with gray at a depth ranging from 12 to 16 inches. The grayish color increases to a depth of 20 inches. The material below this depth is very compact mottled yellow and light-gray silt loam or silty clay loam containing small concretions and some fragments of red shale. This is underlain by mottled chocolate-red and bluish-gray plastic clay or a claypan containing some reddish-brown concretions. At a depth of about 40 inches compact clay of more chocolate-reddish color is reached. The subsoil proper is everywhere very compact and commonly contains material of a chocolate-red or Indian-red color.

There are a number of variations in this soil as mapped. Some included areas are of Croton loam. On a flat about one-half mile northwest of Rahway the surface soil is brown or yellowish-brown loam or silt loam. This is underlain at a depth of 5 or 6 inches by yellow silty clay loam, generally mottled with gray at a depth of 15 or 20 inches and compact at 18 or 20 inches. Below this is chocolate-red compact sandy clay or silty clay with some small gravel and fragments of red sandstone in places. In a depression one-fourth mile west of this boring, the material is brown silty loam grading at a depth of about 12 inches into yellow silty clay loam or heavy silty loam underlain at a depth of about 24 inches by mottled yellow or pale-yellow and gray silty clay loam. Chocolate-red clay occurs at about 30 inches, and below this is some light-yellow mottling with more reddish material below.

This soil occurs only in the southern half of the area. The most important tracts are south of Linden and northeast of Woodbridge. Croton silt loam occurs in depressions and flats and at the headwaters of streams. Drainage ranges from imperfect to poor.

Only a very small part of this soil is farmed, but a rather large area is utilized for pasture. Some areas still remain in timber consisting chiefly of maple, oak, ash, and hickory, with some gum. Some areas close to real-estate developments remain idle.

Where cultivated, Croton silt loam requires underdrainage and liberal applications of lime. In places it is difficult to drain properly the nearly impervious claypan layer present. In such areas blasting, which loosens the compact stratum, must be resorted to.

WHITMAN SILTY CLAY LOAM

Typical Whitman silty clay loam consists of gray or grayish-brown silty clay loam 8 or 10 inches thick, underlain by mottled bluish-gray and pale-yellow rather plastic silty clay or clay which at a depth of about 28 inches gives way to compact mottled chocolate-red, yellow, and bluish-gray clay.

Included in mapping are some areas of Whitman silt loam consisting of gray or bluish-gray silt loam 8 or 10 inches thick overlying mottled bluish-gray and yellow rather plastic silty clay loam underlain at a depth of about 20 inches by compact rust-brown and reddish-brown gritty loam mottled with bluish gray. Small areas of Whitman loam are also included with this soil.

This soil is most extensive in association with the Holyoke soils between Millburn and Little Falls. It occupies level, flat depressions or low situations adjacent to or at the heads of streams. Drainage is poor.

None of this soil is under cultivation, but in places it is utilized as pasture land. Much of it still remains in timber consisting of various hardwoods. In places the material is stony; such areas are indicated on the map with stone symbols.

If this soil is to be brought under cultivation, underdrainage and liberal liming are necessary. Owing to its location, however, the greatest part of this soil in the Bergen area may probably best be utilized as pasture and timber land.

PODUNK LOAM

The surface soil of Podunk loam is brown mellow loam from 8 to 12 inches thick. This is underlain by yellow or brownish-yellow loam which becomes sandy in the deep subsoil. In the areas where drainage is more imperfect the subsoil is heavy and mottled bluish gray, yellow, and light gray. Some areas of Podunk sandy loam and of Podunk fine sandy loam have been included with this soil in mapping.

Podunk loam has its chief occurrence in the northern half of the Bergen area. It represents the better-drained first-bottom soils of the glaciated region and is made up mainly of wash from near-by gneissic material. It is most extensive along Ramapo, Wanaque, Pompton, and Saddle Rivers. Drainage ranges from good to imperfect, but all this soil is subject to overflow during flood stages of the adjacent streams.

Podunk loam is utilized principally as pasture land, although some of it is cultivated to corn and grass and some late truck crops. Floods are a drawback in cultivating this soil, but if overflow can be avoided crop yields are good.

Land prices vary with location but are usually very high.

PAPAKATING SILT LOAM

The surface of Papakating silt loam is black, dark-brown, or dark-gray silt loam, about 8 inches thick. This is underlain by bluish-gray or dark-gray sandy clay loam mottled with pale yellow and grading below into more sandy clay of much the same color. The subsoil is variable but commonly contains considerable sand and some gritty material. In the valley of Hackensack River this soil is sandy below a depth ranging from 12 to 20 inches. Owing to their small extent areas of Papakating loam, Papakating sandy loam, and Papakating fine sandy loam were included with this soil in mapping.

Papakating silt loam occurs chiefly in the northern half of the area on first bottoms of small streams. It is generally adjacent to the Gloucester and Merrimac soils. Drainage ranges from imperfect to poor.

This soil is utilized only as pasture land. Most of it still remains in forest, consisting principally of pin oak, elm, maple, and gum, with some hickory, together with an undergrowth of ferns, grasses, and sedges.

WEHADKEE SILT LOAM

The surface soil of Wehadkee silt loam consists of light-brown or gray silt loam from 3 to 5 inches thick. This grades into light-gray

silt loam mottled with yellow and underlain at a depth of 10 or 12 inches by light bluish-gray plastic clay mottled with pale yellow and yellow at a depth of 36 inches. In places the lower part of the subsoil is mottled grayish yellow or pale yellow and bluish gray. In other places, especially near or adjacent to the Wethersfield soils the subsoil frequently contains considerable mottling of chocolate red, dark reddish brown, or Indian red.

This soil, which consists of material washed from adjacent glaciated soils of Triassic age, occurs in one small area, covering about one-half square mile, in the southern part of the area surveyed near Fords. It is imperfectly drained.

Agriculturally Wehadkee silt loam is of little importance. Where cleared it is utilized for pasture, but most of it remains in forest, consisting chiefly of pin oak, hickory, and maple, with some gum.

BERMUDIAN LOAM

Typical Bermudian loam consists of chocolate-red or dark reddish-brown loam underlain at a depth of 10 or 12 inches by brownish-red, Indian-red, or chocolate-red silt loam continuous to a depth of 3 or more feet. In most areas there is little change in color between the surface soil and subsoil, but in places yellowish-red and grayish mottles occur in the subsoil below a depth of 15 inches. In other places the subsoil is sandy.

This soil occurs chiefly in the southern half of the area along streams adjacent to glaciated Triassic sandstone and shales. It differs from Wehadkee silt loam in being better drained. The drainage ranges from good to imperfect.

This soil is utilized only for pasture. It supports a good growth of grasses even during dry seasons. Practically all of it is cleared of timber. Areas are subject to overflow during flood stages.

MUCK

Muck is composed of black vegetable matter well advanced in decomposition, together with some inorganic mineral soil matter. The black material is everywhere 24 or more inches thick in typical muck, and it may extend to a depth of several feet. It is underlain by materials ranging from rather stiff impervious clay to sandy clay, sandy loam, or sand. The color of the substratum also is variable, grayish shades predominating but some yellow and green materials being present. In most places below a depth of 20 or 24 inches the organic material becomes more brown and peaty, indicating that at this depth the decomposition is not so advanced as in the material above. In many areas, especially in the wetter situations, this peaty material occurs much nearer the surface.

Included with muck as mapped are some unimportant areas of Clyde silty clay loam, Papakating silt loam, and the Whippany soils. These inclusions are necessary because small areas of all the included soils occur in such close association with the muck that it is not possible to indicate them on the map.

The most important areas of muck are near Paramus, 2 miles west of Oradell, near Ramseys, and northeast of Allendale. Smaller areas are scattered throughout the northern half of the area.

Muck occurs in low, swampy, poorly drained depressions and is unsuited for cultivation unless it is reclaimed by drainage. Most of it remains in forest consisting chiefly of maple and gum, together with some oak and other water-tolerant species. Coarse grasses growing in tussocks are common, as are also mosses and ferns. Where uncleared the surface is covered with decaying leaves, and timber débris is abundant.

Some of this soil has been cleared and drained by open ditches and is suitable for agriculture. Where properly drained and cultivated excellent yields are obtained from such crops as celery, onions, and lettuce, although in wet seasons there is always some danger from floods. Crops are more subject to injury from frost on muck than on the adjoining higher lands.

Where cleared and drained, muck is held for high prices. Values of the virgin soil are low.

Muck, intermediate phase.—This phase of muck differs from the typical material in that the organic deposit is not more than 24 inches thick. It is underlain by grayish clay, sandy clay, or sand, mottled with yellow, bluish gray, and greenish gray. This intermediate soil occurs in close association with the typical material and with the shallow phase of muck. None of the intermediate phase has been reclaimed. The forest growth on it is similar to that on typical muck.

Muck, shallow phase.—The shallow phase of muck consists of black organic material not more than 10 inches thick, underlain by heavy bluish-gray clay mottled with yellow and generally becoming more sandy with depth. In places the material below a depth of 30 inches consists of greenish-gray or grayish sandy loam or sand. Some areas of the Whippany soils, of Papakating silt loam, and of Clyde silty clay loam were included with this phase of muck in mapping.

Practically all the shallow muck is wooded. Some small areas have been cleared and utilized for pasture, especially in dry seasons. When cleared the soil supports a heavy growth of coarse grasses growing in tussocks, and in the wetter places flags are abundant.

This phase of muck, if reclaimed by drainage, no doubt would have excellent agricultural possibilities.

TIDAL MARSH

Areas mapped as tidal marsh comprise low level flats adjacent to large streams and subject to daily tidal inundation. The soil material is made up of dark-brown or black silty clay loam containing different amounts of decaying vegetable matter, underlain by dark-gray or bluish-gray silty clay.

There are 31,296 acres of tidal marsh mapped in the area. Many acres are in the metropolitan district and are utilized for building and factory sites. In such areas, dikes have been constructed to prevent tidal inundation. Other areas have been diked and partly drained or are situated at a slightly higher level than the surrounding marsh and thus are subject to overflow only by the higher tides. Such areas occur south of Hackensack.

The only agricultural value of tidal marsh is for the production of salt hay. This is cut during ebb tide and is utilized in packing glass-

ware and other breakable materials and to some extent for rough feed and stable bedding.

If reclaimed by dikes and drainage ditches no doubt this material would have real agricultural possibilities, but such reclamation is expensive and should be undertaken only on a large scale under some cooperative plan of the landowners interested.

MEADOW

Meadow, as mapped, includes soils so varied in texture and color that they could not be placed in any soil type. Much of it consists of light-brown silty clay loam, grading at a depth between 18 and 24 inches into mottled rust-brown and gray sandy clay which is underlain at a depth between 30 and 36 inches by bluish-gray sandy loam, loamy sand, or sand. Some areas of Papakating silt loam, of the Whippany soils, of Clyde silty clay loam, of swamp, and of some Whitman silty clay loam were included in mapping.

None of this class of land is under cultivation. Some areas are cleared and when not excessively wet are utilized as pasture. Cleared areas are covered with a tussock growth of coarse grasses and other water-tolerant plants. The timber consists of swamp maple and gum, together with buttonbush, alder, and some birch.

Meadow is best suited for forestry, at least until such a time as the lack of available agricultural land makes reclamation desirable.

ROUGH STONY LAND

Rough stony land comprises rough, rugged, stony areas, most of which are steep and broken and covered with large boulders, stone fragments, or outcrops of bedrock. This material is extensive in the mountainous region in the northwestern part of the area, along the ridge fronting on Hudson River, and scattered elsewhere in the northern part of the area. It occurs in close association with the Gloucester and Holyoke soils and supports a growth of hardwood timber similar to that found on forested areas of those soils.

Rough stony land is nonagricultural, being too steep and stony for cultivation. Its value lies wholly in the forest products.

UNCLASSIFIED CITY LAND

The unclassified city land shown on the map without color lies within or adjacent to the boundaries of numerous towns and cities in the eastern and northeastern parts of the area. This district, separated from New York City only by Hudson River, is used entirely as building sites and is so densely populated that determination of the various soil types is not practical.

SWAMP

Areas mapped as swamp consist of very wet bottom land of very variable texture and material. Swamp is mapped in stream bottoms or at the headwaters of small streams. The areas are frequently covered with water and are too wet to be used satisfactorily as pasture. Most areas are covered with a growth of various hardwoods. A very elaborate and comprehensive system of drainage would be needed were these areas to be brought under cultivation.

MADE LAND

The principal areas of made land are those occurring on the west side of Newark Bay at the mouth of Passaic River, between Newark and Jersey City. These are rather flat areas whose surface has been brought up to a level somewhat higher than that of the adjacent marshland by dredging or pumping material from the bottom of the adjacent streams. Predominantly, the material consists of a mixture of silt, clay, and sand, together with some decaying vegetable matter. The areas are used for railway tracks, warehouses, docks, and other structures and have no particular importance in an agricultural way.

A few small areas in the northern part of the region covered by the survey differ somewhat in character of material, although they have been built up in much the same manner and for the same purpose.

CLAY PITS

This classification comprises areas over which most of the surface has been altered either by removal of the topsoil as a result of mining excavations or by dumping excavated soil material in connection with the same operations. These excavations have been made in order to take out commercial clay. The areas have no present value for agriculture but when abandoned may prove valuable for forestry.

SUMMARY

The Bergen area is in the northeastern part of New Jersey, adjoining New York on the north and separated from it by Hudson River on the east. It includes all of Hudson and Bergen Counties, a large part of Essex County, and parts of Passaic, Union, Morris, and Middlesex Counties.

Elevations in the area range from sea level to more than 1,200 feet. Drainage is effected by several large streams and rivers flowing in a general southerly direction. Most of the area is adequately drained.

Settlement in the Bergen area began as early as 1658, but county boundaries were not fixed until later. The proximity of New York has always had a marked effect on agricultural development. The population in 1920 was more than 1,500,000.

Transportation facilities are excellent, railroads being numerous and highways good. Telephone service and electric power are available on almost every farm.

New York City and the many other cities and towns in the area furnish ready markets for farm products.

The climate is characterized by rather cold winters and mild summers. Extremes of temperature are rare and of short duration. Rainfall is adequate for the successful production of crops.

Agriculture is practiced near cities and towns and in outlying districts. Extremely intensive methods prevail, except in the more remote outlying districts.

Farms are well equipped. Houses and farm buildings are modern and in good repair. Although the system of farming prohibits the rotation of crops, other modern farming practices, such as fertilization and the control of insect and plant pests, are common.

Land values are based more largely on real-estate value than on agricultural worth and are extremely high.

Practically all the Bergen area has been glaciated. The soils were derived largely from the glaciation of the underlying rocks, including red sandstones and shales, gneiss, and trap. Twenty-six soil types and nine phases, representing 13 soil series, and 7 miscellaneous types of material are mapped.



[PUBLIC RESOLUTION—No. 9]

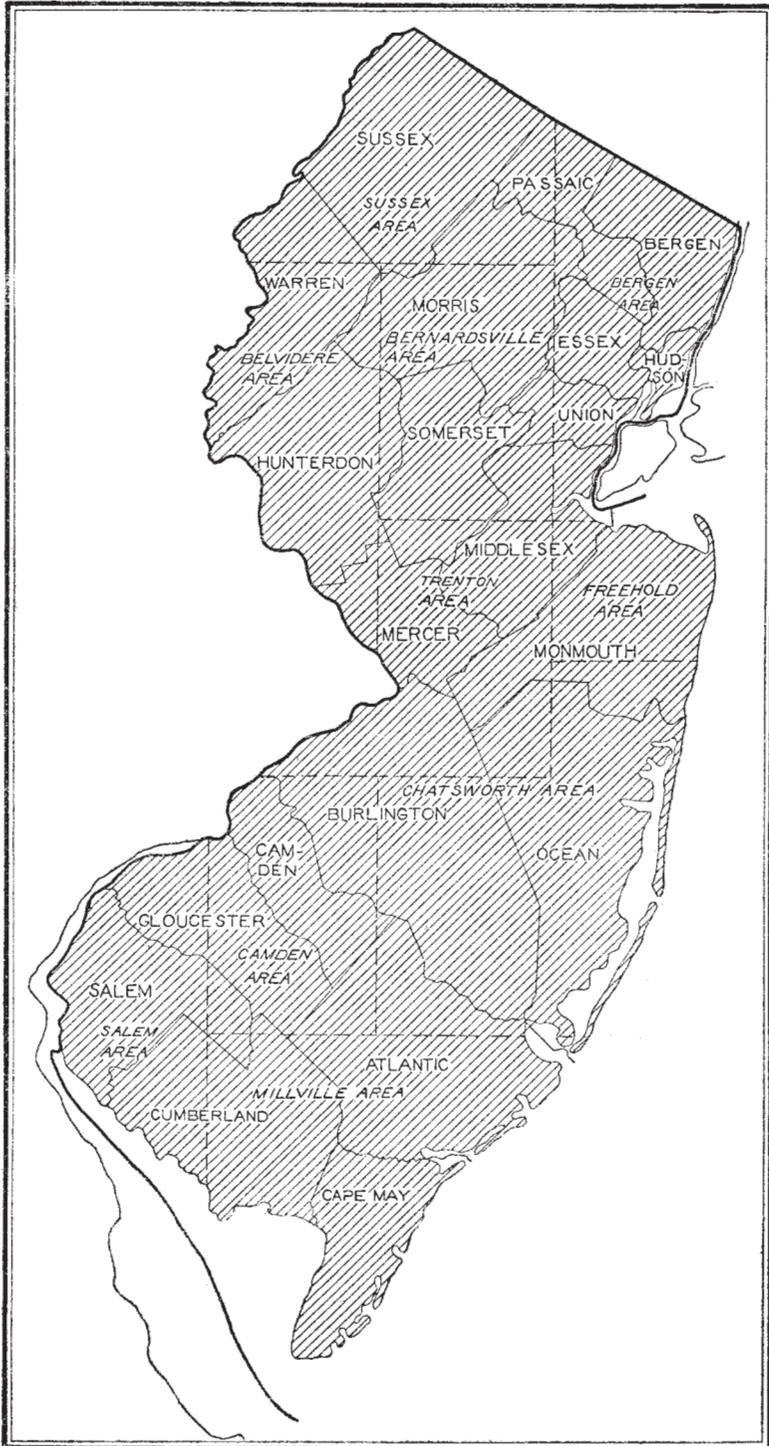
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture"

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]



Areas surveyed in New Jersey shown by shading

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