SOIL SURVEY
OF ESSEX COUNTY

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BY

N. R. RICHARDS
EXPERIMENTAL FARMS SERVICE

AND

A. G. CALDWELL and F. F. MORWICK
ONTARIO AGRICULTURAL COLLEGE

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GUELPH, ONTARIO
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REPORT No. 11 OF THE ONTARIO SOIL SURVEY

EXPERIMENTAL FARMS SERVICE, DOMINION DEPARTMENT OF AGRICULTURE AND THE ONTARIO AGRICULTURAL COLLEGE

PREFACE

The soils of Essex County were surveyed during the summer of 1939.

Other Counties and Districts surveyed and maps published are as follows:

1. *Norfolk..Map only*
2. *Elgin...Map only*
3. *Kent..Map only*
4. *Haldimand...Map only*
5. *Welland...Map only*
6. *Middlesex..Map only*
7. *Carleton...Map and Report*
8. *Parts of Northwestern Ontario..........Map and Report*
9. *Durham..Map and Report*
10. *Prince Edward...................................Map and Report*

Soil Erosion and Land Use Survey,
Hope Township Project Area.............Map and Report

In addition to the above the following Counties have been surveyed.

Oxford	*Peel*
Wentworth	*Dufferin*
Halton	*Northumberland*
York	*Grenville*
Peterborough	*Perth*
Brant	*Huron*
Waterloo	*Simcoe*
Lincoln	*Wellington*
	Dundas

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ACKNOWLEDGEMENTS

The Dominion Department of Mines and Resources, Surveys and Engineering Branch, Hydrographic and Map Service, supplied the base maps. The final copy of the Soil Map for lithographing was prepared by the Cartographic Section of the Field Husbandry Division, Central Experimental Farm, Ottawa.

Helpful suggestions pertaining to classification and correlation, and assistance in critically reviewing the manuscript came from Professor G. N. Ruhnke, Ontario Agricultural College, Dr. P. O. Ripley, Dr. A. Leahey, Mr. P. C. Stobbe, Dominion Department of Agriculture and others.

Office space for the survey party was provided by the Dominion Experimental Station, Harrow. The helpful suggestions offered by the personnel of the Experimental Station, Harrow and the Agricultural Representative of the Provincial Department of Agriculture are gratefully acknowledged.

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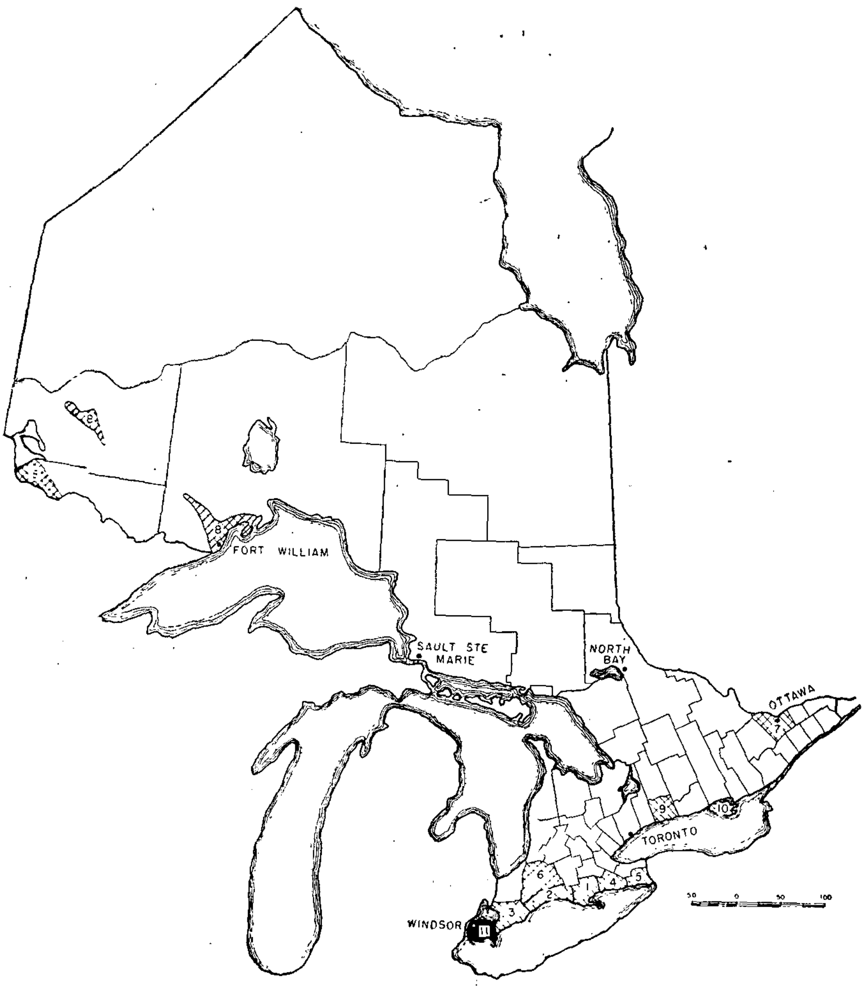


FIG. 1—Outline map of Ontario showing location of Essex County and other areas for which soil maps have been published.

Soil Survey of Essex County, Ontario

by

N. R. Richards, A. G. Caldwell and F. F. Morwick*

PART I

GENERAL DESCRIPTION OF THE AREA

Location and Area

Essex County lies in the southwestern extremity of Southern Ontario. Kent County on the east is the only land boundary. It is bounded by Lake St. Clair to the north, the Detroit River to the west and Lake Erie to the south. The city of Windsor in the northwest section of the County is 108 miles from London and 241 miles from Toronto.

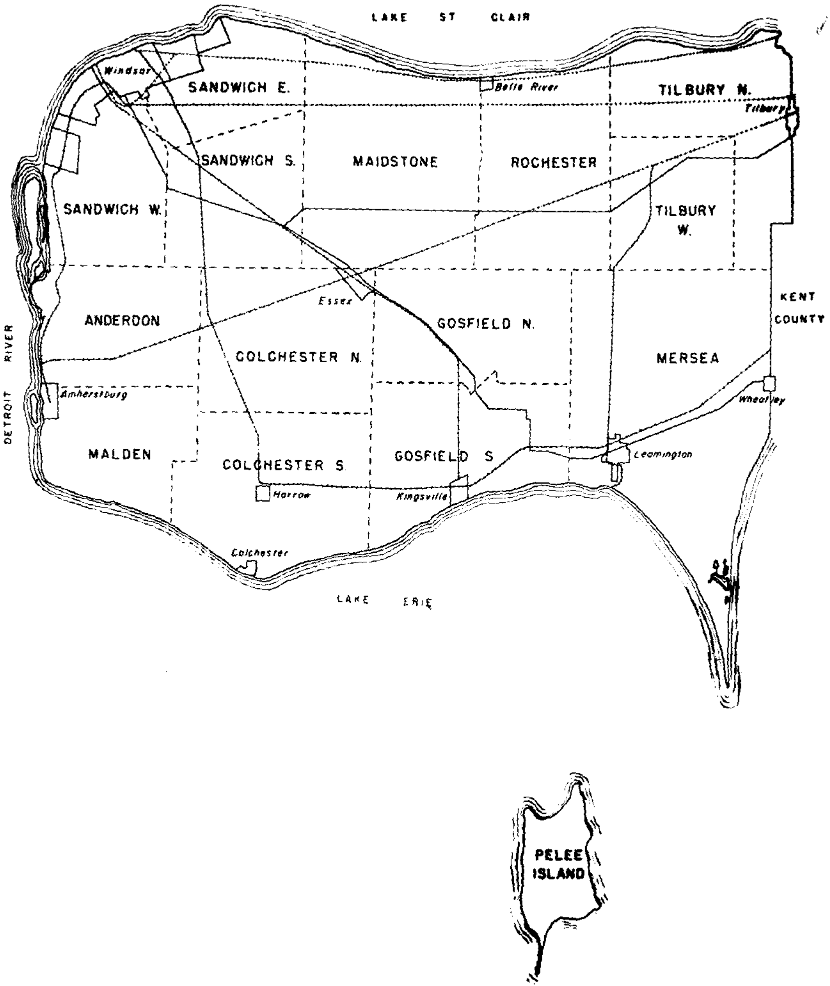


FIG. 2—Outline Map of Essex County showing townships, towns, railways, etc.

*Mr. G. A. Hills (formerly with the Experimental Farms Service, and now with the Department of Lands and Forests, Toronto) was in charge of the field party during the original survey and was assisted by Mr. L. R. Webber; the analytical work was done under the direction of Mr. A. L. Willis; Miss G. V. Palmer assisted with the drawing of maps, charts, etc.

The area of the County consists of approximately 452,480 acres (1941 census.) The area in farms is approximately 392,567 acres, the remainder being taken up by roads, centres of population, etc.

County Seat and Principal Towns

The city of Windsor, a large industrial centre and Canada's motor capitol, is situated at the junction of Lake St. Clair and the Detroit River.

Amherstburg, an important industrial centre, is located further down the Detroit River. The town of Essex, the County Seat, is located at the approximate centre of the County. At Harrow, in the southwestern part of the County, is an important Dominion Experimental Farm. Leamington in the southeast is in the centre of the early market gardening area.

Population and Racial Origin

The total population of Essex County according to the 1941 census was 174,230 persons of whom 24,596 or 14% were on farms, 129,791 were urban dwellers and 19,843 were living in the rural areas but not carrying on agricultural pursuits.

Total population	174,230
British	98,141
French	38,174
All others	37,915

Unlike most counties, the rural population of Essex County has shown an increase in the last two decades. This trend may be attributed to the development of the early vegetable and market gardening industry in the county. The following population figures were prepared from the Census of Canada 1941.

Year	Rural Population	Urban Population
1901	35,110	20,702
1911	35,196	32,351
1921	33,433	69,142
1931	40,808	118,972
1941	44,439	129,791

Transportation and Markets

Essex County is well supplied with roads and railways connecting all parts of the County with centres of population and other parts of the Province.

Highway No. 2 is the main east-west connection between Windsor, London and other cities to the east. Running parallel to Lake St. Clair, Highway No. 39 connects Stoney Point, Belle River and Tecumseh with Windsor. Highway No. 98 provides an alternate east-west route from Tilbury to Windsor south of No. 2 Highway.

Highway No. 3, the Talbot Road, one of Ontario's pioneer roads, connects Leamington and the southern part of the County with the centres to the east along Lake Erie. From Leamington it extends northwest through Ruthven and Essex to Windsor. Highway No. 18 travels south from Windsor along the Detroit River through LaSalle and Amherstburg. Thence, Highways No. 18 and No. 18A swing east parallel to Lake Erie through Harrow, Colchester and Kingsville to connect with Highway No. 3 at Leamington.

In addition to these main arteries, there is an excellent network of County and Township roads to serve the needs of the less travelled sections of the County.

The Canadian National and Canadian Pacific main railway lines from Toronto to Windsor run through the northern part of the County parallel to Lake St. Clair. The Pere Marquette Railway connects Windsor, Harrow, Kingsville, Leamington, Wheatly and St. Thomas to the east.

The Michigan Central Railway lines from Amherstburg and Windsor meet at Essex to proceed east through Comber and Tilbury to St. Thomas. A branch line connects Leamington and Comber. The Windsor and Amherstburg Electric Railway connects these two centres along the Detroit River.

These railways and highways supply excellent facilities for marketing the County's produce.

PART II

FACTORS AFFECTING THE FORMATION OF ESSEX COUNTY SOILS

The soils in any region tend to reflect or indicate the factors affecting their formation. Over a broad continental area the variations in climate and type of natural vegetation are dominant factors, whereas locally the parent material from which the soil is formed and the topography and drainage tend to be more important. The length of time that the soil forming processes have been operating also affects the nature of the soil. A detailed study of a cross-section of a natural soil in depth will reveal much information regarding the factors which have affected its formation. Conversely a study of the factors affecting soil formation will yield much information pertaining to the soils themselves.

The Parent Soil Materials

The glacial lakes had a most profound effect on the materials on which Essex County soils developed. The glaciers which deposited large amounts of glacial drift elsewhere also laid down unassorted stony materials in this area. However, as the ice melted and the ice-front retreated, there were deep glacial lakes covering most of this area for a long time. During this time the waves smoothed out the ridges and considerable amounts of sediment and outwash material were deposited.

The morainic influence is strongest in the southern part of the county. Small, irregular stony ridges occur among the outwash (sands and gravels) soils along Lake Erie in the Townships of Gosfield South and Colchester South. These are remnants of light stony moraines whose finer materials have since been removed by water to the closely associated gravelly and sandy soils (beaches and bars). In local areas, a morainic soil (Harrow loam) occurs where the mixture of stones, silt, clay and sand has been little changed. In the Perth soils in Malden Township, the morainic influence, though not so marked, is evidenced by the large number of stones.

The broad hill in the Leamington-Ruthven area is composed of fluvio-glacial materials. At the time of the first of the glacial lakes in this region (Lake Maumee) the large stream which flowed between the two lobes of ice had its delta in this area *. Much of the sand and gravel, no doubt accumulated during this time. Later as the ice receded and the lake waters lowered, this hill became an island and gravel beaches were formed around it at two or more levels. Several other lower beach ridges or bars were formed during this time, such as, the one extending northwest from this area through the town of Essex.

The bedrock underlying the county is mostly limestone of Devonian age but with the exception of the southwest corner near Amherstburg, and Pelee Island, there is a considerable depth of drift over it, the deepest being about one hundred and fifty feet.†. The following analyses of limestones from quarries

*Leverett, F., and Taylor F.B. The Pleistocene of Indiana and Michigan and the History of the Great Lakes. U. S. Geological Survey Monograph 53, 1915.

†Caley, J. F., Paleozoic Geology of the Windsor-Sarnia Area. Dept. of Mines and Resources, Geological Survey, Memoir 240.

near Amherstburg and on Pelee Island indicate the presence of both high-calcium and magnesian limestones‡.

Magnesian limestone (Amherstburg) $CaCO_3$ 79.32% $MgCO_3$ 18.76%

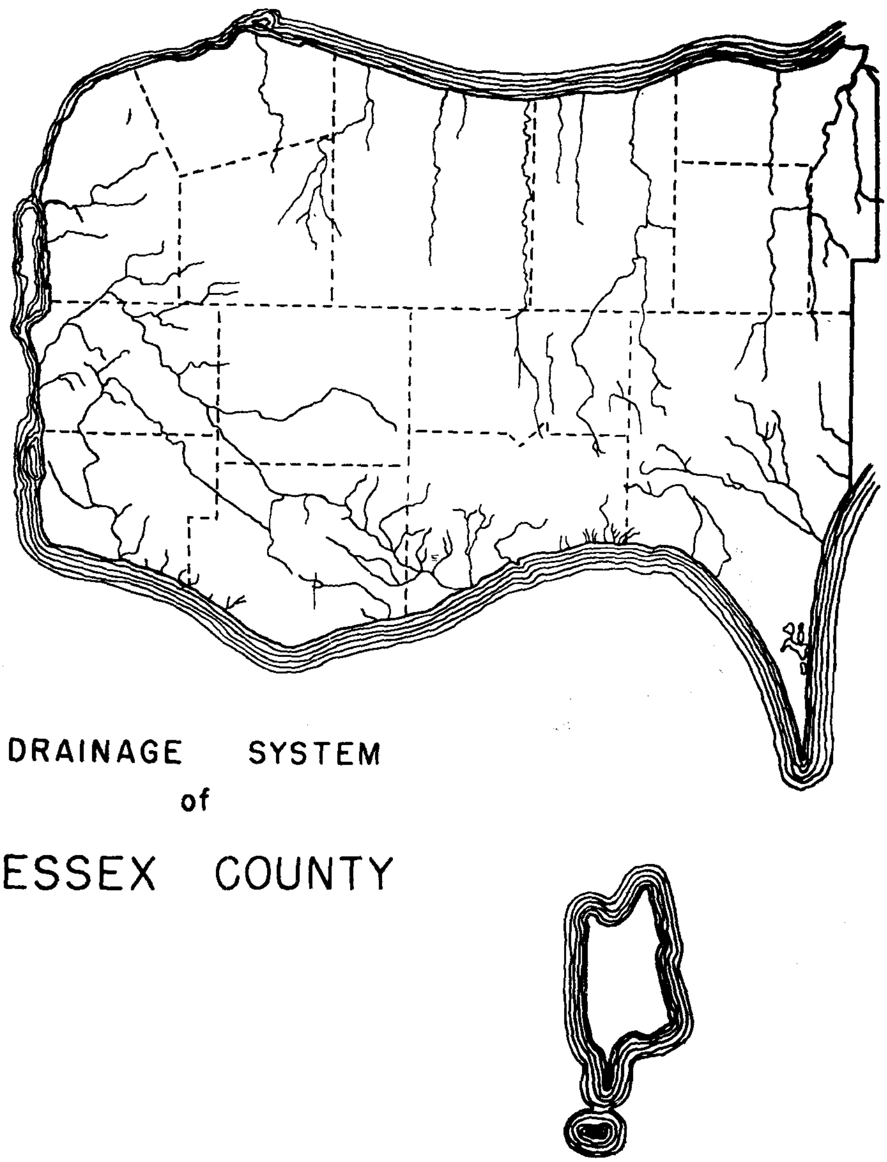
High-calcium limestone (lower in same quarry) $CaCO_3$ 97.16% $MgCO_3$ 0.97%

Magnesian limestone (Pelee Island) $CaCO_3$ 90.43% $MgCO_3$ 7.78%

The drift over all the county contains a considerable amount of limestone as well as appreciable amounts of shale and some igneous rock material.

‡Goudge, M. F., Limestones of Canada Part IV Dept. of Mines and Resources, No. 781.

Relief



DRAINAGE SYSTEM of ESSEX COUNTY

Essex County is predominantly a smooth clay plain with scattered sandy and gravelly knolls and ridges. One sizeable hill, which rises over a hundred feet above the surrounding plain, occurs in the Leamington-Ruthven area. Lake Erie to the south has an altitude of 572 feet above sea level and Lake St. Clair to the north 576. Many cross-sections between the two lakes do not rise above the 650 foot contour and some remain below the 625. The highest point, near Ruthven is about 740 feet above sea level.

Numerous small rivers and creeks carry the drainage water into the lakes and rivers which bound the county on three sides. The Ruscom and Belle rivers are the largest, flowing northward into Lake St. Clair and the Canard drains most of the central western part of the county into the Detroit River. The streams flowing southward into Lake Erie are comparatively short.

Owing to the flat topography and heavy texture of most of the soils, artificial drainage is used extensively to improve the productivity of the land. The natural drainage system has been supplemented with open ditches and dredge cuts to serve as outlets for the tile drains which have been installed on many of the farms in this area.

Climate

Essex County is in a very favourable climatic position when compared to other parts of Ontario. It is notably the earliest and warmest part of the Province. However, there is considerable variation of climate within the county. Putnam and Chapman* make a separate division for the Leamington area, which includes the small area of lighter textured soils along the shore of Lake Erie, as well as Pelee Island.

This Leamington area includes the southernmost part of Canada. Pelee Island extends as far south as the northern border of the state of California. Its warm climate and light soil are exceptionally well adapted to the growing of early, tender vegetables. The growing season usually begins during the first week of April, nearly a week earlier than any other area in the Province. This places the grower of such crops as asparagus, strawberries, early potatoes and early corn in a very favourable position. The average length of the growing season is about 216 days. The average frost-free period of 165 to 169 days is of special importance to such crops as tomatoes, tobacco and corn.

The area suffers considerably from drought. As a region it has the lowest annual precipitation, only 28.1 inches; its average snowfall is only 32 inches. Chapman and Putnam state that there is little agreement as to what interval or what amount of precipitation constitute a "drought," but it is generally felt that 1.0 inch or less of rain has a distinctly detrimental effect. In the Leamington area three years out of five are apt to have drought periods. The annual mean of 48°F., winter mean of 26°F., spring mean of 69°F., and fall mean of 51°F., are all the warmest temperatures in the Province. Because of the prevailing high summer temperatures, the effectiveness of the precipitation is very low even though slightly more than half falls during the growing season. In this area it would appear to be quite advantageous to grow early crops which will be unaffected by the late summer droughts.

*Putnam, D.F., and Chapman, L. J. The Climate of Southern Ontario, Sci. Agr. Vol. XVIII, No. 8, April 1938.

On Pelee Island the conditions are quite similar but there is a slightly longer frost-free period.

In the rest of the county the mean annual temperature is 47°F., one degree lower. The growing season is from 203 to 213 days long. The area is all south of the 70° July isotherm. The climatic environment is suitable for the growing of a large number of crops which include sugar beets, seed corn, tobacco, etc. The extreme low recorded in the district was -27°, seven degrees lower than the low for the Leamington area. These factors, together with the heavy soils, account for the lack of tender fruits in the area. The area is, however, intensively cultivated supporting large acreages of corn, soybeans, sugarbeets and canning crops.

The average precipitation varies from 28 to 30 inches per annum; the snowfall averages about 40 inches. The drought period usually occurs two years in five which is somewhat less than in the Leamington area.

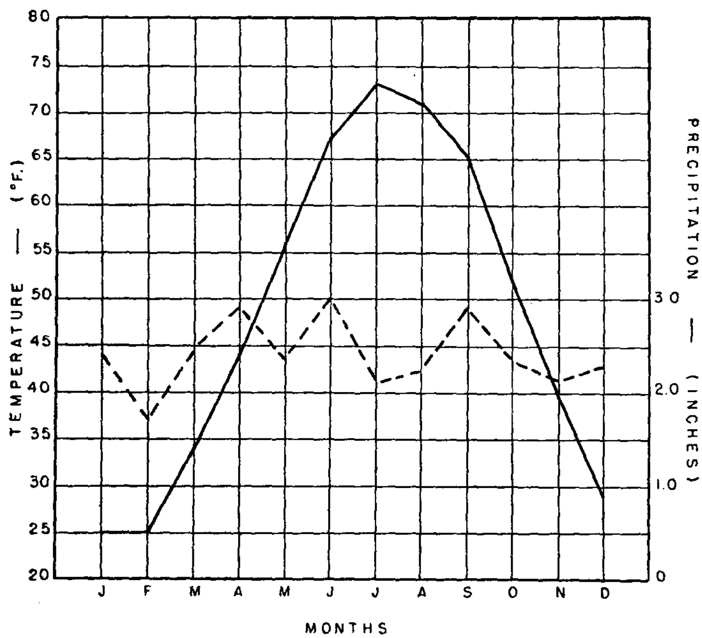


FIG. 4—Diagram showing Mean Monthly Temperature and Precipitation for Leamington, Ontario (21 Year Period)

In tables (1) and (2) the precipitation and temperature of points within the county are compared with distant points. Ottawa and Guelph, are included to give the comparative figures for these experimental stations. Grimsby and Simcoe give a comparison with the Niagara and Norfolk areas. The information in these tables was obtained from the Meteorological Division, Department of Transport—Canada.

TABLE 1

MONTHLY AND ANNUAL AVERAGES OF DAILY MEAN TEMPERATURE FOR SEVERAL SELECTED POINTS

	Period of Record	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Immediate Stations														
Windsor	47	24	24	33	46	57	68	72	70	63	51	38	27	48
Harrow	20	25	26	35	45	57	68	72	70	64	52	40	29	49
Leamington	21	25	25	34	44	56	67	73	71	65	52	40	29	48
Pelee Island	36	25	24	34	45	56	70	75	74	66	54	41	29	49
Distant Stations														
Ottawa	65	12	13	24	41	55	65	70	66	58	46	32	17	42
Guelph	44	20	18	29	42	54	63	68	66	59	48	36	24	44
Stratford	64	21	20	29	42	54	64	69	67	61	48	36	25	45
Kapuskasing	19	−2	2	14	31	46	57	62	60	51	39	22	6	32
Huntsville	30	14	12	24	39	52	61	66	64	57	45	32	19	41
Simcoe	21	24	24	31	43	54	65	69	67	62	50	38	28	46
Grimsby	19	25	24	33	45	54	64	71	69	62	51	40	29	47

*Temperature in degrees Fahrenheit.

TABLE 2

AVERAGE MONTHLY AND ANNUAL PRECIPITATION IN INCHES FOR SEVERAL SELECTED POINTS

	Period of Record	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Immediate Stations														
Windsor	47	2.31	2.16	2.42	2.24	3.08	3.35	3.42	2.69	2.59	2.17	2.45	2.24	31.12
Harrow	20	1.99	1.67	2.21	2.48	1.94	2.71	1.88	2.04	2.61	1.87	1.72	1.99	25.11
Leamington	21	2.41	1.72	2.44	2.91	2.34	3.01	2.11	2.22	2.89	2.35	2.14	2.29	28.83
Pelee Island	36	2.41	1.99	2.27	2.74	2.83	3.04	2.58	2.52	2.55	2.21	2.35	2.01	29.50
Distant Stations														
Ottawa	65	2.93	2.17	2.77	2.70	2.47	3.52	3.39	2.56	3.23	2.93	2.98	2.58	34.23
Guelph	44	2.39	1.74	1.79	2.38	2.72	2.84	3.07	2.86	2.50	2.39	2.44	2.14	29.26
Stratford	64	3.20	2.65	2.93	2.67	3.08	3.17	3.36	3.04	3.31	3.29	3.59	3.42	37.71
Kapuskasing	19	2.00	1.06	1.56	1.82	2.12	2.33	3.43	2.94	3.54	2.50	2.39	1.90	27.59
Huntsville	30	3.09	2.45	2.78	2.09	2.85	3.69	2.96	2.70	3.84	3.44	3.24	3.28	36.41
Simcoe	21	3.51	2.64	2.93	3.20	2.51	2.81	2.92	2.59	3.00	2.68	3.31	3.05	35.15
Grimsby	19	2.81	2.23	2.37	3.01	2.89	3.18	2.81	3.01	2.71	2.82	2.38	2.00	32.22

Natural Vegetation

Although the natural forest that covered Essex County at the time of the advent of the first settlers is nearly all gone there is sufficient evidence to indicate that it was chiefly hardwood trees. Halliday places the county in the deciduous forest region—Niagara section.*

On the heavier soils the original forest was an association of broad-leaved trees. The elms (American and Rock) probably occurred most frequently and were intermingled with ash, oak, hickory, sycamore and soft maple. On the lighter soils near Lake Erie there is an intermixing of maples, oak, cherry and beech.

Due to the southerly position of the county, one finds many species that do not grow in the more northerly sections of Ontario. Amongst these are chestnut, tulip tree, mockernut and pignut hickories, scarlet, black and pin oaks, black gum, blue ash, magnolia, popaw, Kentucky coffee tree, redbud, red mulberry and sassafras. In the county, black walnut, sycamore, swamp white oak and shagbark hickory are common.

However, the association consists primarily of beech and sugar maple, together with basswood, red maple and (Northern) red, white and bur oak.

In two small areas, one north of Tecumseh and the other north of Tilbury, a soil with a much deeper surface horizon rich in humus occurs. It is believed that this area developed under a wet grassland type of vegetation. It is reasoned that this caused the deep surface development similar to the prairie soils.

*Halliday, W. E. D., A Forest Classification for Canada. Bull. 89, Forest Service, Dept. of Mines and Resources.

PART III

THE CLASSIFICATION AND DESCRIPTION OF ESSEX COUNTY SOILS

The soil on any site is a complex body. It is the result of a definite set of conditions of climate, vegetation, relief, drainage, parent material, and cultural practices. The product of the interaction of these factors is manifest in the soil profile. It is upon the basis of soil profile that the soils in Essex County are classified. In order to map soils it is necessary to consider length and breadth as well as depth. Thus when making a soil map, areas, in which the soil profile is reasonably similar, are shown on the soil map as the same soil type.

In a well drained soil one finds a series of well-defined horizontal layers of material. These layers, or horizons, vary in thickness and such properties as color, texture, structure, consistency, and clarity of demarcation. In poorly drained soils the horizons are often not as well marked and are frequently mottled. The series of layers from the surface down to and including the parent material is called the soil profile.

The Soil Profile

Soil layers or horizons are grouped under three main headings—A, B, and C. The A horizon has been leached of some mineral constituents but contains an accumulation of organic materials in the upper part. Under forest vegetation the A_0 occurs as an accumulation of organic materials—leaves and wood in varying stages of decay. In the A_1 layer the mineral particles are coated with organic matter, endowing this layer with its dark color. The A_2 layer has little or no organic coating and is the most leached layer in the profile. The A_{22} is usually lighter in color and in this region is sometimes the layer of maximum leaching.

The B horizons are usually darker in color and heavier in texture than the A_2 horizon and the structural aggregates are well formed. It is a layer of accumulation of some of the materials removed from the A horizon in the leaching process. It is chiefly iron, alumina, and fine clay that accumulate in this layer. The B_2 represents the layer of maximum accumulation and the B_1 and B_3 are transitional layers from A to B and B to C respectively.

The parent material from which the soil has developed is designated as the C horizon. The upper slightly weathered part of the C horizon is sometimes designated as the C_1 horizon.

Profile Variations

Profiles vary in color, clarity of demarcation, and depth, depending on such factors as parent material, drainage, relief, texture, climate, vegetation and farming practices. The normal type for the region, as diagrammatically illustrated for the Fox Series on Page (19) occurs only under conditions of good drainage with forest vegetation. The various combinations of characteristics can be recognized and the soils classified on the basis of the appearance of the soil profile. Under conditions of good drainage with open sandy parent material a deeply weathered profile exhibiting a shallow A_1 layer and a weakly developed B horizon occurs. On poorly drained sites relatively more organic matter accumulates and the A_1 becomes deeper. Under these conditions the B horizon is normally replaced by a "Glei" horizon. It is usually a drab grey color with or without rusty brown blotches or mottles. Although a great number of combinations of soil conditions are possible and can be classified, the result of the dominant type of development in Essex County are reflected in the Grey-Brown Podsolic Great Soil Group on the well-drained soils, the Dark Grey Gleisolic on the poorly drained intrazonal, the Wiesenboden on the poorly drained intrazonal soils that developed under non-forest vegetation, and the Bogs on the poorly drained peats and muck.

Regional Soil Survey

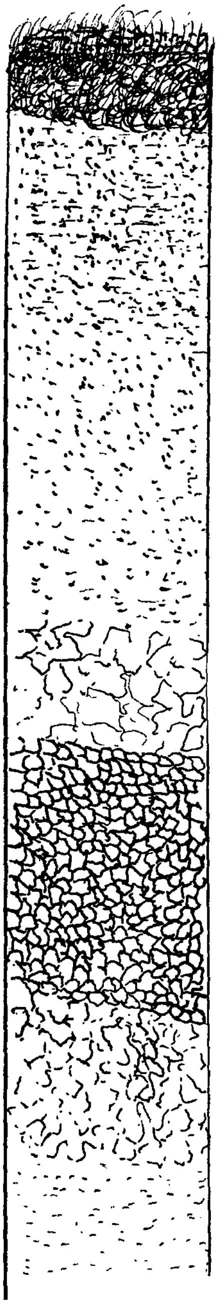
Under the vegetative and climatic environmental conditions that prevail in Essex County the well drained soils exhibit Grey-Brown Podsolic characteristics.

The following description of a Fox sandy loam profile is typical of the development on a well drained virgin site.

Location: Lot 5, Conc. A., Mersea Township.

Site: On a very slight slope towards Lake Erie (one quarter of a mile to the south).

Vegetation: Red and white oak, cherry; thickly wooded.



A_0 and A_{00} horizons—(1-1½ inches). A covering of recent leaves mixed with partially decomposed leaves.

A_1 horizon—(3-4 inches), dark grey brown sandy loam; high in organic matter; medium crumb structure; very friable consistency; stonefree; pH 6.0.

A_{21} horizon—(10-12 inches), light brown sandy loam; weak platy to single grain structure; friable consistency; stonefree; pH 5.9.

A_{22} horizon—(15 inches), light yellow brown sandy loam; lighter than A_2; weak platy structure; very friable consistency; stonefree; pH 5.8.

B_1 horizon—(8 inches) slightly mottled, light orange and greyish brown loam; mixture of A and B horizons; granular structure; friable consistency; stonefree; pH 6.2.

B_2 horizon—(12-15 inches) brown sandy clay loam; medium nuciform structure; friable consistency; stonefree; pH 6.8.

B_3 horizon—(10 inches) mixed brown loam and grey sandy loam (grading between B and parent material); weakly developed nuciform structure; stonefree; pH 6.8.

C horizon—Grey calcareous stonefree sand; large proportion of dark colored fragments, pH 7.4.—7.6.

The chemical characteristics of this type are indicated in table (3).

TABLE 3

ANALYSIS OF A FOX SANDY LOAM PROFILE

(Moisture-Free Basis)

Location—Essex County, Mersea Township, Con. 1, Southwest of Leamington.
Site—Almost level.
Vegetation—Maple, beech, oak and hickory.

Horizon	Depth in Inches	pH	Nitrogen %	Loss of Ignition	SiO_2	AL_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	P_2O_5
A_1	0-3	6.9	0.06	2.53	81.02	9.25	2.21	1.39	0.65	1.28	1.31	0.12
A_1	3-6	7.0	0.04	1.38	81.78	9.54	2.29	1.36	0.65	1.56	1.61	0.11
A_2	12-18	6.6	0.01	0.93	82.17	9.65	2.25	1.38	0.69	1.55	2.01	0.07
A_3	24-30	6.8	0.01	0.85	81.69	8.78	2.39	1.51	0.69	1.86	1.15	0.09
B	42-48	6.3	0.02	1.73	76.91	11.48	3.91	1.44	0.81	1.73	1.26	0.09
C_1	66-72	8.8	0.03	8.93	66.53	8.13	1.93	10.22	1.80	1.22	1.35	0.07
C_2	84-90	8.9	0.03	9.19	66.71	8.22	1.75	10.10	1.49	1.42	1.20	0.06

*Analysis by:

Chemical Laboratories,
Science Service, Department of Agriculture,
Ottawa, March 23, 1945.

L. E. Wright,
Chemist.

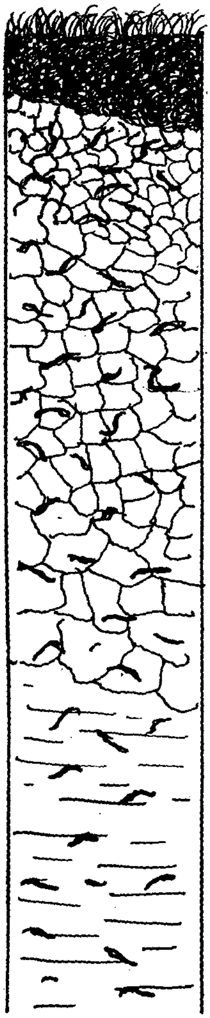
On the heavy textured, poorly drained areas of the county, the soils exhibit the characteristics of the Dark Grey Gleisolic Great Soil Group. Soils in this group are characterized by a fairly deep A_1 layer high in organic matter. The glei A_2 is usually a light grey, often mottled with yellow brown. The structure ranges from medium nuciform to medium blocky. The G (gleiB) is usually heavier and tends towards a massive structure.

The following description of a Brookston clay is typical of this type of development.

Location: Lot 3, Conc. X Sandwich South.

Site: Level position on heavy ground moraine material, (possibly modified by lacustrine action.)

Vegetation: Elm predominant; considerable oak, ash, and soft maple; occasional hard maple; some grass—woodlot may have been pastured.



A_1 horizon—(4-6 inches), very dark grey to black silty clay; medium to fine crumb structure; very friable consistency; stonefree; pH 6.7.

Glei A_2 horizon—(6-8 inches), drab grey clay; yellow brown mottlings which increase with depth; coarse nuciform structure; stonefree; pH 6.6.

G_1 horizon—(18 inches), drab grey clay with yellow brown mottling; coarse blocky structure; hard consistency; pH 7.0.

G_2 horizon—(6-8 inches), drab grey to light grey clay, coarse blocky to massive structure; hard consistency; pH 7.2.

C horizon—(at 36 inches), grey to light grey, heavy gritty clay till; calcareous; pH 7.6.

Elm predominated the natural vegetation on the poorly drained, heavy textured soils

Under conditions of poor drainage and a vegetation of grasses, reeds and sedges a soil has developed which has a deep dark surface layer (usually over ten inches) and a drab blue grey subsoil. These soils are classed with the great soil group, Wiesenboden (or Meadow Soils.)

Under conditions of still poorer drainage layers of partially decomposed organic matter accumulate. When this layer is shallow the soil developed is usually considered to be a Half Bog. The deeper deposits, called Muck, are classed as Bog soils.

Units of Classification

A soil series is a group of soils formed from similar parent materials and having similar profiles but varying within a narrow range of texture, particularly in the surface soil. The Fox series was first mapped in Norfolk County and has been mapped in several counties since that time. Wherever it is mapped it exhibits similar profile characteristics.

The soils within a soil series are divided into soil types on the basis of texture. The name Fox sandy loam refers to a soil in the Fox series with a sandy loam surface.

Phases are used to indicate variation from the normal soil type in such factors as surface stoniness, erosion, shallowness, etc. A Burford loam, shallow phase, would be a soil of the Burford series, with a loam surface, but having a relatively shallow gravelly deposit underlain by clay or other heavy materials at depths less than three feet.

Those soils developed on similar parent materials but differing in characteristics of the solum due to differences of relief or drainage are referred to as a "soil catena." In the following key the catenary relationship of the soils of Essex County is indicated.

KEY TO THE CLASSIFICATION OF THE SOILS IN ESSEX COUNTY

A. SOILS FORMED FROM LIMESTONE TILL

(a) Poor natural drainage

(i) Dark Grey Gleisolic Great Soil Group.

1. Parkhill loam.......... 5,000 acres
2. Parkhill loam, red sand spot phase.......... 5,000 acres

B. SOILS FORMED FROM LACUSTRINE MATERIALS

I. Medium Textured Materials.

(a) Imperfect natural drainage.

(i) Grey Brown Podsolic Great Soil Group

1. Tuscola fine sandy loam.......... 6,000 acres

(b) Poor drainage

(i) Dark Grey Gleisolic Great Soil Group

1. Colwood fine sandy loam.......... 7,000 acres

II. Heavy Textured Materials

(a) Poor natural drainage.

(i) Formed under deciduous forest; (dark surface usually less than 10 inches.)
Dark Grey Gleisolic Great Soil Group.

1. Toledo clay.......... 17,500 acres
2. Toledo silt loam.......... 1,000 acres

(ii) Formed under grasses, reeds and sedges; (dark surface usually more than 10 inches.)
Wiesenboden Great Soil Group.

1. Clyde clay.......... 2,500 acres

C. SOILS FORMED FROM LUCUSTRO-MORAINIC MATERIALS.

I. Limestone parent material with some shale.

(a) Imperfect natural drainage

(i) Grey Brown Podsolic Great Soil Group.

1. Perth Clay.......... 9,000 acres
2. Perth clay loam.......... 8,000 acres

(b) Poor natural drainage

(i) Dark Grey Gleisolic Great Soil Group.

1. Brookston clay.......... 250,000 acres
2. Brookston clay loam.......... 30,000 acres
3. Brookston clay, sand spot phase.......... 18,000 acres

II. Shaley limestone parent materials

(a) Imperfect natural drainage

(i) Grey-Brown Podsolic Great Soil Group.

1. Caistor clay.......... 13,500 acres
2. Caistor clay loam.......... 2,500 acres
3. Caistor clay, sand spot phase.......... 1,500 acres

(b) Poor natural drainage

(i) Dark Grey Gleisolic Great Soil Group

1. Jeddo clay.......... 3,500 acres

D. SOILS FORMED FROM POORLY SORTED OUTWASH MATERIALS

(a) Good natural drainage

(i) Grey Brown Podsolic Great Soil Group.

1. Harrow sandy loam	3,500 acres
2. Harrow loam	4,000 acres

E. SOILS FORMED FROM WELL SORTED OUTWASH MATERIALS

I. Sandy Materials.

(a) Excessive natural drainage.

(i) Azonal Group.

1. Plainfield sand	1,700 acres

(b) Good natural drainage.

(i) Grey Brown Podsolic Great Soil Group.

1. Fox sandy loam	5,300 acres

(c) Poor natural drainage

(i) Dark Grey Gleisolic Great Soil Group.

1. Granby sand	1,000 acres

II. Gravelly Materials

(a) Good natural drainage

(i) Grey Brown Podsolic Great Soil Group.

1. Burford loam	3,700 acres
2. Burford loam, shallow phase	5,300 acres

F. SOILS FORMED FROM SHALLOW SANDS OVER CLAY

(a) Imperfect natural drainage

(i) Grey Brown Podsolic Great Soil Group.

1. Berrien sandy loam	16,000 acres
2. Berrien sand	8,000 acres

(b) Poor natural drainage

(i) Dark Grey Gleisolic Great Soil Group.

1. Wauseon sandy loam	3,000 acres

G. MISCELLANEOUS SOILS

Farmington	2,000 acres
Eastport sand	2,500 acres
Bottom land	7,300 acres

H. ORGANIC SOILS

Marsh	7,000 acres
Muck	1,700 acres

DESCRIPTION OF ESSEX COUNTY SOILS

A. SOILS FORMED FROM LIMESTONE TILL

Limestone tills are commonly found in physiographic forms, such as drumlinized till plains and smooth till plains. The Parkhill is the poorly drained member of the Guelph catena. The well drained member does not occur in sufficiently large areas to warrant its separation in Essex County.

The Parkhill soils have developed from a mixture of Onondaga magnesian limestone and smaller amounts of dark brown Huron shale, as well as occasional Precambrian rocks. The unassorted till has been altered slightly by mixing with sandy outwash and finer lacustrine materials. The parent material is loamy in nature containing a small percentage of fine material and a considerable amount of pebbles and stones. The subsoil is freely permeable but because of the level or depressional topographic position occupied by the Parkhill series it is poorly drained.

(a) Poor natural Drainage

Parkhill Loam (5,000 acres)

Parkhill Loam—Red Sand Spot Phase (5,000 acres)

Other than the sharp colour contrast between the dark surface and drab grey lower layers the horizons in the profile are poorly defined. The profile exhibits characteristics typical of the Dark Grey Gleisolic soils. The following profile description is of a cultivated soil:

A_c—6-8 inches dark grey brown or very dark grey loam; medium crumb structure; friable consistency; stonefree; high in organic matter; neutral, pH 7.0.

G —20-24 inches of drab grey loam mottled with light yellow brown; weak blocky structure; gritty; pH 6.8 7.2.

C —Light grey calcareous loamy till; gritty; chiefly derived from limestone with some shale and precambrian rocks; numerous stones; pH 7.8.

The topography of the Parkhill series is level to slightly undulating. Both the external and internal drainage are poor. The natural forest vegetation includes elm, ash, oak, with some beech, maple, and sycamore.

Parkhill loam occurs in two tracts. One immediately west of Harrow and the other in the southeastern part of the Township of Gosfield South.

Parkhill Loam (red sand spot phase)

The area mapped as red sand spot phase is characterized by shallow sandy knolls scattered over the area. These knolls are slightly acid and the reddish color, especially in summer, is quite noticeable. Chemical analyses from a sample west of Harrow show the HCl extract to contain 41.9% Fe_2O_3 It is quite possible the pronounced red colour is due to the high iron content.

Agriculture

The Parkhill types are mostly tile-drained and are intensively cropped. Their chief use is in the growing of vegetables and canning crops, which include cabbages, lettuce, celery and tomatoes. Considerable corn, wheat, beans, burley and black tobacco is grown. In the undrained condition, the Parkhill soils produce fair forage crops. However before red clover and alfalfa can be satisfactorily included in the seed mixture drainage improvement is desirable. On the red sand spot phase, where the depth of sand exceeds two feet, orchards grow fairly well, providing the drainage is satisfactory.

The chief fertility need on this type is phosphorus and to a lesser extent potash and organic matter, particularly on the sand spot phase.

B. SOILS FORMED FROM LACUSTRINE MATERIALS

While the continental glacier was receding much, and at times, all of Essex County was submerged by water of the glacial lakes. Streams fed by the melting ice carried fine materials into the lakes where they settled out in the still water. The occurence of varves in the lacustrine soils of Essex County is not uncommon.

The medium textured soils of Essex County occur in the Brant catena,the Tuscola being the imperfectly drained member and the Colwood the poorly drained member. The heavy textured lacustrine soils that developed under a forest vegetation are members of the Brantford catena. Only the poorly drained member, the Toledo, was mapped in Essex County.

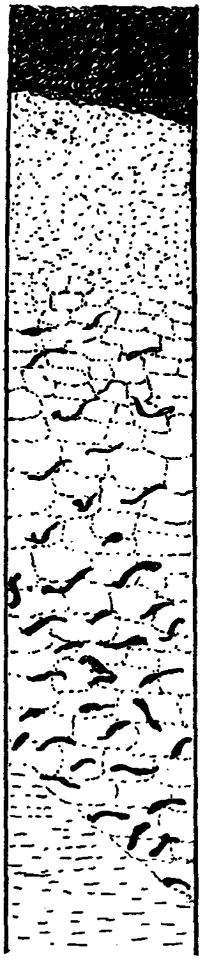
The Clyde series presumably developed under grass vegetation and poor drainage on heavy lacustrine materials.

I. Medium Textured Materials

(a) Imperfect Natural Drainage

Tuscola Fine Sandy Loam (6,000 acres)

The Tuscola soils occur chiefly in an area south of Harrow and another area north and east of Leamington. The profile exhibits characteristics similar to the Grey Brown Podsolic soils. The following profile description is of a cultivated soil.



A_C 6-8 inches of dark brown fine sandy loam; fine crumb structure; friable consistency; high in organic matter; stonefree; pH 6.8.

A_2 10-12 inches of light grey brown fine sandy loam; fine crumb structure; friable consistency; stonefree; some mottling on lower part of horizon; pH 7.0.

B —30-36 inches stratified fine sand, silt and clay; light grey mottled with yellow brown; friable consistency; stonefree; pH 7.2.

C —Light grey, calcareous, stratified silt and clay; stonefree; pH 7.8.

The topography ranges from level to slightly undulating.

The natural drainage is imperfect.

Elm and soft maple are the dominant species native to this series.

Agriculture

This soil type is used extensively for the growing of vegetables, canning crops, corn, beans, wheat, burley and black tobacco and to a lesser extent grapes and tree fruits. Flue-cured tobacco is grown on some of the better drained sites but the soil type is not well suited to its production. Clovers are grown successfully. This type responds to improved drainage and some of the above crops can be grown successfully only if the drainage is improved.

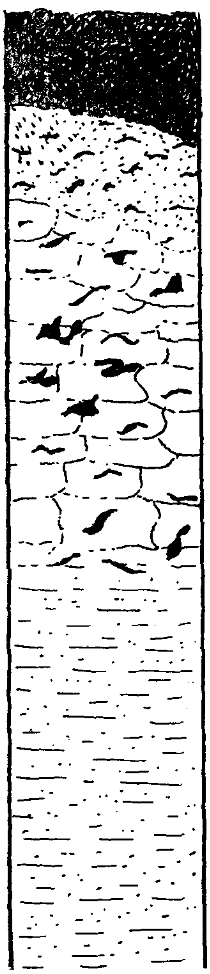
Where intensive cropping to intertilled crops is practised on the long, gentle slopes erosion may become a problem.

(b) Poor Drainage.

Colwood Fine Sandy Loam (7,000 acres)

The Colwood series is the poorly drained associate of the Tuscola and belongs to the great soil group, Dark Grey Gleisolic. The main area is in the township of Sandwich West.

The profile horizons are often indistinct.



A_c—6 inches dark grey, fine sandy loam; fine granular structure; friable consistency; stonefree; pH 6.8.

A_2—6 inches of grey loam and fine sandy loam with yellowish brown mottlings; very weak fine nuciform structure; stonefree; pH 6.8.

G —20 inches grey loam and silt loam with light yellowish brown mottlings; somewhat massive structure, stonefree; pH 7.2.

C —Grey calcareous loam, fine sandy loam, and silt loam; stratified or varved; stonefree; pH 7.6.

The topography is level to depressional. The natural drainage is poor. The Colwood developed under deciduous tree cover consisting chiefly of soft maple and elm.

Agriculture

When the Colwood is artificially drained, it is well suited to the production of vegetables, canning crops, and sugar beets. Without improved drainage it is used largely for hay and pasture or remains under tree cover.

The chief fertility need of this soil is phosphorus in conjunction with the improvement in drainage indicated above.

II. Heavy Textured Materials

(a) Poor Natural Drainage

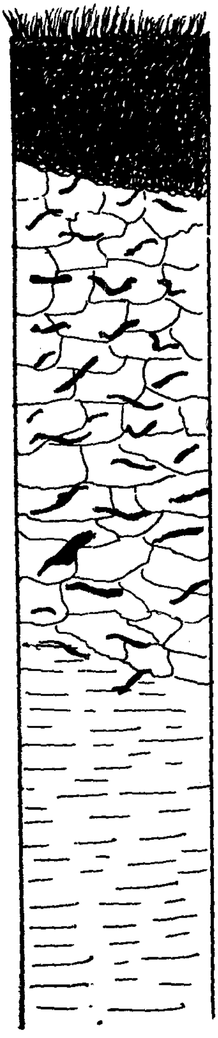
(i) Formed under deciduous forest; dark surface usually less than 10 inches deep.

Toledo clay (17,500 acres)

Toledo Silt Loam (1,000 acres)

The Toledo soils developed from fine textured lacustrine materials under a deciduous forest and exhibit the characteristics of the Dark Grey Gleisolic Soils. The main areas occur in Sandwich West and the Point Pelee district of Mersea Township. Toledo silt loam is mapped south of Windsor in the township of Sandwich West and differs from the clay in the higher proportion of silt that it contains. The Toledo is the poorly drained member of the Brantford catena.

The following is a general description of a profile under cultivated conditions.



A_c—8-10 inches of dark grey to black clay and silt loam; medium to large granular structure; sticky to plastic when wet; stonefree; high in organic matter; pH 7.0.

G —24-30 inches of heavy grey plastic clay with yellow and orange brown mottles; coarse blocky structure; tough, plastic consistency; stonefree; pH 7.0.

C —Grey calcareous heavy clay; stonefree; pH 7.6.

The topography is level to slightly undulating. The natural drainage is poor. The natural forest vegetation is dominantly elm with some ash and red oak.

Agriculture

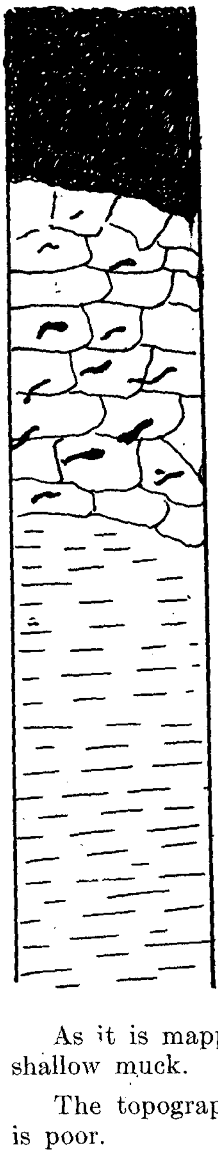
The chief limitation to successful crop production on the Toledo soils is poor drainage. Provided drainage improvement is effected, wheat, corn and beans grow satisfactorily. In the Point Pelee area draining and pumping are necessary to provide satisfactory drainage. Once drained these soils are well suited to the growing of tomatoes and onions.

(ii) Formed under grasses, reeds and sedges; dark surface usually more than 10 inches deep.

Clyde Clay (2,500 acres)

Clyde clay, the only member of the series in Essex County, is mapped in the Riverside-Tecumseh area and north of Tilbury. It is a highly organic soil developed under very wet conditions with a vegetation of grass, reeds, cattails and swamp cover. The Clyde series exhibits the characteristics of the Wiesenboden soils.

The profile is characterized by a deep black surface layer.



A_c—10-12 inches of dark grey to black clay; coarse crumb structure; slightly plastic when wet; stonefree; pH 7.0.

G_1—10 inches of dark grey clay, slightly mottled; plastic; weakly developed blocky structure; stonefree; pH 6.8.

G_2—Grey clay with yellowish brown mottlings; massive structure; plastic consistency; stonefree; pH 7.0

C —Grey calcareous stonefree clay;

As it is mapped in Essex the Clyde series includes some small areas of shallow muck.

The topography is level to slightly depressional. The natural drainage is poor.

Agriculture

Very little livestock is kept on the Clyde series. The land is devoted chiefly to the production of canning crops, wheat, corn and beans. The land is intensively cropped with very little land devoted to pasture. Artificial drainage is essential for the type of farming practiced on this soil. The cost of drainage is high as dykes and pumping stations must be maintained. The Clyde is a highly productive and reliable soil once satisfactory drainage conditions are effected. To maintain productivity and a satisfactory physical condition in the Clyde soils adequate organic matter levels must be maintained.

C. SOILS FORMED FROM LACUSTRO-MORAINIC MATERIALS

The parent material of this group of soils is a heavy ground moraine which has been altered to greater or lesser degree by wave action and lacustrine deposition. The depth of sediment on the surface varies from practically nil to two or three feet. Two catenas occur on the lacustro-morainic materials, the Huron and the Haldimand. The Huron catena has developed from dolomitic limestone materials intermixed with a fair proportion of shale. The imperfectly drained member, the Perth, and the poorly drained member, the Brookston, were both mapped in Essex County.

The Haldimand catena, which is similar in many respects to the Huron catena, is developed on parent material that is considerably higher in shale. The well drained member is not represented but the imperfectly drained member, the Caistor series covers a considerable acreage. The poorly drained member is the Jeddo series.

The favorable climatic environment of Essex County increases the usability of the Huron and Haldimand catenas over other areas. With improved drainage, the long growing season permits the growing of high value crops. Large areas of similar types in Huron, Perth, and Wellington counties grow relatively low value crops because of the higher snowfall and shorter growing season. With low value crops it is doubtful if tile drainage on the poorly drained member would be a profitable investment.

I. Limestone Parent Material With Some Shale

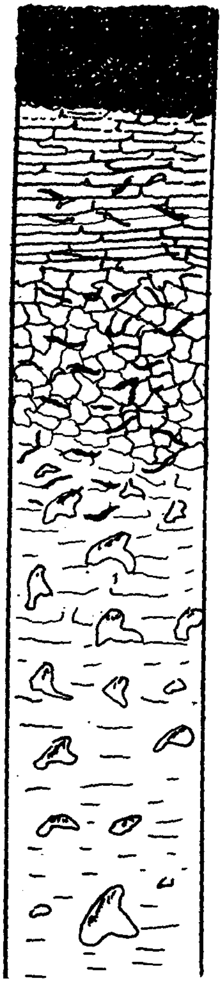
(a) Imperfect Natural Drainage.

Perth Clay (9,000 acres)

Perth Clay Loam (8,000 acres)

Although the Perth soils are imperfectly drained the profile exhibits sufficient Grey Brown Podsolic characteristics to be included with that group.

The following is a description of a profile on a cultivated soil.



A_c—6 inches of dark grey clay loam; medium crumb structure; friable consistency; some stones; pH 6.5.

A_2—10 inches of mottled yellow brown clay loam; medium nuciform structure; friable consistency; stony; pH 6.5.

B —10-12 inches of mottled brown clay; coarse blocky structure; plastic when wet; stony; pH 7.0.

C —Grey calcareous heavy clay till; some brown mottles; coarse blocky structure; plastic consistency; gritty; pH 7.4.

Surface boulders occur but rarely in sufficiently large numbers to prohibit cultivation. Occasionally it is necessary to pick and draw stones from the fields.

The topography of the Perth series in Essex County is nearly level to slightly undulating. The natural drainage is fair but some poorly drained spots are included in mapping. The natural forest vegetation is elm, ash, hickory, with some oak and maple.

Fairly large areas of Perth clay and Perth clay loam occur in the southwestern section of the county.

Agriculture

The Perth types are used mostly for general farming and dairying and are fairly well adapted for these purposes. There are a few apple orchards on the Perth Soils but the chief cash crops are corn, wheat, tobacco and canning crops.

The chief fertility needs are organic matter and phosphate. Drainage improvement is sometimes necessary for satisfactory crop production depending on the crop to be grown.

(b) Poor Natural Drainage

Brookston Clay (250,000 acres)

Brookston Clay Loam (30,000 acres)

Brookston Clay—sand spot phase (18,000 acres)

The Brookston series is the poorly drained member of the Huron catena. This series has a fairly high organic matter content in the surface soil and it exhibits the characteristic of the Dark Grey Gleisolic soils.

The profile horizons (except the A_1) are less distinct than in the associated well drained soils.

A_c—6-8 inches of dark grey brown clay; medium granular structure; sticky when wet; almost stone-free; pH 6.8—7.0.

GA_2—6 inches of grey drab clay with yellow brown mottlings; fine to medium nuciform structure; sticky when wet; pH 6.8.

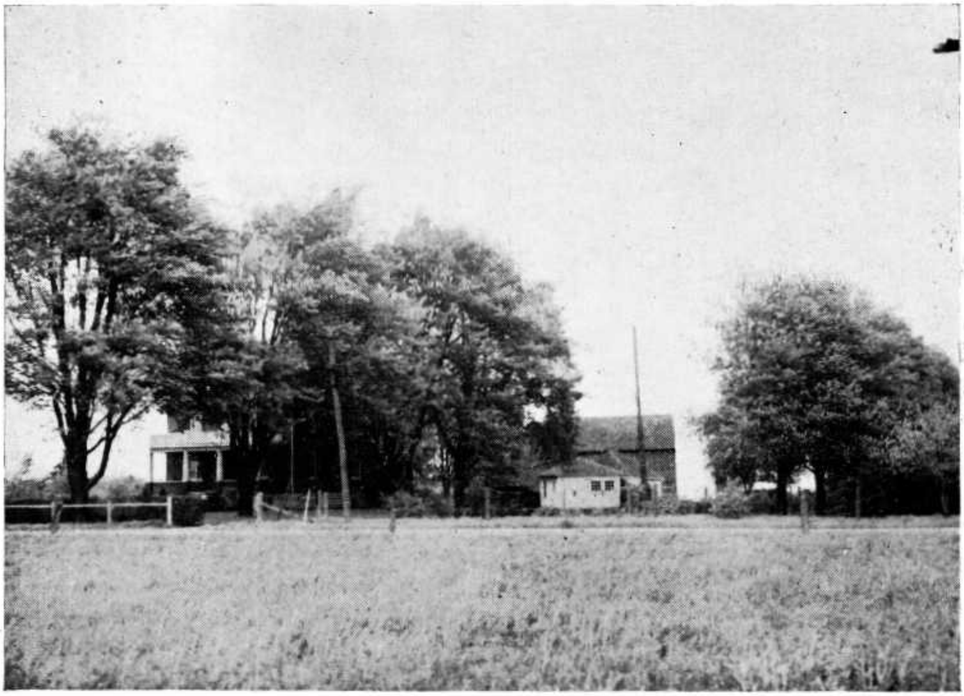
G_1—18 inches of grey clay with yellow brown mottling; coarse blocky structure; tough and plastic; pH 7.0.

G_2—6-8 inches of grey to light grey clay; mottling less intense than in G_1; very coarse blocky to massive structure; tough and plastic; pH 7.2.

C —Heavy calcareous clay till; grey to light grey in colour; gritty; containing shale and limestone fragments; tough and plastic pH 7.8.

There is usually a certain amount of grit and small stones throughout the profile but occasionally there is none in the top 2 or 3 feet. The topography is level to slightly undulating and the natural drainage is poor. The natural forest vegetation is elm with considerable ash, red oak, and soft maple, and occasional hard maple, sycamore, and hickory. Brookston clay, the most extensive soil type in Essex County, is mapped in every township. Brookston clay loam is a large block covering most of Windsor Township and extending south in the County.

Brookston clay (sand spot phase) occurs in large areas in Mersea Township both north and east of Leamington. Small areas are scattered throughout the county. It is often found in association with the Berrien series. The sand spot phase is a condition where shallow sandy knolls similar to the Berrien are scattered over an area of Brookston clay. Usually the sand does not exceed three feet in depth at the centre of the spot. These knolls are more acid having a pH of 6.3 to 6.5.



A Farmstead on Brookston Clay Loam

Agriculture

A considerable amount of general farming, including dairying and beef-raising, is practised on the Brookston series. It grows excellent forage crops of red clover, sweet clover, grasses and alfalfa when drained. Most of the area which has been improved by tile drainage grows large acreages of cash crops such as corn, wheat, beans, canning crops, peas, burley and black tobacco. A few young orchards on drained Brookston appear to be doing fairly well.

The land use on the sand spot phase is similar to the rest of the series except where the area of sandy surface is quite extensive. These areas are often used for vegetable, strawberry and raspberry production. Maintenance of adequate fertility and organic matter levels are more difficult on the sand spots.

The greatest limitation to crop production on the Brookston soils is poor drainage. However, since Essex County is situated in an area where the climate permits the growing of a large number of cash crops, drainage improvement is usually a profitable investment. One of the major problems on the Brookston soils is the maintenance of satisfactory organic matter levels under a short rotation and concentrated cash cropping system of farming. Inherently the Brookston soils are well supplied with organic matter, fairly well supplied with potash and low in phosphorus. Depending on the crop to be grown both potassic and phosphatic fertilizers may be necessary for satisfactory yields.

II. Shaley Limestone Parent Material

(a) Imperfect Natural Drainage

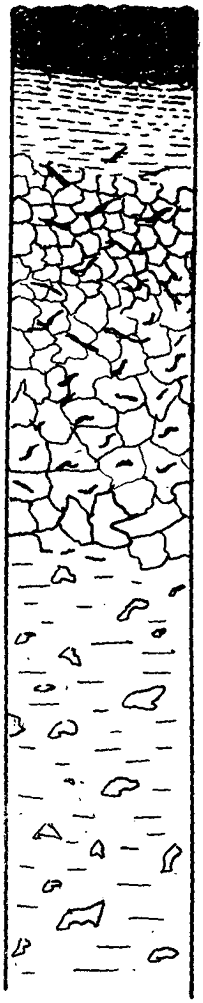
Caistor Clay (13,500 acres)

Caistor Clay Loam (2,500 acres)

Caistor—sand spot phase (1,500 acres)

The Caistor series is the imperfectly drained member of the Haldimand catena. The well drained series does not occur in sufficiently large areas to be mapped in the County. These soils developed from heavy ground morainic tills. The parent material is fairly high in limestone but the shale is present in such quantity that it has a pronounced effect on the profile developed. The Caistor types are located principally in the townships of Gosfield South and Colchester South.

The profile horizons are less distinct than in the well drained Haldimand soils.



A_1—4-6 inches of dark grey clay or clay loam; medium granular structure; friable consistency, sticky when wet; medium to low in organic matter; pH 6.0.—6.3.

A_2—6 inches of yellow brown clay; mottled; medium nuciform structure; friable consistency; pH 6.0.

B_1—8 inches of dark yellowish brown mottled heavy clay; coarse blocky structure; hard consistency; pH 5.8.—6.0.

B_2—16 inches of brown heavy clay; very coarse blocky to massive structure; very hard consistency; pH 6.4—7.0.

C —Grey heavy gritty clay till; fragmental to massive structure; calcareous; pH 7.4.

The natural vegetation is hardwood association of elm, oak, ash, hickory and some beech and maple. The topography is level to undulating and the natural drainage is fair. On the more strongly undulating topography erosion may be moderate, particularly when row crops are grown. The A_2 horizon usually shows up on the slopes imparting a distinct greyish cast to the knolls.

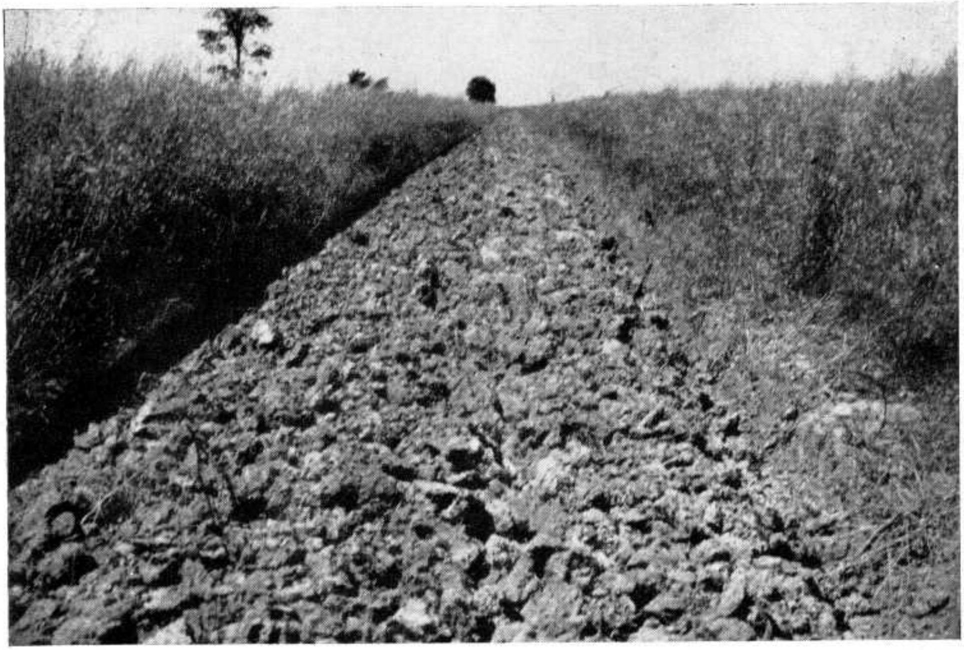
Caistor clay is mapped in South Colchester and South Gosfield. With good farming practices it is a fairly productive soil.

Caistor clay loam is found in the area near the lake west of Kingsville. General farming is the usual type of agriculture practised.

Caistor (sand spot phase) is found in association with the Caistor clay loam. It represents a condition in which low lime sandy materials appear as shallow knolls on the typical Caistor.

Agriculture

The clay and clay loam types of the Caistor series are used for general agriculture, stock raising and some cash cropping. Maintenance of organic matter and satisfactory fertility levels are the chief problems associated with the Caistor soils. Liming should be beneficial since most of the Caistor soils are acid in reaction. In addition to general farm crops commonly grown in a dairy system of farming, cash crops such as wheat, corn, beans, tomatoes burley and black tobacco are grown. Inherently the Caistor series is low in organic matter, phosphorus, and calcium and only moderately well supplied with potash.



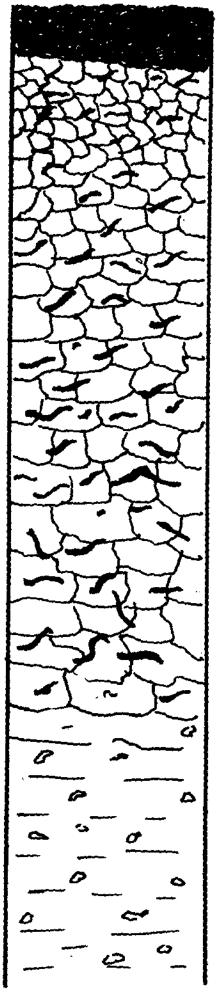
The organic matter content of the acid Caistor soils can be built up through the use of legumes and lime.

On the Caistor sand spot phase, where the sand is deeper and more extensive, truck crops, vegetables, strawberries, raspberries, burley and black tobacco may be grown. The chief fertility needs of the Caistor sand spot phase are organic matter, phosphate, lime and potash. The use and management of the sand spot phase is similar to that of the Brookston sand spot phase.

(b) Poor Natural Drainage

Jeddo Clay (3,500 acres)

Jeddo clay is the poorly drained member of the Haldimand catena. It occurs in one fairly large tract northeast of Harrow. In part of the area it has a shallow accumulation of lacustrine material. It exhibits the characteristics of the Dark Grey Gleisolic soils.



A_1—3-4 inches of grey to dark grey clay; fine granular structure; friable, sticky consistency; stonefree; pH 6.0.

GA_2—6-8 inches of drab grey clay with yellow brown mottling; weak blocky structure; hard, sticky consistency; some grittiness; pH 6.0.

G_1—18 inches of drab grey heavy clay with yellow brown mottling; medium blocky structure; sticky to plastic when wet; gritty; pH 7.0.

G_2—12 inches of grey heavy clay; less mottling than in the G_1 horizon; medium blocky to massive consistency; gritty; pH 7.0.

C —Grey calcareous heavy clay till; a few stones and grit of limestone and shale origin; pH 7.6.

The natural forest vegetation is mostly elm with some hickory. The topography is almost level and the natural drainage is quite poor.

Agriculture

Drainage improvement has not been carried on as extensively on the Jeddo soils as on the Brookston series. In Essex County the Jeddo series occurs in an area where it appears difficult to obtain outlets. The depth of the organic layer is deeper than in the Brookston and the stonefree, lacustrine overburden covering the underlying gritty till, ranges from a few inches to over two feet in places. This is considerably greater depth than is usually found on the Brookston series. Usually the Jeddo is slightly more acid than the Brookston.

In Essex County the Jeddo soils are used chiefly for the growing of grain and row crops such as wheat, corn, and beans. Only a very small proportion of these soils are used for pasture and forage crop purposes. Poor drainage is the greatest limitation to crop production.

D. SOILS FORMED FROM POORLY SORTED OUTWASH MATERIAL

1. Good Natural Drainage

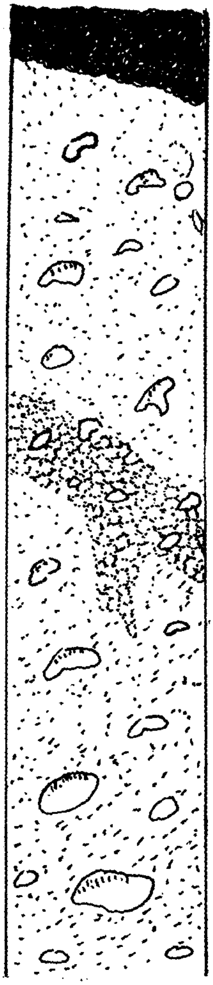
The poorly sorted materials probably resulted from the action of waves on a sandy moraine. They are characterized by sandy materials containing scattered stones and local bouldery ridges. The Harrow loam type is underlain by materials containing a large proportion of fine materials.

Harrow Sandy Loam (3,500 acres)

Harrow Loam (4,000 acres)

Both the sandy loam and loam types of the Harrow series are found in the Harrow—Kingsville—Leamington area. The Harrow series is well drained and is the only catenary member mapped and is characteristic of Grey Brown Podsolic soils. The range in characteristics of the Harrow series is wide. On a survey, where a larger scale of mapping was being used, much of the Harrow loam would be correlated with the Guelph and Huron catenas.

The following is a profile description of Harrow sandy loam.



A_C—3-6 inches of dark grey brown sandy loam; fine crumb structure; low in organic matter; friable consistency; occasional stones and large boulders; pH 6.2 to 6.5.

A_2—16-24 inches of light yellow brown sand; friable consistency; weak platy structure; occasional stones; pH 6.2.

B —6 inches of reddish brown loam; fine nuciform structure; friable consistency; pH 7.0.

C —Grey sand with some grit and stones; calcareous; pH 8.0.

The types vary from sites that are free of stones to those that are quite bouldery. The bouldery ridges occur chiefly on the Harrow sandy loam type.

The Harrow loam is formed from slightly heavier parent material. The profile is sometimes underlain by a clay loam till. The loam type as mapped includes small areas which are imperfectly drained.

The natural forest vegetation is mostly hard maple, oak, and beech with some walnut, ash and elm. The topography is undulating and the natural drainage is good with inclusions of imperfectly drained areas in the Harrow loam type.

Agriculture

The Harrow series is intensively farmed. Early vegetables, raspberries, and strawberries are important crops. Peach, pear, and cherry orchards appear to grow well. Tobacco is grown extensively but owing to the variability of texture, the Harrow loam is less well suited to the growing of flue-cured tobacco than is the lighter textured sandy loam type.

Important considerations when farming the Harrow series are fertility and organic matter maintenance, and erosion control where intensive cultivation is practised. In dry years the use capability of the series would be greatly increased if irrigation facilities were available. The main fertility needs of the Harrow soils are organic matter, phosphate and potash.

E. SOILS FORMED FROM WELL SORTED OUTWASH MATERIALS.

The parent material of this group of soils was deposited in still or slowly moving water by the post glacial lakes that covered Essex County and occurs as well sorted gravelly and sandy outwash deposits, which assume the form of sand bars, outwash plains or beaches. The sandy materials are members of the Fox catena, of which the Plainfield is the excessively drained, the Fox the well drained, and the Granby the poorly drained members. The gravelly materials are members of the Burford catena, of which the Burford is the well drained and only member mapped in Essex County. Where pits are exposed the gravel reaches several feet in depth as exhibited at Ruthven. However in other parts of the country the overburden of gravel is shallow and rests on heavier materials at depths of three feet and less. Such conditions are mapped as a shallow phase. In Essex County the outwash materials contain a large proportion of limestone materials, with lesser amounts of dark brown shale.

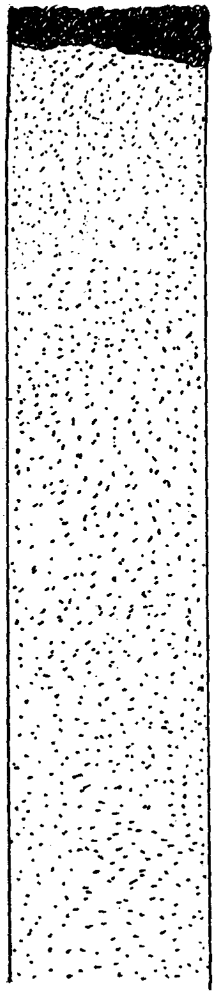
I. Sandy Materials

(a) Excessive Natural Drainage

Plainfield Sand (1,700 acres)

This type occurs as excessively drained sand ridges in Sandwich West and Mersea Townships.

The coarse nature of the materials allow for ready percolation of soil moisture and an A/C type of profile has developed. Only occasionally is there a faint trace of a B horizon. The Plainfield exhibits the characteristics of an azonal soil.



A_C—3-4 inches of yellow grey sand; low in organic matter; single grain structure; stone free; pH 6.0.

C —Light yellow sand grading into grey sand; single grain structure; grey sand usually calcareous; stonefree; pH of upper part of horizon about 6.0; occasionally heavier textured materials may occur at depths of 5 to 6 feet.

The natural forest vegetation is maple, beech and cherry. The drainage is excessive and the topography strongly undulating and ridged.

Agriculture

Very little of this type is cultivated. It is quite droughty and subject to wind and water erosion. For this reason much of the area has gone to wasteland. A peach and cherry orchard appeared to be doing well on this type.

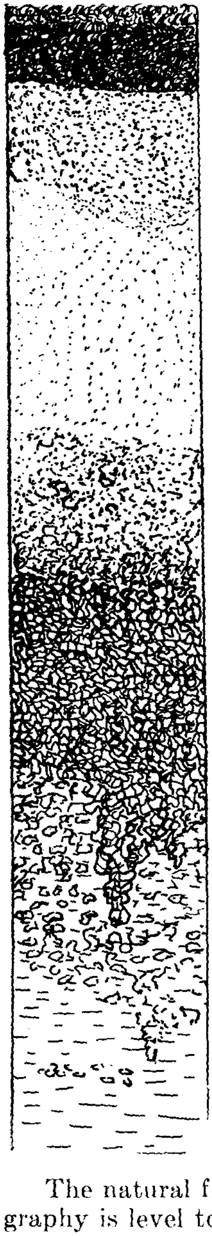
Because of inherent low fertility and susceptibility to wind erosion the Plainfield would appear to serve its most useful purpose under permanent tree cover. The phosphorus and potassium content is very low as well as very low organic matter levels.

Fox Sandy Loam (5,300 acres)

(b) Good Natural Drainage

The Fox series is the well drained member of the catena bearing the same name. It is developed on well sorted sandy and fine gravelly materials.

The Fox exhibits the characteristics of the Grey Brown Podsolic soils. In woodlots, where the profile has been undisturbed shallow podsols have developed in the A horizon of the former Grey Brown Podsolic profile.



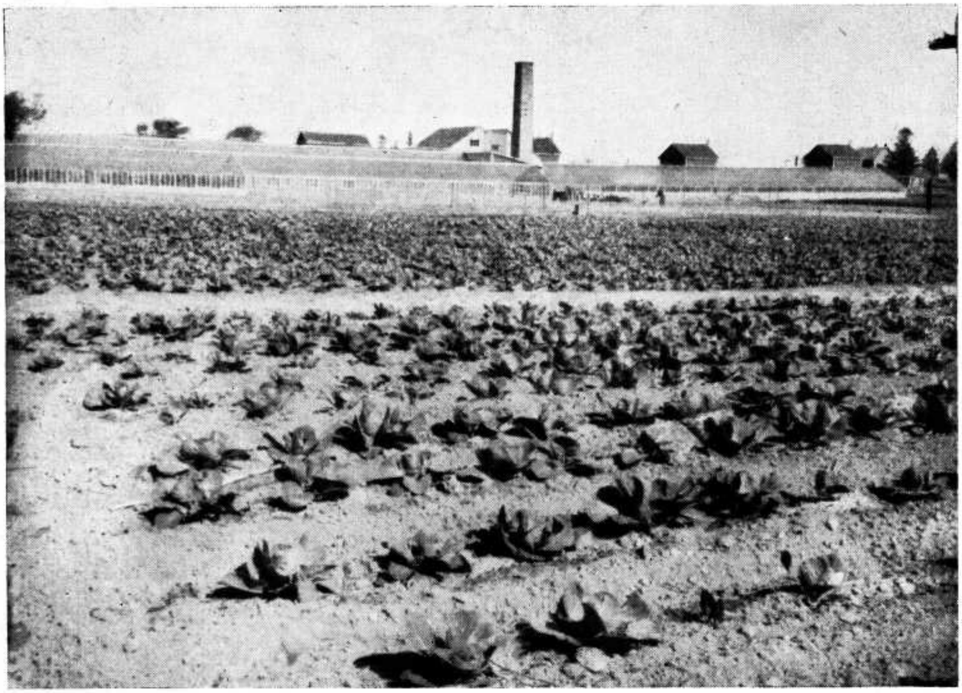
A_c—5-6 inches of dark brown sandy loam; medium in organic matter content; medium crumb structure; very friable consistency; stonefree; pH 6.0.

A_2—15-42 inches of light brown sand and sandy loam; wavy horizon; weak platy structure; friable consistency; pH 5.8.

B —6-24 inches of reddish brown sandy clay loam or loam; wavy horizon; medium nuciform structure; sticky when wet; pH 6.6.

C —Well sorted grey sand and gravel at 4 to 7 feet; derived chiefly from dolomitic limestone with a fair proportion of shale and silica; high in carbonates; pH 7.6 to 7.8.

The natural forest vegetation is cherry, red oak and white oak. The topography is level to undulating. The natural drainage is good to excessive.



The Fox soils are used for the production of high value, cash crops.

Agriculture

The Fox series is used extensively for the production of specialized crops being well suited to the growing of tree fruits, (peaches and cherries) early vegetables, small fruits, and flue-cured tobacco. Its uniformity, good drainage, workability, and light texture make it especially suited to the production of early crops. It is probably the most highly valued soil type in the county.

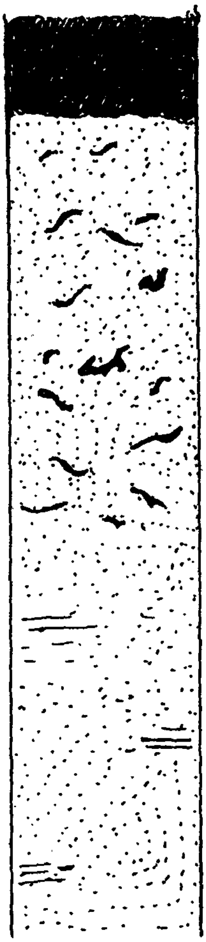
Droughtiness, low fertility levels and low organic matter content are the chief limitations to optimum crop production. Both the potassic and phosphatic content are low. The use of cover crops is a commendable practice as it helps maintain organic matter and prevents erosion. Because of the high value crops grown on the Fox soils, heavy applications of fertilizer are profitable and desirable.

(c) Poor Natural Drainage

Granby Sand (1,000 acres)

The Granby is the poorly drained member of the Fox catena and exhibits the characteristics of the Dark Grey Gleisolic soils. It occurs chiefly in one large block south of the city of Windsor.

The following description is of a cultivated soil.



A_c—6 inches of very dark brown sandy loam; high in organic matter; fine crumb structure; very friable consistency; pH 6.8.

G —30 inches of grey sand; occasional rusty coloured mottles; structure poorly defined, usually single grain; stonefree; pH 7.0.

C —Grey calcareous stonefree sand; pH 7.6.

The topography of the Granby sand ranges from level to depressional. Often it occurs in saucer shaped areas making it particularly difficult to drain. The natural forest vegetation is mostly elm with some ash and soft maple.

Agriculture

Some of it is cleared and cropped but most of the area is in permanent pasture or woodlot. When cleared and drained the Granby is used for the growing of vegetable crops. Usually the cost of drainage improvement is warranted because of the high value crops that can be grown once drainage improvement is effected.

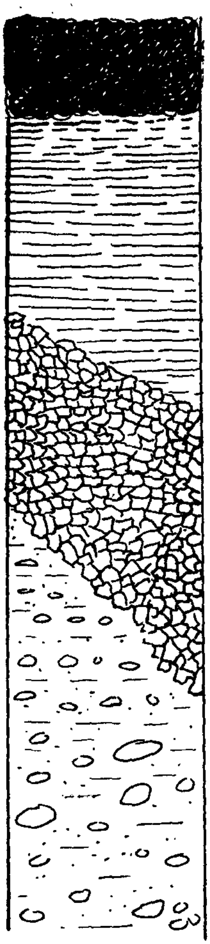
II. Gravelly Materials

(a) Good Natural Drainage.

Burford Loam (3,700 acres)

Burford Loam—Shallow Phase (5,300 acres)

The Burford series is developed on well sorted gravelly materials derived largely from dolomitic limestone and containing smaller proportions of shaley and siliceous materials. The Burford is the well drained member of the catena of the same name. The profile exhibits well developed Grey Brown Podsolic characteristics. The following is a description of a cultivated profile.



A_C—6 inches of dark brown loam; medium crumb structure; friable consistency; medium organic matter content (under cultivation some areas have become moderately gravelly, particularly where the upper layers have been eroded); pH 6.5.

A_2—12-18 inches of light yellow brown loam or sandy loam; medium nuciform structure; friable consistency; moderately stony or gravelly; pH 6.5 to 6.8.

B —6-18 inches of light brown gravelly clay loam; wavy horizon; medium nuciform structure; hard consistency when dry, sticky when wet; pH 7.0.

C —Grey, gravelly outwash; well sorted; largely of dolomitic limestone origin, with smaller proportion of shale and siliceous material; calcareous; pH 7.8.

The Burford loam occurs as fairly large tracts, one north of Ruthven and another between LaSalle and Windsor.

Shallow ridges occur in Essex County running across the area in a southeast and northwesterly direction. Heavier textured clay till materials occur at depths varying from 3-6 feet, such a condition being mapped as Burford loam—shallow phase. Often the B horizon is less well defined in the shallow phase than in the Burford loam and occurs at the juncture of the gravelly and heavier textured underlying material.

The natural forest vegetation is chiefly hard maple and beech with some ash and elm, especially on the shallow phase. The drainage is good and the topography varies from level to undulating, except in the ridges where the slopes become steeper.

Agriculture

The Burford series is intensively cultivated. It is an early soil supporting good crops of vegetables and small fruit. The Burford loam type grows good orchards of peaches, cherries, apples and pears. Peaches and cherries sometimes suffer on the shallow phase because the roots appear to confine themselves only to the gravelly materials. Corn, wheat, beans and some tobacco are grown on this soil also. However it is not as well adapted to the growing of flue-cured tobacco as is the Fox series.

The chief limitations of the series are moderately low content of potash, phosphorus, and organic matter, and in the case of the shallow phase, depth of gravel over clay.

F. SOILS FORMED FROM SHALLOW SANDS OVER CLAY

(c) Imperfect Natural Drainage

The shallow sands over clay are a result of wave action in the post glacial lakes which left sand bars from 3 to 6 feet in depth over the heavy clay till. On the fairly level topography in Essex County this condition hinders internal drainage to such an extent that no well drained profiles occur on this type of formation. Large acreages of imperfectly drained soils occur and they are mapped as the Berrien series. The Berrien is the imperfectly drained member of the Bookton catena and the Wauseon is the poorly drained member.

Berrien Sandy Loam (16,000 acres)

Berrien Sand (8,000 acres)

The Berrien series is imperfectly drained. The largest areas are in Mersea township, Colchester South, and Sandwich West. Other smaller areas are mapped throughout the county. Mottling occurs in the lower A_2 and B horizon and although the horizons are less well defined than the well drained member of the catena, the profile exhibits characteristics of the Grey Brown Podsolic soils.

A_c—4-6 inches of grey brown sand or sandy loam; weak fine crumb structure; stonefree; pH 6.0 to 6.5.

A_2—12-24 inches of yellow brown sand or sandy loam; colour becomes paler yellow with depth; usually contrasty mottlings in lower part of horizon; stonefree; pH 5.8.

B —18-24 inches of mottled yellow grey sandy loam; few to numerous rusty brown concretions; stonefree; pH 6.5.

C —Grey calcareous sand; stonefree; usually contains a small amount of free carbonates; pH 7.4.

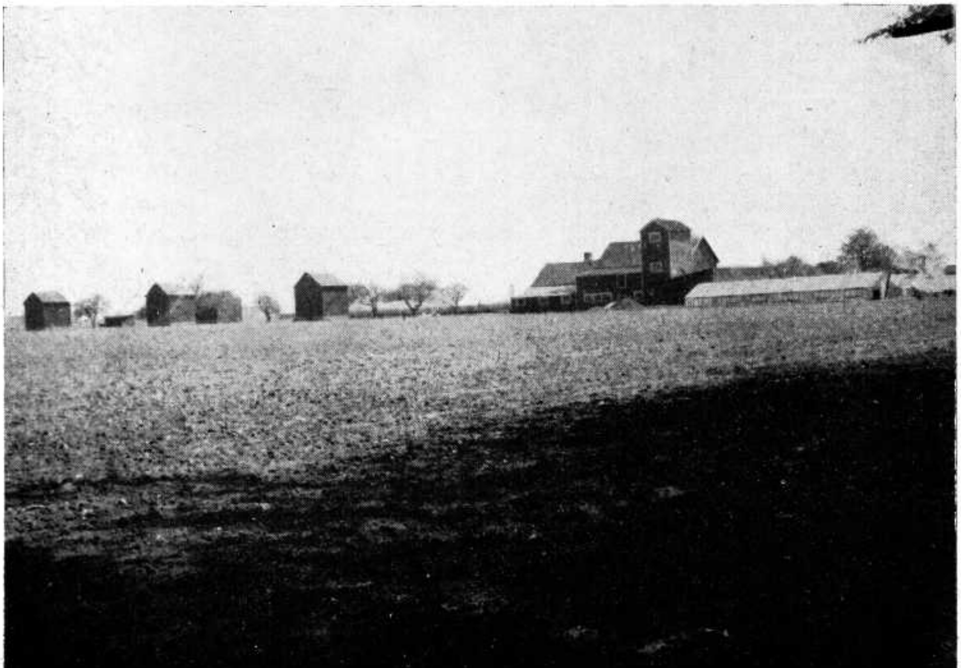
D —Heavy calcareous clay till at 3 to 6 feet; till similar to the materials of the Huron catena.

As mapped the Berrien series contains inclusions of small poorly drained spots which cannot be indicated on a map of one inch to the mile scale. Under undisturbed virgin conditions a thin podsol profile has developed in the A horizon of the former Grey Brown Podsolic profile. The formation of a second profile in the deep A horizons of the Grey Brown Podsolic soils, particularly the light textured materials, is not uncommon in Ontario.

The topography is slightly undulating. The natural forest vegetation consists of hard maple, beech, oak, elm, ash and hickory. The drainage is imperfect over most of the area but approaches a Granby-like condition in the saucer-shaped depressions that are characteristic of the topography, and which are too small to be separated on an inch to the mile scale of mapping.

Agriculture

The Berrien sandy loam is fairly well suited to the growing of a wide range of high value cash crops. Flue-cured tobacco, burley and black tobacco, canning crops, early vegetables, raspberries and strawberries are grown on these soils. The fruits such as apples, cherries and pears are usually confined to those areas where the sand exceeds three feet in depth over clay. The Berrien sand, particularly the area mapped south of Windsor, appears to be less well suited to the growing of the above crops. This is due in some part to the lower fertility levels that exist in the sand and to the greater frequency of poorly drained saucer-shaped areas.



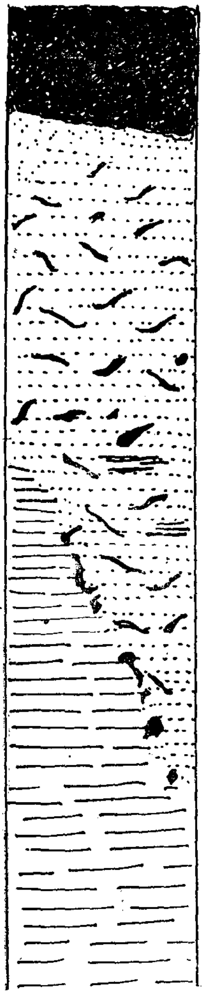
Flue-cured tobacco is grown on the Berrien sandy loam.

Erosion is slight on most of the series. The chief fertility needs are phosphate, potash, and lime. Organic matter maintenance is necessary for successful crop production. Drainage improvement greatly increases the use capability of the Berrien soils and a large proportion of the area mapped has been tile drained.

(b) Poor Natural Drainage.

Wauseon Sandy Loam (3,000 acres)

Wauseon sandy loam is the poorly drained member of the Bookton catena. The greater part of the type occurs along the shore of Lake St. Clair on the northern fringe of the county. The profile exhibits the characteristics of the Dark Grey Gleisolic soils.



A_C—8 inches of black sandy loam; fine crumb structure; high in organic matter; stonefree; pH 7.0.

G —20-40 inches of yellow and orange sandy loam with occasional thin strata of clay; pale yellow, low contrast mottling; stonefree; pH 7.2.

C —Grey calcareous sand; stonefree; pH 7.2. to 7.4.

D —Heavy calcareous till; occurs at depths of 3 to 6 feet.

The natural forest vegetation is mostly elm and ash. The topography is level to depressional. The natural drainage is poor to very poor.

Agriculture

Much of the area is as yet uncleared. Under natural conditions the Wauseon is wet and the nature of the topography and the underlying heavy textured materials make drainage improvement difficult. However, once drainage improvement is effected, the Wauseon functions similarly to the Berrien. Provided fertility levels are maintained fair crops of corn, tomatoes and forage crops are produced. The phosphatic and potassic levels are very low.

G. MISCELLANEOUS SOILS

Farmington (2,000 acres)

The Farmington, for the most part occurs on Pelee Island with one small area being mapped on the mainland near the town of Amherstburg. The outstanding characteristic of the Farmington is an overburden of variable texture underlain by limestone bedrock at depths of three feet and less. Where the overburden is shallow, one foot and less, this soil is very droughty and used almost entirely for pasture purposes. However, where the depth to bed rock reaches three feet the soil functions similarly to a shallow phase of a series to which it is most closely related.

The Farmington soils of Pelee Island serve a highly useful purpose as grazing land.

On Pelee Island much of the Farmington is devoted to pasture land and scrub tree growth which makes an excellent haven for pheasants for which the island is well known. The moisture relationships of the Farmington soils are variable. In the spring of the year the soil becomes saturated with water and the internal drainage is restricted due to the underlying bed rock. Later in the season the overburden dries out and a droughty condition prevails. The Farmington is well supplied with lime and low in phosphorus and potassium.

Eastport Sand (2,500 acres)

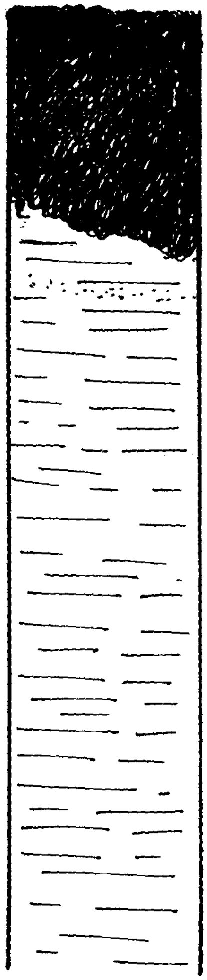
The Eastport sand occurs as dunes and beaches with very little or no vegetative cover. It is a very droughty soil. The Fertility levels are so low that sufficient vegetative cover to prevent wind erosion is not produced.

The soil materials are derived from coarse grey sand and fine gravel. The profile exhibits very little horizon differentiation. Where a scanty vegetative cover has been established, there is usually a thin grey layer underlain by coarse yellowish brown sand which fades into grey sands and fine gravel at depths of 24 inches and greater. The profile is stonefree and occasionally calcareous throughout.

The Eastport sand serves its greatest use capability as recreational land for summer cottages or when replanted to trees.

Bottom Land (7,300 acres)

Soils adjacent to stream courses and subject to flooding during part or whole of the season are mapped as Bottom Land. The physical and chemical characteristics of Bottom Land are variable. The horizons in the profile are poorly differentiated. Bottom Land approaches an alluvial soil more closely than any other soil mapped in the County. It is well suited to the growing of pasture crops and is used extensively for this purpose.



Dark surface of variable depth; underlying materials vary in texture and colour; usually strata of fine and coarse textured materials intermixed with one another; pH usually neutral to slightly alkaline.

H. ORGANIC SOILS

Marsh (7,000 acres)

The Marsh land of Essex County is usually under water for all or part of the growing season. For the most part it occurs along rivers or lake shores and supports a vegetative cover of sedges, cattails, rushes and the occasional tree.

The agricultural potentialities of the marsh lands are practically nil. During part of the season they sometimes provide pasture but for the most part the chief use of marsh land is for recreational purposes such as duck hunting, trapping etc. In areas where the land has been reclaimed it functions similarly to the Muck soils.

The Dykes hold back the waters of Lake Erie. This reclaimed land is highly productive.

Muck (1,700 acres)

The largest expanse of Muck used for agricultural purposes in Essex County occurs in concessions A, B, C and D of Mersea Township, in the Point Pelee area. About 1,300 acres are being used for the growing of vegetables, particularly onions.

The Muck soils of the Point Pelee area have been reclaimed and the waters of Lake Erie are dyked back. Fairly extensive pumping systems are in operation to remove the excess water. Irrigation is carried on to provide sufficient moisture during the growing season.

Dark coloured organic layer ranging in depth from 15 to 30 inches; usually about neutral in reaction; surface layer contains less peaty and fibrous material than the lower layers; underlain by sticky, massive, bluish grey clay.

The Muck soils are low in phosphorus and potassium. Usually heavy applications of fertilizer are required for the crops commonly grown. In drought periods the Muck dries out and is subject to the ravages of wind erosion. Erosion control measures in the form of windbreaks lessen the hazard and increases the use capability of these soils.

PART IV

AGRICULTURE

Present Agriculture

Essex County is possibly the most intensively farmed county in Ontario. General farming is carried on extensively and a fair proportion of the home grown grains are fed and the livestock marketed as beef, pork and dairy products. In Essex there is also considerable cash cropping with emphasis on the growing of corn, wheat, and sugar beets for sale. In this category the large acreages of canning crops grown throughout the county to supply the many canning factories in the area might also be included.

Many Essex County farms are intensively cropped and highly mechanized

A large portion of Essex County's income is derived from the early vegetables and fruits that are grown in the southern part of the county.

The following table compiled from 1941 Census indicates the proportion of the gross farm income from the major sources.

TABLE 4

COMPARATIVE VALUE OF FARM PRODUCTS IN ESSEX COUNTY

Field crops	54.5% of the gross value
Animal products	15.7% " " " "
Stock sold alive	12.8% " " " "
Vegetables, fruits and greenhouse products	14.3% " " " "

These figures indicate that livestock and livestock products account for less than 30% of the gross farm income in Essex County. Field crops, vegetables and fruits make up nearly 70% of the gross income. Hence it appears that livestock is of secondary importance in the economy of Essex County with cash cropping receiving the most attention.

Greater Windsor provides a lucrative fluid milk market.

With a large portion of the crops being sold off the land and little being fed to livestock the depletion of soil fertility is accelerated. In this sort of economy, soil-building legumes and green manuring crops should be grown to balance the soil depleting crops.

TABLE 5

PRESENT LAND USE (1941 CENSUS)

A.	Acres	%
Total land area	452,480	100
Occupied land	392,567	87
Improved cleared land	357,357	79
Unimproved occupied land	35,210	8
Including:		
Natural pasture	12,796	2.8
Marsh or wasteland	4,969	1.1
Wooded	17,445	3.8
B.		
Number of farms	5,608	
Average acres per farm	70	
Average improved, cleared land per farm	63.7	

From these figures it appears that the average size of an Essex County farm is 70 acres, of which about 64 acres is under cultivation. The average area of wooded land is approximately 3 acres per farm. This is indicative of the intense type of agriculture practised and the large proportion of land cleared. The farms in the general farming area are larger than seventy acres but the farms devoted to market gardening have a small acreage which greatly reduces the average.

TABLE 6

ACREAGE AND DISTRIBUTION OF CROPS IN ESSEX COUNTY (1941 CENSUS)

Wheat	40,468	acres
Barley	5,097	"
Oats	63,986	"
Rye	892	"
Corn for husking	93,412	"
Buckwheat	716	"
Corn for fodder	1,884	"
Beans (including soybeans)	2,889	"
Peas (dry)	83	"
Mixed grain	1,549	"
Cultivated hay	43,976	"
Timothy	2,975	"
Alfalfa	16,272	"
Sweet clover	5,893	"
Potatoes and Sugar beets	6,746	"
Tobacco	7,676	"
Tree and small fruits	3,825	"

Early Settlement and Agricultural Development

Lumbering was an important industry in Essex County. In 1881 large quantities of lumber and charcoal were being exported to the United States. At this time two-thirds of the county was still under bush with twenty-five saw mills and thirty charcoal kilns in operation.

According to the report of the "Ontario Agricultural Commission" of 1881, settlement of Essex County commenced about 1700. These settlers were principally French Canadian who took up land in Sandwich West. Settlement began in Rochester Township about 1790 and by 1881 nearly all the county was settled.

Early agriculture was of the self-sustaining type but by the time of the report of the "Ontario Agricultural Commission" of 1881 large acreages of wheat, coarse grains and shelling corn were grown. About half a million bushels of wheat were sold out of the County per year. Little corn was exported but about 100,000 bushels were supplied to the distilling industry locally.

Horses were exported to the United States and to Manitoba where they brought good prices. Beef cattle were exported alive to England. Large numbers of hogs were raised and pork packing was an important industry.

Tree fruits were still not very numerous but it was evident that successful fruit growing endeavours could be established because of the favourable climate and suitable soil conditions that prevailed in the County.

The report of 1881 recognized the value of underdraining and already large acreages of low land had been brought under cultivation through this practice. Very few artificial fertilizers were used, the farmers relying on barnyard manure and the virgin fertility of their soils. With the clearing of the land, agriculture has intensified in Essex County to a point where it is one of the most productive areas in the Province.

The Utilization and Management of Essex County Soils

Profitable farming, is dependent in a large measure, on the farmer's ability to adapt his farming practices to the physical characteristics of his land. Nutrient uptake by the plant is greatly influenced by these characteristics. Such physical factors as topography, texture, depth to bedrock, etc., a farmer does not attempt to alter, but fits his agriculture to the conditions as they exist. Other factors such as moisture-holding capacity, fertility, structure, and natural drainage can be modified to increase the productivity of the soil.

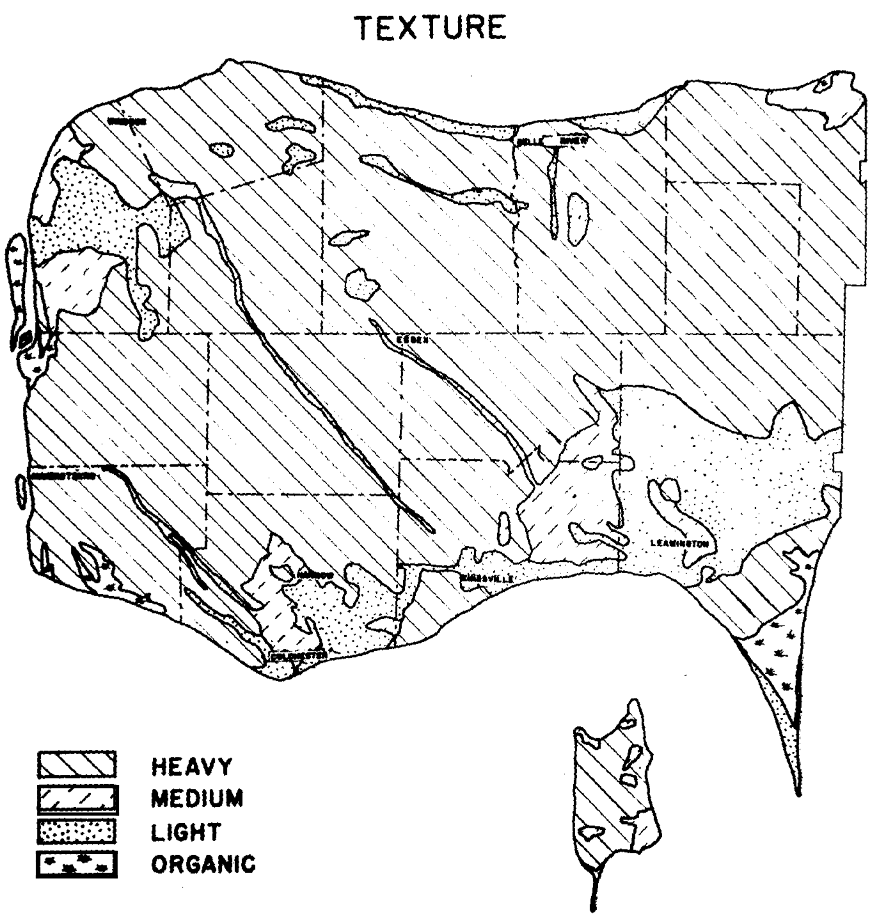


FIG. 5—Outline Map of Essex County showing distribution of the heavy, medium and light textured soils.

For purposes of discussion the soils of Essex County have been grouped on a textural basis, and the extent of distribution of the heavy, medium and light textured soils of the County is shown in diagram (5).

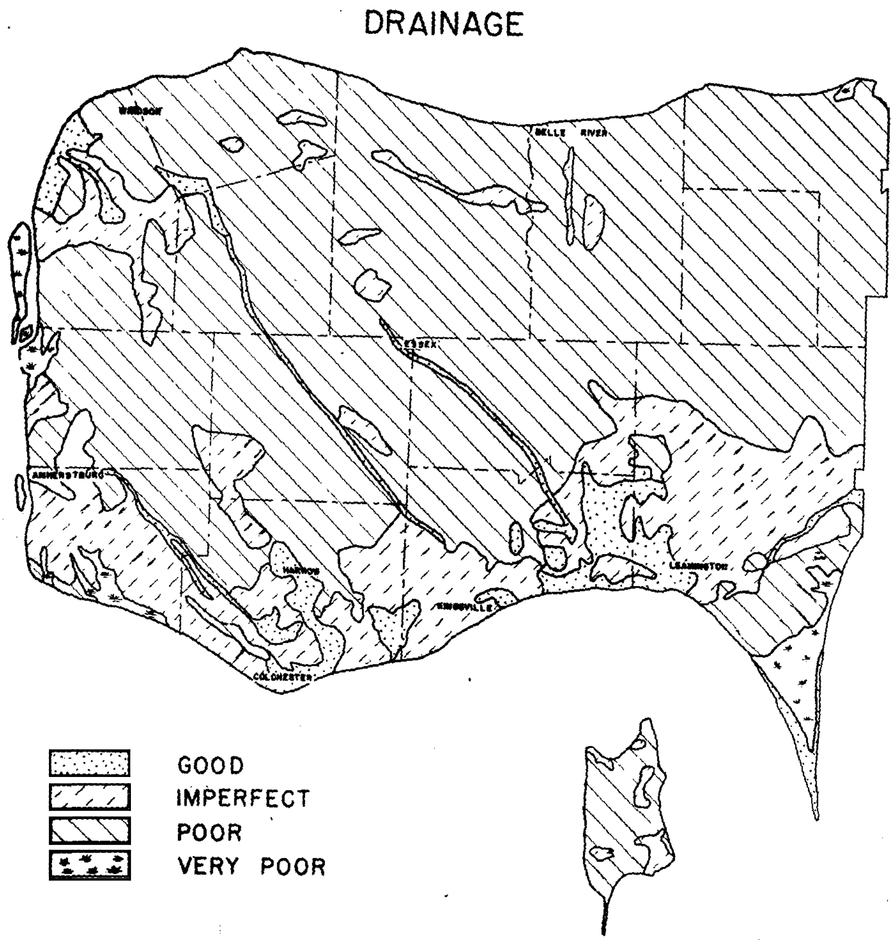


FIG. 6—Outline Map of Essex County showing distribution of good, imperfect, poorly and very poorly drained soils.

1. Heavy Textured, Poorly Drained Soils

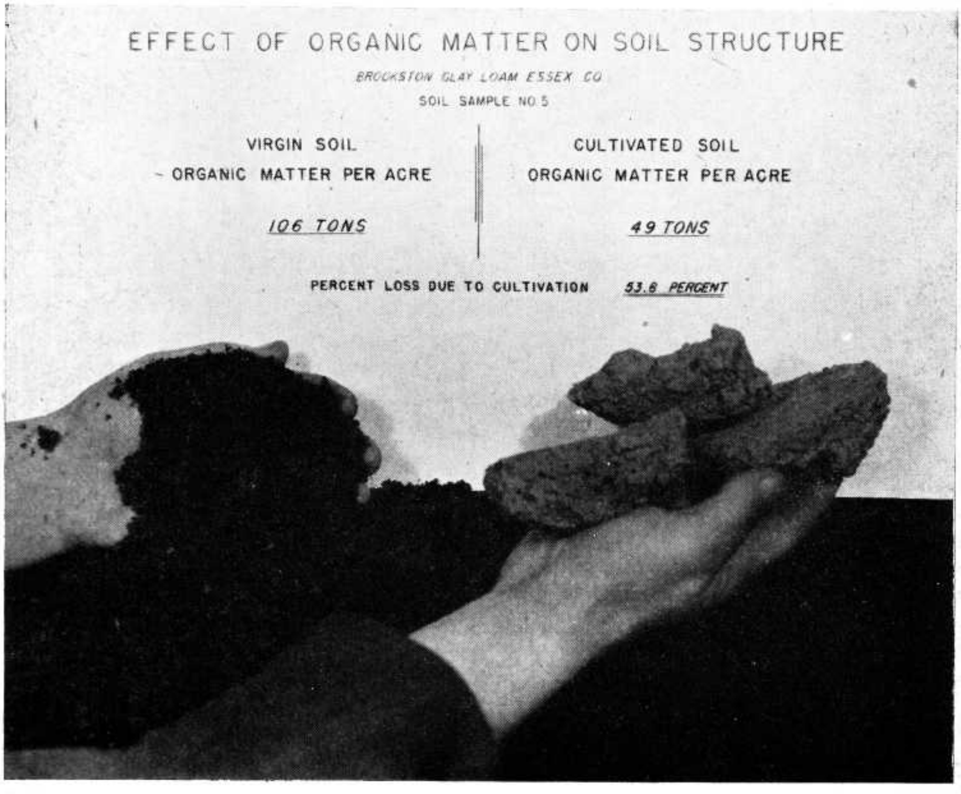
TABLE 7

ACREAGE OF HEAVY TEXTURED, POORLY DRAINED SOILS

Soil Type	Acreage
Brookston clay	250,000
Brookston clay loam	30,000
Clyde clay	2,500
Toledo clay	17,500
Toledo silt loam	1,000
	301,000

The heavy textured Brookston, Clyde, and Toledo soils make up approximately two-thirds of the area of Essex County. Maintenance of satisfactory physical condition and drainage improvement are the chief land use problems of concern on these soils.

A large proportion of the poorly drained soils have been tile drained, particularly the Brookston and Clyde and to a lesser extent the Toledo. Drainage improvement has been very effective on these soils, in that it has greatly increased their use capability to grow a wider range of crops. However, in an area where there is a high concentration of row crops, (tobacco, tomatoes, corn, etc.) the organic matter content of the surface soil has been lowered. This in turn has destroyed the soft, mellow crumb and granular structure that prevailed under natural conditions. Consequently the soil has become less permeable, and in areas where tile placed at four rod intervals formerly provided adequate drainage, it is now necessary to place them every two rods.



The soil on the left was obtained from a fence row. The soil on the right came from a field where there had been a very small proportion of forage crops in the rotation. Note the difference in structure!

The importance of maintaining an adequate level of organic matter in the heavy textured soils of Essex County cannot be over emphasized. The increase or decrease of the organic matter content is a fair indicator of whether the cultural practices are developing or destroying the productivity of the soil.

On this farm the corn stalks are raked and burned

Soil organic matter, or more specifically humus, aids in conserving mineral plant nutrients and by its rate of decomposition partially controls their liberation. Humus also modifies soil structure, colour and moisture holding capacity. In heavy soils, structure is extremely important. Soils with good structure are easier to drain, earlier in the spring, and easier to work.

Experience has shown that even the best soils will not produce cereal crops exclusively without declining yields. In some sections of the United States the single crop system has been carried on for 40, 50 and even 60 years. In every case, however, it was found necessary to adopt a more diversified type of agriculture because of the low yields and excessive weediness.

Conservation is the key to the situation. Organic matter is easily destroyed but is costly and difficult to rebuild. It can be easily maintained by including crops in the rotation which returns organic matter to the soil. Crop residues (straw from combining, corn stalks, etc.) should be turned under with 80 to 100 pounds of nitrogen fertilizer to the acre to ensure rapid decomposition. Failure to add the nitrogen may result in a depressed yield in the succeeding crop. The value of legumes in the rotation cannot be overestimated but they do not take the place of fertilizer. For best results the rotation should include forage crops and particularly legumes along with cereal grains and row crops. Applications of manure and fertilizer must be made to avoid depleting the soil of plant nutrients. As the livestock population is small the Essex County farmer is not interested in growing too many fodder crops. Therefore, he might grow alfalfa for alfalfa meal and turn down the second crop for green manure. Another very good green manure crop is sweet clover. Some Essex County farmers have been very successful in growing alsike for seed. Alsike and red clover are not as valuable from the soil building standpoint as alfalfa but, nevertheless, they can make a valuable contribution to the rotation.

And this is what happens!

The use of commercial fertilizers is recommended subject to a soil test. Most frequently these soils are low in phosphate. Fertilizers contribute to higher yields of both grain and plant residues. If these residues are incorporated into the soil, they will add to its tilth and fertility.

Manures, where available, should be properly used for maximum value from the limited supply. Careful attention should be given to methods of handling the manure so there will be as little loss as possible.

These soils are well suited to general farming, dairying and stock raising and to certain types of specialization. Wheat and clover are grown under improved drainage conditions. The Brookston soils are well adapted for the

Corn stalks plowed down with nitrogenous fertilizer add much needed organic matter to the soil

production of canning tomatoes. Other cash crops are corn, wheat, barley, burley and black tobacco, field beans, soybeans and sugarbeets. There are a few orchards on drained Brookston soils but under natural conditions these soils are not adapted to growing tree fruits. Once drainage improvement is effected on the heavy textured soils they function similarly. The Toledo, being a lacustrine soil is slightly more impervious than the Brookston and Jeddo. The Jeddo, being formed from shale-limestone parent material, may require lime in heavier applications and more frequently than the Brookston. However, according to table (18) the use of lime on the Brookston may be necessary in some areas. The Clyde soils are high in organic matter and well supplied with other plant nutrients. Once drained, caution should be exercised in maintaining satisfactory organic matter levels in the heavy textured soils and in avoiding the development of a physical condition that aggravates the drainage problem.

2. Heavy Textured, Imperfectly Drained Soils

TABLE 8

Soil Type	Acreage
Caistor clay	13,500
Caistor clay loam	2,500
Perth clay	9,000
Perth clay loam	8,000
Total	33,000

Soybeans are grown extensively on the level lands of Pelee Island and the Mainland

The heavy textured, imperfectly drained soils occupy less than 10% of the total occupied land area of Essex County. For the most part the crops that are grown on the poorly drained heavy textured soils are also produced on the Caistor and Perth soils with moderate to good success. Although these soils are imperfectly drained, the lack of adequate drainage does not limit their usefulness to as great an extent as on the poorly drained soils. Usually on the poorly drained soils the tile should be placed at regular intervals. On the imperfectly drained soils, however, because of the undulating topography, the main objective in tile draining is to remove the water from the saucer-shaped depressional areas that occur in association with the knolls and swells.

The Perth soils contain more organic matter and are less acid than the Caistor soils. If adequate drainage is provided the main requirements for satisfactory crop production is the maintenance of adequate organic matter and fertility levels. The phosphorus levels are low and the potassium levels are medium to low. In the Caistor soils the organic matter levels are very low. Liming would prove beneficial for most crops, particularly legumes.

3. Medium Textured, Imperfectly and Poorly Drained Soils

TABLE 9

Soil Type	Acreage
Colwood fine sandy loam	7,000
Parkhill loam	5,000
Parkhill loam—red sand spot phase	5,000
Tuscola fine sandy loam	6,000
Total	23,000

About 6% of the soils of Essex County are contained in this group. Under natural conditions the reaction ranges from neutral to slightly alkaline. When cultivated and drained there is a tendency for the alkalinity to be reduced and the surface soil becomes slightly acid.

The fertility levels of these soils are usually fairly good in the natural state. Due to the imperfect and poor drainage conditions that prevail the organic matter content is medium to high.

Drainage improvement is the main requirement that increases the use capability of these soils. General farming is carried on extensively and fairly large acreages are devoted to the growing of corn, tomatoes, sugar beets and truck crops. In the Windsor area the Colwood fine sandy loam is used for the growing of vegetable crops.

Drainage improvement is sometimes more difficult on the Parkhill soils than either the Tuscola or Colwood because of the basin like topography that often occurs. When the drainage conditions are improved through tiling the problems of management are similar to those found on the heavier textured soils. Because of the prevalence of row crops the need for maintaining adequate organic matter and fertility levels is very important.

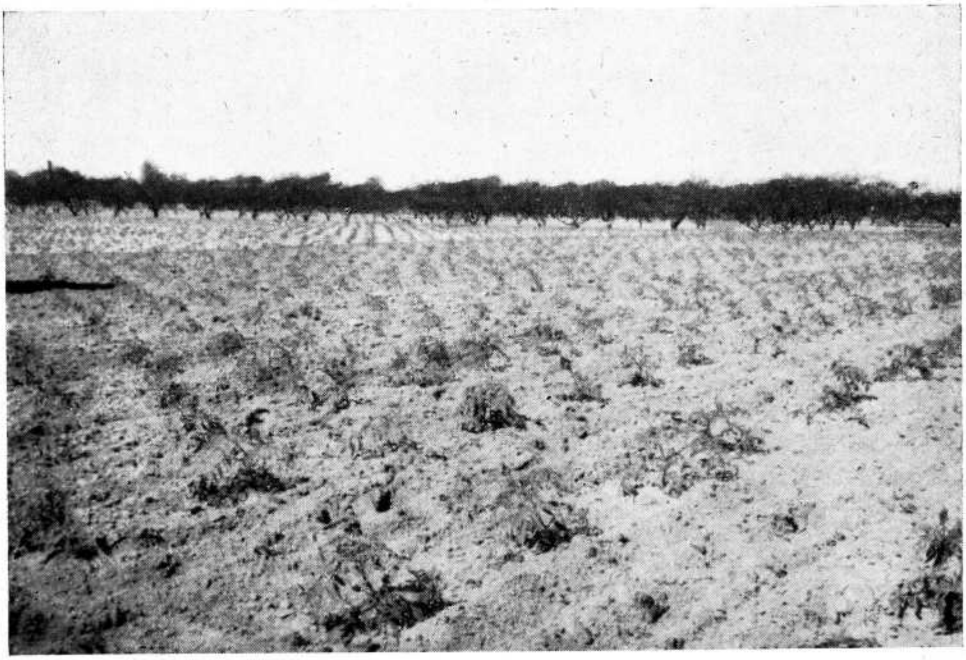
4. Well Drained, Light to Medium Textured Soils

TABLE 10

Soil Type	Acreage
Burford loam	3,700
Burford loam, shallow phase	5,300
Fox sandy loam	5,300
Harrow loam	4,000
Harrow sandy loam	3,500
Total	21,800

The Burford, Fox and Harrow soils make up slightly over 5% of the Essex County area. The soils contained in this group are devoted largely to specialized farming. The light to medium texture, and the open pervious materials permits early spring cultivation. Satisfactory physical characteristics make these soils well suited for growing early vegetables, tree fruits and tobacco.

The Fox is well suited to the production of flue-cured tobacco and the Harrow loam and Burford soils, because of the heavier texture, are more adapted to the growing of burley and black tobacco. The Harrow series, because of greater variability in texture, is somewhat less desirable and less reliable than is the Fox series.



Tree fruits, vegetables and canning crops are grown on the well drained sandy soils.

The level of plant nutrients, under natural conditions is quite low. Often the Fox and Harrow series are acid and require lime. Since the light textured soils are used extensively for the production of high value cash crops, heavy applications of phosphatic and potassic fertilizers are required for satisfactory yields. The application of nitrogenous fertilizer will vary according to the crop to be grown.

The Burford series, and the Harrow loam are slightly better supplied with plant nutrients and are fairly well adapted to tree fruit production, small fruits, vegetables, canning crops, etc. The rate of application of fertilizer will vary with the crop to be grown.

The establishing and maintaining of adequate organic matter levels in the well drained, light to medium textured soils is of prime importance. For the most part, the Fox and Harrow occur in an area within the County that has a relatively high occurrence of drought. In addition to providing a more desirable physical condition in the surface soil, the organic matter assists in moisture conservation. The rotation on these soils is usually short with a minimum of forage crops included in it. This makes it necessary to rely on green manure crops and barnyard manure to maintain satisfactory organic matter levels.

5. Light Textured, Imperfectly and Poorly Drained Soils

TABLE 11

Soil Type	Acreage
Brookston clay—sand spot phase	18,000
Berrien sandy loam	16,000
Berrien sand	8,000
Caistor clay sand spot phase	1,500
Granby sand	1,000
Wauseon sandy loam	3,000
Total	47,500

About one-ninth of the soils of Essex County are contained in this group. With the exception of the Granby sand, the other types are all underlain by heavier materials at fairly shallow depths. The presence of the heavy textured layer inhibits drainage.

In the Brookston clay, sand spot phase, and the Caistor clay, sand spot phase, the depth of sand is most variable. Often at the centre of the spot the depth will be 3 to 4 feet thinning out to a few inches at the edge. Between the spots the clay comes to the surface and exhibits the same characteristics as the Brookston and Caistor series. The deposit of sand over the heavy materials in the Berrien series is more uniform, usually reaching a depth of 3 to 4 feet. The Granby is a deep sandy type, and occurs in level to depressional topography. Both the internal and external drainage in the Granby series is poor. The sandy deposits are deficient in nitrogen, phosphorus, and potassium. Heavy applications of barnyard manure and fertilizer are required for successful crop production. The sandy knolls are often quite acid and liming should be beneficial, particularly if legumes are to be included in the rotation.

Drainage improvement is needed on the Caistor clay, sand spot phase, and the Berrien series, and is almost essential on the Granby sand and Brookston sand spot phase for crops commonly grown in the area. The light textured soils underlain by heavy materials are used for the growing of specialized crops such as, small fruits, canning crops, vegetables and flue-cured tobacco. The success of fruit, dairy, and general farming is dependent on local conditions of drainage and management.

The main problems of management on these soils are drainage, and low fertility. Rates of application of fertilizer will vary according to the crop to be grown. Use of green manuring crops and barnyard manure is highly recommended to build up and maintain adequate organic matter levels.

Crop Adaptability Ratings for Essex County Soils

The ability of a soil to produce depends on a number of factors of which drainage, fertility and climate are extremely important. As noted earlier in this report the climate of Essex County is quite favorable to the growth of general farm crops as well as some specialized crops. Most soils in the county have a fairly good level of fertility. However, much of the land suffers from poor or at least imperfect drainage. To produce good crops it is usually necessary to improve the drainage of these soils by the use of tile drains. In view of the fact that much of the land in the county is tile drained and as a result is more productive, it was deemed advisable to make a dual rating. Thus the expected improvement in the capability of a type to produce a specific crop when the drainage is improved is indicated.

Throughout the report the limitations and special adaptabilities of soil types to grow certain crops have been discussed. An estimate of the ability of the soil types to grow specific crops is herewith presented. In making these ratings the inherent characteristics of the soil were weighed against the requirements of specific crops. The ratings do not carry an implication of mathematical precision. They are made for crops commonly grown in the area under prevailing systems of management. The rating may change with the introduction of new varieties, new crops, etc., or other unforeseen factors. A knowledge of the soil characteristics was supplemented with observation of the crops being grown. Thus the expression of these ratings depends upon the judgement of those responsible for preparing them.

As the requirements of crops differ very widely, a soil type which is placed in the category, Good Cropland, will not be good for the growing of all crops grown in the area. Some soil types are classified as good because of their adaptability to the production of specialized crops even though their fertility level may not be high.

Good Cropland

TABLE 12

SOIL TYPES AND ACREAGE OF GOOD CROPLAND

Soil Type	Acreage
Brookston clay	250,000
Brookston clay loam	30,000
Burford loam	3,700
Burford loam, shallow phase	5,300
Clyde clay	2,500
Fox sandy loam	5,300
Harrow loam	4,000
Harrow sandy loam	3,500
Perth clay	9,000
Perth clay loam	8,000
Toledo clay	17,500
Toledo silt loam	1,000
Total	339,800

The Fox, Harrow and Burford series are rated as good cropland because of their adaptability to the production of high value cash crops such as fruits, early vegetables and flue-cured tobacco in spite of their relatively low fertility. The heavy textured soils, (Brookston, Clyde, Perth and Toledo series) are placed in the same group because of the high inherent fertility they possess. For satisfactory yields the heavy textured soils should be drained. Table (17) indicates that the heavy soils enjoy a much better rating when drained, than do the light textured, well drained soils.

Good to Fair Cropland

TABLE 13

SOIL TYPES AND ACREAGE OF GOOD TO FAIR CROPLAND

Soil Type	Acreage
Berrien sandy loam	16,000
Brookston, sand spot phase	18,000
Caistor clay	13,500
Caistor clay loam	2,500
Caistor, sand spot phase	1,500
Colwood fine sandy loam	7,000
Jeddo clay	3,500
Parkhill loam	5,000
Parkhill loam, red sand spot phase	5,000
Tuscola fine sandy loam	6,000
Muck	1,700
Total	79,700

In general the soils contained in this group are inadequately drained for the production of most of the crops commonly grown in the area, and have fair fertility levels. Muck is included in this group because when drained, and under the climatic environmental conditions of Essex County it produces excellent crops. In other areas of Ontario the Muck soils would receive a much lower rating. The Caistor and Jeddo are rated lower than the Perth and Brookston because of their more acid condition and lower organic matter content. The Parkhill and Tuscola soils are contained in this group because of inadequate drainage and only medium fertility.

Fair Cropland

TABLE 14

SOIL TYPES AND ACREAGE OF FAIR CROPLAND

Soil Type	Acreage
Berrien sand	8,000
Granby sand	1,000
Wauseon sandy loam	3,000
Total	12,000

Because of one or a combination of low fertility and inadequate drainage these soils are not adapted to the production of crops commonly grown in the area. The Berrien sand is imperfectly drained and very low in fertility while the Granby and Wauseon series are poorly drained and low in fertility.

Fair to Poor Cropland

TABLE 15

SOIL TYPES AND ACREAGE OF FAIR TO POOR CROPLAND

Soil Type	Acreage
Farmington loam	2,000
Plainfield sand	1,700
Bottom Land	7,300
Total	11,000

Generally the soils contained in this group are marginal for the production of most farm crops. Where the soil materials reach a depth of thirty inches and greater the Farmington produces fair crops of oats and barley, alfalfa, red clover and pasture. Excessive drainage limits the usefulness of the Plainfield sand for agricultural purposes. Bottom land produces fair to good pasture crops and is used extensively for this purpose.

Submarginal Cropland

TABLE 16

ACREAGE OF SUBMARGINAL CROPLAND

Soil Type	Acreage
Eastport sand	2,500
Marsh	7,000
Total	9,500

The Eastport has practically no agricultural usefulness. The beach and dune sand is used largely for recreational purposes. The marsh land is flooded for most of the season and provides very little pasture for livestock. It too, is used largely for recreational purposes.

TABLE

CROP ADAPTABILITY RATING

	Fall Wheat		Oats and Barley		Husking Corn		Soy Beans		Alfalfa		Red Clover	
	T.D.*	N.D.†	T.D.	N.D.	T.D.	N.D.	T.D.	N.D.	T.D.	N.D.	T.D.	N.D.
Good Cropland												
Brookston clay	G–F	P	G	F–P	G	F	G	F	G–F	P	G–F	P
Brookston clay loam	G–F	P	G	F–P	G	F	G	F	G–F	P	G–F	P
Burford loam	....	F	....	G–F	....	G–F	....	G–F	....	F	....	F
Burford loam (shallow phase)	....	F	....	G–F	....	G–F	....	G–F	....	F	....	F
Clyde clay	G–F	P	G	P	G	P	G	P	G–F	P	G–F	P
Fox sandy loam	....	F	....	F	....	F	....	F	....	F	....	F
Harrow loam	....	F	....	G–F	....	G–F	....	G–F	....	F	....	F
Harrow sandy loam	....	F–P	....	F	....	G–F	....	G–F	....	F–P	....	F–P
Perth clay	G	F	G	F	G	G–F	G	G–F	G	F	G	F
Perth clay loam	G	F	G	F	G	G–F	G	G–F	G	F	G	F
Toledo clay	G–F	P	G	F–P	G	F	G	F	G–F	P	G–F	P
Toledo silt loam	G–F	P	G	F–P	G	F	G	F	G–F	P	G–F	P
Good to Fair Cropland												
Berrien sandy loam	F	F–P	F	F–P	....	F	....	F	F	F–P	F	F–P
Brookston sand spot phase	F	P	G–F	F–P	G–F	F–P	G–F	F–P	F	P	F	P
Caistor clay	G–F	F	G–F	F	G–F	F	G–F	F	G–F	F	G–F	F
Caistor clay loam	G–F	F	G–F	F	G–F	F	G–F	F	G–F	F	G–F	F
Caistor sand spot phase	F	F–P	F	F–P	F	F–P	F	F–P	F	F–P	F	F–P
Colwood fine sandy loam	F	P	G–F	P	G–F	F–P	G–F	F–P	F	P	F	P
Jeddo clay	F	P	F	F–P	G–F	P	G–F	P	F	P	F	P
Parkhill loam	G–F	P	G–F	F–P	G–F	F–P	G–F	F–P	G–F	P	G–F	P
Parkhill loam (red sand spot phase)	G–F	P	G–F	F–P	G–F	F–P	G–F	F–P	G–F	P	G–F	P
Tuscola fine sandy loam	F	F–P	G–F	F	G–F	F	G–F	F	F	F–P	F	F–P
Muck	....	....	....	....	....	....	....	....	....	....	....	....
Fair Cropland												
Berrien sand	P	P	P	P	....	F–P	....	F–P	P	P	P	P
Granby sand	F–P	P	F	P	F	P	F	P	F–P	P	F–P	P
Wauseon sandy loam	F	P	F	P	F	P	F	P	F	P	F	P
Fair to Poor Cropland												
Farmington loam	....	....	....	F	....	....	....	....	....	F	....	F
Plainfield sand	....	P	....	P	....	P	....	P	....	P	....	P
Bottom Land	....	....	....	....	....	....	....	....	....	....	....	....
Submarginal Cropland												
Eastport	....	....	....	....	....	....	....	....	....	....	....	....
Marsh	....	....	....	....	....	....	....	....	....	....	....	....

*T.D.—Tile Drained

†N.D.Natural Drainage

FOR ESSEX COUNTY SOILS

Alsike		Timothy		Potatoes		Canning Tomatoes		Tree Fruits		Sugar Beets		Flue-Cured Tobacco		Burley Tobacco		Pasture	
T.D.	N.D.	T.D.	N.D.	T.D.	N.D.	T.D.	N.D.	T.D.	N.D.	T.D.	N.D.	T.D.	N.D.	T.D.	N.D.	T.D.	N.D.
G	F	G	F	P	P	G	P	F	P	G	P	P	P	G	P	G	G-F
G	F	G	F	P	P	G	P	F	P	G	P	P	P	G	P	G	G-F
——	F	......	F	......	G-F	......	G-F	......	G	......	F	......	F	......	F	......	G-F
......	F	......	F	......	G-F	......	G-F	......	F	......	F	......	F	......	F	......	G-F
G	F-P	G	F-P	P	P	G	P	P	P	G	P	P	P	G	P	G	F
......	F-P	......	F-P	......	G	......	F	......	G	......	P	......	G	......	F-P	......	F
......	F	......	F	......	G-F	......	G-F	G	F	......	F	......	F	......	F	......	G-F
......	F	......	F	......	G	......	F	......	G	......	F-P	......	G	......	F	......	F
......	G	......	G	P	P	G-F	F	F	P	G-F	F	P	P	G-F	F	G	G
......	G	......	G	P	P	G-F	F	F	P	G-F	F	P	P	G-F	F	G	G
G	F	G	F	P	P	G	P	P	P	G	P	P	P	G	P	G	G-F
G	F	G	F	P	P	G	P	P	P	G	P	P	P	G	P	G	G-F
......	F	......	F	......	G-F	......	F	G-F	F	P	P	......	F	......	F-P	......	F
G-F	F	G-F	F	......	F-P	G-F	F-P	F	P	G-F	P	P	P	G-F	P	G	G-F
G	G-F	G	G-F	P	P	F	F-P	F	P	F	F-P	P	P	G-F	F	G-F	G-F
G	G-F	G	G-F	P	P	F	F-P	F	P	F	F-P	P	P	G-F	F	G-F	G-F
......	F	......	F	......	F-P	F	F-P	F	P	F	P	P	P	G-F	F	F	F
G-F	F	G-F	F	G-F	P	G-F	F-P	P	P	F	P	P	P	G-F	P	G-F	F
G	F	G	F	P	P	G-F	P	P	P	F	P	P	P	G-F	P	G	F
G-F	F	G-F	F	F	P	G-F	P	F	P	G-F	P	P	P	G-F	P	G-F	F
G-F	F	G-F	F	F	P	G-F	P	F	P	G-F	P	P	P	G-F	P	G-F	F
......	G-F	......	G-F	G-F	F	G-F	F	G-F	P	F	F-P	F	P	G-F	F-P	G-F	F
......	......	......	......	G-F	P	G	P	......	......	......	......	......	......	......	......	P	P
P	P	P	P	......	F	......	P	F	F-P	P	P	......	F	......	P	......	P
F	F-P	F	F-P	F	P	F	P	P	P	F	P	F-P	P	F-P	P	F	F
G-F	F	G-F	F	G-F	P	G-F	F-P	P	P	F	P	P	P	F	P	F	P
......	F-P	......	F-P	......	P	......	......	......	......	......	......	......	......	......	......	......	F-G
......	P	......	P	......	F	......	P	......	F	......	P	......	P	......	P	......	P
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PART V

DISCUSSION OF ANALYTICAL DATA

The physical and chemical composition of surface samples from the major types in Essex County are given in tables (18) and (19) of the appendix. Samples were procured from only the major soil types and where possible were taken from permanent pasture fields. A brief discussion of the physical and chemical results follows:

Mechanical Analysis

Mechanical analysis was conducted on the Essex County soils following the Bouyoucos Hydrometer Method. The individual size groups of soil particles contained in the soil separates were as follows—

Sand 1.00 to 0.05 millimeters in diameter.

Silt 0.05 to 0.002 millimeters in diameter.

Clay less than 0.002 millimeters in diameter.

The soil classes referred to in the report are:

A. Clay soils, a collective term referring to all soils with more than 20% clay.
   Clay loam 20% to 30% clay and less than 50% silt.
   Silty clay loam, 20% to 30% clay and more than 50% silt.
   Clay, over 30% clay.

B. Loam, soil with less than 20% clay, less than 50% silt and less than 50% sand.

C. Sandy loam,—soil with less than 20% clay and 50% to 80% sand.

D. Sand—soil with more than 80% sand.

E. Silt loam—soil with more than 50% silt and less than 20% clay.

The results of the mechanical analyses in table (18) indicate that there is a fairly wide variation in the sand, silt and clay content of the different soil series. A large proportion of the Essex County soils are heavy textured, (i.e. have 20% or more clay.)

Reaction

The majority of the Essex county soils analysed have a pH ranging from 6.0 to 7.0. There are, however, a number of series where liming should be beneficial, particularly if legumes are to be included in the rotation. The light textured soils (Fox, Berrien and Harrow) appear to be in need of lime. The Caistor samples and the one Jeddo sample have a pH below 6.0 and should respond to lime. For the most part the Brookston samples showed a pH in excess of 6.0. However samples (No. 26, 27, 28, 30, 54, 59, 68, 69, 71, 77) have a soil reaction similar to those found on the Caistor and Jeddo series. It is possible that the latter samples are more closely related to the Jeddo series and were included with the Brookston on the inch to the mile scale of mapping.

The pH determinations indicate the need for lime on the well and imperfectly drained light textured soils and on the Caistor and Jeddo series.

Phosphorus

There are no figures available to indicate the total amount of phosphorus present in Essex County soils. In developing the method used in determining readily soluble phosphorus, the authors, Lohse and Ruhnke, state that soils containing less than 60 pounds of phosphorus per acre appear to indicate very marked phosphate deficiency. No figure had been previously suggested to indicate what might be considered as a sufficient amount for general farm crops. The results of analyses by this method, compared with those obtained by the Modified Thornton Method,* would indicate that 200 pounds per acre might be accepted as a tentative figure for soils which are not too strongly alkaline.

The results of 105 samples show 53 to have less than 60 pounds of phosphorus per acre and 83 or 79% to have less than 200 pounds per acre. The above results indicate that, generally speaking Essex County is a phosphate deficient area. The Toledo and Clyde soils contain the highest amounts of phosphorus, although the one sample obtained from the Clyde is not sufficient to indicate a trend. The Brookston soils, which occupy 280,000 acres in the county (excluding the sand spot phase) show a wide variation in phosphorus content. Of a total of 31 samples from this series, ten have less than 60 pounds per acre, and twenty-six less than 200 pounds per acre. Only 2 samples from the Perth series, which is the well drained associate of the Brookston, have an excess of 200 pounds per acre, while the remaining 4 samples all had less than 60 pounds per acre. The 14 samples from the Caistor series were all low in phosphorus and contain less than 60 pounds per acre, which according to Lohse and Ruhnke would indicate marked phosphate deficiency. The Harrow, Fox, Berrien and Wauseon series all are low in phosphorus. Too few samples were procured from the Burford and Jeddo series to indicate a trend.

The chemical analyses of the phosphorus content of Essex County soils by the Lohse and Ruhnke Method ($KHSO_4$) would indicate that they are low to deficient in this element. In interpreting the results of the chemical analyses, consideration must be given to (1) where possible that samples were procured from long term pastures to minimize variability due to management and (2) the figures herewith presented show the relative amounts of phosphorus contained in the Essex County soils according to *soil type.*

Potassium

Approximately 167 pounds potassium (200 pounds K_2O) per acre plow depth is generally considered necessary for the production of general farm crops. For specialized crops such as canning crops, tree fruits, vegetables and tobacco larger amounts are required. The amount available to the growing plant in the soil types of Essex County is indicated in table (18).

Generally speaking the heavy textured soils are fairly well supplied with this element. The Toledo samples all showed in excess of 200 pounds per acre, ranging as high as over 600 pounds per acre. Five of the 31 samples procured from the Brookston clay and clay loam showed less than 167 pounds per acre while the remaining 26 samples had an excess of that amount. The

*Ruhnke, Rivaz and Ewen—A Comparative Study of Rapid Chemical Tests and Neubauer Analyses on some Typical Southern Ontario Soils, Scientific Agriculture 19:4, 199-210, 1938.

remaining series mapped in the County, particularly the medium and light textured soils (Parkhill, Tuscola, Harrow, Fox, Berrien, Wauseon, and the sand spot phase of the Brookston) all appear to be deficient in potassium.

The level of potsassium will vary according to soil management but for purposes of comparison these figures may be considered as reasonably constant. In summary the heavy textured soils of Essex County appear to be well supplied with potassium and the medium and light textured soils have a low to very low content of this element.

Calcium and Magnesium

The elements calcium and magnesium are quite similar as regards their available forms, and the conditions which affect their availability. In both cases, the exchangeable form usually represents the great bulk of the readily available supply, and according to Truog in fertile loam soils that are not more than slightly acid this commonly amounts to 3000 to 5000 pounds per acre plow layer of calcium and about one-fourth to one-third as much magnesium.

The Colwood series exhibits the lowest calcium content, none of the five samples showing in excess of 1000 pounds per acre. The Caistor, Jeddo (one sample), Fox, Harrow and Berrien are less well supplied with calcium than the Brookston, Perth, Tuscola, Toledo and Clyde soils. The medium to low amounts of calcium contained in many of the Essex County soils, together with the slightly acid reaction reflect the need for lime in this area. There is a fairly wide variation in calcium content in some of the series, Attention is directed particularly to the Brookston series. Twenty-three of the 31 samples procured from this series has in excess of 6000 pounds per acre, while 4 of the samples show less than 3000 pounds per acre. The parent material of the latter samples may be more closely related to those of the Haldimand catena (Caistor and Jeddo). On an inch to the mile scale of mapping areas too small to be separated are included with other series. These samples show a calcium content much lower than the average found on the Brookston.

For the most part the soils of Essex County appear to be fairly well supplied with magnesium. The Fox, Harrow, and Berrien generally speaking contain less than the other series. The need for magnesium on these light textured outwash soils warrants further investigational work.

Organic Matter

Generally speaking the heavy and medium textured soils of Essex County are fairly well supplied with organic matter. The organic matter content reported in table (18) indicates the levels that occur in permanent pastures. It is reasonable to expect that the organic matter levels in permanent pasture areas will be higher than those found in areas where a short rotation is practised and particularly where there is a high concentration of cash crops such as corn, tobacco, soybeans, etc.

The organic matter content is highest in the heavy textured poorly drained soils, and lowest in the well drained light textured soils. Thirteen of the 31 samples procured from the Brookston series show an organic matter content of less than 6%. Of the 21 samples analysed from the Perth and Caistor series only 3 show an organic matter content in excess of 6%.

In interpreting the results of the organic matter content of Essex County consideration must be given to (1) the results are from samples obtained from long term pastures and (2) under natural conditions 417,000 acres (92+%) of the soils of Essex County are imperfectly or poorly drained. Inherently these soils were well supplied with organic matter. With drainage improvement and continuous cropping there has been a definite lowering of the organic matter content. The need for the maintenance of adequate organic matter levels cannot be over-emphasized because therein lies the answer to maintenance of desirable soil structure and permeability which are essentials in establishing a satisfactory physical condition in Essex County soils.

Base Exchange Capacity and Per Cent Saturation

The base exchange capacity and per cent saturation of the Essex County surface samples are presented in table (19). In developing a fertility concept for the soils of the area, a knowledge of the amounts of the various elements present is important. However, according to the findings of investigational work, more important still is the ratio of the occurrence of one element with respect to another on the exchange complex. There appears to be little general agreement as to what constitutes an optimum calcium/potassium ratio or calcium/magnesium ratio. From table (19) it appears that a wide variation in ratio exists within series. The results of the base exchange capacity and the per cent base saturation are included in the Essex County Soil Survey Report to be used as a guide in developing a fertility concept for the area and should be interpreted in consideration of the crop to be grown.

According to table (19) the base exchange capacity varies within series according to the organic matter content and the clay content. Generally speaking the heavier textured soils have a higher exchange capacity than the medium and light textured soils. The highest exchange capacity of 61.75 M.e./100 grams occurred on the Toledo clay, with clay content of 39.4% and an organic matter content of 18.18%. The lowest base exchange capacity of 3.44 M.e./100 grams occurred on the Wauseon series with a clay content of 11.8 and an organic matter content of 9.81%. The figures in table (19) indicate that there is as great a variation in base exchange capacity within series, depending on the range in fine clay and organic matter content, as there is between different series on the heavy textured soils.

APPENDIX

TABLE 18

CHEMICAL AND PHYSICAL COMPOSITION OF SURFACE SOIL FROM ESSEX COUNTY, ONTARIO(1).

Soil Type	Sample No.	Location			Sand	Silt	Clay	Reaction pH Glass Electrode	Phosphorus Readily Soluble (2)	Potassium Replaceable (3)	Calcium Replaceable (4)	Magnesium Replaceable (5)	Organic Matter (6)
					Bouyoucos Hydrometer								
		Township	Lot	Conc.	per cent 1.-05mm	per cent .05-002mm	per cent <.002mm		Lb. P/acre	Lb. K/acre	Lb. Ca/acre	Lb. Mg/acre	%C x1.724
Berrien sandy loam	64	Colchester S		1	69.0	16.0	15.0	6.22	18	66	4,000	530	5.82
	53	Sandwich W.	28	3	74.9	15.2	9.9	5.81	20	100	3,880	544	6.57
	78	Gosfield N.	25	8	76.6	12.6	10.8	5.74	16	94	2,320	1,274	7.43
Berrien sand	51	Sandwich W.	33	1	81.3	10.2	8.5	5.35	16	59	1,200	272	4.05
	102	Mersea	225	Leamington Road	80.2	10.3	9.5	5.10	26	46	1,120	744	7.03
	104	Mersea	224	Leamington Side-Road	81.2	9.2	9.6	6.30	24	114	2,480	....	5.84
Brookston clay	1	Sandwich E.			51.6	28.4	20.0	6.42	84	124	6,720	846	8.70
	3	Sandwich S.	13	9	35.6	31.4	33.0	7.04	166	228	9,640	1,052	6.30
	4	Anderdon	13	7	23.2	33.2	43.6	6.62	220	520	12,440	1,968	10.58
	92	Pelee Island			21.6	34.0	44.4	6.82	250	444	9,600	1,166	5.73
	95	Pelee Island	21		19.4	35.4	45.2	7.02	320	380	9,720	1,638	5.09
	96	Pelee Island	57		21.4	41.4	37.2	5.61	20	126	4,200	1,006	3.87
	67	Gosfield S.	6	4	29.2	31.0	39.8	6.11	102	308	7,080	1,745	5.85
	17	Malden		9	28.8	34.0	38.2	6.41	136	280	11,240	1,968	9.09
	99	Mersea	16	A	17.4	30.2	52.4	7.36	332	416	12,280	1,696	8.04
	42	Colchester N.	10	8	18.8	28.2	53.0	6.40	174	452	8,920	1,555	7.06
	43	Colchester N.	27	N. Gesto Road.	30.8	31.6	37.6	6.40	120	298	11,040	1,832	9.51
	44	Colchester N.	4	13	31.6	31.8	36.6	6.89	216	464	12,480	1,326	9.85
	25	Rochester	25	3	26.4	36.4	37.2	6.11	120	296	9,240	1,419	9.16
	33	Rochester	W½14	4	20.6	35.6	43.8	6.25	168	472	12,320	1,603	11.85
	34	Rochester	W½14	4	21.2	35.0	43.8	6.44	194	388	11,480	1,463	9.75
	85	Tilbury N.	14	2	30.0	29.2	40.8	6.41	158	378	11,480	1,745	10.32
	31	Tilbury W.			22.8	32.0	45.2	6.19	140	400	10,360	1,647	9.04
	32	Tilbury W.	4	6	24.8	31.8	43.4	6.05	194	700	11,680	1,419	11.75
	58	Sandwich E.		1	29.6	36.0	34.4	6.56	142	328	12,840	1,832	11.56
	71	Maidstone	12	5	44.4	27.8	27.8	5.72	20	144	2,960	1,006	3.40
	72	Maidstone	17	3	35.4	31.6	33.0	6.40	49	242	10,840	1,322	9.90
	59	Sandwich E.		3	17.6	43.4	39.0	5.85	92	340	6,720	1,375	5.95
	54	Anderdon	31	4	27.4	38.6	34.0	5.88	30	246	5,840	1,191	5.61

	68	Gosfield N.	7	7	25.4	29.8	44.8	5.60	100	374	8,360	1,745	8.99
	77	Gosfield N.	19	9	44.8	24.0	31.2	5.12	16	170	2,520	1,322	4.54
	26	Rochester	25	6	27.8	31.8	40.4	5.94	53	198	6,280	1,006	4.99
	28	Tilbury N.	6	19	28.8	32.6	38.6	5.03	18	228	2,640	870	4.08
	27	Tilbury W.	15	10	28.4	30.8	40.8	5.18	23	178	3,120	336	3.85
	30	Tilbury W.	N½ 5	11	25.0	32.2	42.8	5.07	8	246	2,800	729	4.08
	69	Maidstone	287		28.8	30.4	40.8	5.31	25	168	4,080	2,061	5.12
	70	Maidstone	6	7	36.4	26.4	37.2	6.51	98	290	11,320	1,589	9.45
Brookston Clay—sand spot phase	79	Mersea	19	8	60.0	19.2	20.8	6.59	41	100	6,180	1,274	6.95
	103	Mersea	224	Leamington Side-Road	40.2	26.6	33.2	6.30	92	181	6,320	1,638	5.02
Burford Loam	46	Malden	72	6	51.2	29.6	19.2	6.82	162	480	6,640	593	6.57
Caistor Clay	2	Sandwich S.	2	6	38.4	35.0	26.6	5.65	22	112	3,800	522	5.05
	24	Anderdon	Auld	½m.n.	28.8	39.2	32.0	5.69	23	158	3,600	593	3.81
	29	Tilbury W.	15	6	30.8	32.6	36.6	4.91	12	199	2,400	636	3.95
	35	Colchester S.	N½17	3	35.0	25.4	39.6	5.20	12	186	7,680	....	3.17
	36	Colchester S.	15	4	14.8	26.6	58.6	5.55	56	418	5,440	1,647	5.64
	41	Colchester N.			16.8	23.0	60.2	5.05	22	362	3,800	1,832	4.81
	66	Gosfield S.	5	1	25.4	33.2	41.4	5.22	37	468	4,120	1,375	5.18
	73	Gosfield S.	3	1	33.8	33.2	33.0	5.22	15	156	2,000	1,851	2.59
	106A	Colchester S.			36.4	21.0	42.6	5.13	5	302	1,834	....	4.16
	106B	Colchester S.			34.4	21.0	44.6	5.43	13	516	2,400	....	4.06
	107	Colchester S.		3	41.4	19.0	39.6	5.24	9	340	2.234	....	4.40
	40	Colchester S.	2	6	37.4	31.6	31.0	6.15	26	208	3,440	685	3.47
	105	Gosfield N.	31	A	26.2	40.8	33.0	6.94	80	274	8,240	1,274	5.07
	9	Colchester S.	13	1	32.8	31.2	36.0	5.75	42	234	6,400	336	7.44
Clyde Clay	60	Sandwich E.		1	22.8	33.4	43.8	6.80	216	280	9,520	1,851	5.18
Colwood Fine Sandy Loam	49	Sandwich W.	16	1	67.0	21.0	12.0	7.47	57	57	6,560	879	5.54
	50	Sandwich W.			69.2	20.6	10.2	7.28	32	55	5,080	1,419	5.02
	52	Sandwich W.	27	2	36.0	40.2	23.8	6.32	112	174	9,440	2,565	9.14
	86	Tilbury N.	13	1	67.6	19.4	13.0	6.94	68	71	8,440	1,322	8.90
	88	Colchester S.	14	2	54.6	22.0	23.4	7.04	134	120	12,600	....	11.79
Farmington Clay Loam	94	Pelee Island	38		32.8	41.6	25.6	7.58	148	174	15,880	....	8.72
Fox Sandy Loam	5	Mersea	1m.	W. Leamington	75.2	12.0	12.8	5.89	74	160	1,280	250	1.61
	6	Mersea		1	78.8	9.0	12.2	5.74	106	88	880	136	1.30

TABLE 18—*Cont'd*

CHEMICAL AND PHYSICAL COMPOSITION OF SURFACE SOIL FROM ESSEX COUNTY ONTARIO

Soil Type	Sample No.	Location: Township	Location: Lot	Location: Conc.	Sand (Bouyoucos Hydrometer) per cent 1.-05mm	Silt (Bouyoucos Hydrometer) per cent .05-.002mm	Clay (Bouyoucos Hydrometer) per cent < .002mm	Reaction pH Glass Electrode	Phosphorus Readily Soluble (2) Lb. P/acre	Potassium Replaceable (3) Lb. K/acre	Calcium Replaceable (3) Lb. Ca/ac.	Magnesium Replaceable (5) Lb. Mg/ac.	Organic Matter (6) %C x1.724
Harrow sandy loam	7	Gosfield S.		2	70.4	15.4	14.2	5.34	43	70	680	88	1.30
	19	Gosfield S.		A	66.2	21.8	12.0	6.19	34	9	3,480	501	....
	8	Colchester S.	13	1	63.2	23.4	13.4	5.69	28	42	2,480	112	3.87
	20	Colchester S.	64	1	64.0	21.6	14.4	6.01	62	74	2,120	316	2.39
	89	Gosfield S.		1	73.6	11.6	14.8	5.55	28	86	960	321	3.43
	65	Colchester S.		1	64.4	18.8	16.8	6.23	16	106	3,440	374	4.81
Harrow Loam	21	Colchester S.	61	1	39.0	31.4	29.6	5.50	20	116	3,520	1,283	4.47
	74	Gosfield S.	5	2	38.4	38.8	22.8	6.90	31	150	6,680	1,536	4.59
Jeddo Clay	37	Colchester N.	16	6	13.6	26.0	60.4	5.49	48	498	5,480	2,017	7.00
Parkhill Loam	11	Colchester S.	79	1	48.2	30.2	21.6	6.75	42	212	9,120	636	8.17
	75	Gosfield S.	W½6	1	53.0	23.0	24.0	6.22	26	106	7,600	1,745	7.02
	76	Gosfield S.	6	3	52.6	25.8	21.6	6.45	60	142	8,880	1,798	9.47
Perth Clay	15	Malden		3	16.8	38.6	44.6	5.92	84	324	7,080	2,061	5.22
	47	Malden	22	1	19.4	41.2	39.4	6.77	56	246	7,360	1,234	5.12
	12	Colchester S.	87	1	31.6	34.8	33.6	6.08	26	182	4,800	593	3.49
	22	Colchester S.	9	4	28.4	34.4	37.2	5.56	18	158	3,160	336	3.85
	45	Colchester S.	2	3	27.4	35.8	36.8	7.24	276	212	13,080	1,234	8.33
	48	Anderdon	28	1	20.0	37.6	42.4	6.94	224	292	11,960	1,603	7.72
Perth Clay Loam	16	Malden		4	39.2	36.6	24.2	6.31	38	122	8,000	549	6.44
Toledo Clay	56	Sandwich W.	13 & 14	2	23.4	45.0	31.6	6.43	182	220	7,280	1,463	4.95
	23	Colchester S.		Town Line	26.8	33.4	39.8	6.73	284	374	12,240	3,071	11.85
	38	Colchester S.	12	5	22.0	23.6	54.4	5.98	130	472	9,400	1,511	8.22
	39	Colchester S.	7	6	16.6	19.4	64.0	6.29	144	636	9,520	1,326	8.28
	55	Sandwich W.	7	3	15.4	35.4	49.2	6.32	252	486	9,680	1,876	7.33
	57	Sandwich W.		1	21.0	38.0	42.0	6.87	116	376	7,240	1,555	4.62
	93	Pelee Island			19.4	36.8	43.8	6.45	330	282	10,240	1,429	6.88

	97 —	Pelee Island			25.2	35.4	39.4	6.94	460	308	18,560	1,059	8.18
	98 —	Pelee Island			24.2	37.4	38.4	6.61	332	400	15,000	2,061	16.54
	100 —	Mersea	16	C	13.6	34.0	52.4	6.62	336	338	10,720	1,745	8.99
	101 —	Mersea	20	A	19.8	32.4	47.8	6.74	248	268	8,520	1,214	5.02
Tuscola Fine Sandy Loam	10 —	Colchester S.	55	1	67.4	18.2	14.4	6.90	90	46	10,080	1,555	10.23
	13 —	Colchester S.	12	1	47.8	36.8	15.4	5.99	70	76	6,720	1,191	6.15
	14 —	Colchester S.	81	1	61.8	24.6	13.6	6.10	22	108	5,200	1,098	6.22
	18 —	Colchester S.	33	1	70.2	18.6	11.2	6.49	22	22	3,720	1,696	3.87
	63 —	Colchester S.	41	1	50.0	29.0	21.0	6.00	41	124	5,720	744	5.18
	90 —	Mersea	239	Dundas Road	69.2	14.4	16.4	5.64	98	74	1,600	744	5.00
	91 —	Mersea	239	Dundas Road	43.8	35.0	21.2	6.74	20	130	9,240	1,322	7.71
Wauseon Sandy Loam	61 —	Maidstone	1	8	78.2	11.0	10.8	6.01	23	50	3,720	530	4.71
	62 —	Maidstone	11	5	74.2	14.8	11.0	6.08	29	128	4,480	1,274	6.81
	87 —	Rochester		4	73.2	15.0	11.8	7.05	72	60	8,360	1,536	9.81

(1) Samples were taken during the course of the Essex County Soil Survey, 1939. Old pastures representative of the type were selected when ever possible. The analyses were done by Mr. A. L. Willis.

(2) Lohse and Ruhnke's method of determining readily soluble phosphorus was employed. For discussion of this method see Lohse, H. W., Ruhnke, G. N., "Studies of Readily Soluble Phosphorus in Soils"—Soil Science 35:6 1933.

(3) Replaceable potassium—Volk and Truog's method of determining replaceable potassium was employed. For discussion of this method see: Volk, N. J., and Truog, E., "A Rapid Method of Determining the Readily Available Potash of Soils"—Jour. Amer. Soc. of Agron. 26,537—46, 1934.

(4) The replaceable calcium was determined on the same extract that was used in the determination of potassium.

(5) Magnesium is determined from the filtrate remaining from the calcium determination.

(6) The organic matter data was obtained by applying the factor 1.7.4 to the per cent organic carbon. The method described by Allison, L. E., "Organic Soil Carbon by Reduction of Chromic Acid"—Soil Science, Oct., 1935, p. 311, was used to determined the per cent organic carbon.

TABLE 19

BASE EXCHANGE CAPACITY[1] AND PER CENT SATURATION OF SURFACE SAMPLES FROM ESSEX COUNTY ONTARIO

Soil Type	Sample No.	Base Exchange Capacity Me/100 gms.	Per Cent Saturation				Ratios	
			[2]H+	Ca++	Mg++	K+	Ca:K	Ca:Mg
Berrien sandy loam....	64	14.60	16.5	68.0	14.9	0.6	118:1	4.6:1
Berrien sand................	51	7.54	44.1	40.0	14.9	1.0	40:1	2.7:1
	53	15.74	23.0	62.0	14.2	0.8	74.8:1	4.3:1
	78	11.15	....	52.0	46.9	1.1	48.3:1	1.1:1
	102	15.25	61.6	18.0	20.0	0.4	47.5:1	0.9:1
Brookston clay............	59	26.57	14.0	63.0	21.4	1.6	38.6:1	3.0:1
	3	25.91	——	93.0	16.7	1.1	83:1	5.6:1
	4	34.44	——	90.0	23.6	1.9	47.1:1	3.8:1
	54	24.11	18.3	60.0	20.4	1.3	46.2:1	3.0:1
	92	33.46	11.9	72.0	14.4	1.7	42.1:1	5.0:1
	95	28.78	——	84.0	23.4	1.7	50.0:1	3.6:1
	96	14.02	——	75.0	29.4	1.1	65.7:1	2.5:1
	67	25.75	1.6	69.0	27.9	1.5	17.2:1	2.5:1
	17	36.74	1.0	76.0	22.0	1.0	78.3:1	3.5:1
	68	33.78	15.4	62.0	21.2	1.4	43.5:1	2.9:1
	77	14.60	18.3	43.0	37.2	1.5	28.6:1	1.2:1
	99	36.16	——	85.0	19.3	1.5	57.9:1	4.4:1
	42	32.80	10.7	68.0	19.5	1.8	38.4:1	3.5:1
	43	38.21	7.3	72.0	19.7	1.0	72.8:1	3.7:1
	44	38.87	——	95.0	14.0	1.8	52.8:1	5.7:1
	25	33.13	11.2	70.0	17.6	1.2	60.9:1	4.0:1
	26	23.78	15.5	66.0	17.4	1.1	65.2:1	3.8:1
	33	41.98	8.8	74.0	15.8	1.4	51.3:1	4.7:1
	34	39.69	11.5	72.0	15.2	1.3	57.4:1	4.8:1
	28	16.73	36.9	40.0	21.4	1.7	22.7:1	1.8:1
	85	29.19	——	98.0	24.6	1.6	59.6:1	4.0:1
	27	16.73	43.4	47.0	8.2	1.4	34.9:1	5.7:1
	30	17.38	40.9	40.0	17.3	1.8	22.2:1	2.3:1
	31	35.59	14.9	73.0	10.7	1.4	50.7:1	3.8:1
	32	39.20	8.8	74.0	14.9	2.3	32.8:1	5.0:1
	58	42.97	6.4	75.0	17.6	1.0	76.5:1	4.3:1
	69	21.65	12.9	47.0	39.1	1.0	47.4:1	1.2:1
	70	38.38	7.9	74.0	17.1	1.0	76.4:1	4.4:1
	71	13.12	10.1	57.0	31.5	1.4	41.1:1	1.8:1
	72	37.56	12.7	72.0	14.5	0.8	90.5:1	5.0:1
	103	22.63	——	70.0	29.7	1.0	68.6:1	2.3:1
Brookston clay loam sand spot phase......	1	23.45	12.5	72.0	14.8	0.7	105:1	4.8:1
Brookston clay loam..	79	19.02	——	81.0	27.5	0.7	119:1	3.0:1
Burford gravelly loam	46	19.52	——	85.0	12.5	3.1	27.2:1	6.8:1
Caistor clay..................	2	13.12	9.5	73.0	16.4	1.1	68:1	4.4:1
	24	16.40	28.9	55.0	14.9	1.2	45:1	3.7:1
	29	14.60	39.3	41.0	18.0	1.7	24:1	2.3:1
	36	27.55	24.5	49.0	24.6	1.9	25.6:1	2.0:1
	41	27.22	35.7	35.0	27.6	1.7	20.6:1	1.3:1
	66	24.11	32.0	42.0	23.5	2.5	17.2:1	1.8:1
Caistor clay loam........	73	11.48	——	43.5	66.4	1.7	25.1:1	0.7:1
	40	13.94	15.9	62.0	20.2	1.9	32.5:1	3.0:1
	105	21.16	——	98.0	24.8	1.7	59:1	3.9:1
	9	27.40	35.9	58.0	5.0	1.1	53.3:1	11.6:1
Clyde clay....................	60	32.14	1.1	74.0	23.8	1.1	66.1:1	3.1:1

TABLE 19—*Cont'd*

BASE EXCHANGE CAPACITY[1] AND PER CENT SATURATION OF SURFACE SAMPLES FROM ESSEX COUNTY ONTARIO

Soil Type	Sample No.	Base Exchange Capacity M.e./100 gms.	Per Cent Saturation				Ratios	
			[2]H+	Ca++	Mg++	K+	Ca:K	Ca:Mg
Colwood fine sandy loam	49	16.89	——	97.0	20.2	0.4	224:1	4.5:1
	50	14.92	——	85.0	39.1	0.5	181:1	2.2:1
	52	33.13	——	71.0	31.9	0.7	107:1	2.2:1
	86	26.90	1.5	78.0	20.2	0.3	237:1	3.9:1
Fox sandy loam	5	4.08	----	78.0	25.1	4.9	16.0:1	3.1:1
	6	3.61	20.7	61.0	15.5	2.8	22:1	3.9:1
	7	3.47	38.0	49.0	10.4	2.6	18.9:1	4.7:1
	19	11.97	8.8	73.0	17.2	1.0	75.8:1	4.2:1
Harrow fine sandy loam	8	8.85	24.2	70.0	5.2	0.6	114:1	13.5:1
	20	8.53	21.7	62.0	15.2	1.1	56:1	4.1:1
	89	13.78	72.1	17.5	9.6	0.8	22:1	1.8:1
	65	11.97	14.0	72.0	12.9	1.1	64:1	5.6:1
Harrow loam	21	15.58	9.0	56.0	34.0	1.0	59:1	1.7:1
	74	20.34	----	82.0	31.1	0.9	88:1	2.6:1
Jeddo clay	37	31.82	29.0	43.0	26.0	2.0	21:1	1.7:1
Parkhill loam	11	28.40	8.8	81	9.2	1.0	84.5:1	8.7:1
	75	23.62	——	80	30.4	0.6	141:1	2.6:1
	76	26.57	——	83	27.9	0.7	123:1	3.0:1
Perth clay	15	26.90	1.3	66.0	31.2	1.5	43:1	2.1:1
	47	25.91	8.2	71.0	19.6	1.2	58.4:1	3.7:1
Perth clay loam	12	18.37	20.4	65.0	13.3	1.3	52:1	4.9:1
	22	15.91	40.5	49.5	8.7	1.3	39.5:1	5.7:1
	45	35.42	——	92.0	14.3	0.8	121:1	6.4:1
	16	25.91	13.7	77.0	8.7	0.6	129:1	8.8:1
	48	37.72	2.5	79.0	17.5	1.0	80.9:1	4.5:1
Toledo clay	23	41.16	——	74.0	30.7	1.2	63.9:1	2.4:1
	38	36.41	17.2	64.0	17.1	1.7	39.2:1	3.8:1
	39	38.38	21.6	62.0	14.3	2.1	29.3:1	4.4:1
	55	25.26	——	95.0	25.3	2.5	39:1	3.1:1
	57	25.26	0.8	72.0	25.3	1.9	37.6:1	2.8:1
	93	33.95	6.6	75.0	17.3	1.1	71:1	4.4:1
	97	61.75	17.3	75.0	7.1	0.6	119:1	10.6:1
	98	49.45	5.8	76.0	17.2	1.0	73.4:1	4.4:1
	100	40.10	14.0	67.0	17.9	1.1	62.4:1	3.6:1
	101	30.75	13.2	69.0	16.3	1.5	45.4:1	4.3:1
	56	34.60	29.8	52.0	17.4	0.8	65 :1	3:1
Tuscola fine sandy loam	10	28.60	——	88.0	22.4	0.2	25.2:1	3.9:1
	13	22.96	5.4	73.0	21.2	0.4	173:1	3.4:1
	14	18.37	3.6	71.0	24.6	0.8	93:1	2.9:1
	18	11.81	----	79.0	59.0	0.2	332:1	1.3:1
	63	20.83	15.6	69.0	14.7	0.7	95.6:1	4.7:1
	90	11.32	36.7	35.5	27.0	0.8	42.2:1	1.3:1
	91	28.78	0.5	80.0	18.9	0.6	140:1	4.3:1
Wauseon sandy loam	61	13.12	11.9	71.0	16.6	0.5	145:1	4.3:1
	62	15.58	——	72.0	33.6	1.0	70:1	2.1:1
	87	3.44	——	61.0	183.8	2.2	271:1	3.3:1

1—Method proposed by Schollenberger, C. J. and Simon, R. H., Soil Science 59:1, 1945, "Determination of Exchange Capacity and Exchangeable Bases in Soil, Ammonium Acetate Method." The alternate method was used on the Essex County soils in which the soil is leached with 1NKcl.

2—By difference.