SOIL SURVEY OF THE BOONVILLE AREA, INDIANA.

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LOCATION AND BOUNDARIES OF THE AREA.

The Boonville area is located in the southwestern part of Indiana, bordering on the Ohio River. It is bounded on the east by the

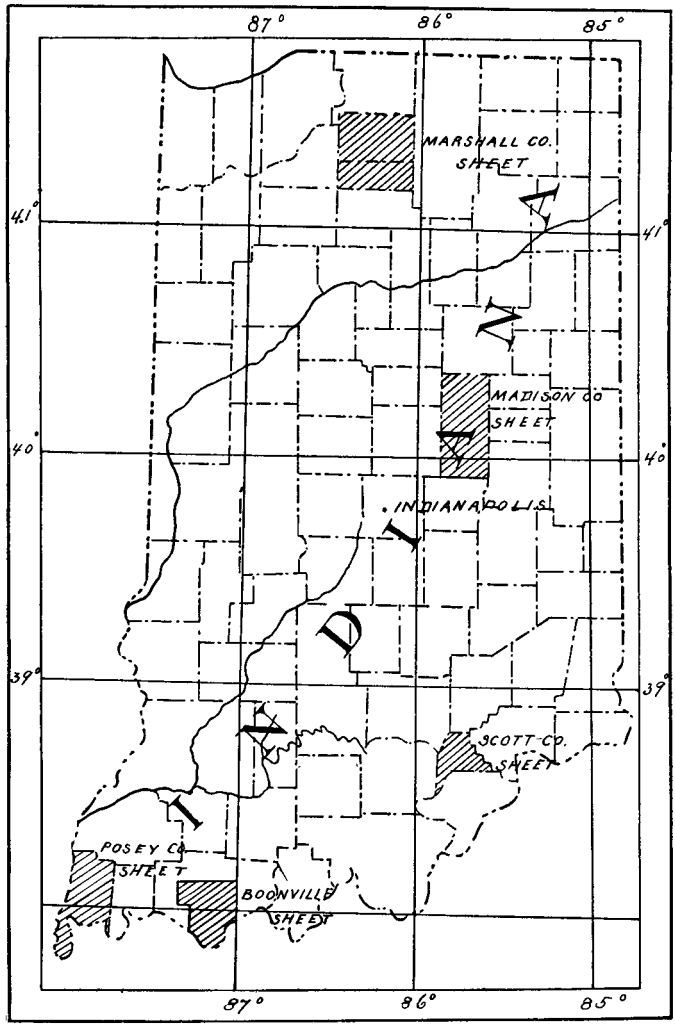

FIG. 30.—Sketch map showing location of the Boonville area, Indiana.

meridian of 87° west longitude and the Ohio River; on the north by a line drawn east and west through Tennyson; on the west by a

line running 10¾ miles north from the Ohio River to 1¾ miles east of the village of Hatfield, thence west for a distance of 4¾ miles, and then north to the northern boundary; and on the south by the Ohio River. This territory includes parts of Warrick and Spencer counties, and embraces 169,216 acres, or approximately 264 square miles.

The area is well adapted to agriculture, which, together with the coal industry, forms the leading occupation of the people.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

In 1803 John Sprinkle crossed the Ohio River from Kentucky and settled at Newburg, Warrick County, and in the same year a few other families followed him, taking up the adjoining lands. These first settlers were all known as "squatters," as the county was not surveyed until 1805, and it was some years after that date before these lands were put on sale by the Government. Four years after the settlement at Newburg the present town of Rockport was established by Daniel Grass, and as supplies for the settlement were easily obtained from Owensboro, Ky., its population rapidly increased. The settlement of the area was at first slow, on account of frequent trouble with hostile Indians, but after the battle of Tippecanoe, in 1811, which effectually destroyed all chance of future annoyance from that source, the population of both the inland section and that along the river increased very rapidly. Many settlers came in from Kentucky, Tennessee, Georgia, Virginia, and the Carolinas, as well as from the States to the east.

The development of the northern part of the area progressed more slowly than that of the section which bordered on the river, because there was no outlet for its products and communication with the outside world was much more difficult. All supplies were taken from the river to Boonville in wagons until the railroad reached that town, in 1873.

At first the settlers cultivated only small areas of corn, grain, and potatoes for home use, depending on the game in the surrounding forests for meat and on trading with the boats which passed up and down the river for all other necessaries of life. The growing of tobacco began to attract attention soon after the area was settled, and later, when good markets for the product were established at Owensboro and Louisville, Ky., its production rapidly increased. Corn, tobacco, wheat, barley, and oats soon began to be cultivated on a comparatively large scale, and gristmills were erected, so that the people no longer depended on Kentucky as a source of supplies.

About 1836 two agricultural societies were organized, one at Rockport and one at Boonville, for the purpose of encouraging the farmers of the area in stock raising and the cultivation of general

farm products. County fairs and farmers' institutes were held yearly, where a small number of stock and a few other products of the surrounding country were exhibited; but no great interest was taken in these attempts until 1856, when a new organization was formed, which continued for years to be the most prosperous agricultural society in the State.

Corn and tobacco continue to be the leading products of the area. A tobacco market was established at Rockport in 1855. The high prices prevailing during the decade from 1860 to 1870 caused a great increase in the tobacco acreage. The supply from the Southern States was cut off during this period, and there was a great demand for tobacco at high prices. The acreage devoted to this crop increased so rapidly that tobacco was soon cultivated almost to the exclusion of all other crops. Spencer County alone is said to have produced as much as 10,000,000 pounds a year. In more recent years the production of tobacco has greatly decreased, but at the present time the prices offered at the neighboring markets of Owensboro and Louisville are causing renewed interest in its cultivation.

One of the most important factors in the development of the northern portion of the area was the advent of the Lake Erie, Evansville and Southwestern Railroad, which reached Boonville in 1873. This afforded adequate means of transporting the products of this section to both the local markets and those situated at a distance from the area. The coal deposits in the immediate neighborhood soon began to be developed, which caused a large increase in population and property values. It had been known for some time that there were coal beds in the hilly sections of the area, but owing to the lack of transportation facilities no attempt had been made to develop them. During the last ten years coal mining has attained considerable local importance, and coal is now being shipped to more distant markets.

The area at the present time is well developed agriculturally. It contains a number of towns and villages, of which Boonville and Rockport are the largest, each having a population of about 3,000. They have a number of small factories and are the centers of trade for large and prosperous rural districts.

CLIMATE.

The area surveyed is not subject to severe winters or to excessive heat during the summer months. The winters are not only mild, but of comparatively short duration. The growing season comprises about six months of the year, during which time crops are safe from damage by frosts. There is usually adequate rainfall for the crops grown, and injury from drought is very uncommon, even to crops maturing in the late summer.

During the early part of the spring excessive rains, occurring both in this State and those to the northeast, together with the melting of the snows farther north, cause the Ohio River to overflow. Large areas of the flat, low lands along its course are flooded, rendering them too wet for the early cultivation of crops.

The last killing frost in the spring usually occurs about April 9, and the first in fall about October 31.

The following table shows the normal monthly and annual temperature and precipitation as observed at Evansville, Ind., which is situated only a short distance southwest of the area:

Normal monthly and annual temperature and precipitation.

Month.	Evansville.		Month.	Evansville.	
	Temperature.	Precipitation.		Temperature.	Precipitation.
	°F.	Inches.		°F.	Inches.
January	35.4	3.31	August	78.4	2.09
February	32.3	2.98	September	71.9	2.48
March	44.6	4.84	October	59.2	2.87
April	57.0	3.55	November	45.0	3.67
May	67.0	4.38	December	35.8	3.02
June	76.3	4.67	Year	56.9	41.40
July	79.6	3.54			

PHYSIOGRAPHY AND GEOLOGY.

The physiographic features of the area are quite marked, varying from rolling uplands and small valleys to bottom lands or river flats. The rolling uplands vary considerably in height, but rarely exceed 500 feet above sea level. The coal knobs, located 3½ miles northwest of Rockport, have an elevation of 600 feet and are the highest hills in the area. The hilliest portions are found in the vicinity of Boonville, in the northwestern corner of the sheet, around Chrisney, in the northern and eastern portions of the area, and to the south and west of Rockport.

The hills in only a few instances have very steep slopes, but as a rule are characterized by their smooth, gently rounded forms, with intervening shallow depressions. At Rockport, where the hills extend to the river, they have a steep, precipitous bluff, 75 to 100 feet above the level of the river, for about 2 miles to the south of that town. Where the surface is undulating or less hilly the soil does not erode to any extent. It is only on the steep sides of some of the higher hills that erosion is very great.

The principal valleys of the area occur along the Cypress Creek Ditch and Little Pigeon Creek, which still flow in the same channels they occupied prior to the Glacial period.

The valley formed by the Cypress Creek ditch has an average width of 1 mile and extends across the area from north to south immediately west of Boonville. The Little Pigeon Creek Valley traverses the area in a northeast and southwest direction and occupies the territory between the Boonville hills on the west and the Chrisney hills on the east. It has an average width of 4 miles and is the largest valley in the area. Numerous other small valleys occur, especially in the hills, where small streams have cut their way through, but they are not of sufficient importance to warrant separate discussion. The streams usually overflow after heavy rains or long wet periods, and the soils found in the valleys are of a silty or clayey character.

The surface of the bottom lands or river flats in the southern part of the area, along the Ohio River, presents a flood plain, cut by numerous small streams, old stream channels, and bayous. These lands are flooded annually by the overflow of the river, and each year new channels and bayous are formed. A few small ridges occur over these bottoms and have an elevation of 3 to 4 feet above the surrounding surface. The elevation of this flood plain is from 340 to 360 feet above sea level.

Following the course of the Ohio River and bordering it is a sand ridge, averaging one-half mile in width, which is somewhat higher than the lands immediately back of it and is rarely overflowed. The soils found in the bottoms are of a stiff clayey character, and owing to their low-lying position are exceedingly difficult to drain.

All the drainage of the Boonville area finds its way into the Ohio River, the streams flowing in a southerly direction and emptying directly into the river. The largest is Little Pigeon Creek, which drains over three-fourths of the area. It enters the area 2 miles east of Tennyson, flows in a southwesterly direction, and passes out about 5 miles west of Richland City. The Cypress Creek ditch, which flows in a southerly direction through the extreme western portion of the area, drains the territory around Boonville and to the west of it. The remainder of the area is drained by smaller streams, which have their sources within the area and flow directly into the Ohio River.

The rocks forming the basal structure of the area belong to the Carboniferous system. The rocks of this system have played an important part in the economic geology of the area, and at present quite extensive coal mines are being developed. The rocks belonging to this period which are more commonly exposed consist of sandstone, shale, and shaly sandstone. Exposures may be seen in different parts of the area, especially in deep road cuts.

Inasmuch as the underlying rocks are everywhere covered by a thick mantle of loess they have played only a minor part in the formation of the soils of the area. During early Quaternary times great ice sheets extended across Indiana some distance north of the area.

As the ice melted and the glaciers began to recede it is believed that a part of the material which later formed the soils of the area was released and carried still farther south and deposited over broad flats by streams then issuing from the glacial front. It was later picked up by the winds and generally redeposited in the form of loess over the surface of the uplands, covering all older geological formations. The soils of the bottom lands are of recent alluvial origin, being made up of reworked loess material and very fine sand, and are generally underlain by alluvium of the Glacial age.

SOILS.

The soils of the area are divided naturally into two general groups—upland and bottom land. The several soils, in their typical occurrence, are quite distinct, each possessing its own physical peculiarities. Six types have been recognized in the area, the Miami silt loam and Miami fine sandy loam being found in the upland division; the Waverly silt loam, Waverly clay loam, Waverly clay, and Waverly fine sandy loam in the bottom-land division of the area.

The following table shows the actual and relative extent of each of the different types found in the area:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Miami silt loam	86,656	51.2	Waverly clay	8,320	4.9
Waverly clay loam	30,208	17.9	Waverly fine sandy loam	3,904	2.3
Miami fine sandy loam	22,848	13.5	Total	169,216	
Waverly silt loam	17,280	10.2			

MIAMI SILT LOAM.

The Miami silt loam is the most extensive type in the area surveyed. Its topographic features, ability to withstand drought, adaptability to a great diversity of crops, and its natural productiveness make it the most valuable soil in the area for general farming purposes.

The soil is a silt loam averaging from 8 to 10 inches in depth, and varying in color from a light ashy gray to light brown, according to the amount of organic matter present. It contains, in its typical form, a small percentage of fine sand, and when recently put under cultivation or in its virgin state carries a large amount of organic matter.

The subsoil, from 9 to 36 inches, consists of a silt loam containing a small proportion of very fine sand in the first few inches. It varies in color from dark red to yellow, and becomes heavier as the depth in-

creases. At a depth of 4 or 5 feet the clay content is much larger and a very heavy silt loam occurs, which is usually of lighter color than that immediately underlying the soil. The material is very compact at a depth of from 25 to 36 inches, making a subsoil very retentive of moisture, while the fine silty texture of the soil prevents the surface from becoming baked, sun cracked, or difficult to cultivate.

The Miami silt loam, covering 51 per cent of the entire survey, occurs in the uplands in all parts of the area. The largest unbroken body occurs in the northeastern part of the area and extends from near Rockport to the extreme northern boundary. Small tracts occupy the low ridges in the vicinity of the flat river bottoms. These differ slightly from the typical Miami silt loam in that the soil is slightly heavier and the underlying subsoil has a larger clay content. These small areas have undoubtedly been submerged at times, and the soil has been slightly altered by material deposited by water, as well as by that washed down from the neighboring uplands.

The topography of the country occupied by this type is rolling. The hills are low and rounded, with gently sloping sides, and the intervening valleys are broad and shallow. This insures good drainage, and with proper attention the land is subject to but little injury from erosion. Artificial drainage is seldom necessary and is practiced in but few localities, the rolling topography being usually sufficient to drain the excess water into the numerous small streams.

The loess from which this soil is derived is of glacial origin. The material, which is supposed to have been transported by wind and water, was deposited as a mantle over the entire country to the southward. It shows no stratification, and has an average depth of from 8 to 10 feet in the more hilly section, although it often reaches a greater depth in the valleys or more level areas. The loess overlies beds of sandstone and shaly sandstone belonging to the Carboniferous system. These rocks, however, have not entered into the composition of the soil, except on an occasional steep slope where a thin layer of sandy shales has been exposed through the process of erosion, in which case they weather rapidly, and, becoming mixed with the silty material, cause a larger percentage of fine sand in the soil of the immediate vicinity.

Great care is necessary to keep the Miami silt loam in a high state of productiveness, and a rotation of crops is very essential in order to secure the best results. Where the soil is in a loose and thorough state of cultivation, as is necessary when the crop is corn or potatoes, it suffers greatly from the effects of erosion and large areas of the subsoil are exposed along the steeper slopes.

The Miami silt loam is well adapted to most of the general farm products of the area. Wheat and oats do especially well and large

yields of clover, timothy, and other grasses are always obtained. Very little tobacco is cultivated on this type, as the other soils of the area are considered better suited to the variety grown in this section. Wheat averages 15 bushels, oats about 30 bushels, and corn from 30 to 35 bushels per acre. Where the soil is well tilled and a good system of rotation practiced, much larger yields are frequently realized without the aid of commercial fertilizers. Clover and timothy average from 1½ to 2 tons per acre, two or more cuttings often being obtained. Apples, peaches, plums, and pears are all successfully grown in the more hilly sections. No attempt has been made to cultivate vegetables and truck crops, except on a limited scale for home use and for local markets, but excellent yields are generally realized from these crops.

The following table gives the mechanical analyses of typical samples of the Miami silt loam:

Mechanical analyses of Miami silt loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct*	*P. ct.*
10796	1 mile E of Pedigo Lake Mills.	Gray to brown silty loam, 0 to 12 inches.	0.1	0.3	0.2	0.5	4.0	84.2	10.7
10798	½ mile S. of Chrisney.	Yellow to brown silty loam, 0 to 10 inches.	.2	.8	.5	1.2	6.1	77.1	13.8
10797	Subsoil of 10796	Heavy silty loam, 12 to 36 inches.	.0	.2	.1	.3	8.7	68.2	22.4
10799	Subsoil of 10798	Yellow silty loam, 10 to 36 inches.	.2	.3	.4	.7	5.2	70.2	22.7

MIAMI FINE SANDY LOAM.

Third in extent and second in agricultural importance among the soil types of the Boonville area is the Miami fine sandy loam. The soil consists of a light to dark brown fine sandy loam, averaging about 8 inches in depth. This sandy loam varies from fine to medium in texture, with the coarser material usually occurring in the upper portions of the soil. The sand content rapidly decreases with depth, and below 8 to 14 inches the subsoil is a heavy fine sandy loam, whose color varies from light red to yellow, generally becoming lighter in the deeper layers. The subsoil found from 20 to 36 inches below the surface is a light silt or clay loam, there being only a small percentage of sand present.

The type is practically uniform throughout the area, with the

exception of a few minor variations in local spots. On some of the higher elevations a sandy phase occurs which consists of a very sandy loam in which the percentage of sand continues to be quite large throughout the entire 3-foot profile. At a lower depth, however, the sand content decreases rapidly, and at 4 or 5 feet below the surface the subsoil is the same as that found underlying the typical soil. The sandy loam of this phase, for a depth of from 20 to 30 inches, is somewhat coarser than that of the typical soil, but grades rapidly into a sandy loam of finer texture at lower depths.

In low positions a somewhat heavier phase of the type is encountered which has been slightly modified by the action of water. The soil in this case is a fine sandy loam to a depth averaging 8 inches, mixed with varying quantities of organic matter. The underlying subsoil is a heavy fine sandy loam which grades into a clay loam at about 15 to 20 inches below the surface. The color of both soil and subsoil varies from gray to brown, depending upon the amount of organic matter present. These variations occur only in limited areas over the main soil type, and are not of sufficient extent to be shown on a map of the scale used.

The Miami fine sandy loam occurs in one extensive body, reaching from the central part to the southwestern corner of the area. It embraces all the territory from a short distance south of Midway southwest to within three-fourths of a mile of the Ohio River. The eastern boundary of this area is formed by the rolling uplands of the Miami silt loam and the western by the bottoms of Little Pigeon Creek. Two small patches of this type are found a few miles northwest of Rockport, bordering the bottom lands of Lake Drain Creek. In the extreme western part of the area, northwest of Hatfield, two small areas are also found.

The topography of this soil is generally level or slightly undulating. Some portions, however, consist of low hills with shallow depressions intervening. The small hills or ridges trend in a northeast-southwest direction, the general slope being to the south and west.

Many small streams and drains flow across this type in a southwesterly to westerly direction, emptying either into Little Pigeon Creek or the Ohio River. In a few instances the streams have cut out wide depressions, and a heavier type of soil is usually found occurring along them. The type possesses good natural drainage. The streams which flow through it afford excellent outlets for all the drainage waters, and only in a very few instances has it been necessary to construct artificial drainage ditches. Occasionally, however, it has been found advisable to widen and deepen the streams, in order to increase their capacity for carrying off the surplus water during times of heavy rains or long wet periods.

In addition to the good natural drainage which this soil type possesses, it also has the power to retain moisture, the underlying silt or clay loam subsoil forming an excellent medium for storage of the soil water, so that with the aid of proper cultivation crops suffer but little from the effects of drought.

Over the more elevated portions of the type, and where the sand content of the soil is above the average, natural drainage is apt to be too thorough for most crops. In this case great care should be exercised in the methods of cultivating, particular attention being paid to the preservation of a surface mulch in order to carry the crops safely through the dry season of July and August. The lower lying portions of this soil type require artificial drainage to secure the best crops. Ditching and tiling greatly improve the productivity of such areas, and a large part of these is being artificially drained at the present time.

The Miami fine sandy loam is of alluvial and glacial origin. The underlying silt and clay loam is undoubtedly reworked loess material washed down from the uplands, while part of the sand which goes to make up the sandy loam was deposited at an early date during times of exceptionally high water. The sand underlying the Miami silt loam bordering this type on the east has been washed over the surface of this soil and has entered into its composition.

The type is well adapted to almost all kinds of crops that will grow in this latitude, with the possible exception of timothy, which requires more moisture than this soil can retain during the dry season. Ordinarily wheat averages 20 bushels per acre. The yield of corn on the cob varies from 40 to 80 bushels per acre, depending upon the manner in which it is cultivated, and of oats only from 25 to 30 bushels, owing to the lack of sufficient moisture fully to mature the crop. Early potatoes yield from 75 to 175 bushels, while the late varieties produce from 100 to 125 bushels per acre.

The Miami fine sandy loam is one of the best soils in the area for the production of tobacco. It produces usually from 700 to 1,000 pounds per acre, although a much higher yield is often obtained. Tobacco is considered a sure crop, and often does well when corn, wheat, and other crops are a failure.

Apples and peaches are grown to some extent, but the apples do not keep as well as those grown on heavier types. Small fruits are cultivated to a limited extent, the quantity produced being scarcely sufficient for home consumption. The soil is well adapted to truck crops, but its distance from good markets renders their production unprofitable at the present time.

The following table gives mechanical analyses of typical samples of this type of soil:

Mechanical analyses of Miami fine sandy loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand 0.25, to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10790	2 miles E. of Hatfield.	Brown fine sandy loam, 0 to 14 inches.	0.0	1.7	10.0	28.6	19.2	32.1	8.3
10788	1 mile E. of Richland City.	Brown to gray fine sandy loam, 0 to 12 inches.	.2	1.7	6.4	27.1	18.6	34.9	11.1
10791	Subsoil of 10790..	Heavy fine sandy loam, 14 to 36 inches.	.1	1.2	7.7	26.1	10.7	39.7	14.2
10789	Subsoil of 10788..	Yellow loam, 12 to 36 inches..	.1	.8	3.0	17.3	14.2	40.3	24.4

WAVERLY SILT LOAM.

The Waverly silt loam covers a very limited part of the area surveyed, but agriculturally it is one of the most valuable soils. The soil has a depth of from 12 to 18 inches. It is a silt loam, slightly plastic when wet, gradually becoming heavier as the depth increases, and varying in color from gray to dark brown, according to the amount of organic matter present.

The subsoil is a light-yellow silt loam, containing a larger percentage of clay than the soil, and becoming heavier at a depth of 25 or 30 inches. In places the subsoil is a mottled, heavy, drab silt loam of a much stiffer nature than the soil, but still retaining its silty character.

The greater part of this type, as it exists in the area, contains a comparatively small amount of organic matter, but in the poorly drained places, where there has been a continual accumulation of humus, the percentage of organic matter is very high.

The Waverly silt loam occurs as narrow strips bordering most of the small streams in all sections of the area, but seldom extends back more than a quarter of a mile from the streams. The largest area, which lies along the Cypress Creek ditch west of Boonville, has an average width of 1 mile. A second extensive area occurs at the head of the Willow Pond ditch, northwest of Rockport, where the soil contains a very large amount of organic matter and is of a much darker color than the greater proportion of the type. The Willow Pond area has only recently been drained and put under cultivation, and both soil and subsoil are of a slightly heavier nature than the typical Waverly silt loam.

In topography the type is level, with a gentle slope toward the small streams. It occupies the low depressions near the sources of

streams and the narrow valleys between the rolling hills. The streams have usually cut their channels down several feet below the lands bordering them, but are generally insufficient to drain thoroughly the larger areas without artificial means. This soil is easily drained by straightening and deepening the small stream courses and cutting lateral ditches at frequent intervals through the wet areas. Tiles are used with excellent results, and at present the greater part of this soil is well drained. When ditched and tiled thoroughly it is very productive, and in several localities its value has been increased from $10 to $50 an acre by the installation of a good drainage system.

The Waverly silt loam is derived from material washed from the uplands at times of heavy rains and deposited in the depressions and shallow valleys, mixed with decaying vegetable matter. The remains of decomposed logs and other organic matter have been found in the soil at a depth of from 6 to 10 feet below the surface, indicating that the now shallow valleys have been gradually built up to this present level by the steady accumulation of material from the uplands.

Where the soil is well drained corn averages from 50 to 70 bushels; wheat, 20 bushels; oats, 40 bushels; clover and timothy, about 2 tons, and tobacco from 1,000 to 1,200 pounds per acre. Large yields of potatoes and other vegetables are obtained. The soil seems best adapted to corn and tobacco. The corn crop is never a failure, and when well cultivated larger yields than those above mentioned are obtained. Tobacco gives large yields per acre, and, as quantity rather than quality is what the growers strive for, much of this soil type is devoted to its production.

The following table gives the mechanical analyses of typical samples of the Waverly silt loam:

Mechanical analyses of Waverly silt loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10806	4 miles N. of Rockport.	Brown to yellow silty loam, 0 to 10 inches.	0.2	0.5	0.5	3.6	10.4	74.8	10.1
10804	2 miles E. of Boonville.	Yellow fine silty loam, 0 to 12 inches.	.2	.2	.1	.5	5.8	82.1	11.1
10805	Subsoil of 10804..	Yellow silty loam, 12 to 36 inches.	.3	.5	.3	.4	5.7	77.8	15.1
10807	Subsoil of 10806..	Yellow heavy silty loam, 10 to 36 inches.	.2	.5	.5	3.5	10.7	67.5	16.7

WAVERLY CLAY LOAM.

The soil of the Waverly clay loam consists of about 6 inches of heavy, light-brown to gray silt loam, often containing small iron concretions scattered over the surface and through the soil. The soil becomes heavier with depth and grades into a very heavy silt loam containing a large percentage of clay. At a depth of from 12 to 20 inches the subsoil is a sticky, mottled clay, usually containing small iron concretions. It becomes stiffer and more tenacious as the depth increases, making the soil difficult to drain. When plowed and exposed to the air the subsoil often becomes whitish in color and dries into hard crusts or clods very difficult to pulverize. There is apparently little organic matter in the soil, except in small swampy areas, and no attempt has been made to drain these areas or to put them under cultivation. In such places the soil is known locally as "glade" or "crawfish" land and is of little agricultural value.

The Waverly clay loam occupies small areas adjacent to many of the small streams, but in the north central part of the area there is one body of considerable extent. This occupies the low, flat country which extends along Little Pigeon Creek and other streams from near Tennyson to where Little Pigeon Creek leaves the area. There are a few ridges and shallow depressions in this area, but the greater part of the land is almost level. It is drained with great difficulty, on account of the compact nature of the soil, the level topography, and the slight elevation above the level of the streams.

Where this soil is ditched and tiled and a complete system of artificial drainage established, the least productive phases have been made to produce average crops. Where no system of drainage is practiced, these lands are either covered with a growth of scrub oak or are used exclusively for pasture.

A small area of the type situated about 2½ miles north of Rockport deserves special mention. It occupies an old terrace of the Ohio River, and has a more rolling topography than the typical areas. This, together with its elevation and nearness to the river, gives it better drainage and a higher crop value than this soil usually possesses. This area is of too small extent, and the soil occurring between the low ridges is too typical of the Waverly clay loam to classify it as a separate soil type.

The Waverly clay loam is derived from the same loess material as the Miami silt loam of the uplands, but its position in the low, flat valleys, only a few feet above the present level of the streams, has caused this material to undergo considerable change. The poor drainage, the addition of finer material washed down from the uplands, the effect of water which collects and spreads over the low

areas in wet seasons, and the material deposited over these sections by former inundations, all combine to make this a much heavier soil than that formed from the loess on the well-drained uplands.

The yields of the various crops cultivated on this soil depend to a great extent on the thoroughness of the drainage and cultivation. With the methods usually practiced corn will average from 10 to 15 bushels and wheat from 10 to 12 bushels per acre. Wheat often gives larger yields in a favorable season if preceded by clover. Very little oats is grown on this type, and a yield of from 15 to 20 bushels per acre is estimated as an average crop.

Tobacco is grown quite extensively on this soil, a heavy, coarse-textured leaf being produced. This tobacco does not command so high a price as that grown on the more sandy soils, but the plants are larger and larger yields are obtained, the average being from 1,000 to 1,200 pounds per acre.

This soil seems best adapted to clover, timothy, and redtop, and a large amount of hay is harvested yearly from it. The hay crop averages from 2 to 3 tons per acre for each cutting, and the facilities for shipping this product to southern cities make it a profitable industry.

The Waverly clay loam varies considerably in agricultural value, according to its position, topography, and the methods used in its management. The greater part of it is considered a very poor soil for general farming purposes, but where it occupies the low ridges a few feet above the more level areas and is well drained very fair crop yields are usually obtained. Small areas frequently appear only a few rods apart where, on account of the local influences of topography and natural drainage, fair yields are produced on one field, while on the adjacent one, which is too wet and poorly drained, nothing except clover and grass can be successfully grown.

The following table gives mechanical analyses of this type:

Mechanical analyses of Waverly clay loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10786	1½ miles NE. of Richland City.	Heavy silty loam, 0 to 6 inches.	0.3	1.0	1.4	3.5	8.9	56.3	28.6
10784	3½ miles E. of Boonville.	Clay, 0 to 6 inches	.3	1.0	.7	1.0	1.8	59.0	36.1
10787	Subsoil of 10786.	Gray clay, 6 to 36 inches	.4	1.3	1.6	3.7	8.6	53.2	31.0
10785	Subsoil of 10784.	Yellow to gray heavy clay, 6 to 36 inches.	.2	.4	.3	.3	1.1	53.9	43.7

WAVERLY CLAY.

The Waverly clay is an alluvial soil found in the low bottom lands bordering the Ohio River. It extends uniformly over that section of the area which is subject to annual inundation during the spring floods.

The soil, to a depth of from 8 to 10 inches, consists of a light-brown clay loam, often containing a small amount of sand. The percentage of silt and clay is very large, and the soil rapidly becomes stiffer and more tenacious with depth, grading into a heavy tenacious clay subsoil of a brown or drab color, which is often mottled in the lower depressions. A few small iron concretions are frequently seen in the more swampy areas, both in the soil and subsoil.

This type of soil is overflowed annually, and when the water recedes the lands, on drying, become baked and sun cracked, making its cultivation difficult.

The Waverly clay occurs in a large area in the extreme southern part of Spencer County and embraces the greater part of the lands lying within the great bend of the Ohio River, southwest of Rockport. It also extends in narrow strips a short distance up the valleys of some of the small streams which flow through this section of the area. These lands are comparatively level, but are traversed by numerous narrow sloughs and shallow, swampy depressions with low ridges intervening.

The type as a whole occupies a basinlike depression, surrounded on three sides by the sand ridge which extends along the banks of the Ohio River and on the north by the rolling uplands. The small streams which flow through it have cut their channels several feet below the surface of the greater portion of the area, and as soon as the floods subside the water covering the lowlands finds its way back to the river through these outlets. Drainage is difficult over a large proportion of the type, but ditching and tiling greatly increase its agricultural value.

The material from which this soil is formed is brought down by the Ohio River at times of high water and is deposited over the areas flooded. During the annual spring floods the river water backs up through the openings which the small streams have cut in the sandy ridge and spreads out over the low flat country of the interior. The fine particles of silt and clay held in suspension are gradually deposited over the bottom lands, while the sand and coarser particles are deposited nearer the main current of the stream. This annual addition of new material to the soil tends to maintain its productiveness, and when the crops are not damaged by overflow large yields are obtained. Along some of the narrow depressions, where the cur-

rent of the stream is strongest during the overflow, the surface soil has been eroded and the stiff clay subsoil exposed. Crops planted in such places are either a total failure or give very low yields.

The Waverly clay is cultivated almost exclusively to corn, which averages about 40 bushels per acre. During favorable seasons and where the land is well drained and cultivated as much as 60 bushels is often produced. Wheat yields from 18 to 20 bushels per acre, although the crop is sometimes destroyed or greatly damaged by the floods. It is estimated that about one wheat crop in three is harvested from this soil. Wheat is often sown in the fall, and if the crop is destroyed by the overflow it is followed by corn planted in the late spring. Oats are grown to a very small extent, as they suffer from the same disadvantages as wheat; but when not damaged by floods 40 bushels per acre may be produced. Tobacco is grown to a limited extent, and about the same grade of the dark export type is obtained as that grown on the Waverly clay loam. The yield is about 1,000 pounds per acre. Clover, timothy, and other grasses give yields of from 2 to 3 tons per acre.

This type, however, is best adapted to the production of corn. The soil is usually in condition to cultivate by the latter part of April, and often at an earlier date, and as the corn crop is planted in May it is very seldom damaged by overflow, and large and profitable yields are thus almost always assured.

The following table gives mechanical analyses of typical samples of the Waverly clay:

Mechanical analyses of Waverly clay.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10808	7½ miles SW. of Rockport.	Heavy clay loam, 0 to 8 inches.	0.3	1.1	0.7	1.8	3.0	58.2	34.8
10810	7½ miles SW. of Rockport.	Brown heavy clay loam, 0 to 10 inches.	.1	.2	.3	1.1	1.5	55.5	41.2
10809	Subsoil of 10808	Stiff clay, 8 to 36 inches	.7	2.2	1.2	2.9	4.7	51.6	36.6
10811	Subsoil of 10810	Brown to gray heavy clay, 10 to 36 inches.	.1	.3	.5	1.5	1.8	46.8	49.0

WAVERLY FINE SANDY LOAM.

The Waverly fine sandy loam is a type of minor importance in the area on account of its limited extent. It is well adapted to a variety of crops, and, owing to its elevation above the flood plain, the crops are seldom seriously injured by the overflows of the Ohio River.

The soil to a depth of 15 inches is a light-brown to gray fine sandy loam, the sand content being usually large and of the finer grades. As the depth increases the soil becomes heavier, and at from 15 to 20 inches passes into a brown fine sandy loam, containing a larger percentage of clay. The sand content, depth of soil, and size of the sand particles often vary according to location. That portion of the type lying nearest the river is of a coarser texture and is often deeper than that immediately bordering the Waverly clay.

The Waverly fine sandy loam occupies a narrow ridge extending along the whole course of the Ohio River, where it forms the southern boundary of the area, except where the Rockport hills reach to the water's edge. This ridge slopes gently toward the low inland basin occupied by the Waverly clay, but its slope toward the river is more abrupt and ends in the steep banks which extend to the water's edge. Its elevation above the river and the neighboring lowlands, together with the sandy nature of the soil itself, gives to this type excellent drainage. Ditching and tiling are never necessary, as only a very small proportion of the type is subject to overflow.

This sandy ridge was formed before the river had cut its channel down to its present level. During times of overflow the water, spreading over the more level sections, deposited the coarser material near the banks of the river. The coarser sands were deposited near the main current, while the finer grades were carried farther inland and laid down near the deposits of silt and clay. As the river gradually deepened its channel, and as more material was annually deposited along its banks, a natural levee was soon formed, consisting of a sand ridge several feet above the flood plain of the river. Small quantities of silt, clay, and organic matter, becoming mixed with the sand, formed a soil which is not only productive, but easily cultivated.

During a very dry season the crop yields are small, but with an average amount of rainfall large yields of oats, corn, wheat, potatoes, melons, and navy beans are secured. Corn averages from 40 to 50 bushels, wheat from 15 to 20 bushels, and oats from 25 to 30 bushels per acre. Tobacco is also grown on this soil and averages about 700 pounds per acre. The yield is not so large as that obtained on the heavier soils, but the leaf grown usually brings a higher price. All vegetables do well on this soil. A large acreage is devoted to navy beans. It is also excellently adapted to alfalfa, while a large yield of clover is always obtained. The type is best adapted to corn,

melons, alfalfa, and early vegetables, the latter being grown for local markets.

The following table gives mechanical analyses of typical samples of the Waverly fine sandy loam:

Mechanical analyses of Waverly fine sandy loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10802	3 miles S. of Rockport.	Brown fine sandy loam, 0 to 12 inches.	0.1	0.4	0.6	23.1	34.7	31.0	9.9
10800	6 miles S. of Rockport.	Gray to brown heavy fine sandy loam, 0 to 15 inches.	.1	.3	.3	9.7	37.6	38.9	13.1
10803	Subsoil of 10802..	Heavy fine sandy loam, 12 to 36 inches.	.1	.1	.4	18.0	32.8	32.4	16.0
10801	Subsoil of 10800..	Brown loam, 15 to 36 inches..	.1	.2	.2	8.0	32.9	41.2	17.5

AGRICULTURAL METHODS.

To obtain the best results on the soils of the area very careful methods of cultivation are necessary.

When the Miami silt loam is constantly kept in the loose condition required for the successful cultivation of corn, the upper soil soon becomes eroded and its productivity is greatly lessened. The underlying subsoil becomes exposed on the surface and the land often fails to give sufficient yields to make its cultivation profitable. The usual method employed to restore these lands to their former state of productiveness is to seed them down to clover. A fair stand of clover is usually obtained, except on a few small areas where erosion has been greatest. The lands are heavily fertilized with stable manure or commercial fertilizer and the fields are pastured to sheep or other live stock. By this method much of the worn-out land in the area has been reclaimed and profitably cultivated to all crops adapted to the soil.

Where a rotation of crops is practiced the upland soils suffer very little from erosion and profitable yields are continuously obtained without the aid of commercial fertilizers. Some system of crop rotation is in use in all sections of the area and on all the soil types, with the exception of the Waverly clay, but crop rotation is of the greatest importance on the Miami silt loam and the Miami fine sandy loam. The soils occupying the river flats and low upland valleys are not so easily eroded, and are annually enriched by the addition of new ma-

terial washed down from the surrounding uplands or deposited by water.

Drainage is the most important factor in the management of the soils occupying the lower and more level sections of the area. The agricultural value of a large proportion of the Waverly silt loam and of the Miami fine sandy loam has been greatly increased where a good system of artificial drainage has been established. The Waverly clay loam, on account of its level topography and slight elevation above the level of the streams, is the most difficult soil of the area to drain, but where ditching and tiling are practicable good results are always obtained. Where tile drainage is used the tiles are laid at a depth of 2½ to 3 feet and are placed 30 or 35 yards apart. These open into the main drainage ditch, which leads to the neighboring stream. This system is adequate to drain the greater part of the upland valleys and low depressions occupied by the Waverly silt loam and the Waverly clay loam, but the topography of some of the small swampy areas occupied by the latter makes thorough drainage almost impossible.

When preparing the soil for the cultivation of wheat the field is plowed about the 1st of August. It is then dragged, harrowed, and rolled three or four times. The wheat is usually drilled in during the first week in September and is harvested early in July. The preparation of the land for oats is about the same as for wheat, except that the land is seldom worked more than twice before the crop is drilled in. Oats are sown during March and April, and the crop is harvested during the latter part of July.

For corn the soil is plowed in the early part of April or as soon as the season permits. It is then dragged or harrowed until it is in a loose and thoroughly cultivated condition. The crop is planted from the 10th to the 20th of May, and should be cultivated once each week until it becomes too large.

Tobacco seeds are first sown in beds located on the sunny hillsides, which afford them a natural protection. The tobacco beds are covered with a thin canvas or cheesecloth. The plants are set out during the latter part of June and the crop matures in September. It is then cut and hung on low scaffolds in the fields until the leaves begin to turn yellow. Great care is taken to protect it during rainy weather while in the field. After a short interval of time it is removed to open, well-ventilated barns, stripped from the stalks, and suspended from scaffolds. It is alternately dried and softened, as the climatic conditions vary from dry to damp, and when thoroughly cured is assorted and put on the market. No curing by means of artificial heat in especially constructed barns is practiced at present in the area.

AGRICULTURAL CONDITIONS.

The agricultural interests of the area are centered in the production of corn, wheat, and tobacco. A limited acreage is devoted to the production of oats, hay, and vegetables, but the climatic conditions, soils, and facilities for marketing all tend to make the area particularly well adapted to the three staples first named. The farmers of the area are intelligent and energetic, and the majority of them are prosperous and free from debt. Large yields of all crops grown, together with the prevailing good prices, have placed the farmers in all sections of the area in excellent financial condition. Great interest is manifested in farmers institutes, agricultural societies, and all kinds of local organizations which tend to advance the interests of the rural population.

The average farm dwelling consists of a neatly painted two-story frame building, while the barns and other outbuildings are modern and well kept. These are always large enough to store the crops, to shelter the small number of stock which each farmer invariably owns, and to protect the farm machinery during the winter months.

About three-fourths of the farmers own the lands they cultivate, the remainder being tenants on the farms of the larger landholders. Lands are usually rented on a share basis, but a few tenants in the upland sections pay cash. When rented on shares the landowner receives from one-fourth to one-third of the crop produced. The tenant furnishes the seed, work animals, farm machinery, fertilizers, and labor, receiving from two-thirds to three-fourths of the crop made. From $3 to $4 an acre is the usual cash rent for farms in the Miami silt loam or Miami fine sandy loam, but a higher rate is obtained for well-drained lands in the Waverly silt loam. The Waverly clay loam and Waverly clay types of soil are never rented for cash, the uncertainty of a profitable yield, on account of the liability of crops on these areas to damage or destruction by floods, droughts, or unfavorable seasons causing the share system to be preferred by the tenant.

The largest farms in the area are situated along the Ohio River on the low, flat areas of Waverly clay. They average from 150 to 300 acres each, and, owing to the annual flooding of this section during the early spring months, they are cultivated almost exclusively to corn. There are comparatively few dwellings or farm buildings in this part of the area, as the farmers cultivating these lands live on the neighboring uplands or on the sandy ridge bordering the river. On the Miami silt loam of the uplands and on the Miami fine sandy loam the farms have an average size of from 100 to 125 acres, and a very large proportion of the land is under cultivation. No large tracts are being cultivated on the Waverly clay loam.

Although some farmers own from 150 to 200 acres of this type, much of it is either used for pasturage or is covered with a growth of hardwood timber.

The average tenant in the area farms from 40 to 75 acres. As a general rule farm labor is plentiful throughout the year, the supply often exceeding the demand, so that many of the farm laborers are compelled at certain seasons to seek employment in the towns or neighboring counties. During harvest there is always a demand for experienced farm hands at good prices, and it is often difficult to obtain them at this season. The labor employed in the area is of a very efficient character. When hired by the month, from $14 to $20, including board, is paid for farm hands, but during harvest from 75 cents to $1 a day is the usual rate.

Corn, wheat, and tobacco are the principal products, each being grown on every variety of soil found in the area. A failure of the corn crop on many of the soil types is very rare, and during a favorable season an excellent crop is always obtained. This crop can not be grown continuously on the rolling uplands without involving damage to the soil from erosion. As the soil becomes loose and friable when frequently cultivated, much of it is washed from the surface of the rolling hills to the neighboring valleys. However, when a rotation of crops is practiced large yields are continuously obtained and the general productiveness of the soil remains unchanged.

A number of varieties of wheat are grown in the area, the most important being the Pool, the Red Wonder, the Russian Red, and the New Columbia. The Pool is the variety most widely grown, but the Red Wonder seems better adapted to the more sandy soils.

The greater part of the tobacco produced in the area is of the dark export type, but on some of the lighter soils a small amount of Burley is grown. The Pryor and One-sucker are the varieties of dark tobacco most widely cultivated, and a vigorous growth of these is always obtained on the heavier soils. The leaf is heavy and oily, varying in color from a light brown to a dark reddish brown. While a comparatively small quantity of Burley tobacco has been grown in the area, the present good prices are causing the production of this variety to increase rapidly. When the difference in the market prices is not very great the farmers prefer to grow the dark export type, as larger yields per acre are produced and it requires much less attention, both while the crop is in the field and while it is being cured. Only a small part of the tobacco grown in the area is consumed in the United States, the greater proportion being exported to foreign markets, where the dark, heavy types of this product are in greater demand.

In connection with the foregoing discussion of the agricultural products of the area it seems advisable to point out again the rela-

tion between these products and the several soils. The Waverly clay and the Waverly fine sandy loam are well adapted to corn. The Waverly silt loam is also excellently adapted to this crop, and when well drained it produces larger yields than any other type in the area. The Miami silt loam is best adapted to wheat. Large yields of wheat are also harvested annually from the Miami fine sandy loam, and while there is no great difference between these types in the yield per acre, that produced on the silt loam of the uplands is of a higher grade and, as a rule, commands better prices on the markets. Large yields of wheat are obtained on the Waverly clay when the crop is not destroyed by floods. The Waverly clay loam, when properly drained, is well adapted to the production of the dark-leaf tobacco, and yields of from 1,000 to 1,200 pounds per acre are realized. This soil, however, is best adapted to clover and timothy, a large part of the hay produced in the area being grown on it.

The Waverly fine sandy loam and the Miami fine sandy loam are well adapted to melons, and the heavier, poorly drained phases of these types produce large yields of oats. Burley tobacco is also grown on these sandy loams, and with proper care in its cultivation, cutting, and curing a very fair grade is often obtained. Tomatoes, small fruits, and early vegetables are well suited to these sandy soils, and limited experiments have demonstrated that alfalfa does well, especially on the Waverly fine sandy loam which borders the Ohio River.

The transportation facilities of the area are excellent. Two branches of the Southern Railroad traverse the area, one of which terminates at Rockport, an important local shipping point on the Ohio River. The facilities afforded by both the river and the railroads cause Rockport to receive a large amount of produce from the surrounding country on the way to more distant markets.

A large number of well-kept coun y roads connect Boonville, Rockport, Chrisney, and other smaller towns with all sections of the surrounding country. The streams are all well bridged, and the more important county roads are macadamized for some miles out from the leading towns.

Several landings are situated at short intervals along the Ohio River, where the products of the neighboring farms are loaded on the small river steamers and transported direct to Louisville, Owensboro, or other large markets. An electric car line is now being constructed to connect some of the smaller towns with Evansville, Rockport, and other important local markets. This will greatly facilitate traffic, and will enable the farmers in certain sections of the area to market their produce with more dispatch and at much less expense than at present.

Owensboro, Ky., is the market for almost the entire corn crop of the area. The large distilleries located there create a constant demand for this product. The greater part of the wheat and tobacco is shipped to Louisville, Ky. A small portion of the tobacco crop is marketed at Owensboro, and a still smaller proportion is shipped direct from the area to foreign markets. Very few farmers own more than a few head of stock. No cattle are raised for other than the local markets, but a large number of hogs are raised and marketed at Louisville and Cincinnati. A few farmers in the area have made a specialty of this industry, and as good prices are obtained it has proved very profitable.

The diversity of crops grown, the natural productiveness of the land, the transportation facilities afforded by the river and the railroads, and the nearness to large markets all tend to make the area surveyed one of the most prosperous sections of the State.

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