SOIL SURVEY

Livingston County Missouri

Series 1950, No. 1

Issued December 1956

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with the
MISSOURI AGRICULTURAL EXPERIMENT STATION

How to Use THE SOIL SURVEY REPORT

THIS REPORT is about the soils of Livingston County, Missouri. It describes each kind of soil and states how it can be used, how it responds to treatment, how to take care of it, and what yields to expect. Maps show the location and extent of each soil. If you want to know how the soils were formed and how they are classified, some information on these subjects will be found in the section, How the Soils of Livingston County Were Formed.

SOILS OF A FARM

If you want to know about the soils on a farm or other tract, first find the right place on the map. The map shows township and section lines, towns and villages, roads, streams, most dwelling houses in rural areas, and other landmarks. Remember that an inch on the map is half a mile on the ground. Each soil is shown by a symbol, such as Ba, and the extent of each area is shown by a boundary line. Color patterns also help you pick out the areas of different soils, although each color pattern is used on several soils that resemble each other in some ways.

The map legend shows the soil symbols, arranged in order so you can find them easily, and the name of each soil. The symbol Ba, for example, is used for Bauer silt loam, 7 to 13 percent slopes. All areas of this soil, wherever they appear on the map, are shown by this symbol and the same color tint. Soil names are listed in the table of contents, so you can turn easily to the right page in the section on soils of Livingston County. This section describes each soil briefly and gives some statements about its use and management. A more detailed description of each soil is provided in the section, Soil Profile Descriptions.

Yields that you can expect from common crops are given in table 2. Soils are listed in order in the left-hand column of this table. Opposite each soil name you will find the yields of crops that can be expected in average years, under two levels of management. These estimates of yields give you a basis for comparing probable responses to management for the different soils.

SOILS OF THE COUNTY AS A WHOLE

A general idea of the soils is given in the section, Soil Associations. This section tells about the principal kinds of soils, where they are found, and how they are related. While reading this section, refer to the soil association map (p. 18). The patterns shown on this map frequently indicate well-defined differences in type of farming, land use, and land use problems.

A newcomer to the county, especially if he considers buying land, will want to know about the climate; types and sizes of farms; principal farm products and how they are marketed; kinds and conditions of farm tenure; availability of water, roads, and railroads; and location of towns and population centers. Information about all these will be found in the sections, Geography of Livingston County, and, Additional Facts About Livingston County.

This publication on the soil survey of Livingston County, Missouri, is a cooperative contribution from the—

SOIL CONSERVATION SERVICE

and the

UNIVERSITY OF MISSOURI AGRICULTURAL EXPERIMENT STATION

Series 1950, No. 1 Issued December 1956

SOIL SURVEY OF LIVINGSTON COUNTY, MISSOURI

Field work by JOHN D. ROURKE, in Charge, and C. H. ATKINSON, Soil Survey,[1] United States Department of Agriculture, and J. A. FRIEZE, Missouri Agricultural Experiment Station

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CONTENTS

[1] Field work for this survey was done when the Division of Soil Survey was part of the Bureau of Plant Industry, Soils, and Agricultural Engineering. C. H. Atkinson was in charge of field work in the period 1947–48. Soil Survey was transferred to the Soil Conservation Service on November 15, 1952.

THE SOIL map and descriptions of the soil units that make up this report are based on a detailed survey made, almost acre by acre, by men trained in soil mapping and soil classification. Suggestions for use and management of the soils are based on research and on the experience of farmers. The survey reveals that there are great differences in the soils of the county. The soils vary in depth, natural fertility, and in ability to remain productive under different kinds of use. Some soils stay wet and cold in spring; but others warm up quickly and can be farmed early. Many of the differences in the soils are already known to the people who farm them. This survey helps to locate, classify, and explain these soil differences. Other differences not so generally known are also described and interpreted. The report is intended mainly to supply information about crops suited to each soil, the general treatment that each soil needs, and the response to expect from such treatment. The survey also contains information useful to land appraisers, community planners, highway engineers, and teachers of agriculture and geography.

GEOGRAPHY OF LIVINGSTON COUNTY

Location and Extent

Livingston County, located in the north-central part of Missouri, has an area of approximately 533 square miles. Chillicothe, the county seat, in the center of the county, is about 70 miles east of St. Joseph and 85 miles northwest of Columbia (fig. 1).

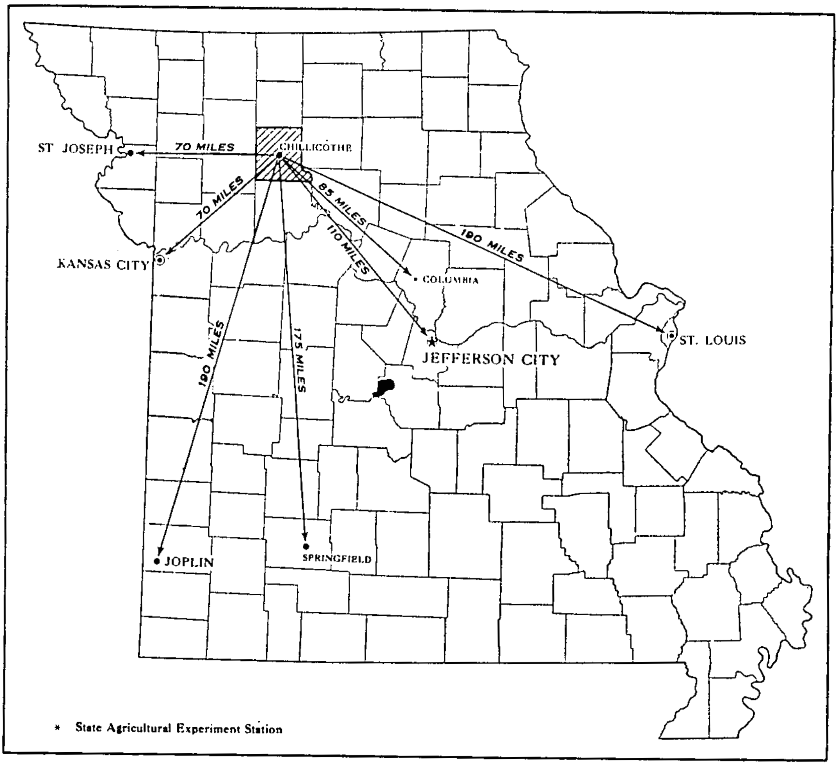

***Figure 1.*—Location of Livingston County in Missouri.**

Physiography, Elevation, and Drainage

Physiography

Livingston County is in the Dissected Till Plains section of the Central Lowland province (*3*).[2] It is in the part of Missouri covered by glaciers thousands of years ago. These enormous ice sheets deposited on most of the original land surface a deep layer of ground rock materials called till. Geologic erosion dissected the till plain left by the glaciers, and distinct drainage patterns developed. Then, after dissection, silty windblown material known as loess was deposited.

The main physiographic divisions of the county are (1) gently rolling to hilly uplands, (2) loess-covered old alluvial terraces, and (3) broad bottom lands.

Uplands.—Considering the upland of the county as a whole, the northeastern part is gently rolling, the northwestern is hilly, and the southern is rolling.

In the northwest, west of Thompson River, hills rise steeply from the stream channels, and the cultivated land is limited to smoother hilltops and gentle slopes in valleys. The steeper slopes are normally pastured or are wooded.

[2] Italic numbers in parentheses refer to Literature Cited, p. 54.

In the northeast, north of the Grand River, hills rise gently from most of the stream channels, and all the soils can be cultivated.

In the southeast the ridgetops are moderately broad and only along the larger streams do the hills rise steeply from the stream channels. Soils of the smaller valleys can be cultivated, but those on steeper slopes bordering valleys of the major streams are used mainly for pasture.

In the southwest most of the upland is rolling, with an occasional steep hill. Exceptions are a few square miles around Blue Mound and the area between Mooresville and the Grand River, where the landscape is hilly and very irregular. The ridges are narrow and the valleys steep-sided.

Terraces.—A nearly level loess-covered old alluvial terrace extends along the north side of the Grand River from a point immediately southeast of Chillicothe to a point immediately north of the Chicago, Burlington, and Quincy Railroad tracks upstream from Medicine Creek. Small isolated areas of this same terrace occur on the west side of Medicine Creek near the village of Chula.

Another small but similar terrace occurs north of Chillicothe and west of Chula in the American Bottoms near the junction of Honey and Crooked Creeks. A third such terrace occurs in the Shoal Creek bottom near the village of Ludlow.

Bottom lands.—Broad areas of bottom land, together accounting for about 30 percent of the county area, occur along streams, principally the Grand and Thompson Rivers and Shoal and Medicine Creeks.

Elevation

Altitudes range from a low of 640 feet where the Grand River leaves the county in the southeastern corner to a high of 985 feet at Blue Mound. In the northwest, altitudes range from 740 feet east of Sampsell to 971 feet at Pinkley School north of Spring Hill. In the southwest, the altitude ranges from 985 feet at Blue Mound to about 700 feet for most of the upland. Most of the southeastern part is between 700 and 800 feet above sea level. The northeastern part has a slight range in altitude, or from 750 to 800 feet.

Drainage

Nearly all the land is drained by the Grand River and its tributaries. The Grand River enters the county about midpoint on the western boundary and flows southeastward through the county. The gradient of the Grand River is very low, so water does not flow rapidly. Drainage ditches tend to fill with sediment. Levees have been built along the large streams but have not been properly maintained. Flooding is a serious problem on the bottom lands. Flood damage is normally greatest in the valleys of the Grand River, Thompson River, Shoal Creek, and Medicine Creek.

Floods are most frequent in spring but have occurred in every month of the year. In 1947 the highest floodwater to date was recorded at Chillicothe pumping station early in June. This flood topped the previous high water mark of 1909 and destroyed nearly all the crops in the main valleys.

Climate

Livingston County has hot summers, moderately cold winters, and wide and rapid changes in temperature throughout the year. Table 1, compiled from records at the weather station in Chillicothe, gives monthly, seasonal, and annual temperatures and precipitation.

Summer temperatures average 74.9° F., and there are many days with temperatures above 80° in July and August. Winter temper-

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Chillicothe, Livingston County, Mo.*

[Elevation, 771 feet]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Total for the driest year	Total for the wettest year	Average snowfall
	°F.	*°F.*	*°F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	29.9	67	−25	1.42	2.07	2.64	4.3
January	24.4	66	−29	1.48	.23	.49	6.5
February	32.3	83	−22	1.45	1.56	.11	3.4
Winter	28.8	83	−29	4.35	3.86	3.24	14.2
March	41.7	88	−1	2.48	3.96	4.19	3.3
April	52.0	94	5	3.22	2.75	5.05	2.6
May	62.9	95	31	4.09	2.92	7.80	0
Spring	52.2	95	−1	9.79	9.63	17.04	5.9
June	72.3	105	41	4.73	2.15	15.46	0
July	77.0	107	48	3.42	1.12	1.62	0
August	75.5	110	46	3.96	1.26	1.21	0
Summer	74.9	110	41	12.11	4.53	18.29	0
September	67.5	100	29	4.78	1.31	5.77	0
October	55.0	95	4	3.14	1.21	2.78	.2
November	41.3	82	−5	2.12	1.09	2.59	1.9
Fall	54.6	100	−5	10.04	3.61	11.14	2.1
Year	52.6	110	−29	[2] 36.29	[3] 21.63	[4] 49.71	22.2

[1] Average temperature based on a 40-year record, 1910–49; highest and lowest temperatures on a 13-year record, 1918–30.

[2] Average precipitation is based on a 36 year record in the period 1878–1946; average precipitation 1947–53 covered by two new stations:

Chillicothe Airport, 3 years, 1947–49, 40.67 inches.

Chillicothe Radio Station KCHI, 3 years, 1950–53, 26.87 inches.

The 42-year average, in the period 1878–1953, for these three stations is 35.93 inches.

Wettest and driest years based on a 22-year record, 1931–53; snowfall, based on a 13-year record, 1917–30.

[3] In 1953.

[4] In 1947.

atures average slightly below freezing. The average date of the last killing frost in spring is April 21, and the first in fall is October 13. The average growing season is 175 days.

The average annual precipitation of 36.29 inches is favorably distributed. About 58 percent of the total average rainfall comes in the 5-month period, May through September. Rainfall increases in frequency and intensity from April through June and then decreases gradually. Most of the summer rain comes in short heavy showers. Winter precipitation usually comes in the form of light rains or snows.

A combination of clear, hot days and low rainfall late in summer frequently reduces yields of corn, soybeans, grass seed, and late hay. Occasionally a severe drought reduces yields of all crops. Sometimes wet weather in spring spoils the first hay cuttings, delays planting of crops, and reduces yields unless the rest of the season is exceptionally favorable. Rains early in fall sometimes prevent complete maturing of crops on the fine-textured soils.

Heavy snowfall late in fall and in winter may prevent winter grazing for a time or damage winter wheat and new seedings of hay. The total snowfall is usually not enough to prevent winter grazing, but the snowstorms make winter grazing uncertain.

Vegetation

The natural vegetation of the county consisted of grasses, shrubs, and trees, none confined to any particular part of the county but scattered over the whole area. Gentle slopes were normally grass-covered, and the steep slopes were forested.

The native grasses, mainly big bluestem (*Andropogon gerardi*), contributed to development of dark-colored fertile soils relatively high in humus. The native trees—deciduous hardwoods—contributed to development of light-colored less fertile soils with lower content of humus. Shrubs grew in association with both the grasses and trees.

The distribution of dark soils indicates that the northeastern part of the county was almost continuous prairie. South of the Grand River, prairie and forest were intermingled. Near Blue Mound the prairie covered all the gently rolling land and forest covered all the hilly land and stream borders. The northwestern quarter of the county was forested, except for the broad ridgetops on which County Highways A and F are now located.

According to Maj. A. J. Roof (*7*), the county was about equally divided between grassland and woodland when early settlers came. By 1912 only a third of the county was wooded. Now, only about a tenth is wooded. The wooded areas are now confined mainly to steep slopes, hilly land, and poorly drained bottom land. Most of the woodland is in the northwestern part of the county along the Grand River.

The dominant trees on the uplands are oak, hickory, elm, and locust. Associated with these are a few maple and ash trees and an occasional hackberry, mulberry, redbud, or dogwood. On the lowlands are oak, hickory, walnut, pecan, elm, cottonwood, birch, sycamore, and a varied undergrowth of raspberry, wild plum, cherry, rose, and briers.

ESTIMATED YIELDS

Table 2 shows yields of important crops to be expected in normal years on the soils of the county under two levels of management. In columns A are the average yields expected under soil-depleting management; and in columns B, those expected under the soil-conserving practices suggested in table 3, p. 11. By comparing average yields obtained on a farm with those listed in table 2, one can judge whether or not soils are producing as much as they might. As shown in table 2, some soils show better yield response than others. This happens because some soils have higher natural fertility than others, or because some soils respond better to management than others. Successful farming requires knowledge of the response of a soil to management.

PRINCIPLES OF GOOD SOIL MANAGEMENT

The main management problems in Livingston County are (1) restoring and maintaining soil productivity, and (2) controlling erosion. Both problems result from continuous cultivation of upland soils under management that has allowed loss of organic matter and plant nutrients. As the upland soils lose organic matter they also lose their ability to absorb water and hold plant nutrients. Increasing runoff brings increasing erosion. The runoff waters carry soil material from the uplands and deposit it on the lowlands during floods. Flood damage, the main problem on the lowlands, is in this way related to undesirable management on the upland soils.

Soil-conserving management will do much to restore and maintain productivity and to control erosion. Such management involves use of crop rotations that include legumes, application of lime and fertilizer according to needs shown by soil tests, control of weeds and insects, and, where needed, practice of contour farming, terracing, and other methods of erosion control.

Crop rotation

The basis of good management is a suitable crop rotation (*8*). Rotations that keep the soil under a plant cover the year round give the most protection from erosion but cannot be used for farmers who require corn and other row crops for livestock. They must choose a rotation that provides some soil protection and fits in most nearly with their particular needs. Then, to safeguard against soil depletion they need to practice contour farming, terracing, or other methods of erosion control suited to the rotation they have selected. Table 3 suggests suitable crop rotations for each soil according to three kinds of use: In the first kind are the least soil-depleting rotations, or those suitable without contour farming, terracing, or other methods of erosion control; in the second, more depleting rotations, which are to be used with contour farming for corn; and in the third, the most depleting rotations consistent with sound management, which require contour farming and terracing.

TABLE 2.—*Estimated average acre yields of principal crops and pasture on soils of Livingston County, Mo., under two levels of management*

[Yields in columns A obtained under soil-depleting management, which means that legumes are not grown often enough in crop rotations, lime and fertilizer are not applied in amounts needed, and erosion control practices are not adequate. Yields in columns B are obtained under soil-conserving management, which means ample use of legumes in crop rotations, adequate control of erosion, weeds, and insects, and applying lime and fertilizer according to needs shown by soil tests]

Map symbol	Soil	Corn		Wheat		Oats		Soybeans		Alfalfa		Clovers		Korean lespedeza		Pasture[1]	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
		Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Acres per cow*	*Acres per cow*
Ba	Bauer silt loam, 7 to 13 percent slopes	25	45	18	25	25	35	([2])	([2])	([2])	([2])	0	1. 8	1. 0	1. 5	6	3
Bb	Blockton silt loam, 1 to 3 percent slopes	45	60	18	25	35	45	15	22	0	2. 5	1. 5	2. 0	1. 5	1. 5	4	2
Bc	Burrell silt loam, 1 to 3 percent slopes	20	40	12	18	20	35	10	16	([2])	([2])	0	1. 3	1. 0	1. 5	6	3
Ca	Carlow clay	25	[3] 40	18	[3] 30	35	[3] 30	20	[3] 30	([2])	([2])	0	[3] 1. 5	1. 5	1. 6	[3 4] 6	[3] 2
Cb	Chula silt loam	50	80	20	30	40	50	25	30	([2])	([2])	0	1. 5	1. 5	1. 5	3	2
Ea	Edina silt loam, 0 to 2 percent slopes	30	60	20	30	35	45	18	27	([2])	([2])	0	1. 8	1. 5	1. 5	4	2
Eb	Edina silt loam, terrace phase, 0 to 2 percent slopes	30	60	20	30	35	45	18	27	([2])	([2])	0	1. 8	1. 5	1. 5	4	2
Ga	Gamma loam, 4 to 8 percent slopes	20	45	15	25	25	40	10	([5])	([2])	([2])	0	1. 5	1. 0	1. 5	5	3
Gb	Gamma loam, 9 to 20 percent slopes	20	([5])	9	([5])	14	([5])	0	([5])	([2])	([2])	0	([2])	. 8	1. 0	7	4
Gc	Gamma loam, dark surface variant, 4 to 8 percent slopes	30	45	15	25	30	45	12	([5])	0	2. 5	0	1. 5	1. 0	1. 5	5	3
Gd	Gamma loam, dark surface variant, 9 to 14 percent slopes	20	([5])	15	([5])	25	([5])	0	([5])	0	2. 0	0	1. 0	0	1. 5	6	4

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Ge	Gamma loam, sand substratum variant, 6 to 12 percent slopes	25	(5)	15	25	30	45	12	(5)	(2)	(2)	0	1.5	1.0	1.5	6	4
Gf	Gorham silty clay	40	[3]65	20	[3]25	35	[3]50	25	[3]30	0	[3]3.0	1.0	[3]2.0	1.5	1.5	5	[3]2
Gg	Gosport loam, 15 to 25 percent slopes	15	(6)	10	18	15	25	(2)	(2)	(2)	(2)	0	(2)	.5	1.0	10	5
Gh	Gravity loam	60	80	25	30	45	55	20	27	0	3.0	1.0	1.5	1.5	1.5	2	1
Ha	Humeston salt loam	40	[3]60	20	[3]25	40	[3]50	25	[3]30	(2)	(2)	1.0	1.5	1.5	1.5	3	2
Ka	Keytesville silt loam, 4 to 7 percent slopes	25	45	15	25	20	40	10	17	(2)	(2)	0	1.5	1.0	1.5	5	3
Lb	Lacona silt loam, 4 to 12 percent slopes	40	75	20	30	35	50	15	20	0	3.0	1.0	1.8	1.3	1.5	4	2
La	Lagonda silt loam, 4 to 6 percent slopes	35	70	20	30	35	45	17	27	(2)	(2)	.8	1.5	1.3	1.5	4	2
Lc	Lindley loam, 4 to 8 percent slopes	20	45	15	25	25	40	10	(5)	(2)	(2)	0	1.5	1.0	1.5	5	3
Ld	Lindley loam, 9 to 20 percent slopes	----	(5)	9	(5)	14	(5)	0	(5)	(2)	(2)	0	1.0	.8	1.0	7	4
Ma	Mandeville silt loam, 4 to 7 percent slopes	20	50	15	25	25	40	0	(5)	0	2.5	0	2.0	1.0	1.5	8	3
Mb	Mandeville silt loam, 9 to 14 percent slopes	20	(5)	15	(5)	25	(5)	0	(5)	0	2.0	0	1.5	1.0	1.5	8	4
Mc	Moniteau silt loam	25	[3]50	12	[3]20	25	[3]40	12	[3]20	(2)	(2)	0	1.0	1.0	1.5	8	[3]3
Na	Nodaway silt loam	45	[3]80	15	[3]30	25	[3]50	20	[3]30	0	[3]3.0	1.0	[3]2.0	1.5	1.5	5	[3]2
Pa	Pershing silt loam, 3 to 5 percent slopes	25	45	12	25	20	40	15	25	0	(2)	0	1.0	1.3	1.3	6	3
Sa	Sampsel silt loam, 4 to 6 percent slopes	35	70	20	30	35	45	17	27	0	(2)	1.0	1.5	1.3	1.5	4	2
Sb	Sandy alluvial land [6]	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Sc	Seymour silt loam, 1 to 3 percent slopes	40	70	20	30	40	50	24	28	0	1.3	1.3	1.8	1.3	1.5	4	2
Sd	Seymour silt loam, terrace phase, 1 to 3 percent slopes	40	80	20	30	40	50	17	27	0	1.3	1.3	1.8	1.3	1.5	4	2
Se	Shelby loam, 4 to 8 percent slopes	35	60	18	25	35	45	15	20	0	3.0	1.0	2.0	1.5	1.5	4	2
Sf	Shelby loam, 9 to 13 percent slopes	20	(5)	15	25	30	40	15	(5)	0	3.0	1.0	2.0	1.5	1.5	4	2
Sg	Shelby loam, 14 to 19 percent slopes	20	(5)	12	(5)	20	(5)	0	(5)	0	2.3	.8	1.3	1.5	1.5	5	3

See footnotes at end of table.

TABLE 2.—*Estimated average acre yields of principal crops and pasture on soils of Livingston County, Mo., under two levels of management*—Continued

Map symbol	Soil	Corn		Wheat		Oats		Soybeans		Alfalfa		Clovers		Korean lespedeza		Pasture[1]	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
		Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Acres per cow*	*Acres per cow*
Sh	Snead silty clay, 7 to 12 percent slopes	([2])	([3])	15	18	20	30	([3])	([3])	([3])	([3])	1. 0	2. 0	1. 0	2. 0	4	2
Sk	Snead stony silty clay, 11 to 20 percent slopes	([2])	([2])	([2])	([2])	([2])	([2])	([2])	([2])	([2])	([2])	([2])	([2])	([2])	([2])	5	3
Sl	Stet silty clay loam	55	70	25	30	35	40	20	25	2. 5	3. 0	1. 5	1. 5	1. 5	1. 5	3	2
Wa	Wabash clay	25	[3] 40	18	[3] 30	30	[3] 40	20	[3] 30	0	[3] 2. 5	0	[3] 1. 5	1. 5	1. 5	6	[3] 2
Wb	Wabash silt loam	55	75	25	[3] 30	35	[3] 45	25	[3] 27	1. 0	[3] 3. 0	1. 0	[3] 1. 5	1. 5	1. 5	3	[3] 2
Wc	Westerville silt loam	40	[3] 65	15	[3] 25	30	[3] 45	25	[3] 30	0	[3] 2. 5	1. 0	[3] 1. 5	1. 5	1. 5	5	[3] 2

[1] Pasture yields expressed in acres per cow, which is number of acres needed to maintain a mature cow for the grazing season. Yields in column A are without use of lime, commercial fertilizer, or pasture renovation; those in column B require use of lime and phosphorus, planting of suitable grasses and legumes, and renovation of pasture as needed.

[2] Crop not suitable for soil.

[3] Yield if protected from overflow.

[4] Yield figure does not apply to sloughgrass areas.

[5] Crop not suggested under this level of management.

[6] Nonagricultural land.

TABLE 3.—*Suitable crop rotations and land use for soils of Livingston County, Mo.*

[Crops and land use indicated by letter symbols as follows:

C=corn. W=winter wheat. M=meadow of mixed legumes and grasses.
S=soybeans. (SCL)=sweetclover catch crop. PP=permanent pasture.
O=oats. (R)=rye winter cover crop. T=timber.

[Rotations based on assumption that maximum quantity of corn is desired. (See text for suggestions on application of lime, manure, and commercial fertilizer.)

[This table based on research and publications of the Missouri Agricultural Experiment Station and is current as of 1950]

Map symbol	Soil	(A) Without contour farming or terracing	(B) With contour farming for corn [1]	(C) With contour farming for corn and terracing [2]
Ba	Bauer silt loam, 7 to 13 percent slopes.	WMMMM	CWMM	CCWMM.
Bb	Blockton silt loam, 1 to 3 percent slopes.	CSOM or CO(SCL)	(3)	(3).
Bc	Burrell silt loam, 1 to 3 percent slopes.	CO(SCL) or SO(SCL)	(3)	(3).
Ca	Carlow clay	SW(SCL)	(3)	(3).
Cb	Chula silt loam	CSW(SCL) or COM	(3)	(3).
Ea	Edina silt loam, 0 to 2 percent slopes.	COM or SWM	(3)	(3).
Eb	Edina silt loam, terrace phase, 0 to 2 percent slopes.	COM or SWM	(3)	(3).
Ga	Gamma loam, 4 to 8 percent slopes.	WMM or PP	COMM	COMM.
Gb	Gamma loam, 9 to 20 percent slopes.	M; PP; or T [4]	(4)	(4, 5).
Gc	Gamma loam, dark surface variant, 4 to 8 percent slopes.	WMM or PP	COMMM	COMM.
Gd	Gamma loam, dark surface variant, 9 to 14 percent slopes.	M; PP; or T [4]	(4)	(4,5).
Ge	Gamma loam, sand substratum variant, 6 to 12 percent slopes.	M; PP; or T [4, 6]	(4)	W or OMM.[4, 5]

See footnotes at end of table.

TABLE 3.—*Suitable crop rotations and land use for soils of Livingston County, Mo.*—Continued

Map symbol	Soil	(A) Without contour farming or terracing	(B) With contour farming for corn [1]	(C) With contour farming for corn and terracing [2]
Gf	Gorham silty clay	SC or SW(SCL)	([3])	([3]).
Gg	Gosport loam, 15 to 25 percent slopes.	PP or T [4]	([4])	([4, 5]).
Gh	Gravity loam	CSOM; CCOM; CO(SCL); or SCO(SCL).	([3])	([3]).
Ha	Humeston silt loam	CSOM or PP	([3])	([3]).
Ka	Keytesville silt loam, 4 to 7 percent slopes.	COMMM	COMM	COMM.
Lb	Lacona silt loam, 4 to 12 percent slopes.	WMMM; WM; CWMMM; or COMMM.	COMM; CWM; or C(R)CWMM.	CWMM; COM; CW(SCL); or C(R)CWM.
La	Lagonda silt loam, 4 to 6 percent slopes.	WMMM or CWMMMM	WM; CWMM; or COMM	CCWMM; CW(SCL); C(R)CWM; or COM.
Lc	Lindley loam, 4 to 8 percent slopes.	WMM or PP	COMM	COMM.
Ld	Lindley loam, 9 to 20 percent slopes.	M; PP; or T [4]	([4])	([4, 5]).
Ma	Mandeville silt loam, 4 to 7 percent slopes.	WMM or PP	COMM	COMM.
Mb	Mandeville silt loam, 9 to 14 percent slopes.	M; PP; or T [4]	([4])	([4, 5]).
Mc	Moniteau silt loam	SW or CO(SCL)	([3])	([3]).
Na	Nodaway silt loam	SC; CC; or SW(SCL)	([3])	([3]).
Pa	Pershing silt loam, 3 to 5 percent slopes.	WMM or PP	COMMM	COMMM.
Sa	Sampsel silt loam, 4 to 6 percent slopes.	WMMM or CWMMMM	WM; CWMM; or COMM	CCWMM; CW(SCL); C(R)CWM; or COM.
Sb	Sandy alluvial land [7]			
Sc	Seymour silt loam, 1 to 3 percent slopes.	WMMM; CWMM; C(R)CWMM; or COMM.	CCWMM; CO(or W)M; C(R)CWM; or WM.	CCWMM; CW(SCL); or COM.

Sd	Seymour silt loam, terrace phase, 1 to 3 percent slopes.	W M M M; C W M M; C(R)CWMM; or COMM.	CCWMM; CO(or W) M; C(R)CWM; or WM.	CCWMM; CWSCL; or COM.
Se	Shelby loam, 4 to 8 percent slopes	WMMM; WM; CWMM or COMMM.	COMM; CWM; or C(R)CWMM.	CCWM; COM; CW(SCL); or C(R)CWM.
Sf	Shelby loam, 9 to 13 percent slopes.	WMMMM; MM; or PP [4]	([4])	WMM.[4, 5]
Sg	Shelby loam, 14 to 19 percent slopes.	PP [4]	([4])	([4, 5]).
Sh	Snead silty clay, 7 to 12 percent slopes.	WMMM; M; or PP	([4])	([4, 5]).
Sk	Snead stony silty clay, 11 to 20 percent slopes.	M; PP; or T [4]	([4])	([4, 5]).
Sl	Stet silty clay loam	SC; SW(SCL); C	([3])	([3]).
Wa	Wabash clay	SC or SW(SCL)S	([3])	([3]).
Wb	Wabash silt loam	CSOM or PP	([3])	([3]).
Wc	Westerville silt loam	SW or CO(SCL)	([3])	([3]).

[1] Corn rows planted on grade and a few terraces used to get proper drainage.

[2] Corn rows planted on contour and terrace system used for erosion control and drainage.

[3] "Contour farming" or "contour farming and terracing" not suggested for nearly level areas, so rotation or land use shown in column (A) applies in columns (B) and (C).

[4] Soil not suitable for corn; if no rotation or use is listed in columns (B) and (C), apply for those columns the rotation or use listed in column (A).

[5] Soils with slopes of more than 11 percent considered too steep for terraces.

[6] Fruit trees, berries, melons, and similar special crops also suitable.

[7] Nonagricultural.

Need for organic matter, fertilizers, and lime

The need for amendments varies according to the kind of soil, the crop to be grown, and past management. Need for lime and fertilizer is best determined by making soil tests (*4*). The county agricultural agent can tell you how to obtain soil tests and help you work out methods of fertilization based on the results of the tests.

CAPABILITY GROUPS OF SOILS

A grouping of soils according to their capability is often used in planning conservation on farms. The soils are placed in eight broad land capability classes, which show, in a general way, how suitable the soils are for crops, grazing, and forestry, and the difficulties or risks in using them. The first class, called class I, includes only the nearly level soils, not subject to erosion, that have good internal drainage. Soils more sloping, less adaptable, more difficult to use, or more erodible are placed in the remaining seven classes.

The soils of this county are arranged by land capability classes in the list that follows. Groups of similar soils within the classes make up capability units. All the soils in one capability unit are essentially the same in major characteristics that affect management and conservation.

Soils of Livingston County, Mo., Arranged by Capability Groups [1]

I. Nearly level easily worked soils that have practically no limitations on use:
  Soils of bottom lands that are medium textured and have moderate to good natural drainage. (Applies only to areas above serious annual overflow):
   Gravity loam.
   Nodaway silt loam.
   Stet silty clay loam.

II. Soils that can be cultivated safely by following practices that overcome minor limitations such as slight risk of erosion or slight wetness:
  Nearly level and gently sloping soils that are mostly medium textured, have medium to fine textured subsoils, and are moderate or slowly permeable:
   Chula silt loam.
   Gorham silty clay.
   Humeston silt loam.
   Blockton silt loam, 1 to 3 percent slopes.
   Seymour silt loam, 1 to 3 percent slopes.
   Seymour silt loam, terrace phase, 1 to 3 percent slopes.
   Edina silt loam, 0 to 2 percent slopes.
   Edina silt loam, terrace phase, 0 to 2 percent slopes.

III. Soils that can be cultivated safely by following practices to overcome one or more major limitations such as wetness, low inherent fertility, or risks of erosion:
  a. Nearly level and gently sloping soils that are medium and fine textured and have slow internal drainage:
   Moniteau silt loam.
   Westerville silt loam.
   Burrell silt loam, 1 to 3 percent slopes.
   Carlow clay.
   Wabash clay.
   Wabash silt loam.

[1] Erosion on slopes of less than 9 percent has not been considered as a factor affecting this grouping.

b. Sloping soils of the uplands that are light colored, medium textured, and of moderately low to low inherent fertility:
  - Lindley loam, 4 to 8 percent slopes.
  - Gamma loam, 4 to 8 percent slopes.
  - Mandeville silt loam, 4 to 7 percent slopes.
  - Pershing silt loam, 3 to 5 percent slopes.
  - Keytesville silt loam, 4 to 7 percent slopes.

c. Sloping soils that are dark colored, medium textured, and of moderate to high inherent fertility:
  - Gamma loam, dark surface variant, 4 to 8 percent slopes.
  - Lacona silt loam, 4 to 12 percent slopes.[2]
  - Lagonda silt loam, 4 to 6 percent slopes.
  - Sampsel silt loam, 4 to 6 percent slopes.
  - Shelby loam, 4 to 8 percent slopes.

IV. Soils that have limitations so severe that they can be cultivated only with extreme care:

Strongly sloping, mostly medium textured soils on uplands:
  - Bauer silt loam, 7 to 13 percent slopes.
  - Gamma loam, 9 to 20 percent slopes.[3]
  - Gamma loam, dark surface variant, 9 to 14 percent slopes.
  - Gamma loam, sand substratum variant, 6 to 12 percent slopes.
  - Mandeville silt loam, 9 to 14 percent slopes.
  - Shelby loam, 9 to 13 percent slopes.
  - Snead silty clay, 7 to 12 percent slopes.

V. Soils nearly level and good for grazing or forestry but too wet, too stony, or too frequently overflowed for cultivation.

(Applies only to areas frequently overflowed; no soils of this class are shown in the survey of the county.)

VI. Soils that are too steep, eroded, wet, stony, or droughty, alone or in combination, for practical cultivation but are fairly good for grazing or forestry:

Steep, shallow or stony soils:
  - Gosport loam, 15 to 25 percent slopes.
  - Lindley loam, 9 to 20 percent slopes.
  - Shelby loam, 14 to 19 percent slopes.
  - Snead stony silty clay, 11 to 20 percent slopes.

VII. Soils more limited in use than those in Class VI, but useful for grazing or forestry:

Severely eroded areas of 9 percent slope or more; and light colored or stony soils having slopes of 20 percent or more.

Soils of this class are not shown separately on the soil map but small areas occur as inclusions in soils of other classes.

VIII. Soil having extreme limitations that make it of little use for cultivation, grazing or forestry; has some value for food and shelter for wildlife and for recreation:

Sandy alluvial land.

[2] If mapped separately slopes of more than 8 percent are in class IV.
[3] If mapped separately slopes of more than 13 percent are in class VI.

SOIL SURVEY METHODS AND DEFINITIONS

The scientist who makes a soil survey examines soils in the field, classifies the soils in accordance with facts that he observes, and maps their boundaries on an aerial photograph or other map.

Field study.—The soil surveyor bores or digs many holes to see what the soils are like. The holes are not spaced in a regular pattern, but are located according to the lay of the land. Usually they are not more than a quarter of a mile apart and sometimes they are much closer. In most soils such a boring or hole reveals several distinct layers, called horizons, which collectively are known as the soil profile. Each layer is studied to see how it differs from others in the profile and to learn the things about the soil that influence its capacity to support plant growth.

Color is usually related to the amount of organic matter. The darker the surface soil, as a rule, the more organic matter it contains. Streaks and spots of gray, yellow, and brown in the lower layers generally indicate poor drainage and poor aeration.

In this survey, the soils that developed under forest are frequently called "light colored," though their Munsell color ratings are moderately dark. The term is used because the forest soils are light colored in comparison to the soils that developed under grass.

Texture, or the content of sand, silt, and clay, is determined by the way the soil feels when rubbed between the fingers, and is later checked by laboratory analysis. Texture determines how well the soil retains moisture, plant nutrients, and fertilizer, and whether it is easy or difficult to cultivate.

Structure, which is the way the individual soil particles are arranged in larger grains and the amount of pore space between grains, gives us clues to the ease or difficulty with which the soil is penetrated by plant roots and by moisture.

Consistence, or the tendency of the soil to crumble or to stick together, indicates whether it is easy or difficult to keep the soil open and porous under cultivation.

Other characteristics observed in the course of the field study and considered in classifying the soil include the following: The depth of the soil over bedrock or compact layers; the presence of gravel or stones in amounts that will interfere with cultivation; the steepness and pattern of slopes; the degree of erosion; the nature of the underlying parent material from which the soil has developed; and acidity or alkalinity of the soil as measured by chemical tests.

Classification.—On the basis of the characteristics observed by the survey team or determined by laboratory tests, soils are classified into phases, types, and series. The soil type is the basic classification unit. A soil type may consist of several phases. Types that resemble each other in most of their characteristics are grouped into soil series.

Soil type.—Soils similar in kind, thickness, and arrangement of soil layers are classified as one soil type.

Soil phase.—Because of differences other than those of kind, thickness, and arrangement of layers, some soil types are divided into two or more phases. Slope variations, frequency of rock outcrops, degree of erosion, depth of soil over the substratum, or natural drainage, are examples of characteristics that suggest dividing a soil type into phases.

The soil phase (or the soil type if it has not been subdivided) is the unit shown on the soil map. It is the unit that has the narrowest range of characteristics. Use and management practices therefore can be specified more easily for it than for soil series or yet broader groups that contain more variation.

Soil series.—Two or more soil types that differ in surface texture, but are otherwise similar in kind, thickness, and arrangement of soil layers, are normally designated as a soil series. In a given area, however, it frequently happens that a soil series is represented by only one soil type. Each series is named for a place near which it was first mapped.

Miscellaneous land types.—Fresh stream deposits or rough, stony, and severely gullied land that have little true soil are not classified into types and series but are identified by descriptive names, such as Sandy alluvial land.

Soil variant.—A soil that differs from a related soil type in one or more important characteristics but covers too small an area to justify a new series and type is mapped as a variant.

Other definitions.—Following are some terms used in soil surveying that may not be generally understood.

Alluvium.—Material deposited by streams.

Claypan.—Firm, plastic layer in subsoil caused by accumulation of clay.

Colluvial-alluvial fans.—Fan-shaped areas at mouths of gullies where material has been washed in by water and has slid down slopes.

Fertility, soil.—Capacity of a soil to provide nutrients in kinds, amounts, and proportions needed for growth of specified plants when light, temperature, and physical conditions of soil are favorable.

Glacial gravel.—Small rock fragments deposited by ice sheets.

Horizon, soil.—Layer in soil, approximately parallel to land surface, that has more or less well defined characteristics produced through soil-building processes.

Loess.—Silty material deposited by wind.

Parent material.—Unconsolidated mass from which the soil profile develops.

Plant nutrients.—Elements essential to plant growth: Nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and molybdenum from the soil; and carbon, hydrogen, and oxygen, largely from air and water.

SOIL ASSOCIATIONS

The map of soil associations (fig. 2) shows general soil patterns in the county. Each association consists of a group of soils that occur in a definite pattern. Most of the associations contain two or three dominant soils, along with others of lesser extent. One association contains just one dominant soil along with the lesser ones. The map is useful in understanding how the different soils occur in the county, and in planning in a general way for good use and management of soils on a community-wide or county-wide basis.

The Seymour-Lagonda-Shelby association occupies most of the upland areas between the major streams. These are dark colored soils formed under prairie vegetation. The Seymour soils are from wind-laid silts, the Lagonda from plastic glacial clay overlain by a thin mantle of wind-laid silt, and Shelby soils from glacial till. Slopes range from nearly level to strongly sloping.

The Lacona-Bauer association occurs in several upland areas south of the Grand River, and in one area of about 5 square miles in Sampsell Township. Lacona soils are deep (up to 50 inches), and Bauer soils are shallow. Both overlie fine-grained shales. Slopes range from gentle to moderately steep.

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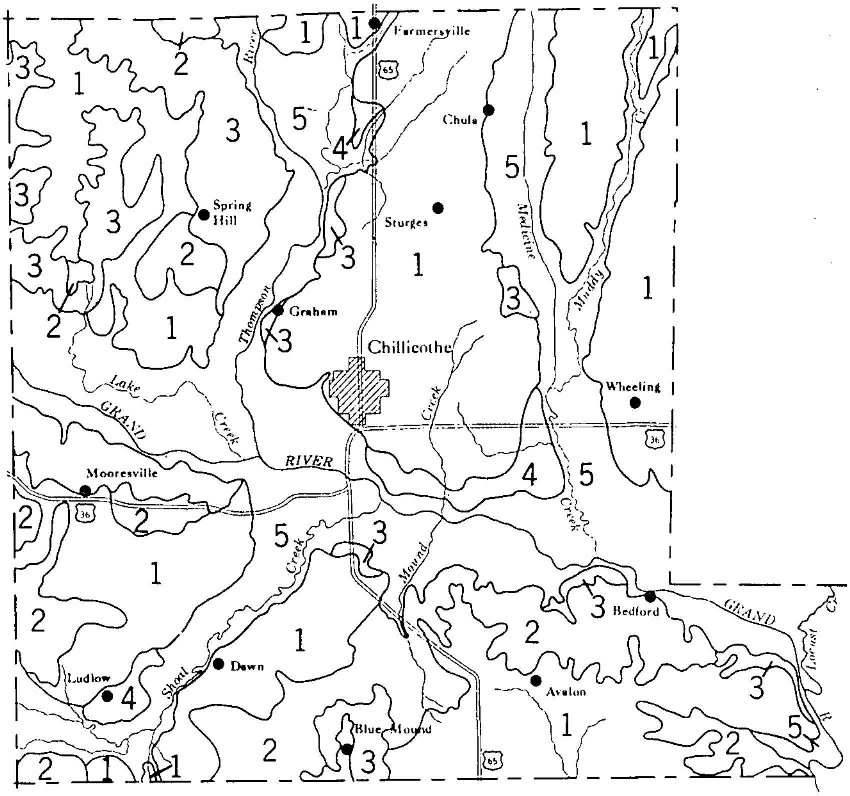

Figure 2.—**Soil associations of Livingston County, Mo.**

1. **Seymour-Lagonda-Shelby**
2. **Lacona-Bauer**
3. **Gosport-Snead-Mandeville**
4. **Edina**
5. **Wabash-Carlow-Nodaway**

The Gosport-Snead-Mandeville association occurs chiefly in the northwestern corner of the county. Another good-sized area lies just south of the Grand River bottoms between Utica and the western county line. Smaller areas occur elsewhere. The Gosport and Mandeville soils are light colored and lie over shale or sandstone. The Snead soils are dark colored and shallow over calcareous shale. Slopes of the soils in this association range from moderate to steep.

Edina soils occur throughout the county. They are dominant in one area north of the Grand River bottom southeast of Chillicothe and in another small area near Ludlow. They are nearly level, moderately dark colored soils with a heavy clay subsoil.

The Wabash-Carlow-Nodaway association occupies the wide bottom lands along the Grand River and its major tributaries.

SOIL DESCRIPTIONS

In the following pages the soils of the county are described and their agricultural relations are discussed. Their acreage and proportionate extent are given in table 4. The statements concerning use and management of the various soils were correct in 1950, the time this survey was made.

TABLE 4.—*Approximate acreage and proportionate extent of the soils in Livingston County, Mo.*

Soil	Acres	Percent
Bauer silt loam, 7 to 13 percent slopes	13, 000	3. 8
Blockton silt loam, 1 to 3 percent slopes	1, 550	. 5
Burrell silt loam, 1 to 3 percent slopes	950	. 3
Carlow clay	36, 200	10. 6
Chula silt loam	2, 900	. 9
Edina silt loam, 0 to 2 percent slopes	1, 100	. 3
Edina silt loam, terrace phase, 0 to 2 percent slopes	3, 800	1. 1
Gamma loam, 4 to 8 percent slopes	1, 250	. 4
Gamma loam, 9 to 20 percent slopes	2, 200	. 6
Gamma loam, dark surface variant, 4 to 8 percent slopes	6, 600	1. 9
Gamma loam, dark surface variant, 9 to 14 percent slopes	4, 300	1. 3
Gamma loam, sand substratum variant, 6 to 12 percent slopes	170	(1)
Gorham silty clay	3, 100	. 9
Gosport loam, 15 to 25 percent slopes	8, 300	2. 4
Gravel pits	225	. 1
Gravity loam	11, 800	3. 5
Humeston silt loam	9, 500	2. 8
Keytesville silt loam, 4 to 7 percent slopes	6, 100	1. 8
Lagonda silt loam, 4 to 6 percent slopes	48, 400	14. 2
Lacona silt loam, 4 to 12 percent slopes	13, 200	3. 9
Lindley loam, 4 to 8 percent slopes	2, 000	. 6
Lindley loam, 9 to 20 percent slopes	2, 000	. 6
Mandeville silt loam, 4 to 7 percent slopes	4, 300	1. 3
Mandeville silt loam, 9 to 14 percent slopes	1, 150	. 3
Moniteau silt loam	2, 100	. 6
Nodaway silt loam	29, 900	8. 8
Pershing silt loam, 3 to 5 percent slopes	400	. 1
Quarries	150	(1)
Sampsel silt loam, 4 to 6 percent slopes	8, 200	2. 4
Sandy alluvial land	1, 450	. 4
Seymour silt loam, 1 to 3 percent slopes	49, 300	14. 4
Seymour silt loam, terrace phase, 1 to 3 percent slopes	1, 750	. 5
Shelby loam, 4 to 8 percent slopes	17, 400	5. 1
Shelby loam, 9 to 13 percent slopes	5, 900	1. 7
Shelby loam, 14 to 19 percent slopes	375	. 1
Snead silty clay, 7 to 12 percent slopes	3, 700	1. 1
Snead stony silty clay, 11 to 20 percent slopes	12, 000	3. 5
Stet silty clay loam	3, 300	1. 0
Wabash clay	14, 800	4. 3
Wabash silt loam	1, 500	. 4
Westerville silt loam	2, 400	. 7
Land area	338, 720	99. 2
Water	2, 600	. 8
Total	341, 320	100. 0

[1] Less than 0.01 percent.

Bauer Soil

Bauer silt loam, 7 to 13 percent slopes (Ba)

This moderately dark colored, shallow, upland soil was derived from Pennsylvanian shales. Most of it has developed under prairie grass, on rolling topography. It is associated with the more gently rolling Lacona and Seymour soils and with the steeper Snead soils.

SOIL PROFILE: The surface soil is dark brown to brown very friable silt loam, 9 to 12 inches thick. It lies directly over yellowish-brown weathered shale. In some places shale fragments are scattered on the surface and through the surface soil.

VARIATIONS AND INCLUSIONS: Some areas of this soil have developed under a mixed prairie-timber vegetation and have a brown surface soil. These areas are west of the Thompson River and south of the Grand River; a few are in the south-central and southwestern parts.

A few scattered areas of this soil, principally in the south-central part, have developed from red clay shale. They have a thin surface layer of reddish-brown silty clay loam, 6 to 8 inches thick, that lies over red, very sticky and plastic weathered clay shale. The soil occurs mainly at a lower elevation than the other residual soils, or at the heads of drainageways.

Bauer soil that developed from sandy shales or sandstones under mixed prairie-timber vegetation occurs in a few areas in the southwest. The thin surface soil, a brown loam 6 to 8 inches thick, overlies yellowish-brown weathered sandy shale or sandstone.

In a few scattered areas essentially all of the surface soil is gone, and the weathered shale is exposed. These eroded areas are shown on the map by the use of special symbol—SS.

USE AND MANAGEMENT: The natural fertility level of Bauer silt loam is medium to high, but it is best suited to small grains, meadow, and pasture crops because of erosion hazard and shallow profile. By the use of terraces or contour farming, corn can be grown on the moderate (7 to 11 percent) slopes. A cropping system that covers the land most of the year is desired for these areas. A suggested rotation system is corn, fall grain, and a grass-legume mixture for 2 to 4 years. For other suggested rotations under various conservation practices refer to table 3.

Most of the areas of this soil on moderately steep (11 to 13 percent) slopes are in pasture. If cultivated, especially to row crops, these areas erode very rapidly. They can best be maintained in meadow or pasture. With soil treatment, high forage yields can be obtained.

Blockton Soil

Blockton silt loam, 1 to 3 percent slopes (Bb)

This dark-colored soil has developed from medium-textured alluvium under a grass cover. It occurs on nearly level to gently rolling stream terraces, principally in the areas occupied by residual soils. The soil is not extensive; the largest areas are along Mound Creek.

SOIL PROFILE: The surface soil is black to very dark gray, very friable, granular silt loam, 9 to 12 inches thick. The upper subsoil is black, slightly sticky and plastic silty clay of subangular blocky structure. The lower subsoil is very dark gray, mottled with yellowish-brown and olive-brown, sticky and plastic silty clay. Surface runoff is slow to medium; internal drainage is slow.

VARIATIONS AND INCLUSIONS: In some places, the surface soil is moderately dark colored and thicker than average because it has been modified by the addition of colluvial material from the adjacent upland slopes.

USE AND MANAGEMENT: This is one of the best general-purpose croplands soil in Livingston County. All of the crops common to the region can be grown. The slow internal drainage makes this soil somewhat slow to dry out, and tillage may be delayed.

Burrell Soil

Burrell Silt loam, 1 to 3 percent slopes (Bc)

This light-colored soil has developed from alluvium under forest vegetation. It occurs on nearly level stream terraces. The soil is not extensive; the largest areas are on the west-central part along the Grand River. In this area it is associated with the Keytesville soil. This soil occurs on the stream terraces, and the Keytesville on an upland bench.

SOIL PROFILE: The surface soil is brownish-gray very friable silt loam of fine granular structure and 8 to 9 inches thick. The subsurface layer, 4 to 5 inches thick, is pale-brown very friable silt loam with a very weak granular structure. The upper subsoil is dark yellowish-brown slightly sticky and plastic silty clay of granular structure. The lower subsoil is a grayish-brown, yellowish-brown, and dark-brown sticky and plastic clay of subangular blocky structure. Surface runoff is slow to medium; internal drainage is slow.

USE AND MANAGEMENT: This soil is best suited to small grains, hay, and pasture, and occasionally to corn. Natural fertility is low, but crops respond to fertilizers. Yields are not so high as on the Blockton soil. Estimated yields for different field crops are given in table 2. For suggested rotations, see table 3.

Carlow Soil

Carlow clay (Ca)

This dark-colored, poorly drained, soil has developed from alluvium under a cover of water-tolerant grasses. It occurs on the flood plains of all the major streams in the county. It is associated with the Nodaway, Humeston and Wabash soils, and is one of the major soils in Livingston County.

SOIL PROFILE: The surface soil is very dark gray, sticky and plastic clay, 10 to 12 inches thick. Below this is 3 to 4 inches of mottled dark-gray, very sticky and plastic clay of blocky structure. The underlying material is gray to dark-gray, flecked with brown, very sticky and plastic massive clay.

VARIATIONS AND INCLUSIONS: Several small areas of slightly better drained silty clay loam are so closely associated with Carlow clay that they have been included with it in mapping. In a few scattered areas, a soil with a silty clay surface layer and well-defined A_2 horizon has been mapped with the Carlow clay.

USE AND MANAGEMENT: Flood control and drainage are the greatest problems in management of this soil. Weed control, maintaining good tilth, and choice of suitable rotation are also important.

This soil (*5*) is best suited to soybeans and, to a lesser extent, to small grains. Soybeans loosen the heavy soil and render it suitable for sowing to fall grains with little or no further preparation. Corn and clovers will not produce good yields and will fail in most seasons. The soil can produce relatively high yields of wheat and barley. Severe injury sometimes occurs from heaving, and also from too much moisture late in winter and early in spring. Oats are well adapted to a heavy clay soil like the Carlow, but the difficulty of early sowing sharply limits their use. For suggested rotations refer to table 3.

The soil is high in organic matter and plant nutrients. It has less need for legumes than some of the eroded upland soils. Green manure, however, supplied in form of deep-rooted legumes, would improve tilth and drainage and add to available nitrogen.

Reed canarygrass will survive on wet soil for long periods; it is best suited to permanent or semipermanent pastures on Carlow clay. Tall fescue and redtop will also probably survive. Bluegrass thrives where the soil is not subject to more than 2 days of flooding.

Chula Soil

Chula silt loam (Cb)

This is a dark-colored soil with a fine-textured subsoil at 18 to 24 inches. It has developed from medium-textured materials under prairie grass on nearly level colluvial-alluvial fans. This soil differs from Humeston silt loam principally in lying at levels above overflow and in having a surface layer 4 to 6 inches thicker.

SOIL PROFILE: The surface soil is very dark gray, very friable silt loam 12 to 15 inches thick. The subsurface layer, 7 inches thick, is grayish-brown to light brownish-gray very friable silt loam. This layer contains a few small iron concretions and is very loose when dry. The upper subsoil is black, dark-gray, and yellowish-brown sticky and plastic silty clay of coarse subangular blocky structure. The lower subsoil is a mottled dark-gray, yellowish-brown, grayish-brown, and light olive-brown sticky and plastic massive silty clay. The underlying material is a mottled grayish-brown and light olive-brown very sticky and plastic massive clay. Surface runoff is slow to medium; internal drainage is slow.

USE AND MANAGEMENT: Chula silt loam is good general-purpose cropland. For suggested rotations refer to table 3. On some areas of this soil, it is desirable to divert the runoff from adjacent upland slopes by the use of terraces.

Estimated yields for different field crops on this soil are given in table 2.

Edina Soils

Edina silt loam, 0 to 2 percent slopes (Ea)

This is a moderately dark colored claypan soil that has developed from loess under a cover of prairie grass. It occurs on broad nearly level ridgetops in association with Seymour silt loam. It is not an extensive soil; the largest areas are in the northeastern part of the county. The soil differs from Seymour silt loam in having a gray subsurface layer and a more compact upper subsoil.

SOIL PROFILE: The surface soil is an 8- to 9-inch layer of dark grayish-brown very friable silt loam of moderate fine granular structure. The subsurface layer, a light brownish-gray very friable silt loam of weak fine granular structure, contains a few small iron concretions and is very loose when dry. The upper subsoil is a very dark-gray, dense, stiff clay of subangular blocky structure. This layer, often called claypan, is hard and compact when dry. The lower subsoil is a mottled gray and yellowish-brown sticky and plastic clay of blocky structure. The underlying weathered loess is very sticky and plastic massive silty clay mottled with dark grayish brown, light olive brown, and brownish yellow. Surface runoff and internal drainage are slow.

VARIATIONS AND INCLUSIONS: In some areas this soil occurs in very close association with nearly level areas of Seymour silt loam. Some areas of the Seymour soil are therefore included in larger tracts of this soil.

USE AND MANAGEMENT: The chief management problems on this soil are fertility and drainage. Because of slow surface runoff and poor internal drainage, water becomes ponded during prolonged wet spells.

The claypan limits the kinds of crops that can be grown. This soil is suited to the common crops of the region that are shallow-rooted. Fair yields of corn, soybeans, wheat, and oats can be expected. After liming and fertilizing, clover does well in favorable years. Seed crops of alsike, Ladino, and red clovers also do well. For suggested rotations refer to table 3.

Edina silt loam, terrace phase, 0 to 2 percent slopes (Eb)

This moderately dark colored claypan soil has developed from loess under a cover of prairie grass. The terrace on which it occurs is about 15 feet above the bottom lands. The most extensive areas are along the Grand River and along Shoal Creek near Ludlow village.

The soil profile of this terrace phase is very similar to that of Edina silt loam, and it is suited to similar uses and has similar management requirements.

Gamma Soils

The Gamma soils are generally light-colored, though a dark-colored variant has also been recognized. They have developed from reddish-colored glacial till of Kansan-Nebraskan age under a cover of either forest or mixed grass and forest. They occur on slopes or narrow rounded ridgetops. The most extensive areas are in the northwest.

USE AND MANAGEMENT: Because of their low natural fertility and erosion hazard, these soils are best suited to small grains, hay, pasture, and to use as woodlots.

Gamma loam, 4 to 8 percent slopes (Ga)

This light colored soil has developed under forest on gentle slopes and narrow rounded ridgetops.

SOIL PROFILE: The surface soil, 8 to 10 inches thick, is brownish-gray, very friable loam of granular structure. The subsurface horizon, 4 to 6 inches thick, is brown to pale-brown, very friable loam. The upper subsoil is yellowish-brown firm to friable sandy clay. The lower subsoil is mottled yellowish-red, very firm sandy clay of massive structure. Surface runoff is medium to rapid; internal drainage is medium.

VARIATIONS AND INCLUSIONS: In places this soil has a fairly large amount of glacial gravel on the surface, throughout the profile, and in the parent material. A few scattered areas with moderate slopes have lost practically all of the surface soil.

Gamma loam, 9 to 20 percent slopes (Gb)

This soil has a profile similar to that previously described for Gamma loam, 4 to 8 percent slopes. It is best used for permanent pasture or woodlots.

Gamma loam, dark surface variant, 4 to 8 percent slopes (Gc)

This moderately dark colored soil has developed under a mixed cover of grass and forest. It occurs on narrow rounded ridgetops.

SOIL PROFILE: The surface soil is grayish-brown to brown very friable loam of moderate fine granular structure and 9 to 11 inches thick. The subsurface horizon, 3 to 4 inches thick, is dark yellowish-brown to brown friable loam. The upper subsoil is yellowish-red firm silty clay. The lower subsoil is mottled dark grayish-brown firm clay. In places the substratum contains an appreciable amount of glacial gravel and a few glacial boulders. The thickness of the till over the residual limestones and shales is variable.

Surface runoff is medium to rapid; internal drainage is medium. Gamma loam, dark surface variant, 4 to 8 percent slopes, is best suited to small grains, hay, and pasture.

Gamma loam, dark surface variant, 9 to 14 percent slopes (Gd)

This soil has a profile similar to that previously described for Gamma loam, dark surface variant, 4 to 8 percent slopes. It has been used mostly for pastures and woodlots, for which it is best suited because of its steep slopes.

Gamma loam, sand substratum variant, 6 to 12 percent slopes (Ge)

This is a moderately dark colored soil. It has developed under grass and forest on sloping topography. The parent material is sandy glacial till or outwash.

SOIL PROFILE: The surface soil is dark reddish-brown to strong brown very friable loamy sand, 12 to 16 inches thick. The subsoil is yellowish-brown friable clay loam to sandy clay. The underlying material is reddish-yellow friable sandy clay loam. In some places small amounts of glacial gravel are in the lower part of the surface layer. Surface runoff is medium to rapid; internal drainage is rapid.

VARIATIONS AND INCLUSIONS: In some places the underlying material of this variant is almost pure sand. In other places there is enough clay to make the soil plastic when moist and hard when dry.

USE AND MANAGEMENT: The more gentle slopes are used for general crop production. The soil erodes easily and tends to be droughty. Because of the good internal drainage, this variant is well suited to fruit trees, melons, and berries.

Gorham Soil

Gorham silty clay (Gf)

This dark, fine-textured alluvial soil overlies a sandy loam substratum. It occurs in the bends of old cut-off or meander channels, chiefly along the Grand River.

SOIL PROFILE: The surface soil, a dark grayish-brown to very dark grayish-brown slightly plastic silty clay, has a moderate medium subangular blocky structure and is 9 to 14 inches thick. The underlying material is dark grayish-brown to light brownish-gray very friable fine sandy loam. Surface runoff is slow; internal drainage is medium.

USE AND MANAGEMENT: The chief management problem on Gorham silty clay is protection from frequent and severe overflow. About one crop in three is either lost or severely damaged by floodwaters. If it could be protected by levees, this would be good general-purpose cropland. The sandy underlying material enables this soil to dry out earlier in the spring than the other heavy-textured bottom-land soils. Its natural fertility level is high, and it is fairly easy to work, compared with the Wabash and Carlow clays.

Gosport Soil

Gosport loam, 15 to 25 percent slopes (Gg)

This light-colored shallow soil has developed under forest vegetation from alternating beds of sandy shale and sandstone. It is associated with Mandeville silt loam and the Snead stony silty clay soils on moderately steep to hilly topography.

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SOIL PROFILE: The shallow surface soil is brown to light-brown very friable loam, 8 to 9 inches thick. This is underlain by yellowish-brown weathered shale. Surface runoff is rapid; internal drainage is medium.

Sandy shale and sandstone rocks, both on the surface and through the profile, prevent cultivation in some areas. These are shown on the soil map by a special symbol for stoniness.

USE AND MANAGEMENT: The natural fertility of Gosport loam is low. It is very erodible under cultivation and droughty because of its low water-holding capacity. It should not be used for cultivated crops and is best suited to pasture or woodlots. The steeper slopes are maintained as farm woodlots in which grazing is restricted.

Gravity Soil

Gravity loam (Gh)

This deep, dark-colored soil has developed from medium-textured material deposited on nearly level colluvial-alluvial fans and in bottom lands. The most extensive fans occur below areas of sloping Shelby soils along Medicine and Muddy Creeks in the east and northeast. The bottom-land areas of this soil occur chiefly along creeks in association with the Humeston and Nodaway soils.

SOIL PROFILE: On the colluvial areas the surface soil is very dark-brown to black very friable loam, 12 to 24 inches thick. In the bottom lands the surface soil ranges from very dark brown to yellowish brown. The upper subsoil is dark grayish-brown friable to slightly sticky and plastic silty clay loam. The subsoil is very dark gray to black plastic silty clay. Surface runoff is slow to medium; internal drainage is medium.

USE AND MANAGEMENT: Gravity loam has high natural fertility. It is easy to work. These two features make it good general-purpose cropland in the county. High yields of all adapted crops can be obtained. After the fertilizer requirements have been met, Gravity loam is a very good soil for alfalfa.

Keeping water off the land is the main management problem. On the fans this soil receives some runoff from the adjacent upland slopes, but this can be controlled by diversion ditches. The bottom lands are subject to occasional moderate overflow and should be protected by levees. The areas occurring on the small stream-bottom lands are generally too narrow and too cutup to be farmed profitably; they are best suited to permanent pasture. For suggested rotations refer to table 3.

Humeston Soil

Humeston silt loam (Ha)

This dark-colored soil has developed from medium-textured alluvium. It is associated with the Carlow and Wabash soils.

SOIL PROFILE: The surface soil is very dark gray, very friable silt loam, 9 to 12 inches thick. The subsurface layer, a grayish-brown to gray very friable silt loam 3 to 6 inches thick, is loose when dry. The upper subsoil is dark-gray, stained with yellowish-brown, sticky and plastic silty clay of moderate coarse subangular blocky structure.

This layer is compact when dry. The lower subsoil is mottled very dark-gray, gray, and yellowish-brown, sticky and plastic, massive silty clay. The underlying material is dark-gray and grayish brown, stained with yellowish-brown, very sticky and plastic, massive clay. Surface runoff is slow to medium; internal drainage is slow.

USE AND MANAGEMENT: Where not subject to overflow, or where protected by levees, Humeston silt loam is good general-purpose cropland.

In the smaller creek-bottom lands, most areas are either too small or too cut up by stream channels to be profitably cultivated. These areas are best suited to permanent pasture. On areas subject to overflow, suitable pasture mixtures would be Reed canarygrass and alsike clover; or redtop, timothy, and alsike clover (*2*). For suggested rotations, refer to table 3.

Keytesville Soil

Keytesville silt loam, 4 to 7 percent slopes (Ka)

This light-colored claypan soil has developed under forest vegetation, mainly from glacial till or shale. It occurs mainly on gentle slopes in bench positions. It is not an extensive soil but is widely dispersed over the county. The largest areas are in the southwest along Rattlesnake Creek.

SOIL PROFILE: The surface soil is grayish-brown very friable silt loam, 9 to 10 inches thick. The subsurface layer, 6 to 7 inches thick, is brown to pale-brown very friable silt loam that is very loose when dry. The upper subsoil is very dark grayish brown and dark yellowish-brown sticky and plastic silty clay with stains of yellowish-brown. This horizon is hard and compact when dry. The lower subsoil—a mottled gray and yellow very sticky and plastic clay—contains many small iron concretions and is very hard and compact when dry. The underlying material is mottled dark grayish brown, olive-yellow, and light-gray, very sticky and plastic, massive clay that contains numerous small iron concretions. Surface runoff is medium; internal drainage is slow.

USE AND MANAGEMENT: Keytesville silt loam is one of the least productive soils in the county; it is best suited to small grains, hay, and pasture. Deep-rooted crops do not grow well because of the compact subsoil. Corn may be grown, however, in a long rotation that is adequately fertilized. For suggested rotations and related conservation practices, refer to table 3.

Lacona Soil

Lacona silt loam, 4 to 12 percent slopes (Lb)

This dark-colored soil was derived from silty shales. It occurs on rounded ridgetops and on rolling to moderately steep slopes in association with the Sampsel and Snead soils.

SOIL PROFILE: The surface soil is dark-brown to brown very friable silt loam, 11 to 15 inches thick. The upper subsoil is reddish-brown slightly sticky and plastic silty clay. The lower subsoil is yellowish-brown slightly sticky and plastic silty clay. This layer grades into dark-brown weathered silty shales. Both surface runoff and internal drainage are medium.

VARIATIONS AND INCLUSIONS: Some areas of this soil, principally north of the Grand River and west of the Thompson River, developed under mixed prairie and forest vegetation and are dark-colored. Several small areas in the south-central part of the county developed from sandy shale on sandstone rather than the usual weathered silty shale.

All the surface soil is gone from a few eroded areas. Some areas on rounded ridgetops have been slightly modified by a thin deposit of loess.

USE AND MANAGEMENT: Lacona silt loam has high natural fertility. It is one of the more productive general-purpose cropland soils in the county. The less steeply sloping areas can be used for corn, but erosion control will be needed. For suggested rotations and various conservation practices, refer to table 3.

After lime and plant nutrients have been supplied, alfalfa and alfalfa-grass mixtures do well. The steeper slopes of this soil are nearly all in permanent pasture and are best suited to this use.

Lagonda Soil

Lagonda silt loam, 4 to 6 percent slopes (La)

This dark-colored soil has developed under prairie grasses from plastic glacial clay overlain by a thin mantle of loess. It occurs on gently rolling to rolling slopes in association with the Seymour and Shelby soils. It is the second most extensive soil and is widely dispersed, mostly in the eastern half of the county.

SOIL PROFILE: The surface soil is very dark brown to dark grayish-brown, very friable silt loam, 12 to 14 inches thick. The upper subsoil—a mottled dark gray and very dark brown sticky and plastic silty clay—is hard and compact when dry. It contains numerous iron concretions, and occasionally appreciable amounts of small gravel. The lower subsoil is mottled very dark-gray and yellowish-brown very sticky and plastic clay of coarse subangular blocky to massive structure. The underlying material is grayish-brown, mottled with yellowish-brown, very sticky and plastic massive clay that contains small amounts of glacial gravel. Surface runoff is medium to rapid; internal drainage is slow. The profile is similar to that of Seymour silt loam, but the lower subsoil of Lagonda silt loam is somewhat heavier and the parent material is different.

VARIATIONS AND INCLUSIONS: In some places, usually near the boundary between Lagonda and Shelby soils, this soil has a subsurface horizon, 6 to 9 inches thick, of grayish-brown to light brownish-gray very friable silt loam of weak fine granular structure. It contains many small iron concretions and is very loose when dry.

The thickness of the loess mantle varies from about 24 inches on the gently rolling areas to less than 12 inches on the rolling areas. Because of this variability, the texture of the surface soil approaches a loam on some of the steeper slopes.

A few scattered areas have lost nearly all of the surface soil. Those areas are marked SS.

USE AND MANAGEMENT: Logonda silt loam has high natural fertility and is easy to till, but it erodes rapidly under intense cultivation unless conservation practices are used.

The soil is used for corn, small grains, hay, and pasture. It is considered one of the better soils for bluegrass. Most grasses and legumes will grow well, but this soil is often too wet for alfalfa.

In general, the gently rolling areas of this soil are managed like Seymour silt loam, and comparable yields are obtained. Most of the steeper areas are in pasture, but some have been cultivated a few years. Unless conservation practices are used, these steep areas will erode rapidly under cultivation because of rapid surface drainage and slow internal drainage. They are best suited for small grains, hay, and pasture. Corn should be grown only in a long rotation.

Lindley Soils

These are light-colored soils. They have developed from Kansan-Nebraskan glacial till under forest vegetation. They are not extensive soils; they occur mainly on the steeper hillsides along the larger streams in the northeastern part of the county.

Lindley loam, 4 to 8 percent slopes (Lc)

This soil occurs on narrow rounded ridgetops and on rolling slopes.

SOIL PROFILE: The surface soil is grayish-brown very friable loam, 8 to 9 inches thick. The subsurface layer, 3 to 4 inches thick, is yellowish-brown to pale-brown very friable loam. The subsoil is mottled grayish-brown to brownish-yellow sticky and plastic gritty clay. Surface runoff is medium to rapid; internal drainage is medium.

USE AND MANAGEMENT: The soil is very erodible under cultivation, and is one of the least productive in the county for general crops. It is best suited to small grains, meadow, and pasture. The soil has low productivity but it responds to fertilizers. For suggested rotations and various conservation practices refer to table 3.

Lindley loam, 9 to 20 percent slopes (Ld)

This soil has a profile similar to that previously described for Lindley loam, 4 to 8 percent slopes.

USE AND MANAGEMENT: Because of steep to hilly slopes and severe erosion hazard, this is a poor agricultural soil. It is best used for pasture or as woodlots. If adequately fertilized, it gives moderately good yields of bluegrass, timothy, and Korean lespedeza.

Pastures protected from overgrazing and erosion generally have a good stand of bluegrass. Poorly managed pastures may have only wild grasses and weeds. The steeper slopes are best used as woodland that is not grazed. Suggested rotations and suitable conservation practices are given in table 3.

Mandeville Soils

The Mandeville are light-colored soils that have developed from silty shales under forest vegetation. They are minor soils in the county that occur on rounded ridgetops and on rolling to moderately steep slopes in association with the Gosport soils.

SOIL PROFILE: The surface soil is dark grayish-brown very friable silt loam, 6 to 9 inches thick. The subsurface layer is brown to light yellowish-brown very friable silt loam of weak medium granular structure and 3 inches thick. The upper subsoil is dark-brown and yellowish-brown sticky and plastic silty clay. The lower subsoil is mottled very dark grayish-brown and yellowish-brown sticky and plastic silty clay of moderate medium subangular blocky structure. Both surface runoff and the internal drainage are medium.

USE AND MANAGEMENT: Mandeville soils have low natural fertility. They will erode severely under intensive cultivation, so they need proper rotations and use of conservation practices, as suggested in table 3. Cultivation of these soils also requires the efficient use of fertilizers. Crop yields are not so high as on the darker colored soils. After the necessary lime and fertilizer requirements have been met, alfalfa-grass mixtures can be grown.

Mandeville silt loam, 4 to 7 percent slopes (Ma)

This soil has a profile similar to that previously described for the Mandeville series. It occurs on rounded ridgetops and on rolling slopes.

When terracing or contour cultivation are practiced, the intensity of the rotation may be increased. Without these practices, however, this soil is best used for fall grains and meadow.

Mandeville silt loam, 9 to 14 percent slopes (Mb)

This soil has a profile similar to that previously described for the Mandeville series. It occurs on moderately steep to steep slopes.

Most areas are in permanent pasture or forest. Cultivation of these areas would create a serious erosion hazard.

Moniteau Soil

Moniteau silt loam (Mc)

Moniteau silt loam is a light-colored, medium-textured soil of the bottom lands that developed under forest vegetation. Most of the areas are along small stream channels in the north-central part of the county.

SOIL PROFILE: The surface soil is grayish-brown very friable silt loam, 9 to 10 inches thick. The subsurface layer—a gray very friable silt loam, 6 to 7 inches thick—is very loose when dry. The subsoil is very dark grayish brown, mottled with yellowish-brown, very sticky and plastic silty clay. The upper part of the subsoil is firm to very firm when dry. Surface runoff and the internal drainage are slow.

USE AND MANAGEMENT: Moniteau silt loam is not suited to general crops, even when protected from rather frequent and moderately severe overflow. It is best suited to soybeans, small grains, and pasture. Crop yields will increase if fertilizer is applied. For suggested rotations, refer to table 3.

Nodaway Soil

Nodaway silt loam (Na)

Nodaway silt loam is the second most extensive bottom-land soil in the county. It is moderately dark colored, medium-textured, alluvial soil composed of recent flood deposits.

SOIL PROFILE: There is no distinct profile. The surface soil ranges fı om dark grayish brown to grayish brown in color and from fine sandy loam to silt loam in texture. This layer ranges from about 10 to 36 inches in thickness and contains lenses, or small layers, of sand, silt and clay. The underlying material is a dark-gray sticky and plastic clay. Surface runoff is slow; internal drainage is medium.

USE AND MANAGEMENT: Nodaway silt loam lies adjacent to major streams. Where protected from frequent and severe overflow, it is one of the best soils in the county for general crops. It is excellent for soybeans and corn. Natural fertility is moderately high. The soil is very responsive to fertilizer, especially nitrogen. For suggested rotations, refer to table 3.

Pershing Soil

Pershing silt loam, 3 to 5 percent slopes (Pa)

This moderately dark colored soil has developed from loess under mixed prairie and forest vegetation. It is an inextensive soil in Livingston County. It occurs on narrow and rounded ridgetops in association with either Mandeville or Seymour soils.

SOIL PROFILE: The surface soil is dark grayish-brown very friable silt loam, 8 to 9 inches thick. The subsurface layer, 5 to 6 inches thick, is gray to light brownish-gray very friable silt loam of weak fine granular structure. The upper subsoil is a grayish-brown to reddish-brown slightly sticky and plastic silty clay of moderate medium subangular blocky structure. The lower subsoil is a grayish-brown sticky and plastic clay, mottled with gray, light olive brown, or yellowish brown. This layer has a weak coarse blocky structure. Surface runoff is medium; internal drainage is slow.

USE AND MANAGEMENT: Although low in natural fertility, this soil responds to green-manure crops and to lime and complete fertilizers. Satisfactory yields can be obtained from crops common to the region, including alfalfa-grass mixtures. For suggested rotations and accompanying conservation practices, refer to table 3.

Sampsel Soil

Sampsel silt loam, 4 to 6 percent slopes (Sa)

The dark-colored Sampsel soil was derived from clay shale and developed under prairie vegetation. It occurs on gently rolling to rolling slopes in association with Bauer, Lacona, and Snead soils. It is not an extensive soil in Livingston County; the largest areas occur in the southern part.

SOIL PROFILE: The surface soil—a very dark grayish-brown very friable silt loam—has a moderate fine granular structure and is 10 to 12 inches thick. On gently rolling slopes, the surface layer probably has a thin mantle of loess. The upper subsoil is very dark-gray very sticky and plastic massive clay mottled with yellowish brown; it contains many small iron concretions. The lower subsoil is mottled very dark grayish-brown, light olive-brown, and yellowish-brown, very sticky and plastic massive clay. Locally it contains many small iron and lime concretions.

In some places this soil is calcareous at a depth of about 36 inches. Surface runoff is medium; internal drainage is slow.

VARIATIONS AND INCLUSIONS: Locally this soil has a well-defined subsurface layer, 3 to 6 inches thick, that consists of grayish-brown very friable silt loam of moderate medium granular structure.

Where this soil occupies basinlike areas the surface soil has been modified by material washed onto it from adjoining slopes.

USE AND MANAGEMENT: This soil had relatively high natural fertility. It is suited to all common crops grown in the county except the deep-rooted ones. Penetration of small roots usually stops at the top of the heavy clay subsoil.

This soil is very similar to Lagonda silt loam, 4 to 6 percent slopes, in use and management problems.

Sandy alluvial land (Sb)

This land occurs along the banks of the major streams; is subject to frequent and severe overflow; and is composed of coarse sand deposited during floods. It shows no soil profile development and is essentially nonagricultural.

Seymour Soils

Seymour silt loam, 1 to 3 percent slopes (Sc)

This dark-colored soil has developed from loess under a cover of prairie vegetation. It occurs on nearly level ridgetops and on gentle rolling slopes in association with the Edina and Lagonda soils. It is the most extensive upland soil in Livingston County. The areas are most extensive in the eastern half but are widely dispersed and frequently occur on higher ridgetops that a have loess mantle.

SOIL PROFILE: The surface soil is about 10 inches of very dark-brown to dark grayish-brown, very friable silt loam of moderate fine granular structure. The upper subsoil is mottled very dark gray, yellowish-brown, and light olive-brown very sticky and plastic clay of moderate medium subangular blocky structure. The lower subsoil is mottled grayish-brown, light olive-brown, and olive-yellow, very sticky and plastic, massive silty clay. This last-named layer contains a number of small iron concretions. The underlying weathered loess is mottled dark grayish-brown, yellowish-brown and olive-yellow, sticky and plastic, massive silty clay. Surface runoff is slow to medium; internal drainage is slow.

VARIATIONS AND INCLUSIONS: Nearly level areas on some of the broader ridgetops have inclusions of closely associated Edina silt loam. These nearly level areas do not have the gray subsurface layer and compact upper subsoil of the Edina soils.

The profile of Seymour silt loam is similar to that of the Lagonda silt loam, but the lower subsoil of Seymour silt loam is not so fine textured and its parent material is deep loess rather than loess over glacial till.

USE AND MANAGEMENT: This soil has moderately high natural fertility, is nearly level to gently rolling, and is easy to farm with power machinery. It is one of the most desirable soils in Livingston County. Liberal use of fertilizers and lime is necessary to maintain high yields.

Seymour silt loam, terrace phase, 1 to 3 percent slopes (Sd)

This dark-colored soil has developed from loess under a cover of prairie vegetation. It occurs on nearly level to gentle sloping alluvial terraces that lie about 15 feet above the bottom lands. The most extensive areas are along the Grand River and along Shoal Creek near the village of Ludlow.

The soil profile is similar to that of Seymour silt loam, 1 to 3 percent slopes, and use and management are much the same.

Shelby Soils

The Shelby are dark-colored soils that developed from glacial Kansan-Nebraskan glacial till. They are loam soils formed under prairie—the third most extensive upland series in the county and the most extensive series developed from glacial till. They occur on rolling to strongly sloping relief in association with Lagonda and Seymour soils. They are mostly in the eastern part of the county.

SOIL PROFILE: The surface soil is 8 to 12 inches of very dark brown very friable loam of well developed fine granular structure. The upper subsoil is dark brown and yellowish brown. The lower subsoil is grayish-brown and yellowish-brown slightly sticky and plastic clay that contains an appreciable amount of small glacial gravel. Quite often the subsoil contains numerous small lime concretions below a depth of 40 inches. The underlying weathered glacial till—a light brownish-gray and yellowish-red, sticky and plastic, massive clay—contains appreciable amounts of glacial gravel. This till is generally calcareous at depths of 4 to 5 feet. Surface runoff is medium to rapid; internal drainage is medium.

VARIATIONS AND INCLUSIONS.—In the central part of the county are areas that have developed under mixed prairie and forest and therefore differ from the normal areas that formed under prairie vegetation. In these central areas the surface soil is lighter colored and not so thick, and there is some indication that a subsurface layer lighter colored than the surface soil is developing.

USE AND MANAGEMENT: These soils are suited to almost all crops common to the region. They are among the most productive. Shelby soils, however, are among the most erodible when cultivated. For suggested rotations and accompanying conservation practices that permit maximum crop production with minimum soil loss, see table 3. After needs for lime and other plant nutrients have been satisfied, alfalfa and alfalfa-grass mixtures can be grown successfully.

Shelby loam, 4 to 8 percent slopes (Se)

This has a profile similar to that previously described for Shelby soils. It occurs on rolling, narrow, rounded ridgetops.

This less steeply sloping Shelby soil is suitable for corn. The erosion hazard requires conservation practices, such as terracing, used in combination with suitable rotations.

Shelby loam, 9 to 13 percent slopes (Sf)

This soil has a profile similar to that previously described for Shelby loam soils, except that it has a thinner surface soil. When this moderately steep soil is placed under cultivation, erosion is a very serious problem.

Shelby loam, 14 to 19 percent slopes (Sg)

This strongly sloping to hilly soil has a profile similar to that previously described for Shelby soils, except the surface layer is somewhat thinner. Because of steep slopes, erosion becomes a very serious problem when this soil is used for row crops. It is therefore best suited to permanent pasture.

Snead Soils

The Snead soils are shallow dark-colored soils derived from calcareous clay shales. They developed under mixed prairie and forest vegetation and occur chiefly on moderately steep to hilly slopes. They are associated with Lacona, Sampsel, and Bauer soils, or with Mandeville and Gosport soils.

Snead silty clay, 7 to 12 percent slopes (Sh)

This shallow dark-colored soil occurs on rolling to moderately steep topography.

SOIL PROFILE: The surface soil is very dark gray sticky and plastic silty clay, 9 to 12 inches thick. The underlying weathered calcareous clay shale is grayish-brown and yellowish-brown, very sticky and plastic, massive clay. The subsoil contains numerous small iron concretions. Surface runoff is medium; internal drainage is slow.

VARIATIONS AND INCLUSIONS: This soil is shallow to limestone on some of the steeper slopes, and occasionally small fragments of limestone occur in the profile.

USE AND MANAGEMENT: This soil is best suited to small grains, hay and pasture. It has high natural fertility. It is not a good soil for general crops, however, because of its heavy texture, shallow depth, and slow internal drainage. For suggested rotations and various conservation practices, see table 3. Bluegrass grows well. The surface layer may be acid, though the soil developed from calcareous material. It should be tested for lime before seeding legumes. The steeper slopes are best suited to permanent pasture.

Snead stony silty clay, 11 to 20 percent slopes (Sk)

This is a stony soil on moderately steep to hilly slopes.

SOIL PROFILE: The surface layer is a very dark-gray sticky and plastic silty clay, 1 to 6 inches thick. Limestone fragments on the surface and in the profile and limestone outcrops prevent cultivation.

This soil is best suited to forest and pasture. The steepest slopes should be used as woodlots.

Stet Soil

Stet silty clay loam (Sl)

This is a deep, dark-colored, bottom-land soil. It occurs chiefly on larger stream bottoms in the southern part of the county.

SOIL PROFILE: The surface layer is 28 to 40 inches of very dark brown to black friable silty clay loam. With increasing depth this layer becomes slightly sticky and plastic and mottled with yellowish brown. The subsoil is very dark-gray, sticky and plastic, massive silty clay mottled with yellowish brown and light olive brown. The subsoil contains numerous small iron concretions. Surface runoff is good and internal drainage is good to moderately good.

USE AND MANAGEMENT: Stet silty clay loam has very high natural fertility. It is second only to Gravity loam in suitability for general crops. It is rarely overflowed. For suggested rotations, see table 3. The chief management problem, as on Gravity loam, is to supply enough plant nutrients to get high yields. After the fertilizer requirements have been met, the Stet soil is well suited to alfalfa or alfalfa-grass mixtures.

Wabash Soils

Wabash clay (Wa)

This soil has developed from fine-textured alluvium. It occurs in association with the Nodaway, Carlow, and Humeston soils. The most extensive areas are on bottoms along the Grand River west of the mouth of the Thompson River and on bottom land along Shoal Creek.

SOIL PROFILE: The surface soil—6 to 36 inches thick—is very dark brown to black very sticky and plastic clay of weak blocky structure. The subsoil is very dark gray, very sticky and plastic, massive clay. Surface runoff is slow; internal drainage is very slow.

USE AND MANAGEMENT: Wabash clay is frequently overflowed, and the floodwaters drain away slowly. The natural surface drainage can be improved, and in several places has been improved, by digging open ditches. This soil dries slowly in the spring and remains wet a long time after a heavy rain. Its use and management problems are similar to those of Carlow clay.

Wabash silt loam (Wb)

The most extensive areas of this soil occur in association with Wabash clay on bottom lands along Shoal Creek.

SOIL PROFILE: The surface soil is very dark-gray friable silt loam, 20 to 28 inches thick. With depth, the texture of the surface layer changes toward silty clay loam. The subsoil is mottled very dark gray, dark yellowish-brown, and light olive-brown slightly sticky and plastic silty clay. Below 48 inches the material is very dark gray, sticky and plastic, massive clay that shows mottles of yellowish brown. Surface runoff is good; internal drainage is slow.

USE AND MANAGEMENT: Wabash silt loam is subject to rather frequent and severe overflow. Where protected from flooding, it is well suited to general crops. Although the natural fertility is high, this soil will show some response to fertilizer. For efficient use of fertilizers, see the section, Principles of Good Soil Management.

Westerville Soil

Westerville silt loam (Wc)

Westerville silt loam is a light-colored, medium-textured, bottom-land soil that developed under forest vegetation. It occurs along the small stream channels in the northeastern part of the county.

SOIL PROFILE: The surface soil is dark grayish-brown to pale-brown very friable silt loam, 9 to 11 inches thick. The subsurface layer is brown and pale-brown very friable silt loam. Below about 24 inches the material changes to brown and yellowish-brown slightly sticky and plastic silty clay. Surface runoff is medium; internal drainage is slow to medium.

VARIATIONS AND INCLUSIONS: A few small areas of brown-colored, deep, medium-textured, well-drained alluvial soil are included with Westerville silt loam.

USE AND MANAGEMENT: Although its natural fertility is low, Westerville silt loam responds to fertilizer. Where protected from rather frequent and severe overflow, it is fair for general crops. For suggested rotations refer to table 3.

HOW THE SOILS OF LIVINGSTON COUNTY WERE FORMED

Each soil has its own set of characteristics that make it different from all the others. Each soil was formed within its own special combination of soil-forming factors. If we know something about how the soils were formed, we can understand better how to use each soil wisely and how to keep it productive for a long time.

At least five important factors have helped make the soils the way they are. *Parent material,* then, is one of the important soil-forming factors. Some soils have been formed on material weathered from rocks very similar to those that now lie beneath. Others have been formed on rock materials laid down, or at least changed, by ice, wind, or water. All three of these agents have been active in placing the different soil parent materials in this county. Parent material does not become soil, however, until several processes have acted on it.

Some plants or animals begin to grow wherever any rock surface is exposed and moisture is present. *Living organisms,* principally vegetation, thus make up another of the five major soil-forming factors. Still another factor is the *climate.* Plants and animals grow only if the temperature is right. Many processes such as leaching and most forms of weathering depend on a supply of moisture or of percolating water.

Percolating water plays such a big part in soil formation that the *relief*, or shape of the land suface, is a major factor that we need to know about. Leached, well-oxidized soils can be formed on the high places, and waterlogged soils in low places where water does not drain away, all in the same parent material and under the same general climate.

The fifth soil-forming factor most commonly mentioned is *time*. We do not find a well-developed soil on a fresh alluvial deposit, nor on a sand dune, nor even on a steep slope where the normal erosion keeps up with processes of rock weathering and soil formation. We need to remember, too, that the time for some processes of soil formation should not be measured from the period in which the soil material was laid down but from the one in which that particular process was able to begin. Acid soils, for example, are the normal result of soil formation in a humid climate; but if the parent material contains lime, an acid soil cannot be formed until the excess lime has been leached out

Factors of Soil Formation

Parent materials

The soils in this county have been formed on five main groups of parent material. One of these is the material weathered from shale, limestone, and sandstone bedrock. The others are gumbotill-like material; glacial till less highly weathered; silty windblown material, often called loess; and waterlain materials, some old and some deposited in recent years on flood plains of the present streams. A separate subsection, Parent Materials of Soils, explains in more detail the relation of soils in the county to the different kinds of materials just mentioned.

Native vegetation

The soils of the county formed under prairie vegetation, mainly big bluestem; under forest, chiefly oak and hickory; or under vegetation that was transitional between the two.

The soils that formed under prairie vegetation have deep, dark-colored surface soil and are well supplied with organic matter in the virgin state. The soils under forest have a shallow, light-colored surface soil, a leached subsurface horizon, and are low in organic matter. Forest soils are less productive than those formed under prairie grasses because soil-forming processes have more completely removed plant nutrients from the forested soils.

The residual soils have developed under forest, prarie, and prairie-forest transition vegetation. Nevertheless, the prairie and prairie-forest soils were too similar in appearance to be shown separately on the soil map.

The soils from glacial till formed under all three kinds of vegetation. The Shelby and Lagonda were under prairie; the Lindley and Gamma, under forest; and the Gamma, dark-surface variant, under prairie-forest.

The soils from loess were under prairie or forest vegetation. The Edina and Seymour were under prairie grasses, and the Pershing under forest.

Climate

Climate is an important factor in soil formation. Soils in regions of similar climate tend to be similar. If the climate is dry, the soils are likely to have high concentrations of soluble salts and lime. If the climate is humid, soluble salts and most of the lime will be washed out and the soils will tend to be acid.

Livingston County has a humid to subhumid climate (*10*). Rainfall has been sufficient to leach most of the lime from all the upland soils except those shallow to calcareous shale or limestone. The leaching has developed acid soil to depths of 2 or 3 feet. This leaching is one of the processes responsible for soil formation in the county.

Relief

Relief is a factor in soil formation because it influences drainage, runoff, and other water effects, including accelerated erosion (*9*). The Edina soils, for example, are on broad nearly level ridgetops where drainage is slow. Consequently, they have a highly leached subsurface horizon and a dense upper subsoil. To cite another example, relief accounts for the shallow depth of residual soils on moderately steep to hilly slopes. Runoff water removes soil material as fast as it forms, so the soils remain shallow.

Time

Time is necessary for development of soils from parent materials (*9*). In general, the soils of Livingston County can be placed in three age groups as follows:

OLD: Soils formed from residual material (except those on steeper slopes) or from glacial till. Soil-forming processes have been acting on these materials as far back as the time the Kansan glacier retreated.

MIDDLE: Soils formed from loess. The processes of formation date back to Peorian times.

YOUNG: Residual soils on steep slopes, where material is eroded away as fast as it forms; and bottom-land soils, where fresh materials are added to the surface every time the streams flood.

Parent Materials of Soils

This subsection points out the relation of the various parent materials to the soil series of the county.

Shale, limestone, and sandstone bedrock.—Bedrock exposures, found mainly in the southern and western parts of the county, show that the rock formations belong to the lower part of the middle Pennsylvanian age (*1*). These formations, listed in order of increasing age, are the Kansas City, Pleasanton, Henrietta, and Cherokee. After these beds of shale, limestone, and sandstone were laid down, they were exposed to weathering for millions of years. Hills and valleys were formed, and apparently a large stream followed about the present course of the Grand River.

Weathering of the rock formations produced soil material. The silty shales and sandstones produced similar soil material because the shales contained quite a lot of silt, and the sandstones appreciable amounts of finer material. The calcareous clay shales and limestone produced heavy-textured (clayey) soils.

Because weathering of two kinds of parent rock frequently produces one kind of soil material, one soil is often underlain by two kinds of parent rock. Table 5 shows the soil series of the county that developed from residuum, the color of the surface soil, and the degree of horizon development.

TABLE 5.—*Color and degree of horizon development of soils from residuum in Livingston County, Mo.*

Series	Color of surface soil	Horizon development
SOILS FROM SILTY SHALES AND SANDSTONES		
Bauer	Dark	Slight.
Gosport	Light [1]	Slight.
Lacona	Dark	Moderate.
Mandeville	Light [1]	Moderate.
SOILS FROM CALCAREOUS CLAY SHALES		
Sampsel	Dark	Strong.
Snead	Dark	Slight.

[1] Formed under forest vegetation and locally referred to as light-colored soils as compared to the much darker soils formed under prairie vegetation.

The soils developed from residuum were to some degree altered by glaciation and deposition of loess. A number of the residual soil areas have large and small stones brought in by glaciers. Loess is undoubtedly present on ridgetops and the more gentle slopes. The loess areas on ridgetops were too small to be mapped separately. The loess on the slopes was so thin it did not influence the profile formed from the underlying rocks.

Glacial till.—Livingston County was covered by glaciers during both the Nebraskan and Kansan glacial ages (*1*). These huge sheets of ice left large quantities of ground-up rock material called glacial till. North of the Grand River and east of the Thompson River this glacial material was left as a smooth, gently sloping plain. Throughout the rest of the county the glacial material was left in patches of varying thickness.

The glacial till has been exposed to weathering for thousands of years, but not all of it for the same length of time. The till on more level areas (up to 6 percent slopes) is highly weathered and has developed a dense, plastic clay layer near the surface. The till on more rolling land (slopes of 7 percent or more) is less plastic.

The soils that developed from glacial till are the Shelby, Lindley, and Gamma, Lagonda, and Keytesville. The Lagonda soil developed from the highly weathered clay till that was influenced by loess in the less rolling areas. The Lindley and Keytesville soils were also influenced by loess to a slight degree.

Loess.—Thousands of years after the Kansas till was laid down, another major soil material, known as loess, was deposited by wind. The soils formed from this material are the Edina, Seymour, and Pershing, and to some extent the Lagonda. On the broad nearly level ridgetops occupied by the Edina soil the loess has accumulated to depths of 72 inches. On the gently rolling ridgetops occupied by Seymour soil and narrow ridgetops occupied by the Pershing soil it has accumulated to depths of 52 inches.

The Lagonda soil, though considered to be derived from till, was partly derived from loess. The parent material of the Lagonda soil depends on the slope. In gently rolling areas the Lagonda soil has about 24 inches of loess, but in rolling areas the loess is no longer discernible.

Alluvium.—The soils developed from alluvial materials differ principally because of differences in texture of the material deposited by flooding streams. Deposits from fast-flowing waters are normally coarse, and those from slow-moving or stagnant waters are fine. It is to be expected that the coarser materials will be near stream channels or in small first bottoms, and that the fine materials, or "gumbo," will be in the larger second bottoms, or terraces, usually some distance from the stream channel.

The Blockton and Burrell soils occur on stream terraces, which are water-laid deposits now well above the level of the bottom land and not subject to flooding. The Gravity soil occurs on both alluvial fans and bottom lands. The other alluvial soils—Carlow, Humeston, Moniteau, Nodaway, Stet, Wabash, Westerville, and Sandy alluvial land—are on the bottom lands.

Classification of Soils by Great Soil Groups

The common dark-colored upland soils belong to the great soil group known as Brunizems, formerly called Prairie soils. These are the Blockton, Gravity, Lacona, Lagonda, Sampsel, Seymour, and Shelby soils.

Gray-brown Podzolic soils are lighter colored and acid. They have been formed under forest vegetation. These soils in Livingston County include those of the Burrell, Lindley, and Mandeville series and the lighter colored Gamma soils.

Soils with tight claypan subsoils were placed in a great soil group called Planosols.[3] The Edina, Humeston, Keytesville, and Moniteau soils belong in this group. The Chula[4] soils have heavy subsoils, but are included in this group.

Snead soils, which are dark-colored shallow soils over limestone have some characteristics in common with those that have been called Rendzinas.

[3] This name probably will be discontinued in the future.

[4] Chula soils are placed in this group with reservation because of the depth to the clay.

Bauer and Gosport soils are shallow over rock, and belong to the great soils group known as Lithosols.

Stet and Wabash soils of the bottom lands are dark colored and are classified as Humic Gley soils.

Other soils from alluvium are the Carlow, Nodaway, and Westerville.

Soil Analyses

Table 6 shows analyses of two upland soils derived from loess, Edina silt loam and Seymour silt loam, and of one soil of the bottom lands, Wabash clay.

Schrader, Frieze, and Rourke also studied unpublished data on soil analyses from the Soils Department, University of Missouri. They compared chemical and physical properties of Shelby loam from both Livingston and Gentry Counties; of Seymour and Grundy soils from the same counties; and of Edina and Lagonda soils from Livingston County.

They found that Shelby loam of Livingston County contains more sand and less clay than Shelby loam of Gentry County, and is also more highly weathered and less productive.

Their comparison showed that Seymour silt loam of Livingston County has more clay in the subsoil than Grundy silt loam of Gentry County, and, furthermore, has a lower organic-matter content and a lower base exchange capacity.

Comparison of Lagonda and Seymour soils showed significant difference in total phosphorus in the subsoil, 900 pounds per acre for the Seymour in contrast to 480 pounds per acre in the Lagonda.

The studies of the Edina silt loam show that its leached subsurface horizon is lower in supply of organic matter, calcium, phosphorus, potassium, and clay than either its surface soil or subsoil.

ADDITIONAL FACTS ABOUT LIVINGSTON COUNTY

Settlement and Population

The first settler in Livingston County, Samuel E. Toad, established a home just west of Utica in the spring of 1831 (*7*). Livingston County was incorporated by act of the Missouri Legislature on January 6, 1837 (*6*). Chillicothe was laid out in 1836 and selected as the county seat in 1839 (*6*).

The early settlers came from Kentucky, Virginia, Tennessee, North Carolina, and counties along the Missouri River. These early settlers preferred to build their homes in the forested areas because they were more familiar with this type of land than with the prairie. Numerous springs in these areas were an easy source of water, and the cleared land could be worked with the implements at hand. The prairie sod was too tough for the farm implements of those days and was therefore used for pasture and meadow (*6*).

The population of the county increased to 1,325 in 1840 (*6*), reached a maximum of 22,302 in 1900, and has since declined. The population in 1950 was 16,532.

TABLE 6.—*Mechanical and partial chemical analyses of three soils in Livingston County, Mo.*

Soil and depths of sampling in inches	Organic matter	Sand (more than 0.05 mm.)	Silt (0.05 to 0.002 mm.)	Clay (less than 0.002 mm.)	pH	Exchange capacity	Exchangeable calcium	Calcium saturation	Total phosphorus	Available phosphorus	Available potassium
	Percent	*Percent*	*Percent*	*Percent*		*Milliequivalents per 100 grams*	*Milliequivalents per 100 grams*	*Percent*	*Lbs. per acre*	*Lbs. per acre*	*Lbs. per acre*
Edina silt loam (5–57N–22W):[1]											
0 to 9	2. 4	2. 6	78. 1	19. 4	4. 9	21. 9	8. 3	38	780	80	224
9 to 13	1. 0	2. 3	80. 3	17. 4	5. 7	21. 4	6. 5	31	----	48	----
13 to 16	0. 8	1. 7	75. 0	23. 3	6. 0	22. 0	7. 7	35	400	34	136
16 to 20	2. 1	2. 0	42. 2	54. 8	5. 2	----	----	----	680	24	280+
20 to 28	2. 0	1. 6	42. 0	57. 4	5. 1	----	----	----	520	27	----
28 to 36	0. 5	3. 5	51. 9	44. 6	6. 4	24. 4	15. 3	63	----	----	----
36 to 40	----	4. 9	52. 0	43. 2	5. 7	24. 3	19. 1	79	----	----	----
40 to 60	----	2. 4	57. 4	40. 2	5. 2	----	----	----	1120	----	280+
Seymour silt loam (11–57N–23W):[1]											
0 to 8	2. 8	6. 3	69. 0	24. 7	6. 3	16. 3	16. 9	100	720	150	204
8 to 11	3. 2	7. 1	63. 6	29. 3	5. 4	16. 1	12. 6	79	880	76	196
11 to 15	2. 4	4. 9	65. 7	29. 4	5. 2	15. 7	11. 9	79	680	56	256
15 to 19	2. 1	4. 3	58. 2	37. 5	5. 2	21. 3	16. 4	77	700	78	280+
19 to 24	2. 0	3. 4	41. 3	55. 3	5. 0	32. 3	19. 6	60	900	34	280+
24 to 28	1. 2	3. 0	46. 3	50. 7	5. 3	32. 7	22. 1	68	----	----	280+
28 to 32	----	2. 6	49. 3	49. 2	5. 3	31. 3	22. 4	71	----	----	280+
32 to 36	----	2. 6	48. 3	50. 1	6. 0	27. 8	21. 7	78	----	----	244
Wabash clay (12–56N–25W):[2]											
0 to 5	4. 1	4. 1	48. 7	49. 9	5. 8	----	----	----	----	----	----
5 to 13	2. 8	2. 4	48. 1	49. 0	5. 6	----	----	----	----	----	----
13 to 22	2. 1	1. 0	43. 5	55. 5	5. 5	----	----	----	----	----	----
22 to 36	1. 6	1. 9	48. 5	49. 6	5. 5	----	----	----	----	----	----
36 to 42	1. 2	1. 3	48. 7	49. 5	5. 5	----	----	----	----	----	----
42 to 54	1. 0	1. 8	49. 2	49. 0	5. 6	----	----	----	----	----	----

[1] Analyses by John D. Rourke and J. A. Frieze, at Missouri Agricultural Experiment Station.
[2] Analyses by Soil Survey Laboratory, Beltsville, Md.

The percentage of rural population has decreased gradually. In 1930, rural population was 56.1 percent of the county total, in 1940 it was 55.5 percent, and in 1950 it was 47.4 percent.

Chillicothe, the largest town and most important trading center in the county, had a population of 8,694 in 1950. Other small towns and villages are Avalon, Bedford, Blue Mound, Chula, Dawn, Farmersville, Ludlow, Mooresville, Sampsell, Spring Hill, Sturges, Utica, and Wheeling.

Most of the inhabitants are engaged in agriculture. Industries are of minor importance and employ few people.

Water Supply

The domestic water supply comes from wells, cisterns, and springs. Many of the farm houses have electric-pump or gravity-flow systems to supply running water. Livestock is watered by wells, walled-up springs, or ponds. Approximately 1,000 ponds had been built by the end of 1948. Many of these ponds are now fenced and stocked with fish and serve a threefold purpose: Water, recreation, and food.

Transportation and Markets

The county has several railroads. A line of the Chicago, Burlington & Quincy Railroad crosses the county from east to west through Wheeling, Chillicothe, Utica, and Mooresville and provides service to Hannibal, St. Joseph, and Kansas City. A line of the same railroad crosses the extreme southeastern corner of the county. A branch line of the Wabash Railroad crosses the county from southeast to northwest through Chillicothe and Sampsell and provides service to St. Louis and Omaha. The Chicago, Rock Island & Pacific Railroad cuts across the extreme northwestern corner of the county. The Chicago, Milwaukee & St. Paul & Pacific Railroad crosses from southwest to northeast through Ludlow, Dawn station, Chillicothe, and Chula.

Two concrete Federal highways pass through the county, United States Highway No. 65 running north to south, and United States Highway No. 36, running east to west. These highways cross at Chillicothe, which is at approximately the center of the county. Two bus companies serve the county over these highways. Besides the main highways, the county has a number of good "blacktop" and graveled county highways and "farm-to-market" roads. Few farms are more than 2 miles from these all-weather roads.

The network of roads and rail lines is ample for shipment of farm products. Most of the grain is fed to livestock on farms, but that sold is trucked to elevators at Chillicothe, Wheeling, or Ludlow and shipped out by railroad. Trucks carry most of the livestock to markets at Kansas City and St. Joseph, Mo., or at East St. Louis, Ill.

Agriculture

Livingston County always has been predominantly agricultural. The early settlers produced only for their own needs. As transportation improved, they grew more crops and livestock for sale. In early days the main source of cash income seems to have been corn and wheat. Soon beef cattle and hogs became the main source of cash income. Corn and wheat were still sold to some extent but were used mainly as feed for livestock to be marketed.

Now, as in the past, the cash crop-livestock system of agriculture is dominant. Nearly all the farmers sell both livestock and crops, the amount of each depending upon prices and weather. The most common practice is to feed crops to animals and market the crops as beef or pork. The following list, compiled from the 1950 Federal census, shows that the livestock farm is dominant in the county.

Type of farm:	*Number*
Livestock	927
Cash grain	201
General	151
Dairy	98
Poultry	34
Miscellaneous and unclassified	309
Total farms in county	1, 720

Most of the farmers keep sheep and sell lambs and wool. Many of the livestock farmers have added milk cows and poultry and now sell cream, eggs, and chickens. The number of dairy farms has increased recently but still accounts for only a small percentage of the total number of farms. Table 7 shows how livestock population has fluctuated in the past 20 years, and table 8, the acreage of important crops.

In 1950 nearly 87 percent of the county was land in farms, divided as follows:

	Acres
Cropland:	
Harvested	134, 561
Used only for pasture	49, 420
Not harvested and not pastured	12, 731
Woodland:	
Pastured	22, 254
Not pastured	12, 332
Other land pastured	49, 781
All other land (house lots, roads, wasteland, etc.)	15, 477
Total	296, 556

The average size of all farms was 172.4 acres in 1950, as compared to 131.5 acres in 1920.

TABLE 7.—*Number of livestock on farms of Livingston County, Mo. 1930–50*

Livestock	1930	1940	1950
Horses and mules	[1] 8, 771	[1] 6, 092	2, 948
All cattle	[1] 22, 234	[1] 22, 073	28, 379
Milk cows	[2] 7, 057	[2] 7, 612	6, 133
Swine	[1] 25, 829	[3] 27, 426	[3] 23, 041
Sheep	[4] 20, 307	[4] 30, 630	[4] 13, 050
Chickens	[1] 233, 451	[3] 191, 228	[3] 152, 609

[1] Over 3 months old on Apr. 1.
[2] Cows and heifers, 2 years old and over Jan. 1, kept for milking.
[3] Over 4 months old on Apr. 1.
[4] Over 6 months old on Apr. 1.

TABLE 8.—*Acreage of major crops and number of bearing fruit and nut trees and grapevines in Livingston County, Mo., 1929–49*

Crop	1929	1939	1949
	Acres	*Acres*	*Acres*
Corn for all purposes	54, 147	50, 756	45, 281
Small grains threshed:			
Oats	13, 672	27, 379	20, 730
Wheat	11, 413	18, 132	19, 616
Rye	187	528	450
All hay	38, 080	24, 144	33, 861
Timothy and clover, alone or mixed	30, 711	7, 494	13, 901
Lespedeza	(1)	3, 976	16, 788
Alfalfa	1, 379	797	1, 875
Small grains for hay	252	983	815
Other hay	5, 738	10, 894	482
Soybeans	3, 830	8, 043	16, 104
Clover and grass seeds:			
Lespedeza	(1)	2, 320	3, 403
All clovers	957	317	[2] 2, 044
Timothy	2, 789	[3] 3, 298	4, 452
	Number	*Number*	*Number*
Peach trees	7, 606	2, 093	4, 113
Apple trees	26, 200	11, 089	6, 941
Cherry trees	3, 123	420	530
Pecan trees	1, 994	205	1, 156
Grapevines	14, 719	2, 660	4, 655

[1] None reported.
[2] Red clover only.
[3] All grasses.

SOIL PROFILE DESCRIPTIONS

This section presents detailed descriptions of profiles for the different soil series in Livingston County. The place in the county where the profile was sampled is given in parentheses following the soil name. The soils are arranged in alphabetic order.

Bauer silt loam (SE¼SE¼ sec. 1, T. 56 N., R. 24 W.):

A_1 0 to 12 inches, dark-brown (10YR 4/3, moist) [5] to yellowish-brown (10YR 5/4, dry) very friable silt loam; moderate medium granular structure.

C_1 12 to 18 inches, yellowish-brown (10YR 5/6, moist) partially weathered shale.

D_r 18 inches +, weathered shale.

Blockton silt loam (NE¼ sec. 15, T. 56 N., R. 24 W.):

A_{1p} 0 to 9 inches, black (10YR 2/1, moist) to very dark-gray (10YR 3/1, dry) very friable silt loam; moderate medium granular structure.

A_3 9 to 12 inches, very dark-gray (10YR 3/1), with specks of yellowish-brown (10YR 5/8, moist), very friable silt loam; moderate very fine subangular blocky structure.

B_1 12 to 16 inches, black (10YR 2/1, moist) friable silty clay loam; moderate fine subangular blocky structure.

[5] Symbols represent Munsell color notations.

B_{21} 16 to 24 inches, black (10YR 2/1, moist) slightly sticky and plastic silty clay; moderate medium subangular blocky structure.

B_{22} 24 to 46 inches, slightly sticky and plastic silty clay; when moist, very dark gray (10YR 3/1) mottled with yellowish brown (10YR 5/8) and light olive brown (2.5Y 5/6); moderate medium subangular blocky structure; numerous small iron concretions.

C 46 inches +, sticky and plastic clay; when moist, mottled black (10YR 2/1) very dark gray (10YR 3/1) and yellowish-brown (10YR 5/8); massive structure.

Burrell silt loam (SW¼NW¼ sec. 5, T. 57 N., R. 25 W.):

A_p 0 to 8 inches, dark-brown (10YR 4/3, moist) to light brownish-gray (10YR 6/2, dry) very friable silt loam; moderate fine granular structure.

A_2 8 to 13 inches, yellowish-brown (10YR 5/4, moist) to very pale brown (10YR 7/3, dry) very friable silt loam; very weak medium granular structure.

B_1 13 to 15 inches, firm to friable silty clay loam; when moist, dark brown (10YR 4/3) coated with light yellowish brown (10YR 6/4); moderate medium granular structure.

B_{21} 15 to 20 inches, dark yellowish-brown (10YR 4/4, moist) slightly sticky and plastic silty clay; moderate medium subangular blocky structure.

B_{22} 20 to 28 inches, sticky and plastic silty clay; when moist, grayish brown (10YR 5/2), brown (10YR 5/3), dark brown (10YR 4/3), and yellowish brown (10YR 5/8); weak columnar and breaks to moderate medium subangular blocky structure.

B_{23} 28 to 36 inches +, sticky and plastic silty clay; when moist, mottled dark grayish brown (2.5Y 4/2), grayish brown (2.5Y 5/2), light olive brown (2.5Y 5/6), and yellowish brown (10YR 5/8); numerous small iron concretions.

Carlow clay (SW¼SW¼ sec. 13, T. 57 N., R. 24 W.):

A_{1p} 0 to 10 inches, very dark-gray (10YR 3/1, moist) to gray (10YR 5/1, dry) very sticky and plastic clay; moderate medium subangular blocky structure.

C_{1g} 10 to 14 inches, very sticky and plastic clay; when moist, mottled dark gray (10YR 4/1), very dark gray (10YR 3/1), and yellowish brown (10YR 5/8); moderate medium subangular blocky structure.

C_{2g} 14 to 48 inches +, very sticky and plastic compact clay; when moist, dark gray (10YR 4/1) flecked with yellowish brown (10YR 5/8); massive.

Chula silt loam (SW¼SE¼ sec. 15, T. 59 N., R. 23 W.):

A_1 0 to 15 inches, very dark-gray (10YR 3/1, moist) to gray (10YR 5/1 dry) very friable silt loam; moderate fine granular structure.

A_2 15 to 22 inches, silt loam; when moist, grayish brown (10YR 5/2) coated with light brownish gray (10YR 6/2); when dry, light brownish gray (10YR 6/2) coated with white (10YR 8/1); very friable when moist, and loose when dry; weak fine granular structure.

B_1 22 to 27 inches, firm to friable silty clay loam; when moist, very dark grayish brown (10YR 3/2) coated with light brownish gray (10YR 6/2); weak fine subangular blocky structure.

B_{21} 27 to 31 inches, sticky and plastic silty clay; when moist, black (10YR 2/1) coated with grayish brown (10YR 5/2); moderate medium subangular blocky structure.

B_{22} 31 to 40 inches, sticky and plastic silty clay; when moist, black (10YR 2/1), dark gray (10YR 4/1), and yellowish brown (10YR 5/8); moderate coarse subangular blocky structure.

BC 40 to 44 inches, sticky and plastic compact silty clay; when moist, mottled dark gray (10YR 4/1), yellowish brown (10YR 5/8), grayish brown (2.5Y 5/2), and light olive brown (2.5Y 5/4); contains numerous medium sized iron concretions; massive.

C 44 to 70 inches +, very sticky and plastic compact clay; when moist, mottled grayish brown (2.5Y 5/2), light olive brown (2.5Y 5/6), and gray (10YR 6/1); contains numerous small iron concretions; massive.

Edina silt loam (SW¼NW¼ sec. 16, T. 58 N., R. 22 W.):

A_{1p} 0 to 8 inches, dark grayish-brown (10YR 4/2, moist) to light brownish-gray (10YR 6/2, dry) very friable silt loam; moderate fine granular structure.

A_2 8 to 11 inches, light brownish-gray (10YR 6/2, moist) stained with yellowish-brown (10YR 5/8, moist) to light gray (10YR 7/2, dry) silt loam; very friable when moist, loose when dry; contains several small iron concretions; nearly massive.

B_{21} 11 to 14 inches, compact clay; when moist, very dark-gray (10YR 3/1) stained with yellowish-brown (10YR 5/8) and yellowish-red (5YR 4/8); very sticky and plastic when moist, and hard when dry; moderate medium subangular blocky structure.

B_{22} 14 to 26 inches, clay; when moist, mottled very dark brown (10YR 2/2), very dark gray (10YR 3/1), yellowish brown (10YR 5/8), and gray (2.5Y 5/0); very sticky and plastic when moist, contains numerous small iron concretions; moderate coarse subangular blocky structure.

B_{31} 26 to 32 inches, very sticky and plastic clay; when moist, mottled dark grayish brown (2.5Y 4/2), grayish brown (2.5Y 5/2), light olive brown (2.5Y 5/6), and brownish yellow (10YR 6/8); contains a few small iron concretions; massive.

B_{32} 32 to 40 inches+, sticky and plastic silty clay; when moist, grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) stained with light olive brown (2.5Y 5/6) and red (2.5YR 4/8); contains a few small iron concretions; massive; horizon more open and friable than B_{31}.

Gamma loam (SE¼SW¼ sec. 28, T. 59 N., R. 24 W.):

A_1 0 to 10 inches, very dark-gray (10YR 3/1, moist) to light brownish-gray (10YR 6/2, dry) very friable loam; moderate medium granular structure.

A_2 10 to 16 inches, brown (10YR 5/3, moist) to pale-brown (10YR 6/3, dry) very friable structureless sandy loam.

B_{21} 16 to 20 inches, firm to friable sandy clay loam; when moist, yellowish brown (10YR 5/6) coated with light yellowish brown (10YR 6/4); moderately weak medium subangular blocky structure; contains a few small glacial pebbles.

B_{22} 20 to 36 inches, same as above except that light yellowish-brown coating on the structure particles is absent; a very thin layer of the coating does occur above the denser horizon below.

B_3 36 to 50 inches, very firm sandy clay; when moist, mottled grayish brown (10YR 5/2), strong brown (7.5YR 5/8), and yellowish red (5YR 4/8) with organic staining of very dark gray (2.5YR 3/0); large amount of fine glacial gravel; massive.

C_{11} 50 to 72 inches, firm clay loam; when moist, mottled strong brown (7.5YR 5/8) and yellowish red (5YR 4/8); contains large amount of fine glacial gravel.

C_{12} 72 inches+, sandy clay; when moist, yellowish red, (5YR 5/8) and brownish yellow (10YR 6/8).

Gamma loam, dark surface variant (SW¼SW¼ sec. 9, T. 58 N., R. 25 W.):

A_1 0 to 11 inches, dark grayish-brown (10YR 4/2, moist) to brown (10YR 5/3, dry) very friable loam; moderate fine granular structure.

A_2 11 to 13 inches, friable loam; when moist, dark yellowish brown (10YR 4/4) splotched with brown (10YR 5/3); moderate fine subangular blocky structure.

B_{21} 13 to 22 inches, firm silty clay; when moist, yellowish red (5YR 4/8); moderate medium subangular blocky structure.

B_{22} 22 to 33 inches, firm clay; when moist, mottled dark grayish brown (2.5Y 4/2) and dark brown (7.5YR 4/4); weak coarse subangular blocky structure.

C_{21} 33 to 70 inches, sticky and plastic clay; when moist, dark yellowish brown (10YR 4/4) mottled with gray (10YR 6/1) and reddish brown (5YR 4/4); contains appreciable amount of glacial gravel and a few glacial boulders; massive.

C_{22} 70 inches+, slightly sticky and plastic silty clay; when moist, grayish brown (2.5Y 5/2) mottled with light olive brown (2.5Y 5/6); massive.

Gamma loam, sand substratum variant:

A_1 0 to 10 inches, dark reddish-brown (5YR 3/4, moist) to brown (7.5YR 5/4, dry) very friable loam; fine granular structure.

A_3 10 to 16 inches, very friable single-grained loamy sand; strong brown (7.5YR 5/8, moist); contains small amount of fine glacial gravel.

B_1 16 to 28 inches, friable clay loam; when moist, yellowish red (5YR 5/8) to yellowish brown (10YR 5/4); moderate fine subangular blocky structure.

B_2 28 to 60 inches, friable sandy clay; when moist, yellowish red (5YR 5/8); moderate medium subangular blocky structure.

C 60 inches +, friable sandy clay; when moist, reddish yellow (7.5YR 6/8,); moderate medium subangular blocky structure.

Gorham silty clay (SE¼SE¼ sec. 14, T. 57 N., R. 24 W.):

1. 0 to 3 inches, dark grayish-brown (2.5Y 4/2, moist) slightly sticky and plastic silty clay; breaks along horizontal lines into moderately weak subangular blocky structure; this layer a recent deposit.
2. 3 to 14 inches, very dark grayish-brown (2.5Y 3/2, moist) slightly sticky and plastic silty clay; moderate medium subangular blocky structure
3. 14 to 18 inches, very dark-gray (10YR 3/1, moist) and very dark grayish-brown (2.5Y 3/2, moist) firm to friable silty clay loam; moderate coarse granular to fine subangular blocky structure.
4. 18 to 36 inches +, very friable fine sandy loam; when moist, dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), and light brownish gray (10YR 6/2); weak fine granular structure.

Gosport loam (SW¼SW¼ sec. 27, T. 59 N., R. 24 W.):

A_1 0 to 9 inches, very friable loam; dark grayish brown (10YR 4/2, moist) to pale brown (10YR 6/3, dry); moderate fine granular structure.

A_3 9 to 14 inches, very friable loam; when moist, very dark grayish brown (10YR 3/2), yellowish brown (10YR 5/6), and yellowish red (5YR 5/8); weak medium subangular blocky structure.

C 14 inches +, weathered shale; when moist, yellowish brown (10YR 5/8) and strong brown (7.5YR 5/8)

Gravity loam (SW¼NE¼ sec. 31, T. 58 N., R. 22 W.):

A_{1p} 0 to 8 inches, very dark-brown (10YR 2/2, moist) to dark grayish-brown (10YR 4/2, dry) very friable loam; moderate fine granular structure.

A_{12} 8 to 15 inches, black (10YR 2/1 moist) to very dark-brown (10YR 2/2, moist) very friable loam; moderate medium granular structure.

A_3 15 to 24 inches, black (10YR 2/1, moist) very friable loam; weak medium subangular blocky structure.

B_2 24 to 30 inches, dark grayish-brown (10YR 4/2, moist) coated with light brownish-gray (10YR 6/2, moist) friable to slightly sticky and plastic silty clay loam; weak medium subangular blocky structure.

C 30 to 48 inches +, black (10YR 2/1, moist) sticky and plastic silty clay; moderate medium subangular blocky structure.

Humeston silt loam (SE¼SW¼ sec. 16, T. 57 N., R. 23 W.):

A_{1p} 0 to 9 inches, very dark-gray (10YR 3/1, moist) to a grayish-brown (10YR 5/2, dry) very friable silt loam; moderate medium granular structure.

A_2 9 to 15 inches, very friable silt loam; when moist, dark gray (10YR 4/1) to gray (10YR 5/1) stained with yellowish brown (10YR 5/8); when dry, light brownish gray (10YR 6/2) and light gray (10YR 7/1) stained with brownish yellow (10YR 6/8); moderate medium granular.

B_1 15 to 21 inches, slightly sticky and plastic silty clay loam; when moist, gray (10YR 5/1) and grayish brown (10YR 5/2) stained with yellowish brown (10YR 5/8); moderate medium subangular blocky structure.

B_2 21 to 30 inches, sticky and plastic silty clay; when moist, dark gray (10YR 4/1) stained with yellowish brown (10YR 5/8); moderate coarse subangular blocky structure.

B_3 30 to 36 inches, sticky and plastic clay; when moist, mottled very dark gray (10YR 3/1), dark gray (10YR 4/1), gray (10YR 5/1), and yellowish brown (10YR 5/8); contains numerous small iron concretions; massive.

C 36 to 48 inches +, very sticky and plastic clay; when moist, dark gray (10YR 4/1) and grayish brown (10YR 5/2) stained with yellowish brown (10YR 5/8); massive.

Keytesville silt loam (NW¼NW¼ sec. 3, T. 56 N., R. 25 W.):

A_p 0 to 10 inches, dark grayish-brown (10YR 4/2, moist) to grayish-brown (10YR 5/2, dry) very friable silt loam; moderate fine granular structure.

A_2 10 to 17 inches, silt loam; when moist, brown (10YR 5/3) coated with pale brown (10YR 6/3); when dry, very pale brown (10YR 7/3); very friable when moist to very loose when dry; nearly massive.

B_1 17 to 19 inches, friable silty clay loam; when moist, dark grayish brown (10YR 4/2) and dark brown (10YR 4/3) coated with pale brown (10YR 6/3); weak fine subangular blocky structure.

B_{21} 19 to 22 inches, silty clay; when moist, very dark grayish brown (10YR 3/2) and dark yellowish brown (10YR 4/4) stained with yellowish brown (10YR 5/8); sticky and plastic when moist to compact when dry; moderate medium subangular blocky structure.

B_{22} 22 to 28 inches, clay; when moist, very dark grayish brown (2.5Y 3/2) and dark grayish brown (2.5Y 4/2) stained with dark reddish gray (5YR 4/2); very sticky and plastic when moist to very compact when dry; contains numerous small iron concretions; moderate medium subangular blocky structure.

C 28 to 36 inches +, very sticky and plastic clay; when moist, mottled dark grayish brown (2.5Y 4/2), olive yellow (2.5Y 6/8), and light-gray (2.5Y 7/2); contains numerous small iron concretions; massive.

Lacona silt loam (SE¼SE¼ sec. 13, T. 56 N., R. 24 W.):

A_{11} 0 to 11 inches, dark-brown (10YR 4/3, moist) to brown (10YR 5/3, dry) very friable silt loam; moderate medium granular structure.

A_{12} 11 to 15 inches, dark-brown (10YR 4/3, moist) friable silt loam; weak very fine subangular blocky structure.

B_1 15 to 18 inches, dark-brown (10YR 4/3, moist) and dark yellowish-brown (10YR 4/4, moist) firm to friable silty clay loam; weak medium subangular blocky structure.

B_2 18 to 38 inches, reddish-brown (5YR 4/4, moist) slightly sticky and plastic silty clay; moderate medium subangular blocky structure.

B_3 38 to 50 inches, yellowish-brown (10YR 5/4, moist) slightly sticky and plastic silty clay; moderate coarse subangular blocky to massive.

C 50 inches +, weathered silty shales; when moist, dark brown (10YR 4/3), brown (10YR 5/3), yellowish brown (10YR 5/4), and strong brown (7.5YR 5/8).

Lagonda silt loam:

A_1 0 to 12 inches, dark grayish-brown to very dark grayish-brown (10YR 3/2 to 4/2, moist) very friable silt loam; moderate medium granular structure.

B_{21} 12 to 18 inches, dark-gray to dark grayish-brown (10YR 4/1 to 4/2, moist) silty clay; moderate medium subangular blocky structure; hard and compact when dry; contains numerous iron concretions.

B_{22} 18 to 24 inches, dark-gray to dark grayish-brown (10YR 4/1 to 4/2, moist), mottled with brownish yellow and some yellow, sticky and plastic clay; coarse subangular blocky to massive.

B_{23} 24 inches +, gray to grayish-brown (10YR 5/1 to 5/2, moist), mottled with yellowish brown, very sticky and massive clay; contains small amounts of glacial gravel; fragments from disintegrated glacial boulders increase with depth.

Lindley loam (SW¼SW¼ sec. 16, T. 59 N., R. 22 W.):

A_p 0 to 8 inches, dark grayish-brown (10YR 4/2, moist) to pale-brown (10YR 6/3, dry) very friable loam; moderate fine granular structure.

A_2 8 to 11 inches, yellowish-brown (10YR 5/4, moist) to very pale-brown (10YR 7/3, dry) very friable loam; weak thin platy structure.

B_1 11 to 16 inches, yellowish-brown (10YR 5/6, moist) splotched with brown (10YR 5/3, moist); firm to friable sandy clay loam; moderate weak medium subangular blocky structure.

B_2 16 to 26 inches, sticky and plastic heavy sandy clay; when moist, mottled grayish brown (10YR 5/2), brownish yellow (10YR 5/8), and yellowish red (5YR 5/8); weak fine to medium angular blocky structure.

B_3 26 to 36 inches, mottled grayish-brown to brownish-yellow (10YR 5/2 to 5/8, moist) very sticky and plastic clay; weak medium angular blocky structure.

C_{11} 36 to 42 inches, grayish-brown to light brownish-gray (2.5Y 5/2 to 6/2, moist), splotched with strong brown (7.5YR 5/8, moist), very sticky and plastic clay; massive structure.

C_{12} 42 to 60 inches +, light brownish-gray (2.5Y 6/2, moist) splotched with strong-brown (7.5YR 5/8, moist); very sticky and plastic clay; massive.

Mandeville silt loam (SE¼NW¼ sec. 33, T. 59 N., R. 24 W.):

A_1 0 to 9 inches, dark grayish-brown (10YR 4/2, moist) to brown (10YR 5/3, dry) very friable silt loam; moderate fine granular structure.

A_2 9 to 12 inches, very friable silt loam; when moist, brown (10YR 5/3) coated with pale brown (10YR 6/2); when dry, light yellowish brown (10YR 6/4) coated with very pale brown (10YR 7/3); weak medium subangular blocky structure.

B_{21} 12 to 16 inches, dark-brown (10YR 4/3, moist) to yellowish-brown (10YR 4/3 to 5/6, moist) sticky and plastic silty clay; moderate medium subangular blocky structure.

B_{22} 16 to 24 inches, mottled very dark grayish-brown to yellowish-brown (10YR 3/2 to 5/8, moist) sticky and plastic silty clay; moderate medium subangular blocky structure.

C 24 inches +, weathered silty shales; when moist, light brownish gray (2.5Y 6/2), very dark grayish brown (10YR 3/2), yellowish brown (10YR 5/8), and yellowish red (5YR 5/8).

Moniteau silt loam (NW¼SE¼ sec. 18, T. 59 N., R. 23 W.):

A_1 0 to 9 inches, dark grayish-brown (10YR 4/2, moist) to light brownish-gray (10YR 6/2, dry) very friable silt loam; moderate fine granular structure.

A_2 9 to 16 inches, grayish-brown (10YR 5/2, moist) to light-gray (10YR 7/2, dry) very friable silt loam; loose when dry; weak fine platy structure.

A_3 16 to 19 inches, brown (10YR 5/3, moist) splotched with gray (10YR 6/1, moist) silt loam.

B 19 to 22 inches, very dark grayish-brown to dark-brown (10YR 3/2 to 4/3, moist), splotched with grayish-brown (10YR 5/2, moist), sticky and plastic silty clay; firm when dry; moderate medium subangular blocky structure.

C 22 to 50 inches, very dark grayish-brown (10YR 3/2, moist), mottled with brown (10YR 5/3, moist), sticky and plastic clay; hard to very hard when dry; massive.

A_{1b} 50 inches +, brown and pale-brown (10YR 5/3 and 6/3, moist), mottled with yellowish brown (10YR 5/8, moist) and with organic stains of very dark-gray (10YR 3/1, moist) sticky and plastic silty clay; massive.

Nodaway silt loam (SW¼NW¼ sec. 25, T. 57 N., R. 23 W.):

1. 0 to 9 inches, very friable silt loam; when moist, dark grayish brown to grayish brown (2.5Y 4/2 to 5/2) stained with yellowish brown (10YR 5/8); when dry, light brownish gray to light gray (2.5Y 6/2 to 7/2); moderate fine granular structure; contains lenses of sand and silty clay.
2. 9 to 28 inches, very friable silt loam; when moist, dark grayish brown to grayish brown (2.5Y 4/2 to 5/2) stained with yellowish brown (10YR 5/8); amount of staining increases with depth; contains lenses of sand and silty clay.
3. 28 to 30 inches, firm to slightly sticky and plastic silty clay loam; when moist, dark gray to grayish brown (10YR 4/1 to 5/2) stained with yellowish brown (10YR 5/8); moderate fine angular blocky structure.
4. 30 to 36 inches +, sticky and plastic silty clay; when moist, very dark gray to dark gray (10YR 3/1 to 4/1) stained with yellowish brown (10YR 5/8); moderate medium subangular blocky structure.

Pershing silt loam (SE¼SW¼ sec. 24, T. 56 N., R. 24 W.):

A_1 0 to 9 inches, dark grayish-brown (10YR 4/2, moist) to grayish-brown (10YR 5/2, dry) very friable silt loam; moderate fine granular structure.

A_2 9 to 14 inches, gray and dark grayish-brown (10YR 5/1 to 4/2) when moist to light-gray and light brownish-gray (10YR 7/2 and 6/2) when dry, very friable silt loam; weak fine granular structure.

B_1 14 to 17 inches, gray (10YR 5/1, moist) crushing to brown (10YR 5/3, moist), friable silty clay loam; moderate fine subangular blocky structure.

B_{21} 17 to 21 inches, grayish-brown (10YR 5/2, moist) to reddish-brown (5YR 5/2, moist) slightly sticky and plastic silty clay; moderate medium subangular blocky structure.

B_{22} 21 to 32 inches, sticky and plastic silty clay; when moist, dark gray (10YR 4/1), brown (10YR 5/3), and reddish brown (5YR 4/4); weak coarse blocky structure.

B_3 32 to 52 inches, sticky and plastic silty clay; when moist, grayish brown (2.5Y 5/2) mottled with gray (2.5Y 5/0), light olive brown (2.5Y 5/6), and yellowish brown (10YR 5/8); weak coarse blocky structure; maximum loess thickness at this location is 52 inches.

D 52 inches +, sticky and plastic silty clay; when moist, light brownish gray (2.5Y 6/2) mottled with very dark grayish brown (2.5Y 3/2) and yellowish brown (10YR 5/8); massive and consists of weathered shale.

Sampsel silt loam (SW¼SW¼ sec. 1, T. 56 N., R. 24 W.):

A_1 0 to 11 inches, very dark grayish-brown (10YR 3/2, moist) to grayish-brown (10YR 5/2, dry) very friable silt loam; moderate fine granular structure.

A_2 11 to 14 inches, dark grayish-brown (10YR 4/2, moist) coated with brown (10YR 5/3, moist) friable silt loam; moderate fine subangular blocky structure.

B_1 14 to 17 inches, very dark-brown (10YR 2/2, moist) coated with gray (10YR 6/1, moist) firm silty clay; moderate medium subangular blocky structure.

B_2 17 to 30 inches, very dark-gray (10YR 3/1, moist) mottled with yellowish-brown (10YR 5/8, moist) very sticky and plastic clay; numerous small iron concretions; weak medium angular blocky structure.

B_3 30 to 36 inches, very sticky and plastic clay; when moist, mottled very dark grayish brown (2.5Y 3/2), dark grayish brown (2.5Y 4/2), light olive brown (2.5Y 5/6), and yellowish brown (10YR 5/8); numerous small iron and lime concretions; massive.

C 36 to 46 inches+, weathered calcareous clay shale; when moist, light brownish gray (10YR 6/2), light gray (10YR 6/1), and yellowish brown (10YR 5/8).

Seymour silt loam (SE¼NE¼ sec. 8, T. 58 N., R. 23, W.):

A_1 0 to 10 inches, very dark-brown (10 YR 2/2, moist) to dark-gray (10YR 4/1, dry) very friable silt loam; moderate fine granular structure.

A_3 10 to 14 inches, very dark-brown (10YR 2/2, moist) to gray (10YR 5/1, dry) very friable silt loam; weak medium granular structure.

B_1 14 to 18 inches, very dark-gray (10YR 3/1, moist) coated with dark-gray (10YR 4/1, moist) friable silty clay loam; moderate fine subangular blocky structure.

B_{21} 18 to 28 inches, sticky and plastic silty clay; when moist, mottled very dark gray (10YR 3/1), dark gray (10YR 4/1), yellowish brown (10YR 5/8), and light olive brown (2.5Y 5/6); moderate subangular blocky structure.

B_{22} 28 to 44 inches, very sticky and plastic silty clay; when moist, mottled grayish brown (2.5Y 5/2), light brownish gray (2.5Y 6/2), light olive brown (2.5Y 5/6), and olive yellow (2.5Y 6/8); contains a few small iron concretions; weak medium angular blocky structure.

B_{31} 44 to 51 inches, very sticky and plastic silty clay; when moist, mottled dark grayish brown (2.5Y 4/2), grayish brown (2.5Y 5/2), light olive brown (2.5Y 5/6), and olive yellow (2.5Y 6/8); contains numerous iron concretions; weak coarse angular blocky structure.

B_{32} 51 to 58 inches, sticky and plastic silty clay; when moist, mottled dark grayish brown (2.5Y 4/2), grayish brown (2.5Y 5/2), light gray (2.5Y 7/2), and olive yellow (2.5Y 6/8); massive.

B_{33} 58 to 63 inches, firm silty clay; when moist, grayish brown (2.5Y 5/2) and light gray (2.5Y 7/2) stained with olive yellow (2.5Y 6/8); weathered loess becomes more open and friable as the depth increases; depth of the loess at this location is 63 inches.

D 63 inches+, very sticky and plastic clay; when moist, light brownish gray (2.5Y 6/2) stained with olive yellow (2.5Y 6/8) and yellowish brown (10YR 5/8); contains numerous small iron concretions; massive; horizon from weathered clay till and contains numerous particles of grit.

Shelby loam (SE¼NW¼ sec. 31, T. 58 N., R. 22 W.):

A_1 0 to 12 inches, very dark-brown to very dark grayish-brown (10YR 2/2 to 3/2, moist) to dark grayish-brown (10YR 4/2, dry) very friable loam; moderate fine granular structure.

B_1 12 to 18 inches, firm to friable sandy clay; when moist, dark yellowish brown (10YR 4/4), dark grayish brown (10YR 4/2), and yellowish-red (5YR 4/6); moderate medium subangular blocky structure.

B_2 18 to 40 inches, slightly sticky and plastic clay; when moist, very dark brown (10YR 2/2), grayish brown (10YR 5/2), and yellowish brown (10YR 5/8); coarse subangular blocky structure; contains appreciable amount of small-sized glacial material.

B_3 40 to 50 inches, grayish-brown to yellowish-brown (10YR 5/2 to 5/8, moist) sticky and plastic clay; contains numerous concretions of lime; massive.

C 50 inches+, light brownish-gray (2.5Y 6/2, moist) stained with yellowish-red (5YR 5/8, moist) sticky and plastic calcareous clay; massive.

Snead silty clay:

A_1 0 to 9 inches, very dark-gray (10YR 3/1, moist) to grayish-brown (2.5Y 5/2, dry) sticky and plastic silty clay; moderate medium granular structure.

A_3 9 to 12 inches, very sticky and plastic silty clay; when moist, dark reddish brown (5YR 3/2) mottled with yellowish brown (10YR 5/8) and light olive brown (2.5Y 5/6); moderate fine subangular blocky structure.

C_1 12 to 18 inches, very sticky and plastic clay; when moist, mottled grayish brown (2.5Y 5/2), light brownish gray (2.5Y 6/2), and yellowish brown (10YR 5/8); weak medium subangular blocky structure.

C_2 18 to 22 inches, grayish-brown (2.5Y 5/2, moist) and yellowish-brown (10YR 5/8, moist) very sticky and plastic clay; numerous small iron concretions; massive.

D_r 22 inches +, limestone rock.

Stet silty clay loam:

A_{11} 0 to 16 inches, very dark-brown (10YR 2/2, moist) to dark-gray (10YR 4/1, dry) friable silty clay loam; moderate medium granular structure.

A_{12} 16 to 28 inches, black (10YR 2/1, moist) friable silty clay loam; moderate medium granular structure.

AB 28 to 40 inches, slightly sticky and plastic silty clay loam; when moist, very dark gray (10YR 3/1) mottled with black (10YR 2/1) and yellowish brown (10YR 5/8); contains small iron concretions; moderate coarse granular structure.

B 40 to 48 inches, sticky and plastic silty clay; when moist, very dark gray (10YR 3/1) mottled with yellowish brown (10YR 5/8) and light olive brown (2.5Y 5/6); contains numerous small iron concretions; massive.

C 48 to 60 inches +, sticky and plastic silty clay; when moist, dark gray (10YR 4/1) mottled with yellowish brown (10YR 5/8), gray (2.5Y 5/0), and light olive brown (2.5Y 5/6); massive.

Wabash clay (SE¼SE¼ sec. 12, T. 56 N., R. 25 W.):

A_{1p} 0 to 5 inches, very dark-brown (10YR 2/2, moist) moderately plastic clay; moderate fine blocky structure.

A_{12} 5 to 13 inches, black (5YR 2/1, moist) very sticky and plastic clay; moderately weak fine blocky structure.

A_{13} 13 to 22 inches, black (5YR 2/1, moist) very sticky and plastic clay; weak fine blocky structure.

A_3 22 to 36 inches, black (N 2/0, moist) very sticky and plastic clay; weak medium blocky structure.

B_{21g} 36 to 42 inches, very dark-gray (10YR 3/1, moist) very sticky and plastic clay; weak coarse blocky structure.

B_{22g} 42 to 54 inches, very dark-gray (5Y 3/1, moist) very sticky and plastic clay; massive.

C_g 54 to 66 inches +, dark-gray (5Y 3.5/1, moist) very sticky and plastic clay; massive.

Wabash silt loam (SW¼SW¼ sec. 7, T. 56 N., R. 24 W.):

A_{11} 0 to 8 inches, very dark-gray (10YR 3/0, moist) friable silt loam varying to silty clay loam; moderate medium granular structure.

A_{12} 8 to 18 inches, very dark-gray (10YR 3/1, moist), with specks of yellowish-brown (10YR 5/8, moist) friable silt loam; weak fine subangular blocky structure.

AB 18 to 28 inches, friable silty clay loam; when moist, very dark grayish brown (10YR 3/2) mottled with dark gray (10YR 4/1) and yellowish brown (10YR 5/8); moderate fine subangular blocky structure.

B_g 28 to 48 inches, slightly sticky and plastic silty clay; when moist, mottled very dark gray (10YR 3/1), yellowish brown (10YR 5/8), and light olive brown (2.5Y 5/6); moderate medium subangular blocky structure.

C_g 48 inches +, sticky and plastic clay; when moist, very dark gray (10YR 3/1) mottled with yellowish brown (10YR 5/8); massive.

Westerville silt loam (NW¼ sec. 31, T. 58 N., R. 22 W.):

1. 0 to 8 inches, dark grayish-brown (10YR 4/2, moist) to pale-brown (10YR 6/3, dry) very friable silt loam; moderate medium granular structure.
2. 8 to 11 inches, very friable silt loam; when moist, brown (10YR 5/3) coated with pale brown (10YR 6/3); when dry, pale brown (10YR 6/3) coated with very pale-brown (10YR 7/3); weak medium subangular blocky structure.
3. 11 to 24 inches, very friable silt loam; when moist, brown (10YR 5/3), light grayish brown (10YR 6/2), strong brown (7.5YR 5/8), and white (10YR 8/2); moderate medium granular structure.
4. 24 to 50 inches +, slightly sticky and plastic silty clay; when moist, brown (10YR 5/3), light brownish gray (10YR 6/2), white (10YR 8/2), yellowish brown (10YR 5/8), and strong-brown (7.5YR 5/8); moderate medium subangular blocky structure.

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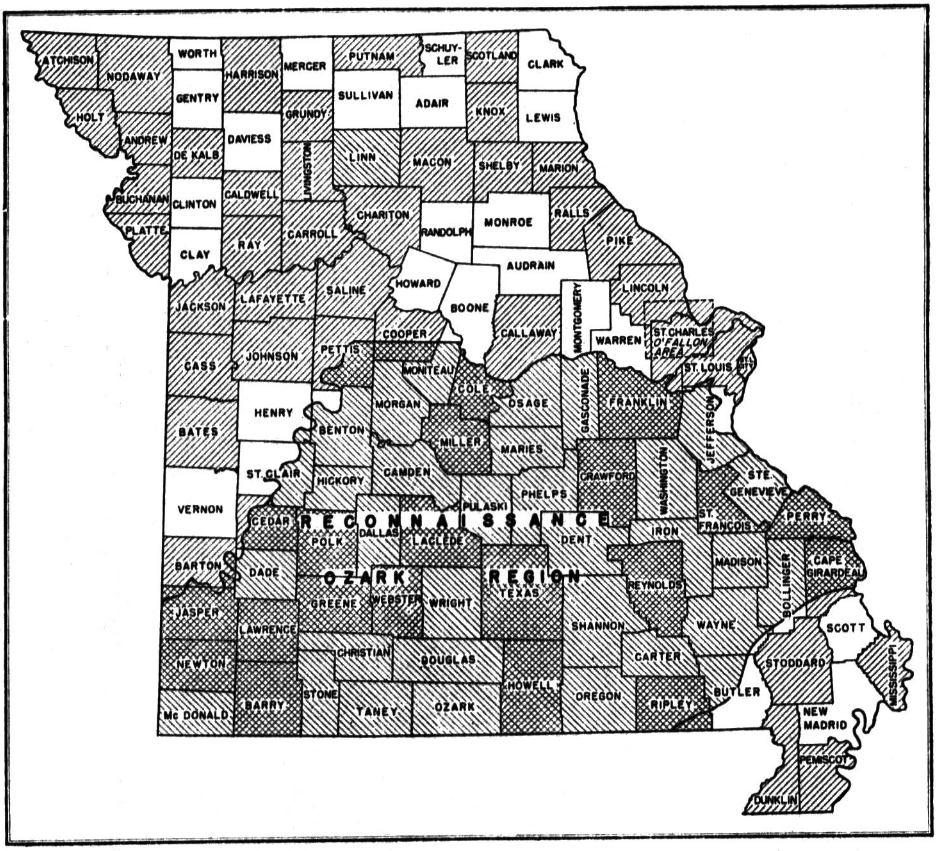

Areas surveyed in Missouri shown by shading—detailed surveys, by northeast-southwest hatching; reconnaissance surveys, by northwest-southeast hatching; areas covered in both ways, by crosshatching.

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