STATE OF ILLINOIS

ADLAI E. STEVENSON, *Governor*

THE SILTING OF LAKE CALHOUN

GALVA, ILLINOIS

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A Cooperative Study by
Illinois State Water Survey Division, Soil Conservation Service
United States Department of Agriculture, and Illinois
Agricultural Experiment Station

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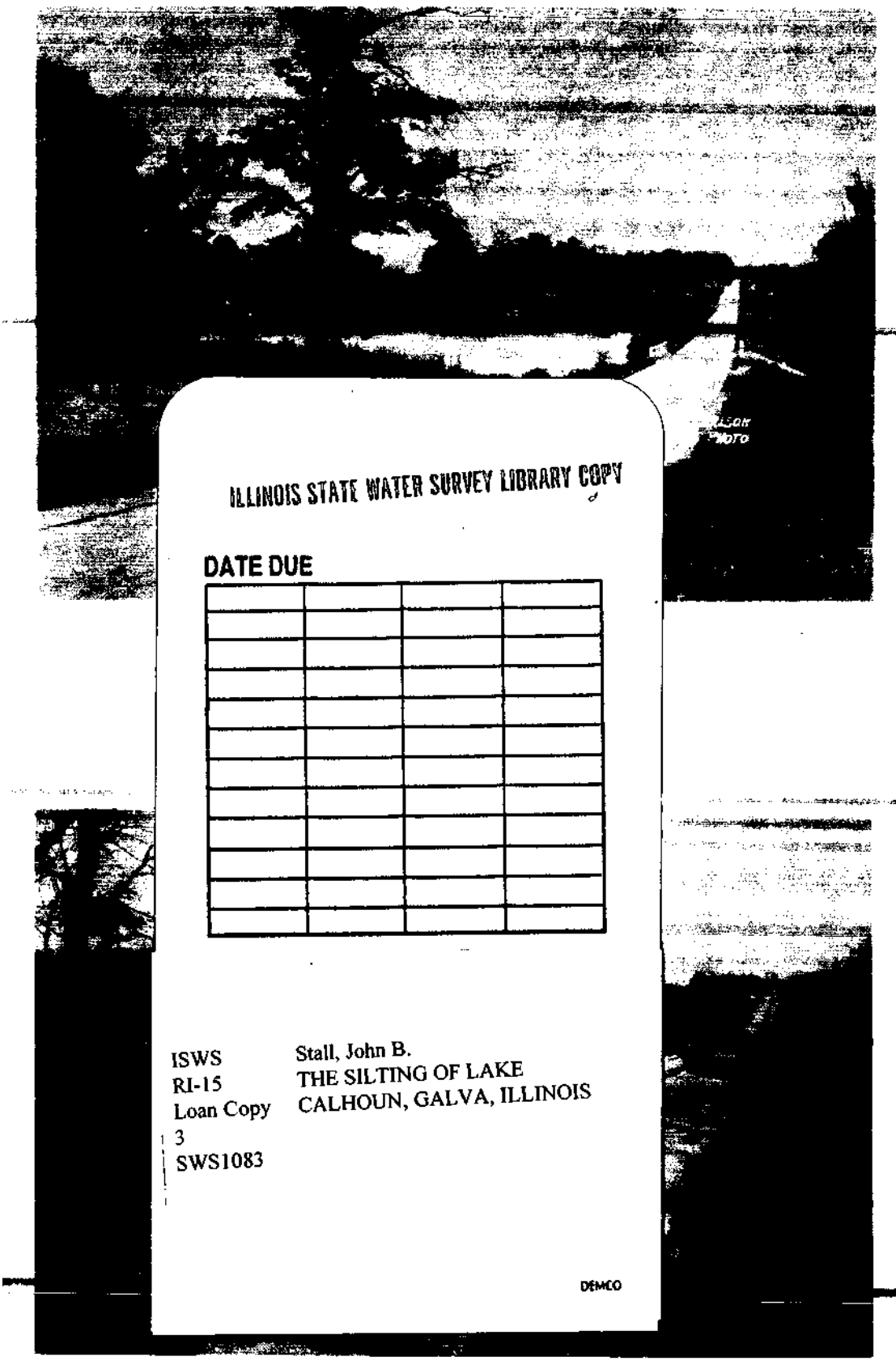

LAKE CALHOUN—1951

CONTENTS

SUMMARY

1. Lake Calhoun, a recreational lake near Galva, Illinois, was constructed in 1924 by the Lake Calhoun Association. Original surface area was 46. 1 acres and the drainage area was 13. 1 square miles.

2. Detailed sedimentation surveys were carried out on the lake in 1936 and 1947. By 1936 the reservoir had lost 35. 7 percent of its original capacity to sediment. By 1947 a total of 73. 6 percent of original capacity had been destroyed by sediment.

3. Prior to 1936, sediment deposited in the lake represented a loss of 1. 88 tons per acre annually from the drainage area. After 1936 this increased to 2. 14 tons per acre annually.

4. Differences in mean annual precipitation during the two sedimentation periods are not great.

5. Lake Calhoun has suffered a greater annual rate of storage depletion than has any other reservoir surveyed to date in Illinois. The annual loss has averaged 3. 21 percent 'while a rate of less than 0. 5 percent would be desirable.

6. During heavy rainfall in May 1950 the spillway failed, draining the lake. The Association clubhouse and private cottages are now overlooking sediment deposits rather than the lake. Recreational activities have been curtailed in the area.

7. Chemical and physical analyses of samples of the lake sediment taken in 1936 and 1947 indicate considerable velocity of water movement within the lake.

8. No apparent change in characteristics is evident in the sediment deposited in the lake prior to 1936 and after 1936.

9. The sediment in Lake Calhoun represents a loss in plant food and topsoil of thousands of dollars to the farmers in the watershed.

10. A watershed conservation survey shows that there are four major soil groups in the watershed. Seventy-three and two-tenths percent of the watershed is classified as dark-colored, permeable upland soil; 1. 7 percent as light-colored, slowly permeable soil; 20. 7 percent as light-colored, permeable soil; and 4. 4 percent as bottomland.

11. Approximately 30 percent of the watershed is nearly level to level, 32 percent is gently sloping (2 to 5 percent), 23 percent is moderately sloping (5 to 10 percent), and 15 percent is strongly sloping (over 10 percent).

12. Of the land in cultivation, 24 percent has no apparent erosion, 44 percent is slight to moderately eroded, 20 percent is moderately severely eroded, and 12 percent is severely eroded. Seventy-nine and four-tenths percent of the entire watershed is in cultivation at the present time.

13. Over 50 percent of the land now in pasture is classified as moderately severely to severely eroded. This indicates that this land has been farmed at one time and has been retired to pasture in recent years.

14. The present land use in the watershed indicates 79. 4 percent of the land is in cultivation, 16 percent in pasture, 1. 3 percent in woods, 2. 9 percent in miscellaneous use, and 0. 4 percent is idle.

15. According to the soil conservation survey, 77. 5 percent of the watershed is suitable for continuous cultivation, 5. 8 percent is suitable for limited cultivation, and 16. 7 percent is suitable only for pasture or woods. One and nine-tenths percent of the land now in cultivation should be converted to pasture or woods. This land is too steep or eroded to cultivate safely.

16. It is estimated that in 1924, Lake Calhoun trapped about 75 percent of the sediment reaching the lake. By 1947, only 20 percent was being trapped, the remainder passing on through the lake and over the spillway.

17. The principal cause of the excessive rate of storage depletion in Lake Calhoun is due to the small amount of storage developed for the size of the drainage area. A lake of this volume should have been constructed on a drainage area much smaller in area. This conclusion confirms a similar finding reported after the 1936 lake survey.

18. Remedial measures must be considered carefully in this case in view of the amount of the sediment load reaching the lake. Abandonment of the lake, though not a pleasant prospect, must be seriously considered in view of probable future sediment damages if enlargement is not possible. The recreational advantages of the area would not be completely destroyed by the absence of the lake.

19. Raising the present dam ten feet would necessitate moving the clubhouse and rebuilding the state highway which crosses the dam. A total of 1280 acre-feet would be impounded. Expected storage depletion would be 1. 0 to 1.5 percent per year due to sedimentation if no conservation work were done on the watershed.

20. Construction of a new dam on Fitch Creek downstream from the present lake has been considered. If 832 acre-feet of water were impounded, expected storage loss would be 1. 6 to 2. 0 percent per year if no conservation work were done on the watershed.

21. Dredging the sediment from the lake does not appear economically feasible in view of the physical factors involved.

22. It is estimated that if the proposed watershed treatment program outlined in this report were applied to the land it would reduce the sediment load reaching the lake by 84 percent. At present, approximately 80 percent of the sediment reaching the lake passes on over the spillway; consequently, it has been estimated that the watershed treatment program alone would not have a great effect in reducing depletion of the little

remaining storage in the present lake.

23. A sound watershed treatment program should be based on a physical inventory of the land. This inventory may be obtained from conservation survey maps such as those prepared on a portion of the watershed.

24. All cropland and pasture should be tested for limestone, phosphorus and potash and treated according to test. This is essential to obtain proper stands of grasses and legumes. Land use adjustments should be based on a physical land inventory. Table 8 in this report shows the adjustments necessary.

25. The major adjustments necessary to place the proposed watershed program into effect are: (1) use the land according to its capabilities (Table 8), (2) treat the soils according to test, and (3) use sound rotations and erosion control practices similar to those suggested in Table 9.

26. The adoption of soil conservation practices means increased net income to the farmer. Illinois studies in an area comparable to the Lake Calhoun watershed showed high-conservation farms had net incomes of $4. 77 per acre (at 1945 prices) per year more than low-conservation farms. This increase, after all costs of conservation were paid, amounts to $7,652 for a 160-acre farm for a 10-year period.

THE SILTING OF LAKE CALHOUN
Galva, Illinois

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INTRODUCTION

OBJECTIVES OF STATE-WIDE PROGRAM

Need for Data. Many people believe that the continuation of present methods of American agriculture will lead our country into an agricultural depression similar to that of the barren wastes of China and Asia Minor. The fertile topsoil is being stripped from its resting place and deposited at the bottom of streams and lakes. This movement of soil ruins the thousands of years of Nature's work in forming the productive topsoil.

The menace of sedimentation, which depletes the capacity of a reservoir, is not generally well understood. That soil erosion takes place in every part of Illinois is evidenced by the turbid water found in streams, especially after heavy rains. Whenever a dam is built to impound the water of a stream, it immediately begins to store the turbid water and the sediment begins to settle out. This decreases the capacity of the impounding reservoir. The destruction of the storage reservoir begins immediately upon its completion.

A study of the State of Illinois has been made[1] which shows that there are only approximately 1100 sites within the boundaries of the state on which reservoirs could economically be located. About 500 of these reservoirs have been constructed to date. Consequently, the development of the remaining one half of the state's reservoirs must be carried out only with a clear understanding of the forces which tend to destroy as well as to elongate the life of a reservoir.

Residents in the vicinity of a lake may notice that it becomes muddy after a rain, but the water quickly clears up again and the public is not reminded that the silt load of the water has settled out and now rests on the bottom of the lake where it occupies space originally designed to store water. Nature's gifts are the basis of all life. It is our duty to halt this waste of natural resources now—before it is too late.

Illinois Program. The seriousness of erosion in Illinois and the consequent rapid reservoir sedimentation led the Illinois State Water Survey Division, the Illinois Agriculture Experiment Station, and the Soil Conservation Service, in 1936 to join in a cooperative study to determine the effects of different reservoir, watershed, and climatic factors on the rate of sedimentation of reservoirs. Up to the present time, sedimentation data in some form are available on 41 reservoirs within the state. Eighteen of these reservoirs have been subjected to detailed sedimentation surveys. By this method it is possible to determine accurately the original and present volume of the reservoir, as well as the rate of storage loss per year. In four cases it has been possible to resurvey a reservoir after an elapsed period of ten years to determine the change in rate of sedimentation where this occurs-.

The state-wide program has been oriented toward determining sediment production indices in those areas of the state in which further reservoir development for water supply is likely to be greatest. Approximately two-thirds of the State of Illinois depends predominately on surface water reservoirs as a means of public water supply. Within this area there are 110 communities

1. Preliminary Data on Surface Water Resources. State Water Survey Division Bulletin No. 31, 157 pp., Urbana, Illinois, 1937.

which now exceed 1, 000 in population, and probably within the next few decades will be in need of an increased public water supply. The natural boundaries of soils and physiography within this portion of the state have determined the specific study areas in which sedimentation work will be concentrated.[2]

The specific objectives of the state-wide program as well as the study reported herein are: (1) to establish information on factors affecting sedimentation; (2) to furnish factual data for future reservoir development; (3) to provide data for estimating sedimentation damages to existing and proposed reservoirs; and (4) to develop methods of sedimentation control.

Need tor This Report. The lake and watershed surveys and this report on Lake Calhoun constitute a part of the state-wide program. This reservoir is representative of one having a small watershed and a very low capacity-watershed ratio. The watershed as a whole is characterized by mature topography, which was developed on the gently undulatory surface of the glacial till plain. The drainage pattern is typically dendritic and the watershed is roughly fan-shaped. Near the north edge of the watershed several points on the upland in Stark County approach an elevation of 850 feet above sea level, or 135 feet above crest level of the lake. The tributary valleys are short but numerous and are V-shaped in cross-section. Only Fitch Creek has developed a true valley flat from which the valley walls rise steeply 50 to 60 feet to the level of the upland.

SCOPE OF INVESTIGATIONS

Lake Survey. A detailed survey of Lake Calhoun was made by the Central Reservoir Party, Section of Sedimentation Studies, Division of Research of the Soil Conservation Service between July 23 and August 6, 1936, under supervision of L. M. Glymph, Jr., Chief of Party. In this survey the original and the then 1936 shoreline of the lake were mapped and a series of ten silt ranges was established on the lake. By this means the original and the 1936 capacity of the lake were determined as well as the volume of sediment deposited in the lake since its construction. Permanent monuments, consisting of iron pipe stamped with identifying station numbers and set in concrete, were used to mark all stations and range ends.

A resurvey of Lake Calhoun was made from July 21-25, 1947 by a field party of the Illinois State Water Survey Division. In making the resurvey it was necessary to remap completely the shoreline because the spillway crest had been raised since the 1936 survey. As a result of the rise in the water level many of the original survey stations were submerged or washed out. In these cases the stations were re-established or alternate stations were located above the present crest line. Soundings along eight of the original ranges across the main body of the lake were measured and new cross-sections were obtained. Since the 1936 cross-sections of the lake showed the original soil profile and the sediment thickness in 1936, the latter was not remeasured but soundings were taken across the ranges to locate the 1947 top of the sediment. By this means the present capacity of the lake, the total volume of sediment deposited in the lake since its construction, and the amount of sediment that had accumulated since the 1936 survey, were determined. Since the spillway crest has been raised, loss in capacity has been computed on the basis of the original as well as the new capacity of the reservoir.

Watershed Survey. As a part of this study a detailed soil conservation survey of portions of the drainage area was carried out by the Soil Conservation Service. Kind of soil, steepness of slope and degree of erosion were mapped to determine, if possible, the areas which contribute most heavily to the sediment reaching the lake. This information also allows recommendations to be made regarding the capabilities of the land for agricultural use.

A study has been made of the history of the land use in the drainage area during the life of the lake. This was carried out by Soil Conservation Service and the Illinois Agricultural Experiment Station to learn of any significant changes in the land use trends during the life of the lake which might affect sedimentation in the lake.

Sediment Samples. During the course of the 1936 survey a series of eleven sediment samples was taken from various parts of the lake by means of a special sampler. The locations of these samples are shown in Figure 3. In 1947 another series of nine sediment samples was taken from the lake. The chemical and physical analyses of all these samples were made by the Illinois Agricultural Experiment Station. These analyses report the texture, colloidal content, volume-weight and presence of plant food constituents in the sediment of the lake. These data give significant indications as to the watershed sources of the sediment in the reservoir. A comparison has been made of the samples obtained in 1936 and 1947.

Interpretation of Results. The final interpretation of the silting problem at Lake Calhoun has been made on the basis of the complete reservoir and watershed data by the three cooperating agencies. Results are presented so as to be most

2. Illinois Sedimentation Program. Unpublished memorandum, 8 pp., State Water Survey, August 30, 1949.

3. Glymph, L. M. and Jones, V. H., Advance Report on the Sedimentation Survey of Lake Calhoun, Galva, Illinois. SCS-SS-16, Washington, D. C., May 1937.

helpful to reservoir owners. The rate of deposition of sediment in the reservoir is very great and therefore remedial measures are discussed to reduce this rate by the application of a complete watershed protective program.

ACKNOWLEDGMENT

The Lake Calhoun Association, Inc. The agencies conducting this survey wish to acknowledge the generous assistance and cooperation of the Lake Calhoun Association, Inc. In the 1936 survey John Lovgren, Secretary of the Lake Calhoun Association assisted by making boats available to the survey party and by furnishing concrete and pipe for the survey monuments. Mr. Leon Best, Secretary of the Association, and Mr. Ingle, caretaker at the lake, provided boats for the 1947 survey.

State Water Survey Division. The resurvey of Lake Calhoun was made by a field party of the Engineering Subdivision consisting of the following men: Bernt O. Larson, Chief of Party, John B. Stall, Assistant Engineer, and Leslie Jones and Douglas Rucker, Engineering Assistants. This division made the computations on the results of the lake resurvey, including the water and sediment volumes. The engineering section of this report was prepared by Mr. Stall. The entire report was compiled by Mr. Stall under the supervision of Mr. H. E. Hudson, Jr., Head of the Engineering Subdivision. Some photographs used in the report were taken by personnel of this division.

Soil Conservation Service. The Soil Conservation Service of the United States Department of Agriculture has participat d in the Illinois sedimentation program in many ways. The original survey of Lake Calhoun was made by the Central Reservoir Party, Section of Sedimentation Studies, Division of Research, from July 23 to August 6, 1936. The field personnel consisted of L. M. Glymph, Jr., Chief of Party, V. H. Jones, Assistant Chief, W. G. Shannon, H. L. Fischer, and D. D. Price. The original survey results and computations of water and sediment volumes were made by the Soil Conservation Service and a report on the sedimentation survey was prepared by Louis M. Glymph, Jr. and Victor H. Jones.[3] The Sedimentation Section of the Office of Research in Washington furnished the specialized field equipment for the resurvey work. Mr. L. C. Gottschalk, Head of the Sedimentation Section, gave technical assistance during two weeks spent with the survey party at the beginning of the summer's work in 1947, and reviewed the present report.

Mr. B. B. Clark, State Conservationist, cooperated by authorizing the soil conservation survey of this watershed by Soil Conservation Service personnel and cooperated with the authors in the compilation of this report. The field work of the watershed survey was carried out by Mr. Lawrence Benson, Soil Scientist, during 1947. Mr. A. A. Klingebiel, State Soil Scientist, analyzed the survey data and prepared the watershed section of the report. H. M. Smith, Soil Scientist, assisted with the preparation of the detailed conservation program needed on the watershed.

Illinois Agricultural Experiment Station. In the 1936 survey the Soil Conservation Service field party obtained eleven sediment samples from the reservoir with the cooperation of Dr. E. E. DeTurk and Dr. R. N. Bray of the Division of Soil Analysis. The field party of the State Water Survey obtained another set of nine sediment samples in 1947. Under the supervision of Dr. E. E. DeTurk, Professor of Soil Fertility, these samples were analyzed in detail in the laboratory of the Agricultural Experiment Station. The interpretation of these analyses and their comparison to watershed soils has been carried out by S. W. Melsted, Associate Professor of Soil Analysis. Dr. Melsted also compiled the section of this report interpreting the analytical results.

Dr. E. L. Sauer, Research Project Supervisor, Soil Conservation Service and Illinois Agricultural Experiment Station cooperating, carried out the study of land use and conservation history of the watershed. This study entailed both field visits and study of public records and their interpretation. Dr. Sauer also prepared the data in this report concerning the costs and benefits of conservation.

Knox County Soil Conservation District. In the conduct of the agricultural phases of this study the Knox County Soil Conservation District cooperated by authorizing the use of federal personnel assigned to the district to carry out the conservation survey of the drainage area.

The Illinois State Soil Conservation Districts Board cooperated in this study by financing the laboratory work in making the sediment analysis. This work was carried out in the laboratories of the Illinois Agricultural Experiment Station.

RESERVOIR

GENERAL INFORMATION

Reservoir. Lake Calhoun is located five miles southeast of the city of Galva in Sections 14 and 23 of T. 13 N., R. 4 E. in Knox County, as shown in Figure 1. The lake was impounded on Fitch Creek, a small stream flowing generally southward into Walnut Creek and thence into Spoon

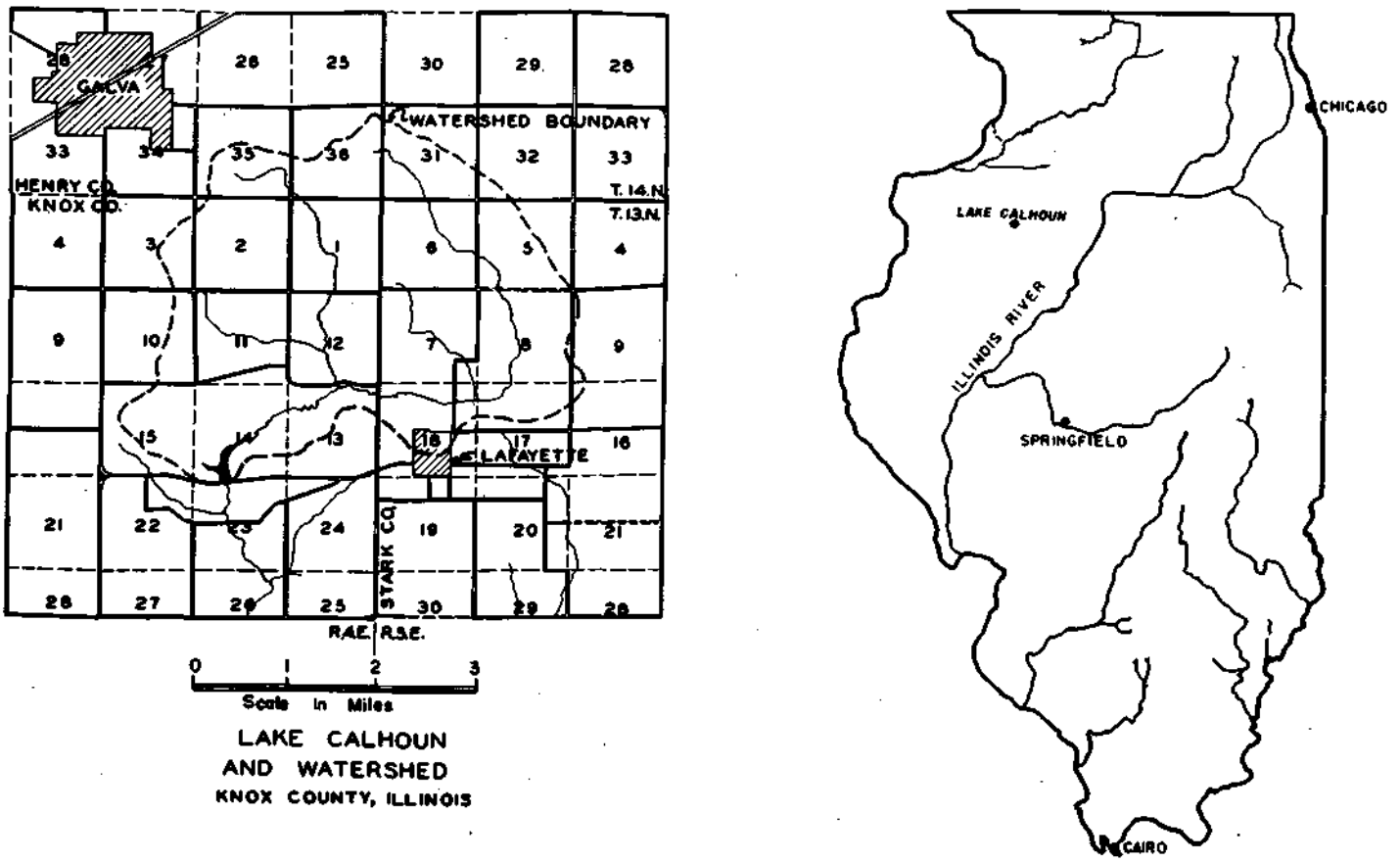

FIG. 1. LAKE CALHOUN LOCATION.

River, a part of the Illinois River system. The valley has steep sides and a well-developed flood plain of approximately 600 feet in width. At the present spillway crest elevation of 718. 64 feet M. S. L., the lake has an average width of 700 feet and extends approximately 3,000 feet from the dam in a northeasterly direction. A tributary arm of the lake, about 1, 000 feet long and 300 feet wide at its lower end, joins the west side of the main basin approximately 800 feet above the dam.

The lake was completed and storage started in September 1924. This is entirely a recreational lake and is owned by the Lake Calhoun Association, Inc. No water is pumped from the lake.

Dam. The dam consists of an earth fill with a puddled core reinforced by a board wall. The dam is 735 feet long, including the spillway at the west end, and has a 24-foot crest which accommodates the pavement and guard rails of State Highway No. 17. The top of the dam is at elevation approximately 728 feet above mean sea level. The slopes of the upstream and downstream faces are 3 to 1 and 2 1/2 to 1, respectively.

Spillway. The concrete spillway is located at the extreme west end of the dam, and has an over-all length of 48 feet. When constructed, this spillway had an effective crest length of 20 feet, overflow passing through four rectangular notches 5 feet wide and 2 1/2 feet deep. The effective crest elevation at the bottom of the notches was then 715.75 feet above mean sea level. In 1946 oak planking was added to the rectangular weirs, thereby raising the effective spillway crest to an elevation of 718. 64 feet above mean sea level.

The outfall channel of the spillway originally consisted of a five-step concrete apron energy dissipator.

Present Condition of Lake - 1952. During heavy rains in May 1950, the spillway failed and was washed out completely. Since that date there has been no water storage in the lake at all. The sediment deposits are exposed to the drying effects of wind and sun; vegetation has sprung up on the sediment deposits. Present condition of the lake is shown in Figure 2.

METHODS OF SURVEY

Range Systems. The record of sedimentation in Lake Calhoun is based on the survey system established in 1936 by the field party of the U. S. Soil Conservation Service under the direction of Louis M. Glymph, Jr., Chief of Party. At that

FIG. 2. VIEW OF EXPOSED SEDIMENT DEPOSITS IN LAKE CALHOUN.

time a detailed sedimentation survey of the reservoir was made cooperatively by the same three agencies conducting the present studies. A triangulation net of 10 stations was expanded from a 600-foot baseline chained across the dam; this served as control for the mapping of the shore line and the establishment of the system of ten silt ranges on the lake. Range ends and triangulation stations were marked with iron pipe set in concrete and stamped with station numbers. Mapping was done with plane table and telescopic alidade to a scale of one inch equals 100 feet. Figure 3 is a base map of the lake showing the survey network.

All values of storage capacity and silt volumes for the reservoir were determined by the range method of survey developed by the Soil Conservation Service and described in their Bulletin No. 524, "Silting of Reservoirs."[4]

4. Eakin, H. M., Silting of Reservoirs, U. S. Dept. of Agriculture Technical Bulletin 524, Revised by C. B. Brown, 168 pp., illustrated. Washington, U. S. Government Printing Office, 1939.

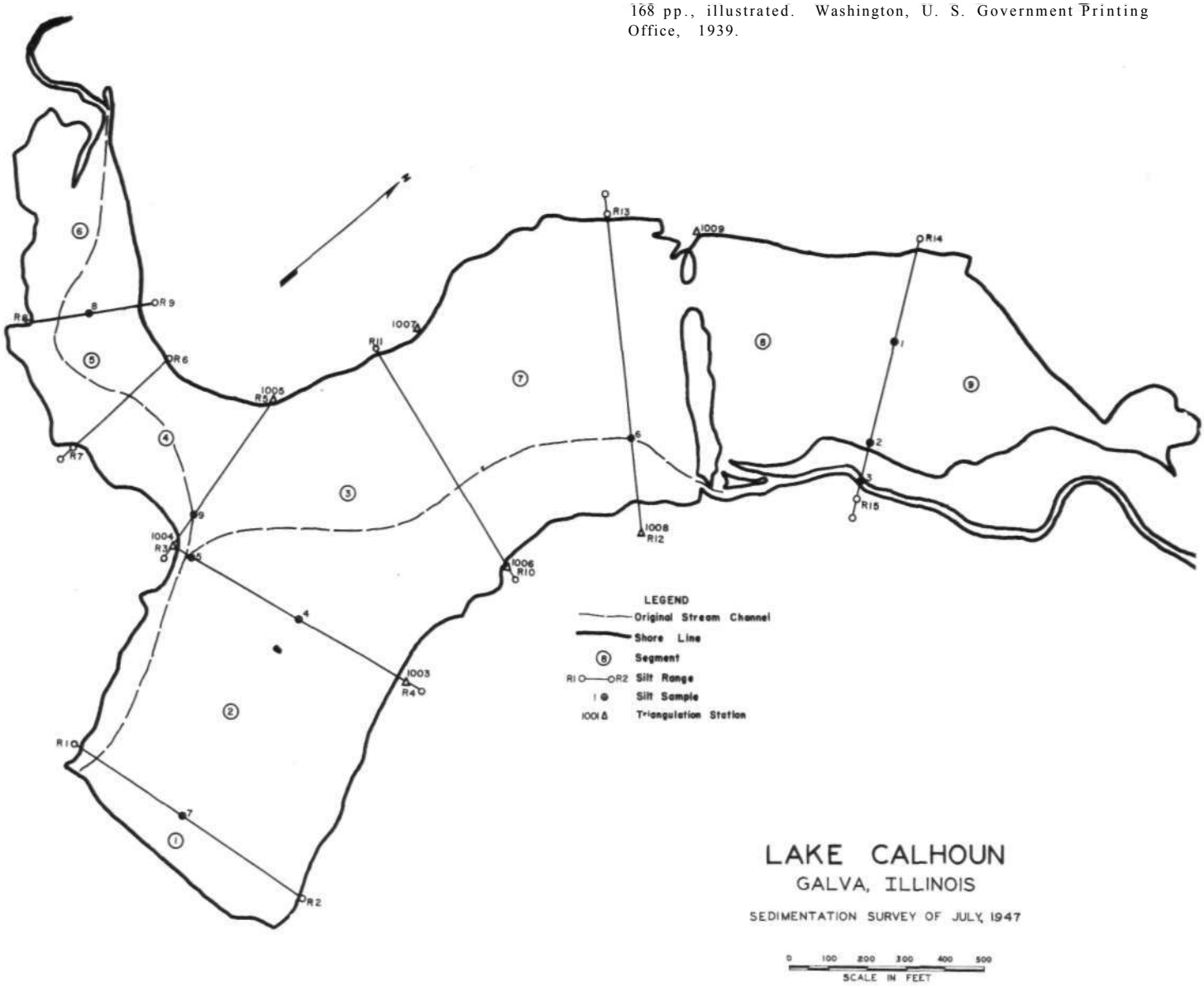

FIG. 3.

Measurement of Sediment. In 1936 soundings of water depth were taken at intervals of 25 feet along each sediment range to locate the elevation of the top of the sediment at that time. Soundings were taken with a bell-shaped 6-pound aluminum sounding weight with a base diameter of 5 inches and a height of 6 inches. At intervals of 50 feet or with alternate soundings, the thickness of the silt was measured with a "spud" bar. This is a specially designed instrument developed for this work by the Soil Conservation Service. As shown in Figure 4 this consists of a steel rod made up of cup-shaped grooves every one-tenth of a foot. On the range line this spud is thrown spearlike into the sediment on the end of a calibrated line. It passes through the soft sediment and penetrates the original soil or pre-reservoir deposit. The bar is then retrieved and in the boat the actual thickness of the sediment is measured by inspecting the small soil or sediment samples retained in the cups.

FIG. 4. USE OF SPUD IN MEASURING SEDIMENT THICKNESS.

In 1947 a detailed resurvey of this reservoir was carried out by a field crew of the State Water Survey Division under Bernt O. Larson, Chief of Party. In making the resurvey it was necessary to remap completely the shoreline because the spillway crest had been raised since the 1936 survey. As a result of this rise in water level, many of the original survey stations were submerged or washed out. In such cases the stations were re-established or alternate stations were located above the present crest line. Since the 1936 cross-sections of this lake showed the original soil profile and the sediment thickness in 1936, these ranges were not re-spudded but were re-sounded to locate the 1947 top of the sediment. A total of 98 measurements were made on the eight ranges shown in Figure 3. On Range 014-015, which had not been previously surveyed, the spud was used to measure sediment thickness. Measurements were made at 50-feet intervals except on the above-mentioned range on which 25-foot intervals were taken.

SEDIMENTATION IN THE RESERVOIR

Summary of Data. Table 1 is a summary of the sedimentation data obtained from the two surveys of Lake Calhoun, together with data derived therefrom which are pertinent to the sedimentation problem in the lake. Since the spillway had not been raised at the time of the 1936 survey, the results of that survey have been converted to the 1947 elevation so that the results of the two surveys will be comparable. All results in Table 1 are based on the 1947 spillway crest elevation. Significant findings shown in this summary are:

1. The capacity of the reservoir for water storage has been reduced by 73. 6 percent since its construction, a period of just 22. 9 years.
2. The sediment accumulation in the lake represents an average annual soil loss of 71.41 cubic feet of soil per acre per year from the watershed.

It is interesting to note that the volume of sediment in the reservoir in 1947 is greater than the original capacity of the reservoir before the dam was raised. This rate of sedimentacion is obviously excessive. An explanation of this high rate of sedimentation can be found by observing the relatively low capacity-watershed ratio (C/W ratio) of the lake. The original C/W ratio of the reservoir was 21.8 acre-feet per square mile. In other words, the reservoir was designed and constructed to furnish about 21.8 acre-feet of storage space for every square mile of watershed. Sedimentation studies in Illinois and in other parts of the country[5] have shown that the original C/W ratio of a reservoir is significant in determining the rate at which the reservoir will collect sediment. A small capacity reservoir which receives sediment from a large watershed area will lose capacity much faster than a high-capacity reservoir with a small watershed. The C/W ratio of 21.8 acre-feet per square mile for Lake Calhoun is undoubtedly one of the principal factors which explain the rapid rate at which Lake Calhoun is losing capacity.

Precipitation. Table 1 shows that from 1924 to 1936 the annual sediment deposited in the lake amounted to 1. 88 tons per acre from the drainage area while during 1936 to 1947 this annual average had increased to 2. 14 tons per acre. This increase in sediment production may have been caused by any of several factors, including differences in intensity, duration, and frequency of precipitation during the two periods. U. S.

5. Brown, C. B., The Control of Reservoir Silting, U.S. D. A. Soil Conservation Service Misc. Publication No. 521, Washington, D. C., 1944.

Table 1

Summary of Sedimentation Data on Lake Calhoun
Galva, Illinois

			Quantity	Unit
Age:[1]		1924-1936	11.9	Years
		1936-1947	11.0	Years
		1924-1947	22.9	Years
Watershed:		Total area[2]	13.1	Square miles
		Net area[3]	13.0	Square miles
Reservoir:				
Area at spillway stage:	Original (El. 715.75)		46.1	Acres
	1936 (El. 715.75)		44.3	Acres
	1947 (El. 718.64)		50.2	Acres
Storage capacity at crest level:	Original (El. 715.75)		285.6	Acre-feet
	1936 (El. 715.75)		136.7	Acre-feet
	Original (El. 718.64)		424.7*	Acre-feet
	1947 (El. 718.64)		112.4	Acre-feet
Capacity per square mile of drainage area:[2]	Original (El. 715.75)		21.80	Acre-feet
	1936 (El. 715.75)		10.44	Acre-feet
	Original (El. 718.64)		38.42	Acre-feet
	1947 (El. 718.64)		8.58	Acre-feet
Sedimentation:				
Total sediment accumulation:		1924-1936[4]	151.7	Acre-feet
		1936-1947	160.7	Acre-feet
		1924-1947	312.4	Acre-feet
Average annual accumulation:				
From entire drainage area:		1924-1936	12.75	Acre-feet
		1936-1947	14.61	Acre-feet
		1924-1947	13.64	Acre-feet
Per square mile of drainage area:[3]		1924-1936	.98	Acre-feet
		1936-1947	1.12	Acre-feet
		1924-1947	1.04	Acre-feet
Per acre of drainage area:[3]	By volume:	1924-1936	66.76	Cubic feet
		1936-1947	76.49	Cubic feet
		1924-1947	71.41	Cubic feet
	By weight:[5]	1924-1936	1.88	Tons
		1936-1947	2.14	Tons
		1924-1947	2.00	Tons
Depletion of Storage:				
Loss of capacity per year (El. 715.75):		1924-1936	4.38	Percent
Loss of capacity per year (El. 718.64):		1924-1936	3.00	Percent
		1936-1947	3.44	Percent
		1924-1947	3.21	Percent
Total loss of capacity (El. 715.75):		1924-1936	52.10	Percent
Total loss of capacity (El. 718.64):		1924-1936	35.72	Percent
		1936-1947	37.84	Percent
		1924-1947	73.56	Percent

1. Storage began September 1, 1924; average date of first survey, July 23-August 6, 1936; average date of re-survey, July 24-25, 1947.
2. Including area of lake.
3. Excluding area of lake.
4. Includes 2.8 acre-feet of above-crest deposits.
5. Based on volume-weights of 12 sediment samples taken in 1947. Average sediment density equals 56.0 pounds per cubic foot.

* In 1946, the spillway was raised from elevation 715.75 to 718.64 feet above mean sea level. Had the spillway been built originally at this elevation, the storage volume would have been 424.7 acre-feet.

Weather Bureau records at Galva, Illinois, show that during the earlier period (1924-1936) mean annual precipitation was 31. 72 inches, while during the latter period (1936-1947) the mean was 32. 33 inches. The long-term annual mean is 32. 02 inches. Since mean average precipitation does not provide information on the intensity, duration, and frequency of precipitation, it is of little value in explaining the increased sediment production. Increased sediment production may also be due to increased intensity of land cultivation in recent years.

Distribution of Sediment. The heaviest deposition has occurred in the upper part of the lake. Percent loss of capacity in the nine segments range from 87 percent in the headwaters at the extreme northeast end of the lake to 54 percent loss of storage near the dam. Figure 5 verifies this and also shows that there would be very little water in the upper section of the lake had not the elevation of the spillway been raised. In no segment does there remain more than 46 percent of the original storage capacity. Figure 5 shows the cross-sections of water and sediment along ranges 01-02 and 011-010 located as shown in Figure 3.

In Table 2 the sedimentation in Lake Calhoun is tabulated in comparison to similar results on four other reservoirs in Illinois. The effect of the capacity-watershed ratio on the storage loss is exemplified by comparing Lake Calhoun to Lake Bracken, near Galesburg. The original capacity-watershed ratio of Lake Bracken was nearly ten times as great as Lake Calhoun. Also, Lake Bracken has lost an average of only 0. 58 percent of original capacity each year, while Lake Calhoun has suffered a loss of 3. 21 percent per year.

Carthage reservoir was constructed with an original storage capacity of 406 acre-feet. This lake receives the drainage from 2. 94 square miles. Lake Calhoun, however, with a comparable original storage volume of 424. 7 acre-feet, was constructed to receive the drainage from 13.0 square miles. The rates of sediment production are not greatly different—2.47 tons per acre per year at Carthage and 2. 00 tons per acre per year at Lake Calhoun. However, percentage-wise, the sedimentation in these two cases is greatly different; the Carthage reservoir has lost only 1. 03 percent per year while Lake Calhoun has lost 3. 21 percent each year.

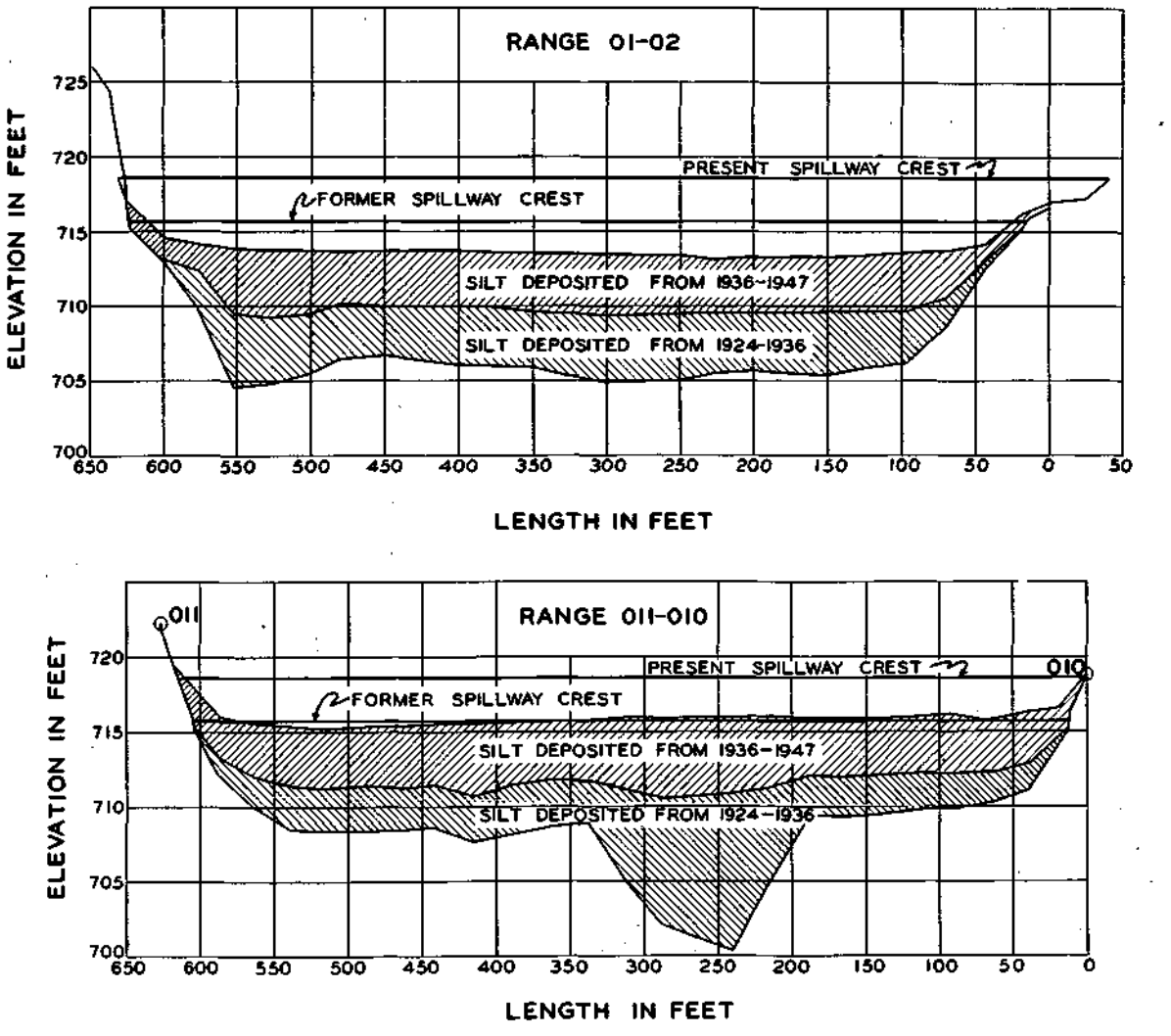

FIG. 5. TYPICAL SEDIMENT CROSS SECTIONS, LAKE CALHOUN.

Table 2

SEDIMENTATION OF LAKE CALHOUN COMPARED TO OTHER ILLINOIS RESERVOIRS

	Lake Calhoun	Lake Bracken, Galesburg	Ridge Lake, Charleston	Carthage Reservoir	Spring Lake, Macomb
Watershed area, square miles	13.1	9.14	1.41	2.94	20.2
Original capacity, acre-feet	424.7	2,881	187.4	406	607
Original capacity/watershed ratio, acre-feet per square mile	38.42	315.3	132.9	138	30.05
Age when surveyed, years	22.9	25.6	6.42	23.4	20.4
Total loss of capacity, percent	73.56	14.90	8.27	24.1	47.28
Annual loss of capacity					
Acre-feet	13.64	16.8	2.44	4.2	14.23
Percent	3.21	0.58	1.29	1.03	2.32
Annual rate of sediment production					
Cubic feet/acre	71.41	129.1	120.3	99	48.19
Tons/acre	2.00	3.37	4.36	2.49	1.44

SEDIMENT CHARACTERISTICS

Analyses Made. The chemical and physical characteristics of the Lake Calhoun sediment were determined by analysis of sediment samples taken from representative locations within the lake, as shown in Figure 3. These sediment samples were analyzed for total nitrogen, total organic carbon, pH, available potassium, available phosphorus, and volume-weight. Two samples, number 4 and 6, were analyzed for base-exchange characteristics and particle size distribution. The data are given in Table 3.

The sediments appear to be quite uniform in their chemical and physical characteristics. The total nitrogen values vary only from 0.13 to 0.24 percent, and the total organic carbon values range from 1.47 to 2.77 percent. Similarly, values for volume-weight vary only from a low of 0.703 to a high of 1.09. This uniformity suggests considerable water movement within the lake and probably a uniformity in depth of sediment deposition. While samples 4, 5, 7, and 9 are uniformly low in volume-weight and high in organic carbon, and samples number 1, 2, 3, 6, and 8 are higher in volume-weight and lower in organic carbon, these differences are not as great as one would expect from the relative locations of these samples in the lake. However, some sorting of sediment has occurred within the lake with the finer deposits nearest to the dam.

Origin of Sediment. The uniformity of texture and chemical characteristics of the sediments indicate that the origin of the sediments must be largely loess and loess-derived soils.

A comparison of the chemical characteristics of the sediment samples taken in 1947 with those of samples taken in 1936 (Table 4) reveals that no apparent change has occurred in the nature of the sediments deposited during this period. In 1936, as now, the sediment materials were quite uniform. This lack of change in the nature of the sediments would seem to indicate that erosion patterns within the watershed are similar to what they were in 1936. Sediment control should, therefore, include measures necessary to prevent erosion on the more sloping cultivated areas of the watershed.

Table 3

Chemical and Physical Data on 1947 Lake Calhoun Sediment Samples

Sample No.	Range	Total N (%)	Total C (%)	Base Ex. Capacity (m.e./100)	Total Bases (m.e./100)	Volume Weight	pH	Available K (lb./acre)	Available P (lb./acre)	Sand (%)	Silt (%)	Clay (%)
1	R14-R15	0.13	2.36			0.842	7.75	300+	100			
2	R14-R15	0.20	2.22			1.02	7.10	300+	123			
3	R14-R15	0.19	1.47			0.998	7.00	300+	104			
4	R4-R3	0.24	2.45	35.6	35.7	0.762	7.00	300+	129	0.1	45.9	49.3
5	R4-R3	0.19	2.26			0.729	7.11	300+	126			
6	R13-R12	0.16	1.90	25.7	29.7	1.09	7.40	300+	144	0.4	65.3	31.1
7	R2-R1	0.23	2.77			0.703	6.62	300+	100			
8	R9-R8	0.13	1.45			1.06	7.75	280	164			
9	R5-R4	0.21	2.44			0.789	6.64	300+	107			

Table 4

CHEMICAL DATA ON 1936 LAKE CALHOUN SEDIMENT SAMPLES

Laboratory Sample No.	Range	Total Organic Carbon (percent)	Total Nitrogen (percent)
S 10860	01-02	2.69	0.257
S 10861*	03-04	2.49	0.238
S 10862	03-04	2.76	0.261
S 10863	03-05	2.42	0.242
S 10864	03-05	1.43	0.229
S 10865	08-09	1.45	0.134
S 10866	012-013	2.31	0.201
S 10867	012-013	2.28	0.208
S 10868	012-013	2.56	0.244
S 10869	014-015	1.97	0.167
S 10870	014-015	2.17	0.200
S 10871	014-015	2.33	0.194
S 10872	014-015	2.07	0.185

*Sample S 10861 contained 39.1 percent clay.

INTRODUCTION

There are a number of factors that may influence the rate of siltation in a lake or reservoir. Among these factors are the size, shape and age of the reservoir, the size of the drainage area, the general topography and steepness of slopes, rainfall characteristics, the kind of soil and the land use pattern. The influence of each of these factors must be evaluated in a watershed where a study is being made of the effects of these factors on rate of siltation. Some of these factors can be adjusted to reduce siltation in the reservoirs, whereas others are permanent physical conditions that cannot be changed.

In an effective sediment-control program for a reservoir or lake the principal sources of sediment must be determined. A detailed soil conservation survey map was prepared by the Soil Conservation Service in the watershed. A special study of the farming conditions was also made. The survey consisted of mapping the kind of soil, percent of slope, degree of erosion and present land use on aerial photos having a scale of 4 inches to a mile. Channel erosion and amount of deposition were also recorded on the survey. A sample system was used in which a 160-acre block was mapped out of each section of land. The sample survey data were extended to represent 8400 acres. The total land area of the basis is actually only 8,320 acres or 13 square miles. Standard soil conservation survey procedures were followed in the preparation of the field maps.

The watershed lies in Lynn Township, Knox County, Goshen Township in Stark County and in Galva Township, Henry County, Illinois. The drainage area is 13. 0 square miles in size and located in the headwaters of Fitch Creek (Figure 1).

The topography in this watershed is level to gently rolling with a small percentage of strongly

Table 5

ACREAGES AND PERCENTAGES OF VARIOUS SOIL GROUPS
IN LAKE CALHOUN WATERSHED

Soil Group	Area	
	Acres	Percent
1. Dark-colored, medium-textured, moderately permeable soils:		
Edgington silt loam group*	107	1.3
Muscatine silt loam group (2 color profile)	1,329	15.8
Muscatine silt loam group (3 color profile)	3,607	42.9
Tama silt loam (shallow to till) group	45	0.6
Tama silt loam group	1,058	12.6
Total	6,146	73.2
2. Light-colored, medium-textured, slowly permeable soils:		
Berwick silt loam group	55	0.7
Blair silt loam group	55	0.7
Clinton silt loam group (mottled phase)	30	0.3
Total	140	1.7
3. Light-colored, medium-textured, moderately permeable soils:		
Clary-Fayette silt loam group	482	5.7
Clary silt loam group (shallow to till)	961	11.4
Hickory gravelly loam group	299	3.6
Total	1,742	20.7
4. Bottomland soils:		
Huntsville loam group	303	3.6
Imperfectly drained Huntsville group	69	0.8
Total	372	4.4
Entire Watershed	8,400	100.0

*Moderately slowly permeable.

rolling land adjacent to drainageways. The general land formation consists of a thick loess covering over weathered glacial drift. Only on the very steepest slopes or seriously eroded spots is till exposed on the surface.

SOIL GROUPS

Four general groups of soil may be found in the watershed, namely (1) dark-colored, medium-textured, moderately permeable (Muscatine-Tama) soil group, (2) light-colored, medium-textured, slowly permeable (Berwick-mottled Clinton) soil group, (3) light-colored, medium-textured, moderately permeable (Fayette-shallow Clary) soil group, and (4) the bottomland (Huntsville) soil group. The acreage and percentage of each of the soil groups may be found in Table .5. Figure 6 shows the general location of these soil groups.

The dark-colored, medium-textured, moderately permeable soil group, Group 1, consists of soils derived largely from loess. On level areas these soils are poorly oxidized and require tile drainage. On the sloping land the soils are well oxidized and erosion is the dominant problem. These soils are very productive and respond well to good management.

Soil group 2, the light-colored, medium-textured, slowly permeable soils are those poorly to imperfectly drained soils that occur on the ridge tops adjacent to the steeper drainageways. Some soils in this group are mapped on slopes which indicate a slowly permeable layer in the subsoil. Small areas of other soil groups are included with this group on the map shown in Figure 6. Good rotations that will improve the internal air-water relationship will improve these soils a great deal. They are generally low in organic matter and respond to good management.

Soils included in group 3 are light-colored, medium-textured, moderately permeable and well drained. These soils occur along the steeper

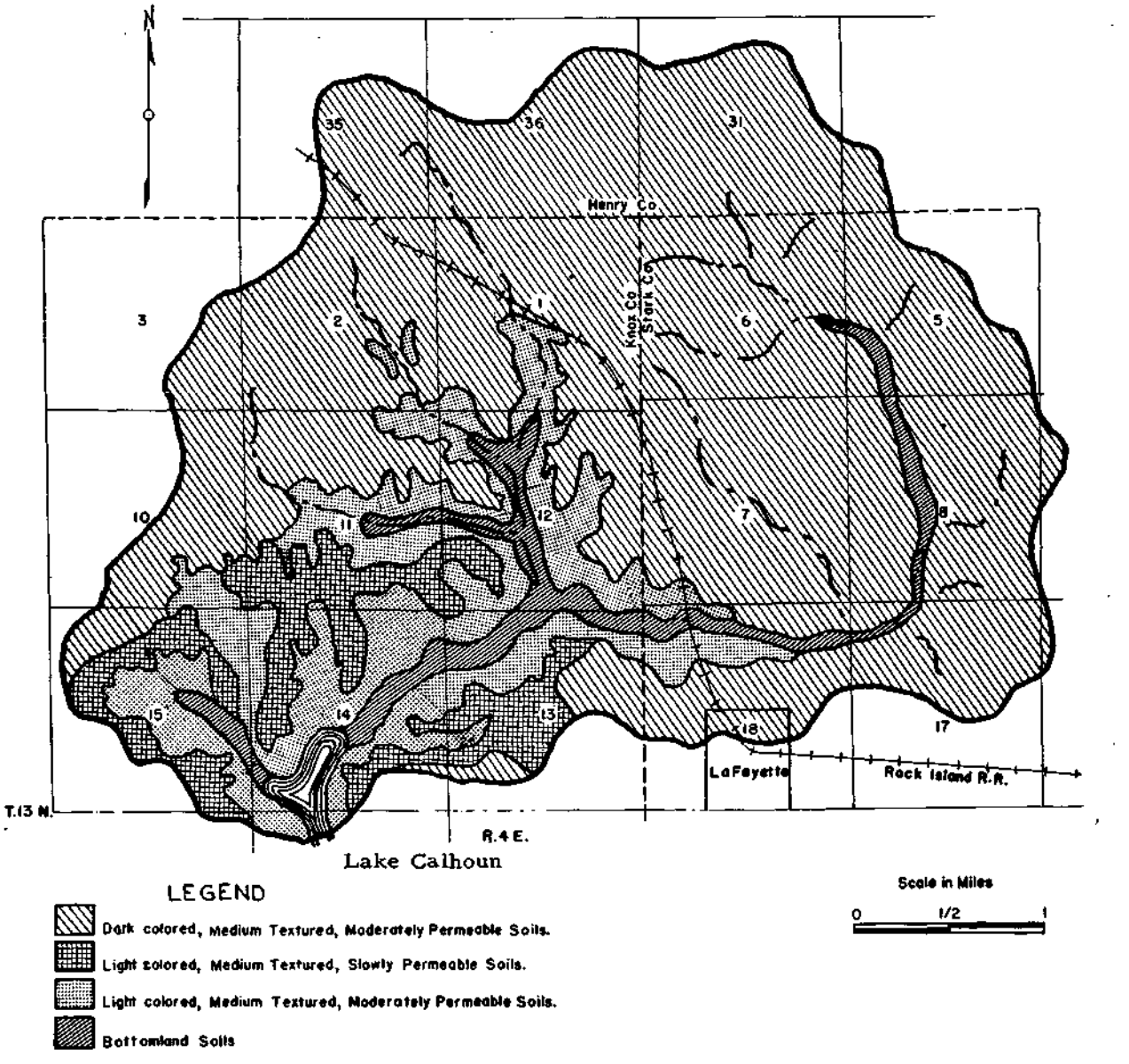

FIG. 6. GENERALIZED SOIL GROUP MAP. LAKE CALHOUN WATERSHED, ILLINOIS.

Table 6

ESTIMATED CROP YIELDS IN LAKE CALHOUN WATERSHED
ON SOILS UNDER GOOD AND FAIR MANAGEMENT*

Soils	Percent of Watershed	Soil Management System	Average Yields (bushels per acre) Corn	Soybeans	Oats
1. Dark-colored, medium-textured, moderately permeable soils	73.2	good	75	27	46
		fair	69	26	43
2. Light-colored, medium-textured, slowly permeable soils	1.7	good	45	19	36
		fair	40	16	33
3. Light-colored, medium-textured, moderately permeable soils	20.7	good	64	24	37
		fair	59	20	30
4. Bottomland soils	4.4	variable, depending on overflow			

*Crop yields estimated from data in Illinois Agricultural Experiment Station Bulletin No. 522.
†Yields apply only to areas suitable for safe cultivation.

drainageways and on the narrow ridge tops. They respond well to good management but are subject to severe erosion. These soils rank second in total acreage in the watershed and comprise approximately 21 percent of the area.

The bottomland soils (group 4) vary a great deal in their potential use. The soils are dark in color and are very productive; however, they occur along drainageways that vary in frequency of flooding. In addition, many of the smaller bottoms are cut up by meandering stream channels resulting in areas too small to cultivate.

The relative productivity of the soils in the watershed may be found in Table 6.

SLOPES

It is generally assumed that in humid agricultural areas, such as Illinois, there is a high correlation between the amount of soil washed from the fields in the watershed and the amount of sediment deposited in the reservoir or lake. If this is true, then the factors that influence soil loss from the fields should be carefully evaluated to determine proper control measures.

The steepness of slope is one of the most important factors affecting soil loss. Soil Conservation Erosion Experiment Stations[6,7] throughout the country have found that as the steepness of slope is doubled the soil loss increases two and one-half times. Figure 7 shows this relationship.

The slopes in the watershed range from level to over 30 percent. Table A in the appendix indicates the distribution of slopes by soil groups. Figure 8 shows the percentages of the various slope groups in the watershed.

Eighty-five percent of all the level land in the watershed occurs in soil group 1 (dark-colored upland soils). Of the soils found on gently sloping land ("B" slopes), 90.4 percent are classified as soil group 1. On the moderately sloping land ("C" slopes) 78.4 percent of the soils occur in soil group 1. All of the soils found on steeper slopes (over 18 percent) are light-colored, medium-textured, moderately permeable group 3 soils.

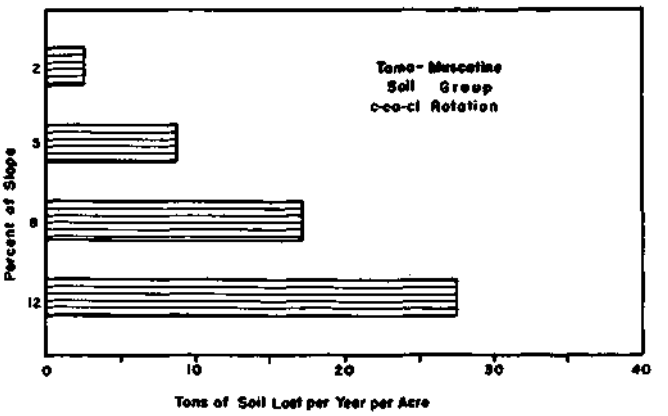

FIG. 7. EFFECT OF SLOPE ON EROSION. (Based on slope and practice data.)

6. Van Doren, C. A. and Gard, L. E., Protecting Your Soil, University of Illinois in cooperation with Soil Conservation Service, Circular N. 667, Urbana, Illinois, 1950.

7. Hays, O. E. and Clark, Noble, Cropping Systems That Help Control Erosion, University of Wisconsin, Bulletin No. 452, Madison, Wisconsin.

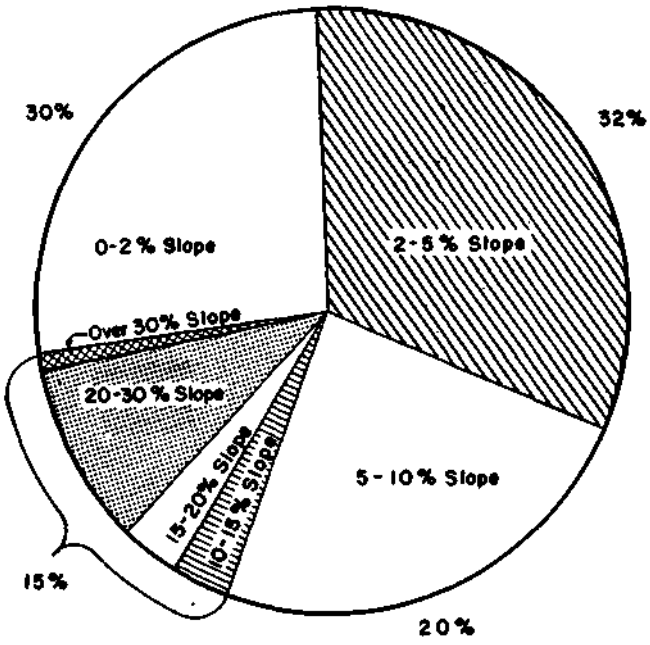

FIG. 8. PERCENTAGE OF VARIOUS SLOPE GROUPS IN LAKE CALHOUN WATERSHED.

PRESENT LAND USE

The present use of the land, whether it be used for cultivated crops, hay, pasture or woods, is another very important factor in soil losses from fields and rate of sediment production in lakes and reservoirs. Fields cropped too strenuously and without regard for slope may produce over one hundred times more soil loss than similar land conditions in permanent vegetation. Five different kinds of land use were classified in the watershed, namely: (1) cropland, (2) pasture land, (3) woodland, (4) idle land, and (5) miscellaneous. Cropland is land on which crops were grown at the time of the survey. This includes crops such as corn, beans, small grain and rotation hay and pasture. Pasture land is land in perennial grasses, and woodland is land which has at least a 40 percent canopy of trees. Miscellaneous land consists of land used for farmsteads, roads, etc., while idle land refers to those areas not used for purposes that would furnish an economic return. For details on the distribution of present land use by the various soil groups and slope groups refer to Tables B and C in the appendix. Figure 9 indicates the distribution of present land use in the watershed. Of the 8400 acres in the watershed, 6667 acres are in cropland, 1340 acres in pasture, 108 acres in woodland, 245 acres in miscellaneous use, and 40 acres in idle land use. Eighty-nine percent of the cropland in the watershed was classified in soil group 1 (dark-colored, permeable soil), whereas 72. 5 percent of the pasture land and 73. 1 percent of the woodland was identified as soil group 3 (light-colored, permeable soil).

Of the land in the watershed being used at the present as cropland 69. 2 percent is located on slopes of less than 5 percent slope, 30. 5 percent on slopes of 5 to 15 percent, and 0. 3 percent on slopes over 15 percent (see Table C, Appendix). Thirty-one and eight-tenths percent of the pasture land occurs on slopes of less than 5 percent, 9. 8 percent is on slopes of from 5 to 15 percent slope, and 58. 4 percent occurs on slopes over 15 percent slope. Ninety-five percent of the land classified as idle occurs on slopes over 15 percent in steepness.

The acreage and percentage of the various land use capability classes in Lake Calhoun watershed by present land use may be found in Table D (Appendix).

The land conditions in the watershed may be classified into three general categories and seven specific classes. The three general categories divide the land into those areas suitable for regular cropping (Class I, II and III land), those suited for limited cropping (Class IV land), and those suited for permanent vegetation (Class V, VI and VII land). The seven specific classes break these three general categories into classes of land according to the hazards involved in using the land. Table D further shows that approximately 78 percent of the watershed is suitable for regular cultivation, 6 percent suitable for occasional cultivation and 16 percent is best suited for pasture or woods. The percentage of the watershed now being cultivated is 79. 4 percent as compared with 84 percent that is suitable for regular and limited cultivation.

Figure 10 is a diagrammatic chart of Table D. It shows the percentage of the various land use capability classes in the watershed as well as the percentage of the various land classes now in cultivation. The greatest misuse of land in the watershed as shown by this figure is the 14 percent of Class VI land and 3 percent of Class VII land that is now being cultivated. This represents 125 acres

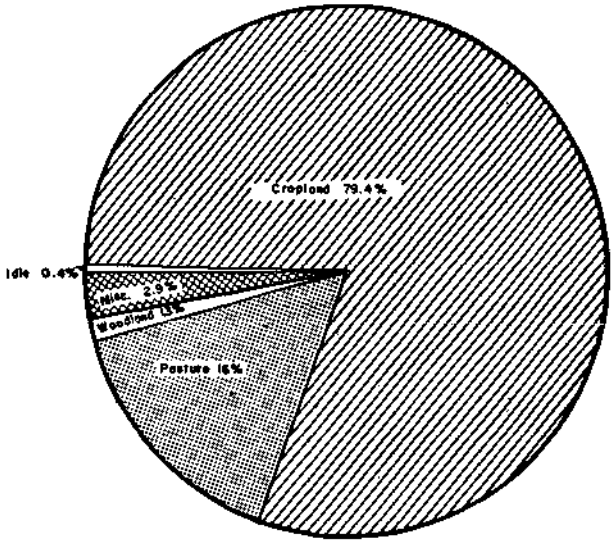

FIG. 9. DISTRIBUTION OF PRESENT LAND USE IN LAKE CALHOUN WATERSHED.

of land in the watershed that should be in permanent pasture or woods but is now being cropped. Another major misuse of land not shown in these tables is cropping the sloping land that is suitable for cultivation (Class II, III and IV) too strenuously and without regard for the direction of slope. This is brought out in Table 8 where a suggested watershed treatment program is presented.

The land use history of Galva Township, Henry County, and Lynn Township, Knox County, in which most of the watershed lies, is shown in Table 7.

A 10-year average (1938-47) in Galva and Lynn Townships indicates that 48 percent of the tillable land was in corn and soybeans, 21 percent in small grain, 27 percent in hay and pasture, and 4 percent miscellaneous. The intensity of cropping is not too strenuous for Class I land; however, it is too strenuous for the sloping land in the watershed. Only 34 percent of the cropland in the watershed can stand this intensive cropping without conservation practices and possibly another 36 percent if careful erosion control practices are followed. It can be generally concluded from these data that relatively large acreages in the watershed are being cropped too intensively to corn and soybeans.

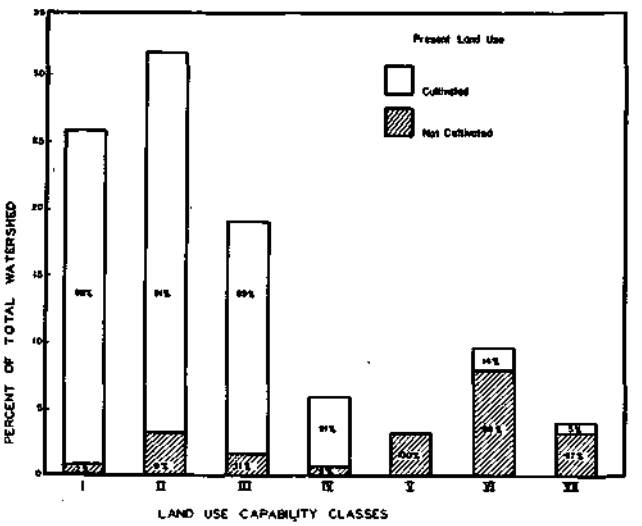

FIG. 10. PERCENTAGE OF THE VARIOUS LAND USE CAPABILITY CLASSES IN LAKE CALHOUN WATERSHED AND PERCENTAGE OF EACH CLASS IN CULTIVATION.

EROSION

In developing a watershed treatment program for protection of a lake or reservoir it is necessary to know the source of sediment and the rate of deposition. In order to analyze this problem both sheet and gully erosion, as well as areas of recent deposition, were recorded on the conservation survey maps. The following erosion groups were mapped:

No apparent erosion: Approximate original depth of topsoil remains.

Slight to moderate erosion: Over seven inches of the original topsoil remaining, no subsoil exposed by the plow.

Moderately severe erosion: Occasional to frequent exposure of subsoil by plow, three to seven inches of topsoil remaining.

Severe erosion: Erosion of the subsoil, less than three inches of topsoil remaining.

Table 7

AVERAGE LAND USE, GALVA TOWNSHIP, HENRY COUNTY, AND LYNN TOWNSHIP, KNOX COUNTY, ILLINOIS, 1938-47*

Items	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947
Acres per farm	147	149	149	155	158	159	164	166	164	165
Percent of farm tillable	85	85	86	84	86	86	86	93	93	93
Percent of tillable land in:										
Corn	46	42	39	41	40	42	45	42	42	43
Soybeans	5	7	8	4	9	6	6	5	4	4
Small grains	24	20	19	21	20	19	20	21	21	20
Hay and pasture	24	26	31	31	29	27	27	27	28	27
Other and idle	1	5	3	3	2	6	2	5	5	6

*Based on assessor's acreage census.

Table 8

Estimated Reduction in Sheet Erosion Annually from a Watershed Treatment Program
Lake Calhoun Watershed

Soil	Cultivated		Permanent Pasture		Woodland		Idle		Miscellaneous		Total Annual Soil Loss	
	Acres	Tons Soil Loss	Acres	Tons Soil Loss	Acres	Tons Soil Loss	Acres	Tons Soil Loss	Acres	Tons Soil Loss	Tons	%
PRESENT LAND USE												
1. Dark-colored, medium-textured, moderately permeable soils	5,959	49,807	77	46	---	---	---	---	110	64	49,917	71
2. Light-colored, medium-textured, slowly permeable soils	41	3,083	93	55	---	---	---	---	6	4	3,142	5
3. Light-colored, medium-textured, moderately permeable soils	523	15,674	972	585	78	47	40	25	129	77	16,408	24
4. Bottomland soils	144	-----	198	---	30	---	---	---	---	---	------	---
Total	6,667	68,564	1,340	686	108	47	40	25	234	145	69,467	100
RECOMMENDED LAND USE												
1. Dark-colored, medium-textured, moderately permeable soils	5,959	6,241	77	15	---	---			110	64	6,320	
2. Light-colored, medium-textured, slowly permeable soils	-----	-----	134	27	---	---			6	4	31	
3. Light-colored, medium-textured, moderately permeable soils	441	965	919	185	254	51			129	77	1,278	
4. Bottomland soils	144	-----	198 (1)	---(1)	29	---			---	---	-----	
Total	6,544	7,206	1,328	227	283	51			245	145	7,629	

Total soil loss annually under present land use was 69,467 tons.
This is an average annual soil loss of 8.3 tons per acre per year.

Total soil loss annually under proposed land use is 7,629 tons.
This is an average annual soil loss of .9 ton per acre per year.
This is a reduction in soil loss from the watershed of 89%.

General Notes

(1) Land capability Class V land.

(2) A soil loss factor of 0.2 ton per acre was assumed on pasture and woods under the conservation program and 0.6 ton under present management. No loss was assumed on level pasture, woods or on the bottoms.

(3) Rotations used as basis for land use without program were based on assessor's acreage figures for Galva Township in Henry County and Lynn Township in Knox County. This rotation was a corn, corn, oats and clover rotation.

(4) Slope and practice data and land use capability recommendations were used as the basis for the recommendations in this conservation program.

(5) It is assumed in the proposed program that all land in cropland and pasture in the watershed will be treated according to soil test. All pastures will be renovated and seeded to desirable grasses and legumes, and proper grazing management will be used.

It is estimated from the results of the survey that over 95 percent of the eroded material comes from sheet erosion. A program to reduce siltation in the lake would necessarily require conservation measures and practices that would greatly reduce sheet-erosion in the watershed. Figure 11 shows the amount of the various erosion classes in the watershed.

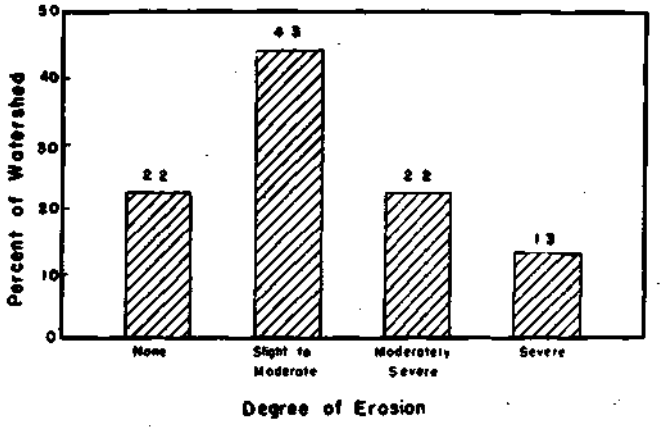

FIG. 11. PERCENTAGE OF DIFFERENT EROSION CLASSES IN LAKE CALHOUN WATERSHED.

The percentages of the total watershed classified as moderately severe and severe erosion were determined by measuring the amount of soil eroded from the fields in the past. These two erosion classes represent 34 percent of the acreage in the watershed, or 2969 acres. Moderately severe erosion indicates 25 to 75 percent of the topsoil removed and some subsoil being mixed with the plow layer, while severe erosion denotes that 75 percent or more of the topsoil is removed and the plow layer is largely subsoil. Approximately 61 percent of the severe erosion is found in the number 3 soil group (light-colored, well drained soil), while 71. 3 percent of the moderately severe erosion occurs on the number 1 soil group (dark-colored upland soil). For details on the distribution of the various erosion classes according to soil group, slope group and present land use refer to Tables E, F, and G in the appendix.

Figure 12 indicates that a relatively large percentage of the land now in cultivation in the watershed is moderately severely to severely eroded. There is little doubt but that these two erosion classes, comprising 32 percent of all the cropland in the watershed (2149 acres), has contributed a great deal to the rate of siltation in Lake Calhoun. In addition to the cropland that has been badly eroded, over 50 percent of the land now in pasture has less than half of the original topsoil remaining (Table G, Appendix). This probably indicates that this eroded pastureland was in cultivation at one time and when it became relatively unproductive through erosion it was converted to pasture.

CONSERVATION

Land in the Lake Calhoun watershed has been farmed without due regard for the kind of soil or steepness of slope. Land, like livestock, differs in its ability to produce. Some kinds of land can be cultivated and allowed to remain in clean tilled crops one-half the time while other kinds of cropland should be in hayland 50 to 75 percent of the time. Some land needs erosion control practices applied to the cropland while others should remain in permanent vegetation. A great deal of the sloping land in the watershed has been farmed as strenuously as the level productive areas. As a result, erosion has taken its toll. There are two main factors that have been very instrumental in producing high soil losses from the fields in the watershed. These factors are (1) cropping the sloping land to the same degree of intensity as the level land, and (2) failing to use erosion-control practices on the sloping cropland. Although the census data indicate that the average percentage of cropland in clean-tilled crops in the watershed is 48 percent, there are many individual fields and farms where corn and soybeans are grown four years out of five. This cropping system is practiced on these fields irrespective of the slope of the land. This practice results in high soil losses. There are other factors of lesser importance, such as failing to maintain grass waterways in fields and along road right-of-ways and the overgrazing of pastures and woods.

The first step in a sound watershed treatment program is to classify the land according to its abilities to safely produce crops such as corn, grain, hay, pasture and woods. Soil conservation survey maps such as those developed for a portion of the watershed, supply the necessary information needed to develop a sound land use program. These maps should be prepared on the remainder of the watershed to supply the needed

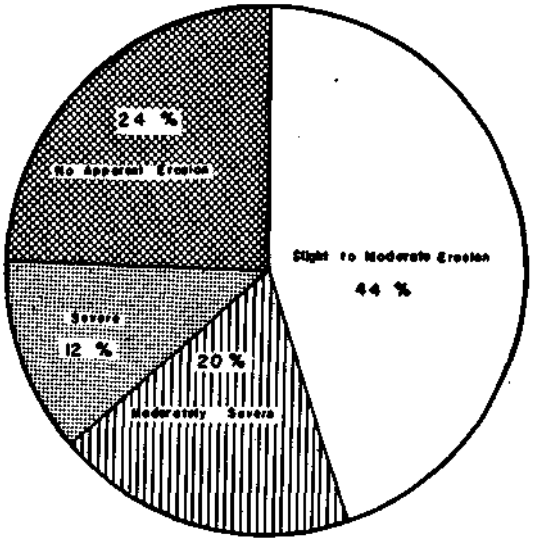

FIG. 12. DISTRIBUTION OF THE FOUR EROSION CLASSES IN THE PRESENT CROPLAND IN LAKE CALHOUN WATERSHED.

basic land information on each field and farm.

Soil tests should be made on all crop and pasture land to determine limestone, phosphate and potash needs. These mineral elements should be applied according to needs in order to grow good stands of legumes and grasses required in a rotation and pasture program that will economically control erosion. The best level land in the watershed should remain in grasses and legumes at least one-fourth of the time. The sloping land suitable for cropping should remain in grasses and legumes a higher percentage of the time. All sloping cropland should be farmed with the slope and adequate erosion control practices used. Properly designed waterways should be established along all watercourses.

Many of the permanent pastures in the watershed are eroded but may be renovated so as to provide greater erosion control and yield larger economic return. Pasture management is essential along with renovation to insure the greatest farm return. Earth and concrete structures may be needed along some watercourses and at the tile outlets. In order to reduce soil loss and also to encourage new growth, timber areas should not be grazed. Isolated areas along drainageways, fence corners and small steep or eroded areas might profitably be planted to desirable shrubs or trees to provide adequate cover for wildlife. Increased wildlife population is most profitable to have in the watershed. They assist in keeping insects under control as well as serving recreational and aesthetic purposes.

RESULTS

CAUSES OF HIGH RATE OF STORAGE LOSS

Watershed Factors. Under present land use conditions it is estimated that the mean annual soil loss from fields in the Lake Calhoun watershed is 8. 3 tons per acre per year (Table 8). During the life of the lake, however, the sediment deposited in the lake has averaged only 2. 0 tons per year per acre of drainage area. This difference is caused by two things. First, a substantial amount of the soil which is eroded from the field may be moved only a short distance and deposited as colluvium at the edge of a field, or as alluvial fans within the stream system or on the stream floodplain during floods. The channels and streams may not have gradients and capacities to carry all of the soil broken losse from the field, all the way into the lake. The remainder is deposited out before it reaches the lake. The second factor affecting this apparent difference is the effectiveness of the lake in trapping the sediment which is carried into the lake.

Reservoir Factors. The trap efficiency of the lake is dependent on the detention time of the inflow and the particle-size of the sediment load. A usable index to probable trap efficiency has been devised by Brown[8] by using capacity-watershed ratio data. By this means it is estimated that as originally constructed in 1924 at spillway elevation 715.75 M.S.L. and having a C/W ratio of 2 1. 8 (see Table 1) Lake Calhoun probably trapped about 70 percent of the incoming sediment. This checks fairly well with results found at Decatur, Illinois,[9] where, on the basis of turbidity records, it was estimated that only 75 percent of the sediment was trapped in the lake during its life. Lake Decatur had an original C/W ratio of 21. 8 acre-feet per square mile; this had been reduced to 16. 1 by 1946.

By 1936, the C/W ratio of Lake Calhoun had been reduced to 10. 4 acre-feet per square mile (see Table 1), and the lake probably trapped only 30 percent of the incoming sediment. By 1947, with a C/W ratio of 8. 6, the percentage of sediment trapped may have been as low as 20 percent.

The high rate of storage loss in Lake Calhoun is due to the small-capacity lake developed in relation to the above-normal rate of sediment inflow from the watershed.

The 1936 survey and report stated, "The findings of this survey indicate that Lake Calhoun has too large a watershed in relation to its storage capacity."[3] This finding is confirmed by the present study.

REMEDIAL MEASURES

Practicability. The condition of the lake in the last several years has been such that the use of the lake has been hampered. While the lake has been utilized only for recreational purposes, the advanced stage of sedimentation in the lake has greatly reduced the usefulness of the lake. In 1947 the deepest water in the lake was 5. 5 feet and 3 feet of this depth was created by the raise in the spillway in 1946. Even after this rise in water level, much of the upper lake was unsuitable for boating and parts of it were practically inaccessible because of the shallow water.

The complete draining of the lake by the 1950 spillway failure stopped all recreational activities dependent on the water, such as swimming, boating and fishing. Because of the money already invested by the lake association in the area, it is

8. Engineering Hydraulics, Chapter XII, Sediment Transportation, by Carl B. Brown, p. 827. John Wiley and Sons, New York, 1950.

9. Brown, C. B., Stall, J. B., and DeTurk, E. E., Causes and Effects of Sedimentation in Lake Decatur, State Water Survey Division, Bulletin No. 37, Urbana, Illinois, 1946.

believed desirable to consider measures to recreate and perpetuate the lake. Because of the great damage caused here by sediment in past years, however, present efforts to rebuild and perpetuate the lake should be based on a realistic concept of the sedimentation problem. In order to prevent or minimize future sediment damages, the remedial measures at this lake should be cautious and well planned. In comparison to the remedial measures discussed herein, the lake owners should seriously consider the possibility of complete abandonment of Lake Calhoun at the present site. This would detract from the value of the present clubhouse and cottages, but the area offers great recreational facilities even in the absence of the lake. While this prospect is not a very pleasant one, it should be given due consideration in light of the enormous sediment problem and other possible remedial measures, including the probable present and future costs and benefits of each.

Raising the Dam. One of the first steps usually considered by lake owners in increasing storage capacity is that of raising the spillway and possibly the dam. Such action is usually subject to limitations as the original dam and spillway were possibly designed to give the most economical project available at that site. As previously mentioned, the spillway at Lake Calhoun was raised three feet in 1946. Since State Highway No. 17 crosses the dam, the cost of removing and replacing the highway must be added to the cost of raising the dam alone.

The raising of the entire dam and spillway would flood additional lands near the present headwaters of the lake. A rise of the lake level would put the lake's edge very near the basement floor of the present clubhouse. If such a raise were made, the clubhouse would have to be moved uphill. The topography is such that an additional elevation of 10 to 20 feet could be gained by moving the clubhouse up the steep bank.

If the present dam and spillway were raised 10 feet above the present 718 M. S. L., the lake created would have a capacity of approximately 1280 acre-feet total, including the 112 acre-feet remaining in the present lake. This larger lake would have a C/W ratio of about 98 acre-feet per square mile of drainage area. The present watershed rate of sediment production, with corresponding increase in trap efficiency, would deplete this new storage capacity at 1. 0 to 1.5 percent per year compared to the 3.21 percent per year suffered in the past at Lake Calhoun. (See Table 1.)

Construction of An Additional Reservoir. Preliminary consideration has been given by the lake owners to construction of a new dam on Fitch Creek at a site one-half mile south of the present dam. At the same water level elevation as the present Lake Calhoun, such a lake would impound about 720 additional acre-feet of water. In addition to the 112 acre-feet remaining in the present lake, total storage would be 832 acre-feet. The capacity-watershed ratio of the new project would thus be 63. 5 acre-feet per square mile. The rate of sediment production experienced in the past in this drainage area would deplete such a lake at a rate of about 1. 6 to 2. 0 percent per year. This is in comparison to the 3. 21 percent lost annually in past years in Lake Calhoun. (See Table 1.)

Dredging. In the program of sedimentation control, consideration must be given to the possibility of the removal of the sediment from the lake by dredging. Past studies have shown that the unit cost of dredging is usually high in comparison to other methods of regaining storage space.

As mentioned previously, the lake in its 1947 condition trapped only an estimated 20 percent of the sediment entering the lake. If the entire sediment in the lake were removed by dredging, the lake would then trap approximately 70 to 80 percent of the incoming sediment. On a long-term basis, under present watershed conditions, the dredged lake would silt at about the same rate as it has in the past.

Sediment Basins. From a long-range planning standpoint, upstream sediment basins must be considered as temporary measures. These basins silt up the same as reservoirs and eventually become ineffective. In addition, the cost of constructing such a basin is generally greater per unit of storage than the reservoirs it protects.[5] The building of numerous farm stock ponds properly constructed and located strategically could serve as miniature sediment basins as well as to serve livestock needs, fire protection, and fish production.

Vegetative Plantings. Proper soil treatment, adequate crop rotation, erosion control practices on sloping land, and a sound pasture renovation and management program on this watershed are essential. In addition, the planting of trees and shrubs in areas suited for woodland or wildlife is highly desired. The local farm adviser and soil conservation district personnel should be consulted for land use planning.

Thick-growing willows or other vegetation could be introduced into the shallow areas of upper Lake Calhoun. Such growths would tend to reduce the velocity of inflowing waters and induce sediment deposition above spillway level in the upper part of this lake.

Watershed Treatment Program. Sedimentation data obtained on Lake Calhoun indicate that by 1947 the lake had been reduced to approximately one-fourth of its original capacity. This represents not only a loss to the community from the standpoint of recreational facilities but also a severe loss to the farmers. This sediment represents many thousands of dollars in plant food and valuable topsoil. Fertilizer can be purchased and

returned to the land, but organic matter and topsoil cannot be readily or economically replaced.

It is far more economical to stop the sediment at its source than to dredge it from a lake or build a new dam. The possibilities and limitations of reducing sedimentation in a reservoir by means of conservation measures on the watershed have been reported in a study by Carl B. Brown.[10] He states:

> "Most of the sediment deposited in reservoirs of low C/W ratio is bed load material. The fine wash load, which our present conservation program is reducing materially and proportionately much more than bed load, mostly passes over the dam. In general, therefore, we are forced to conclude that reservoirs of low C/W ratio will not be protected by the soil conservation districts programs because: First, these programs do not rapidly reduce the bed load inflow, which primarily causes the silting; second, such reservoirs are silting rapidly and the time available to protect them is too limited with respect to time required for application of control measures; and third, the value of such reservoirs does not ordinarily justify supplementary control works which would retard bed load movement. "

On the basis of the conservation survey made in the Lake Calhoun drainage area and described earlier in this report, a program of land treatment has been drawn up. This program is based on the agricultural use of the farm land in accordance with its physical capabilities. The program will reduce greatly the loss of soil from the farmers' fields and will thus reduce the sediment reaching Lake Calhoun.

However, at present Lake Calhoun traps only an estimated 20 percent of the sediment reaching the lake. Under this condition, only the largest size particles are caught in the lake; the finer material passes on over the spillway. The conservation program outlined in Table 8 for the watershed will materially reduce the rate of sediment reaching the lake. This proposed watershed treatment is the most strenuous use to which the land should be farmed. It is estimated from the data available that the soil loss under the proposed watershed treatment program would reduce the present loss of 69, 467 tons annually to 7, 629 tons annually. This represents an 89 percent reduction of the soil leaving the fields. It is reasonable to assume that reducing the amount of soil lost from the fields will also result in smaller amounts of sediment reaching the reservoir.

Tables 8 and 9 itemize a general watershed treatment program. In order to develop a sound land use program on farms, assistance should be obtained from the farm adviser or the local soil conservation district. Although the measures shown in Table 9 are designed largely to reduce sheet erosion from the field, it is estimated that over 95 percent of the total load entering the reservoir is derived from this source. The proposed program would result in a reduction of approximately 84 percent of the total sediment load brought to the lake. Because of other factors discussed above, however, principally the very low capacity-watershed ratio of Lake Calhoun, it is not believed that a large reduction in the rate of sediment deposition in the lake can be accomplished by the watershed program. Although the sediment load reaching the lake can be reduced by 84 percent, or to 16 percent of its present value, this 16 percent is approximately equal to the small portion of the present load which now stops in the lake. An 84 percent reduction would thus not have a great effect in protecting the lake.

To recommend a long-range watershed treatment program to reduce sedimentation in Lake Calhoun under its present condition may seem useless. However, the methods and treatments prescribed in this program can be successfully used to protect a larger Lake Calhoun if the dam were raised, or on a new site should another lake be built. Disregarding the value of a watershed treatment program as outlined in Table 8 for reducing silting in the lake itself, the program would repay the farmers many times in benefits reaped from greater yields and a permanent long range soil management program. This proposed program provides for farming the land in such a manner as to obtain the maximum economical returns over a long period of time as well as to reduce the present soil losses from the fields approximately 89 percent.

The data in Table 8 showing the estimated soil loss in the watershed from the present farming system as compared to the proposed program were developed from the soil conservation survey maps and available research information.[11] These soil loss figures are relative and are especially valuable in comparing the differences between the present and proposed program.

In comparing the present with the proposed program the greatest reduction in soil loss occurs on the cultivated land. The soil loss from the present program is over ten times greater than from the proposed watershed program. The great reduction in soil loss is due largely to growing less cultivated crops on the sloping land and to the use of conservation practices. Present erosion hazards in the watershed are illustrated in Figures 13 and 14. The proper use of erosion control practices such as contouring, terracing and strip cropping, can reduce soil losses from a field 30 to 85 percent. All acreage adjustments from the present to the proposed land use program are minor.

10. Brown, Carl B., Aspects of Protecting Storage Reservoirs by Soil Conservation, Journal of Soil and Water Conservation, Vol. I, No. 1, July, 1946.

11. Van Doren, C. A. and Klingebiel, A. A., Slope and Practice Limitations for Illinois. Mimeograph Release, Urbana, Illinois, January 1948.

Table 9

Estimated Conservation Practices and Rotations on Cropland
Lake Calhoun Watershed

Soil	Suggested Erosion Control Practices				Suggested Rotations					
	No Practices (acres)	Contour[1] Cultivation (acres)	Terraces (acres)	Strip[1] Cropping (acres)	Corn,[2] Soybeans, Oats, Clover (acres)	Corn,[2] Soybeans, Oats, 2 years Alfalfa, Brome (acres)	Corn,[2] Oats, 2 years Alfalfa, Brome (acres)	Corn, Oats, 3 years Alfalfa, Brome (acres)	Corn, Oats, 4 years Alfalfa, Brome (acres)	Small Grain, 4 years Alfalfa, Brome (acres)
1. Dark-colored, medium-textured, moderately permeable soils	2,108	2,738	669	444	4,228	838	509	---	384	---
2. Light-colored, medium-textured, slowly permeable soils	None in cultivation.				None in cultivation.					
3. Light-colored, medium-textured, moderately permeable soils	---	89	25	327	-----	94	2	18	310	17
4. Bottomland soils	144	-----	---	---	144	---	---	---	---	---
Total	2,252	2,827	694	771	4,372	932	511	18	694	17

1. If practical, terracing may be used to further reduce soil losses.
2. Soil losses may be further reduced by leaving the land in grasses and legumes a greater percentage of the time.

The suggested amounts and kinds of rotations and erosion control practices needed in the watershed treatment program may be found in Table 9. No erosion control practices are needed on 2252 acres of the 6667 acres in cultivation in the watershed. The major erosion control practices recommended are: contouring 2827 acres, strip cropping 771 acres, and terracing 694 acres. Additional terraces would further reduce soil loss.

The most intensive rotation recommended allows the land to remain in grasses and legumes at least one-fourth of the time. This rotation is recommended on level land and on gently sloping land (less than 5 percent) where contouring or terracing is used. The recommended rotations requiring grasses and legumes three or more years out of every five are designed for the steep or badly eroded land that is still suitable for limited cultivation.

FIG. 13. SLOPING LAND FARMED UP AND DOWN THE HILL RESULTS IN HIGH SOIL LOSSES.

FIG. 14. WATERWAYS SHOULD BE SEEDED TO GRASS TO PREVENT WASHING.

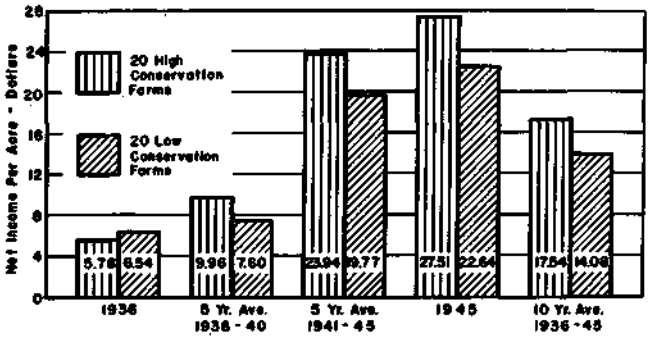

FIG. 15. NET INCOME PER ACRE, PHYSICALLY COMPARABLE HIGH AND LOW CONSERVATION FARMS, MCLEAN COUNTY, 1936-1945.

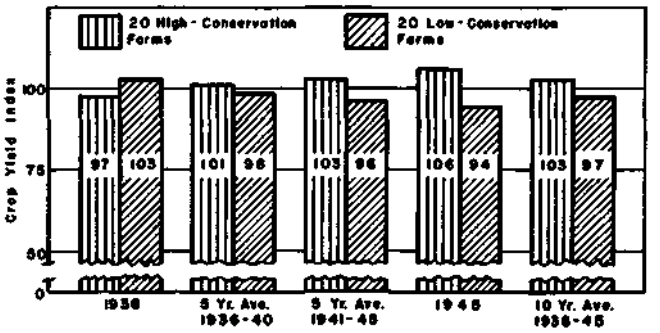

FIG. 16. CROP YIELD INDEX, PHYSICALLY COMPARABLE HIGH AND LOW CONSERVATION FARMS, MCLEAN COUNTY, 1936-1945. (Average yields of all crops for all farms equals 100.)

Cost and Benefits of Conservation. Studies of actual farms in the state show that the application of soil conservation measures by the farmer himself can be justified economically because of increased crop yields and increased net farm income.

The long-time benefits of conservation are certain. However, considerable effort and money must be expended before positive results are achieved. Conservation benefits are demonstrated by studies comparing matched high and low conservation farms in McLean County for the period 1936-1945. The farms compared had similar land-use capabilities and were similar in size but one group of farmers used soil and water conservation practices and the other group did not use them. Figures 15 and 16 show the benefits of conservation in terms of income changes and crop yield changes.

Conservation costs including fertilizer and seed amounted to approximately $35 per acre on the high-conservation farms. This was about twice the amount spent for conservation on the low-conservation farms.

The high-conservation farms had average net incomes of $3. 46 per acre per year more for the 10-year period. (This was after accounting for all expenses, including costs of conservation.) This increased income amounted to $5, 536 for a 160-acre farm for the 10-year period. At 1945 prices the increased net income from conservation amounted to $4. 77 per acre, or $7, 632 for a 160-acre farm for a 10-year period.

Conservation costs and benefits in the Lake Calhoun watershed would be comparable or greater than those in the McLean County study. While the McLean County farms studied have a higher proportion of tillable land, this would be offset by the present unproductive pastureland in the Lake Calhoun watershed which would be brought into profitable production by application of a complete conservation plan. The Lake Calhoun watershed is more of a livestock producing area and recent studies show that livestock farmers often gain more from a conservation program than do grain farmers.

APPENDIX

Table A

Distribution of Slope Classes in Each Soil Group
Lake Calhoun Watershed

Soil Group	A Slopes (0 - 2 percent)		B Slopes (2 - 5 percent)		C Slopes (5 - 10 percent)		D Slopes (10-15 percent)		E Slopes (15-20 percent)		F Slopes (20-30 percent)		G Slopes (over 30 percent)		Total
	(acres)	(%)	(acres)	(%)	(acres)	(%)	(acres)	(%)	(acres)	(%)	(acres)	(%)	(acres)	(%)	(acres)
1. Dark-colored, medium-textured, moderately permeable soils	2,113	85.0	2,428	90.4	1,528	78.4	77	32.4	---	----	---	----	---	----	6,146
2. Light-colored, medium-textured, slowly permeable soils	---	----	85	3.2	---	----	40	16.8	15	5.3	---	----	---	----	140
3. Light-colored, medium-textured, moderately permeable soils	---	----	173	6.4	421	21.6	121	50.8	270	94.7	745	100.0	12	100.0	1,742
4. Bottomland soils	372	15.0	---	----	---	----	---	----	---	----	---	----	---	----	372
Entire Watershed	2,485	100.0	2,686	100.0	1,949	100.0	238	100.0	285	100.0	745	100.0	12	100.0	8,400
Percent of Total Watershed		29.6		32.0		23.2		2.8		3.4		8.9		0.1	

Table B

Distribution of Land Use Classes in Each Soil Group
Lake Calhoun Watershed

Soil Group	Cropland		Idle Land		Pasture		Woodland		Miscellaneous		Total
	(acres)	(%)	(acres)	(%)	(acres)	(%)	(acres)	(%)	(acres)	(%)	(acres)
1. Dark-colored, medium-textured, moderately permeable soils	5,959	89.4	---	----	78	5.8	---	----	109	44.5	6,146
2. Light-colored, medium-textured, slowly permeable soils	42	0.6	---	----	91	6.8	---	----	7	2.9	140
3. Light-colored, medium-textured, moderately permeable soils	522	7.8	40	100.0	972	72.5	79	73.1	129	52.6	1,742
4. Bottomland soils	144	2.2	---	----	199	14.9	29	26.9	---	----	372
Total	6,667	100.0	40	100.0	1,340	100.0	108	100.0	245	100.0	8,400
Percent Total Watershed		79.4		0.4		16.0		1.3		2.9	100.0

Table C

Distribution of Land Use Classes in Each Slope Class
Lake Calhoun Watershed

Slope Class	Cropland		Idle Land		Pasture		Woodland		Miscellaneous		Total	
	(acres)	(%)	(acres)	(%)	(acres)	(%)	(acres)	(%)	(acres)	(%)	(acres)	(%)
A (0 - 2 percent)	2,252	33.8	---	----	199	14.9	29	26.9	5	2.1	2,485	29.6
B (2 - 5 percent)	2,360	35.4	1	2.5	227	16.9	---	----	98	40.0	2,686	32.0
C (5 - 10 percent)	1,836	27.5	1	2.5	96	7.2	---	----	16	6.5	1,949	23.2
D (10 - 15 percent)	201	3.0	---	----	35	2.6	---	----	2	0.8	238	2.8
E (15 - 20 percent)	16	0.2	38	95.0	213	15.9	8	7.4	10	4.1	285	3.4
F (20 - 30 percent)	2	0.1	---	----	558	41.6	71	65.7	114	46.5	745	8.9
G (over 30 percent)	---	----	---	----	12	0.9	---	----	---	----	12	0.1
Total	6,667	100.0	40	100.0	1,340	100.0	108	100.0	245	100.0	8,400	100.0

Table D

Land Capability Compared with Existing Land Use at Time of Survey
Lake Calhoun Watershed

	Cropland		Idle Land		Pasture		Woodland		Miscellaneous		Entire Watershed	
	(acres)	(%)	(acres)	(%)	(acres)	(%)	(acres)	(%)	(acres)	(%)	(acres)	(%)
Class I Land Suitable for cultivation, requiring no erosion-control practices to maintain soil for general agricultural practices	2,251	33.8	---	----	---	----	---	----	5	2.0	2,256	26.8
Class II Land Good land that can be cultivated safely with easily applied practices	2,423	36.3	1	2.5	138	10.0	---	----	100	40.8	2,662	31.7
Class III Land Moderately good land that can be cultivated safely with such intensive treatments as terracing and strip cropping	1,428	21.4	1	2.5	156	11.6	---	----	14	5.7	1,599	19.0
Class IV Land Best suited to hay or pasture, but can be cultivated occasionally, usually not more than 1 year in 6	440	6.6	---	----	43	3.2	---	----	2	0.8	485	5.8
Class V Land Level land best suited to permanent pasture; narrow bottoms subject to overflow and impractical to cultivate	---	----	---	----	198	15.1	29	26.9	---	----	227	2.7
Class VI Land Not recommended for cultivation; best suited for permanent pasture	116	1.8	38	95.0	489	36.5	79	73.1	124	50.7	846	10.1
Class VII Land Not recommended for cultivation; suited for woodland or pasture with major restrictions in use	9	0.1	---	----	316	23.6	---	----	---	----	325	3.9
Entire Watershed	6,667	100.0	40	100.0	1,340	100.0	108	100.0	245	100.0	8,400	100.0
Percent of Total Watershed	79.4		0.4		16.0		1.3		2.9			

Table E

Distribution of Erosion Groups in Each Soil Group
Lake Calhoun Watershed

Soil Group	No apparent erosion (acres)	(%)	Slight to moderate erosion (acres)	(%)	Moderately severe erosion (acres)	(%)	Severe erosion (acres)	(%)	Total (acres)
1. Dark-colored, medium-textured, moderately permeable soils	1,468	79.8	2,983	83.1	1,303	71.3	392	34.4	6,146
2. Light-colored, medium-textured, slowly permeable soils	---	----	85	2.4	---	----	55	4.8	140
3. Light-colored, medium-textured, moderately permeable soils	---	----	523	14.5	525	28.7	694	60.8	1,742
4. Bottomland soils	372	20.2	---	----	---	----	---	----	372
Total	1,840	100.0	3,591	100.0	1,828	100.0	1,141	100.0	8,400
Percent of Total Watershed		21.9		42.8		21.8		13.6	

Table F

Distribution of Erosion Groups in Each Slope Class
Lake Calhoun Watershed

Slope Class	No apparent erosion (acres)	(%)	Slight to moderate erosion (acres)	(%)	Moderately severe erosion (acres)	(%)	Severe erosion (acres)	(%)	Total (acres)
A (0 - 2 percent)	1,840	100.0	645	18.0	---	----	---	----	2,485
B (2 - 5 percent)	---	----	2,514	70.0	170	9.3	2	0.2	2,686
C (5 - 10 percent)	---	----	81	2.3	1,212	66.3	656	57.5	1,949
D (10 - 15 percent)	---	----	---	----	8	0.4	230	20.2	238
E (15 - 20 percent)	---	----	1	*	206	11.3	78	6.8	285
F (20 - 30 percent)	---	----	350	9.7	220	12.0	175	15.3	745
G (over 30 percent)	---	----	---	----	12	0.7	---	----	12
Total	1,840	100.0	3,591	100.0	1,828	100.0	1,141	100.0	8,400

*Less than 0.1 of 1 percent.

Table G

Distribution of Erosion Groups in Each Land Use Class
Lake Calhoun Watershed

Land Use Class	No apparent erosion (acres)	(%)	Slight to moderate erosion (acres)	(%)	Moderately severe erosion (acres)	(%)	Severe erosion (acres)	(%)	Total (acres)
Cropland	1,607	87.3	2,911	81.0	1,314	71.9	835	73.2	6,667
Idle land	---	----	---	----	---	----	40	3.5	40
Pasture	199	10.8	394	11.0	494	27.0	253	22.2	1,340
Woodland	29	1.6	71	2.0	8	0.4	---	----	108
Miscellaneous	5	0.3	215	6.0	12	0.7	13	1.1	245
Total	1,840	100.0	3,591	100.0	1,828	100.0	1,141	100.0	8,400

REPORTS OF INVESTIGATIONS

ISSUED BY THE STATE WATER SURVEY

No. 1. Temperature and Turbidity of Some River Waters in Illinois. 1948.

No. 2. Groundwater Resources in Winnebago County, with Specific Reference to Conditions at Rockford. 1948.

No. 3. Radar and Rainfall. 1949.

No. 4. The Silt Problem at Spring Lake, Macomb, Illinois. 1949.*

No. 5. Infiltration of Soils in the Peoria Area. 1949.

No. 6. Groundwater Resources in Champaign County. 1950.

No. 7. The Silting of Ridge Lake, Fox Ridge State Park, Charleston, Illinois. 1951.*

No. 8. The Silting of Lake Chautauqua, Havana, Illinois. 1951.

No. 9. The Silting of Carbondale Reservoir, Carbondale, Illinois. 1951.

No. 10. The Silting of Lake Bracken, Galesburg, Illinois. 1951.

No. 11. Irrigation in Illinois. 1951.

No. 12. The Silting of West Frankfort Reservoir, West Frankfort, Illinois. 1951.

No. 13. Studies of Thunderstorm Rainfall with Dense Raingage Networks and Radar. 1952

No. 14. The Storm of July 8, 1951 in North Central Illinois. 1952

No. 15. The Silting of Lake Calhoun, Galva, Illinois. 1952

*Out of print.