UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
WASHINGTON, D. C.
H. H. BENNETT, CHIEF

ADVANCE REPORT

on the

SEDIMENTATION SURVEY OF WELLFLEET RESERVOIR

WELLFLEET, NEBRASKA

May 10 to 19, 1937

by

Victor H. Jones

Sedimentation Studies
Division of Research
SCS-SS-23
July 1938

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In cooperation with

Nebraska Agricultural Experiment Station
Lincoln, Nebraska
W. W. Burr, Director

and

Division of Conservation and Surveys
University of Nebraska
Lincoln, Nebraska
G. E. Condra, Dean

ADVANCE REPORT ON

THE SEDIMENTATION SURVEY OF WELLFLEET RESERVOIR

WELLFLEET, NEBRASKA

INTRODUCTION

The sedimentation survey of Wellfleet Reservoir was made by the Section of Sedimentation Studies, Division of Research, Soil Conservation Service, during the period May 10 to 19, 1937. The survey party consisted of Leland H. Barnes, chief of party, Mark P. Connaughton, Alvin T. Talley, Robert M. Dill, Richard K. Frevert, and Alfred J. Kjarsgaard. Preliminary data were secured and arrangements for the survey were made by Louis M. Glymph, Jr. Studies of the lake sediment and an inspection of the drainage basin were made by Victor H. Jones, assisted by the field party.

This investigation was made in cooperation with the Nebraska Agricultural Experiment Station, the University of Nebraska Division of Conservation and Surveys, and the Nebraska State Game, Forestation, and Park Commission. F. L. Duley, field representative of the Research Division, aided in arranging for the cooperative study.

Mechanical analyses of sediment samples were made under the direction of Professor W. H. Metzger in the soils laboratories of Kansas State Agricultural College at Manhattan.

The Soil Conservation Service acknowledges the assistance and cooperation of J. M. Buckaloo, of Wellfleet, who furnished historical information and photographs of the lake basin.

GENERAL INFORMATION

Location (fig. 1):

State: Nebraska.

County: Lincoln. Sections 9 and 16, T. 9 N., R. 30 W.

Distance and direction from nearest city: The dam is one-fourth mile west of Wellfleet.

Figure 1

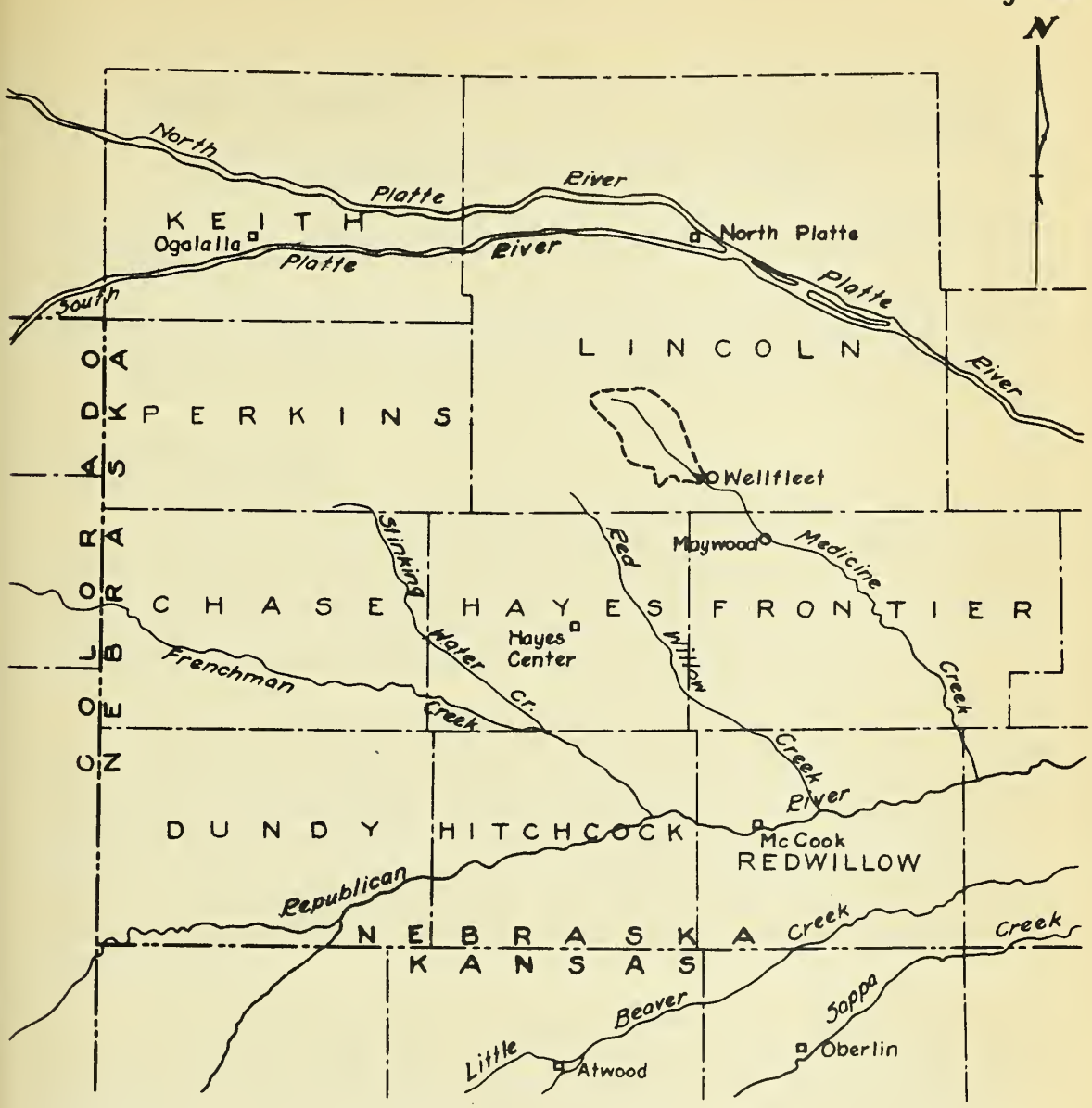
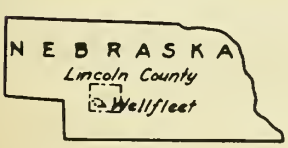


Figure 1

LOCATION MAP ~ UPPER REPUBLICAN RIVER AND WELLFLEET RESERVOIR

Scale in Miles

0 5 10 20 30



KEY MAP

LEGEND

- Towns and Cities
- Rivers and Creeks
- Wellfleet Reservoir
- Watershed Boundary

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Drainage and backwater: Medicine Creek and its tributaries. Below the dam this creek flows generally southeastward about 60 miles to join the Republican River at Cambridge, in the northwestern part of Furnas County.

Ownership: The Nebraska State Game, Forestation, and Park Commission.

Purpose: The reservoir is the center of the Wellfleet Recreation Grounds, extensively used for fishing, boating, and picnicking.

Description of dam.

Wellfleet Reservoir is impounded by an earth-fill gravity-type dam 400 feet long which extends approximately northeastward across Medicine Creek valley. The crest of the dam, which forms the roadbed of unsurfaced State Highway 23, is 20 feet wide and has a maximum height of 17 feet above the stream channel. The upstream and downstream faces have slopes of $2\frac{1}{2}$:1 and $1\frac{1}{2}$:1, respectively.

Because of the prevailing northwesterly winds that often blow directly down the lake, there is a strong tendency for wave erosion on the dam. As a protection the upstream face of the dam has been covered by concrete-block riprap extending 1 foot above maximum water level. In addition, a line of floating rectangular wooden frames, joined by strong wire and extending from shore to shore, has been installed 20 feet above the dam. Grass and willow shoots have been planted on both faces of the dam to prevent erosion by run-off water.

The drop-type concrete spillway is near the center of the dam, 160 feet from its east end. Normal overflow passes under the road and over a crest composed of heavy planks 8 feet long which are fitted into concrete slots so that they may be removed to change the crest level. The crest was 2,753.60 feet above sea level during the survey, and its level had not been changed during the life of the lake, except for a 15-day period in the spring of 1936 when the lake was partly drained for repair work on the dam. Auxiliary overflow capacity is provided by two concrete troughs 1 foot deep and 8 feet wide, one on each side of the normal spillway. The auxiliary spillways extend across the road and carry water only when the lake level rises 4 feet above the main spillway.

Date of completion: October 1931. The age of the reservoir at the time of the survey was 5.6 years.

Length of lake: 1.44 miles. A small delta has formed at the head of the reservoir but had not decreased the total length at the time of survey.

Area of lake at crest stage:

	Acres
Original	73.2
At date of survey	72.6
Reduction by sedimentation	0.6

Storage capacity to crest level:

	Acre-feet	
Original	519	(167,000,000 gallons)
At date of survey	464	(151,000,000 gallons)
Reduction by sedimentation	55	(16,000,000 gallons)

General character of reservoir basin.

Wellfleet Reservoir has a relatively long, narrow, sinuous basin, which occupies the valley bottom from bluff to bluff throughout its length. Its width varies from 230 feet at range R20-R22 to a maximum of 950 feet at range R5-R6 (fig. 2, following p. 16). Although the shore line is irregular in minor detail the basin has no arms or bays, because all tributaries entering the lake have such steep gradients that no backwater is ponded in their channels. A small irregular delta, 0.6 acre in area, has formed at the debouchure of Medicine Creek, but it merely projects into the lake without decreasing its total length.

All the shore, except at the head of the reservoir, is steep and bluff-like (figs. 3 and 4), rising about 18 feet in an average distance of 60 feet to the level of a well-defined terrace. The submerged slopes likewise are very steep and descend abruptly from crest level to the original valley floor. Nearly all profiles of the ranges illustrate the typical steep-sided, flat-bottomed, troughlike form of the basin. The submerged creek channel is so small that it was difficult to identify during sounding and silt measurements. The channel has an average depth of about 1 foot and a width of 10 to 15 feet. From the head of the lake to range R1-R2 near the dam the original channel bottom has a gradient of 8.3 feet per mile.

Figure 3.--Bluff of loess at the south end of Wellfleet dam.

Figure 4.--Head of Wellfleet Reservoir, showing delta.

Area of drainage basin: Estimated at 45 square miles on the basis of an automobile traverse and study of the soils map of Lincoln County.[1] Of this area only about 15 square miles has well-defined surface drainage.

General character of drainage basin.

Geology.--Wellfleet Reservoir is in the northern part of the Great Plains province. Its entire drainage area is underlain by relatively unconsolidated sedimentary deposits of Tertiary, Pleistocene, and Recent age. Detailed information concerning the stratigraphy is not available, but the following generalized section was adapted from publications of the Nebraska Geological Survey.

Generalized section of strata in the vicinity of Wellfleet Reservoir

	Thickness in feet
Quaternary:	
Recent:	
Sand; in dunes on the upland in the northern and western parts of the drainage basin.....	0-100
Alluvium; on valley bottoms.....	0-20
Late Pleistocene:	
Peorian loess; on the upland.....	50-150
Loveland loess and sand; exposed only in valleys.....	50-100
Early Pleistocene:	
Sands and gravels; exposed in a single locality but believed to underlie much of the region.....	0-50+
Tertiary:	
Pliocene:	
Ogallala formation--	
Lime-cemented sandstones and silts, with interbedded sands and gravels; not exposed in drainage area.....	100-400±
White River group, including Brule clay and Chadron formations; may or may not be represented at depth, probably thin.	
Cretaceous:	
Pierre shale formation--	
Shale, dark gray to black, relatively impervious; underlies the Tertiary unconformably; not exposed within the watershed.	

[1] Goke, A. W., Nieschmidt, E. A., and Roberts, R. C. Soil Survey of Lincoln County, Nebraska. U. S. Dept. Agr., Bur. of Chem. and Soils, Ser. 1926, Rept. 35.

A striking feature of the drainage basin is the vast bulk of loess and sand deposits upon which the present topography and soils have been developed. The sand deposits represent several geologic periods, ranging from late Tertiary to Recent.

The widespread sand deposits of the northern and western parts of the drainage area were derived from early Pleistocene sands and gravels and from the underlying sandy Tertiary deposits,[2] as well as from sandy loess of Peorian age. They are responsible for the peculiar topography and drainage of the region, and in general have not developed a true soil. The great loess formations[3] are composed chiefly of angular silt-size particles and very fine sand, and are soft and powdery.

Alluvium of Recent age on the valley bottom of Medicine Creek occupies less than 2 percent of the watershed area. It consists of sand, silt, and clay and contains much organic matter. Small peat beds occur in a few places in and near the lake.

The bedrock of Tertiary and Cretaceous age has practically no relation to sedimentation in Wellfleet Reservoir, except as it affects the circulation of ground water. The widespread Ogallala formation of Tertiary (Pliocene) age is covered everywhere in the region except for a few small outcrops in the deeper valleys south of the drainage area. It consists of a series of sands, silts, and gravels with indurated zones, and provides active ground-water circulation. The dark impervious Pierre shale underlies the entire drainage basin but does not appear at the surface. It has a definite effect upon subsurface drainage in limiting the downward migration of ground water.

Topography, erosion conditions, and drainage.--The topography within the watershed of Wellfleet Reservoir is of two markedly different types, namely, dune topography and dissected plateau topography, both of which were developed upon a rolling plain which had a regional slope to the southeast. Approximately 65 percent of the drainage area, designated by the symbol D on the watershed map (fig. 5), is covered with more or less active sand dunes which belong to several generations of dune formation. The sand-dune area occupies the entire periphery of the drainage basin on the west and north and extends nearly to Medicine Creek along the greater part of its north bank. During the dry years of 1934 to 1937 considerable land in the dune area was unwisely planted to corn and wheat. As a

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[2]Lugn, A. L. The Pleistocene geology of Nebraska. Nebr. Geol. Survey Bull. 10, 2d Series, pp. 128-168, 1935.

[3]See footnote 2.

FIGURE 5

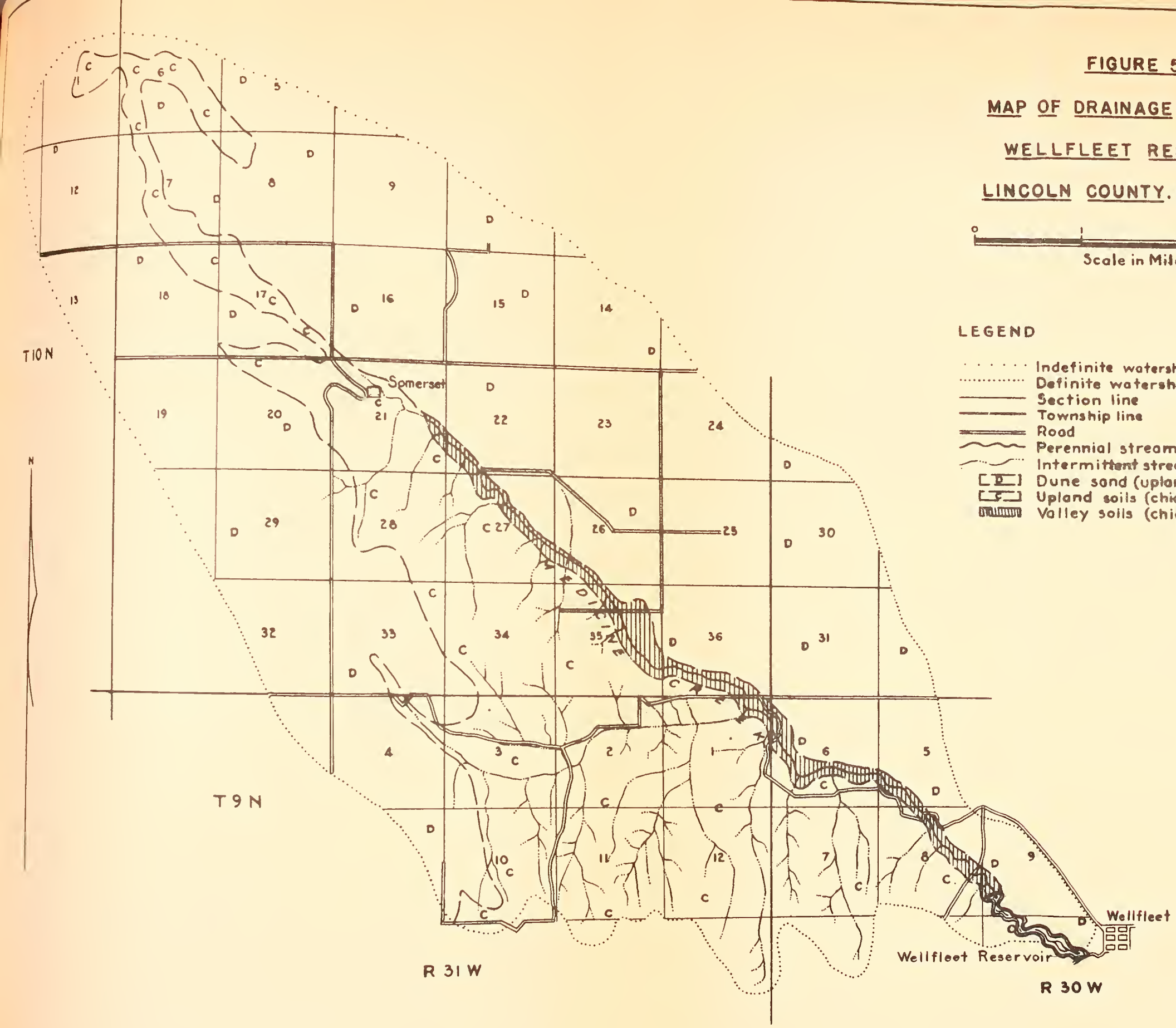
MAP OF DRAINAGE AREA OF WELLFLEET RESERVOIR LINCOLN COUNTY. NEBRASKA

0 1 2 3

Scale in Miles

LEGEND

- Indefinite watershed boundary
- Definite watershed boundary
- Section line
- Township line
- Road
- Perennial stream
- Intermittent stream
- D — Dune sand (upland)
- C — Upland soils (chiefly Colby series)
- Valley soils (chiefly Cass series)



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result, many of the old dunes which were formerly stabilized by rather scanty grasses are now in motion and have overwhelmed farmhouses, roads, and fences.

The individual dunes range from 10 to 35 feet in height, and bare depressions or "blowouts" are common. Surface drainage has not developed in the sand-hill area because practically all the rainfall sinks immediately into the porous sand and goes to ground-water storage or remains for short periods as temporary lakes and ponds in the numerous depressions. A few rather indistinct troughlike depressions, in sections 30 and 31, T. 10 N., R. 30 W., and sections 15 and 21, T. 10 N., R. 31 W., trend southeastward toward the main valley. These are probably older stream valleys now masked by the surficial sand deposits, but they carry no through flows at present. The average elevation of the sand-hill area is about 3,050 feet above sea level, or 300 feet above the surface of the reservoir.

The watershed boundary on the north and west is very indistinct because of the total absence of surface drainage courses; therefore this part of the boundary is indicated by a distinctive symbol in figure 5.

In the southeastern part of the drainage basin an upland comprising about 20 percent of the total area has been deeply and intricately dissected until no flat areas greater than one-half square mile remain. This upland originally had a relatively smooth surface with a gentle eastward slope and was covered with loess deposits ranging from 100 to 300 feet in thickness. The upland is essentially the area denoted by the symbol C in figure 5.

Both gully development and sheet erosion have been very active on this upland, especially since the extensive development of agriculture in the region. As a result, the upland is now traversed by a complex, dendritic system of canyons and gullies which have produced an extremely rugged topography. A relief of 200 feet within 1 mile of the Medicine Creek valley is common, and vertical banks ranging from 50 to 100 feet in height are numerous. The smaller gullies within 1 mile of the valley average about 100 feet in width, 60 feet in depth, and 0.5 mile in length. They are stark, precipitous notches in the loess with nearly vertical banks and heads (figs. 6 and 7). The larger gullies have maximum lengths of about 3 miles, widths of 50 to 100 yards, and depths approaching 250 feet near the main valley. Many of them have alluvial bottoms which have become stabilized by a dense growth of grass. The bottoms have very flat transverse profiles but are steeply inclined downstream. Numerous springs and seeps in the loess deposits furnish sufficient moisture for a good grass cover in these valleys, but in some of the bottoms cultivation has resulted in renewed erosion. The numerous intermittent

Figure 6.--Head of gully in loess 1 mile southwest of Wellfleet dam.

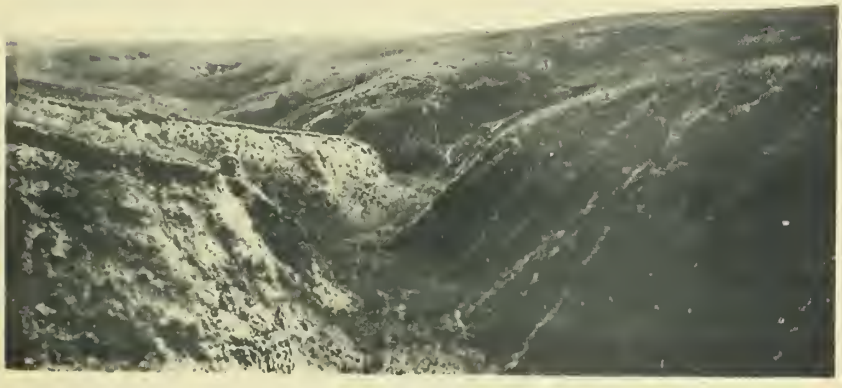

Figure 7.--Gully in loess 1 mile southwest of Wellfleet dam.

streams in figure 5 show the position of the major canyons and gullies.

Medicine Creek has developed a small valley flat which is nearly 1,000 feet wide in places near Wellfleet. The stream is at grade for a distance of about 5 miles above the lake, and has a definite channel as far upstream as Somerset, but it has no continuous channel through the upper 5 miles of its course. Permanent flow begins about 6 miles above the lake.

The steep bluffs along the lake, ranging from 6 to 25 feet in height, truncate a distinct terrace which slopes upward to merge with the valley slopes about one-fourth mile from the creek. Springs occur along the north bluff for at least 4 miles above the dam. They furnish sufficient water to maintain permanent flow in Medicine Creek and to keep the lake at or near crest level even during dry seasons. Springs are much smaller and less numerous on the south side of the valley. This observation supports the conclusion of Dr. G. E. Condra and others that extensive movement of ground water occurs through the unconsolidated formations southward from the Platte Valley.[4] It is probable that Wellfleet Reservoir receives water that has fallen as rain in areas considerably north of the watershed, as well as water that has traveled underground from the Platte Valley.

Soils.--The soils of the drainage area, ranging from clean, infertile dune sand to productive silt loam, have been divided into five generalized groups,[5] as shown in table 1.

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[4]Condra, G. E. Geology and water resources of the Republican River Valley and adjacent areas, Nebraska. U. S. Geol. Survey Water Supply Paper 216, 1907.

Condra, G. E., and Reed, E. C. Water-bearing formations of Nebraska. Nebr. Geol. Survey Paper 10, 1936.

[5]Goke, A. W., Nieschmidt, E. A., and Roberts, R. C. Soil Survey of Lincoln County, Nebraska. U. S. Dept. Agr., Bur. Chem. and Soils, Ser. 1926, Rept. 35, p. 4 and soil map.

Table 1.--Soils of the Wellfleet Reservoir drainage basin

Soil	Description and occurrence	Proportionate area
		Percent
Dune sand.....	Clean sand with local areas of sandy soil, including Valentine sand and loamy sand; on upland and slopes.	67.1
Colby fine and very... fine sandy loams.	Grayish-brown sandy silt loam.. chiefly broken phase; on upland, mainly in southeast.	24.8
Hall fine and very.... fine sandy loams, including colluvial phase.	Dark grayish-brown very fine ... sandy loam; on gully bottoms and slopes.	4.4
Bridgeport loamy sand.	Grayish-brown loamy sand; on... terraces and slopes.	2.0
Cass loam.....	Dark-brown to black sandy..... loam; on valley bottom of Medicine Creek.	1.7
		100.0

Dune sand is the most widespread soil type and supports only sparse grasses. Most of it is relatively clean fine sand, from which nearly all the silt and clay particles have been removed by wind action.

The area of Colby soils on the upland is agriculturally the most important part of the drainage area. The chief crops are wheat, corn, and alfalfa. The broken phases on the slopes are suitable only for grazing. The Hall soils are fertile and fairly well watered by springs issuing from the loess deposits but occupy only a small part of the drainage area.

The Bridgeport soils of the terraces and slopes are unstable and adapted only to controlled grazing.

The Cass loam of the valley bottom is a productive soil but is subject to flooding and has poor drainage. It has little importance because of its small area.

The only areas that can be regarded as tillable lands are those of the Colby, Hall, and Cass soils, which together cover 30.7 percent of the drainage area.

Land use.--As no exact data on land use in the Wellfleet Reservoir drainage basin have been compiled, estimates were made during the course of the reservoir survey and are presented in table 2.

Table 2.--Land use in the Wellfleet Reservoir drainage basin in 1937
(Figures are approximate)

Land use	Proportionate area	
	Sand-hill section	Valleys and southeast upland
	Percent	Percent
Crops:		
Wheat	0	3
Corn	0	3
Oats	0	2
Hay (chiefly grass and alfalfa)	3	11
Total cropland	3	19
Farmsteads and gardens	0	2
Idle land (chiefly sand dunes)	26	3
Grazing land	36	11
Total area of section	65	35

The only valuable crop land is in the southeastern part of the area, as indicated in table 2. Cultivated areas are confined to relatively small tracts of undissected upland, small tributary gully bottoms, and the main valley bottom. The steeply sloping areas can be used only for hay crops and grazing.

In the sand-hill section attempts have been made to cultivate numerous fields of corn and wheat, but all these areas observed during the survey had been overwhelmed by drifting sand. Figures 8 and 9 illustrate the drifted areas. Excessive grazing has also removed the grass sufficiently to reactivate many of the old dunes. If carefully controlled grazing should be practiced throughout the sand-hills section, most of the dunes would remain stabilized by the native grass adapted to growth on the sand. Several farms and ranches in the area have been abandoned.

Mean annual rainfall: 21 inches, according to records of the Nebraska State Planning Board and the United States Weather Bureau.

METHOD OF SURVEY

The original and remaining capacities and the volume of sediment in Wellfleet Reservoir were determined by the range method of survey.[6] Primary triangulation was begun by establishing a base line, consisting of three segments having a total length of 1,500 feet, along the bluff bordering the south shore near the dam. From the base line seven additional control points were established around the lake by plane-table triangulation.

The shore line, 4.1 miles in length, was mapped by plane table and telescopic alidade on a scale of 1 inch to 200 feet. For measurement of sediment and water depths 20 ranges were established across the reservoir at suitable intervals. Triangulation points and range ends were permanently marked with concrete posts 6 inches in diameter and 2 feet long set flush with the ground surface. The appropriate survey numbers were stamped on the upper ends of $\frac{1}{2}$-inch carriage bolts and washers which were imbedded in the concrete. The elevation of spillway crest was determined by a level traverse from a U. S. C. and G. S. bench mark (No. A-165, el. 2,809.512 feet) on the northeast corner of the water tower foundation at the C. B. and Q. Railroad depot in Wellfleet.

Samples of bottom sediment were scooped from the lake bottom at five well-distributed localities and preserved in the wet condition in sealed glass jars for shipment to the laboratory.

A capacity curve (fig. 10) was prepared by means of 1-foot contours on the silt surface drawn from sounding data.

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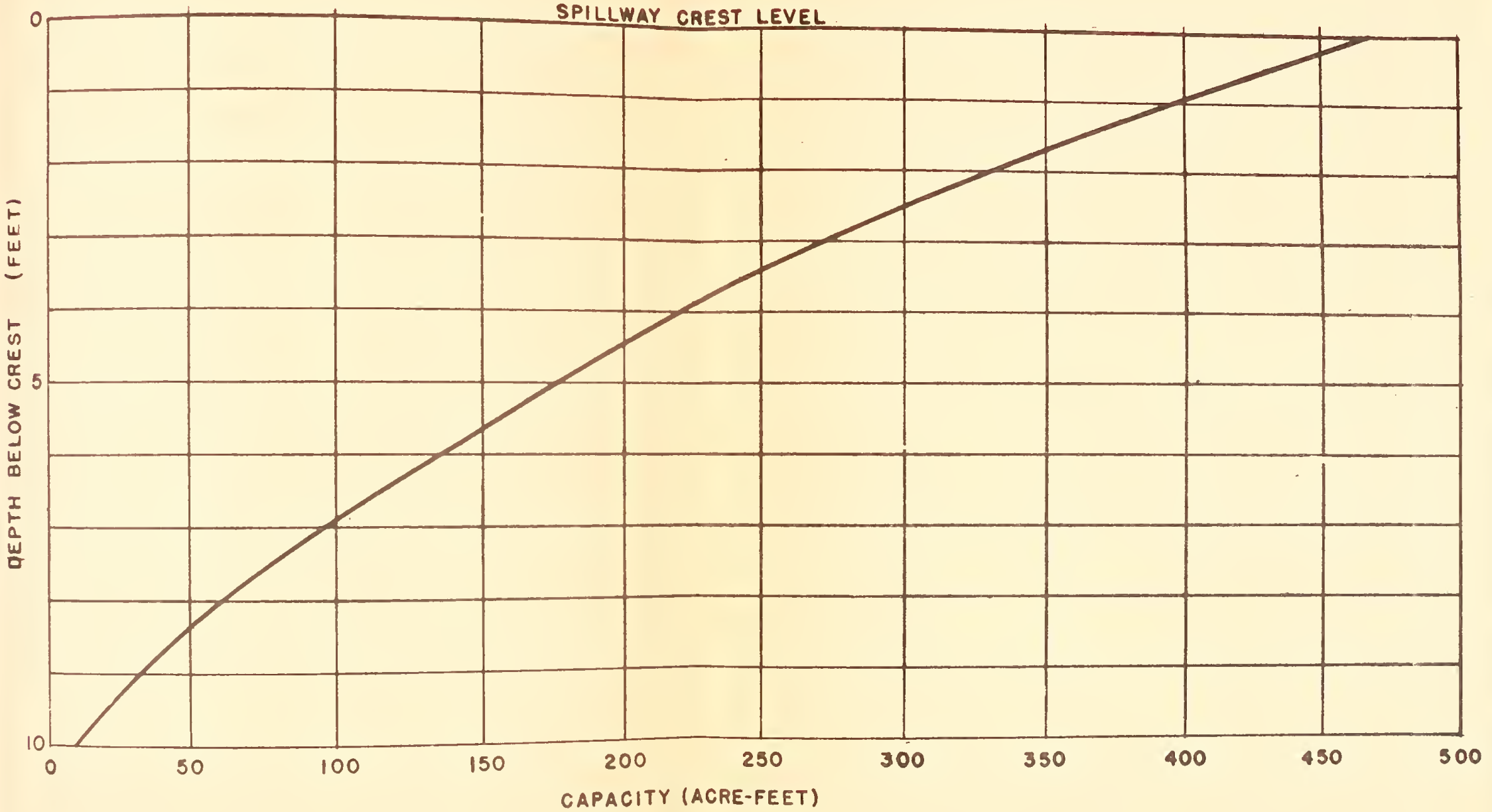
[6]Eakin, H. M. Silting of reservoirs. U. S. Dept. Agr. Tech. Bull. 524: 25-28, 129-135, 1936.

Figure 8.--Dune sand in a formerly cultivated field in Wellfleet Reservoir watershed (N½ W. ¼ sec. 8, T. 9 N., R. 30 W.)

Figure 9.--Road cut through sand dunes in Wellfleet Reservoir watershed (N. E. ¼ sec. 16, T. 10 N., R. 31 W.)



◦FIGURE 10. WATER-STORAGE CAPACITY CURVE — MAY 1937◦
◦WELLFLEET RESERVOIR — LINCOLN COUNTY, NEBR.◦

SEDIMENT DEPOSITS

Character of Sediment

Mechanical analyses of five samples of sediment from the upper half of the reservoir are given in table 3. The analyses were made by the hydrometer method and consequently are only approximate. The sand fraction, including all material coarser than 0.05 millimeter, consists chiefly of fine and very fine sand.

Table 3.--Mechanical composition of sediment samples from Wellfleet Reservoir

Sample No.	Location	Sand >0.05 mm	Silt 0.05 to 0.005 mm	Clay <0.005 mm
		Percent	Percent	Percent
1....	Range R9-R10, 15 ft. from R10....	83.4	8.5	8.1
2....	Range R17-R18, 57 ft. from R17...	81.9	13.0	5.1
3....	Range R27-R28, 67 ft. from R27...	73.9	15.5	10.6
4....	Range R30-R31, 98 ft. from R31...	75.5	13.5	10.0
5....	Range R30-R31, 196 ft. from R31..	71.0	18.5	10.5

As shown by the analyses, the principal constituents of the reservoir sediment in relative order of abundance are: (1) sand, (2) silt, and (3) clay. Most of the sand is so fine, however, that in field identification the sediment in general would be classified as predominantly silt.

In the lower part of the lake, between ranges R1-R2 and R5-R6 (fig. 2), the deposits consist chiefly of dark gray silt but include some very fine sand, although in smaller proportions than in the upper part of the reservoir. The sediment is soft and incoherent and could be washed easily from the silt-measuring apparatus. Above range R5-R6 the proportion of fine sand and vegetal debris increases toward the head of the reservoir.

Above range R9-R10 plant material comprises about 40 percent of the bulk of the bottom deposits. The color of this sediment is predominantly gray, although it ranges from light gray to nearly

black. White mica in very small flakes is a conspicuous accessory constituent of the lake sediment, as well as the underlying valley sands.

The top-set beds of the delta, together with much of the bottom sediment in segments 18, 19, and 20, are composed of a pulpy mixture of sand, silt, and vegetal debris.

Coarse sand and fine gravel were observed only in the channel on ranges R27-R28 and R27-R29. The gravel, with maximum diameters of 8 millimeters, is composed of chert, quartz, and granite.

The original flood plain beneath the lake sediment is composed mainly of fine gray sand, containing many leaves and reeds. This alluvium is considerably more compact than the overlying lake deposits. A deposit of coffee-colored peat, ranging from a few inches to 3 feet in thickness, occurs beneath the lake deposits in much of the area above range R15-R17. The channel areas are underlain by light-gray fine sand.

Distribution of Sediment

The sediment deposits in Wellfleet Reservoir are rather uniformly distributed throughout its length. (See fig. 11.) The maximum thickness of sediment on range R1-R2 is 1.2 feet beneath 10.4 feet of water,[7] and the average thickness is about 0.7 foot. Comparable thicknesses of sediment beneath gradually shallowing water occur up the lake as far as range R17-R18, where the maximum thickness is 1.8 feet beneath water 7 feet deep. From this range upstream to range R20-R21 the average thickness is about 1 foot. In the narrow reach including segments 13 and 14, however, less sediment has accumulated, as for example on range R20-R22, where the maximum sediment thickness is only 0.8 foot.

Segments 18, 19, and 20, at and near the debouchure of Medicine Creek (fig. 2, following p. 16), have received the greatest thickness of sediment in the reservoir and have also suffered the highest capacity loss. They have lost nearly two-thirds of their original capacity, whereas segments nearer the dam have suffered losses ranging from 6 to 20 percent. A thickness of 5 feet of sediment, the maximum for the reservoir, was measured in the channel on range R30-R31.

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[7]All water depths are with reference to spillway crest level.

Figure 11

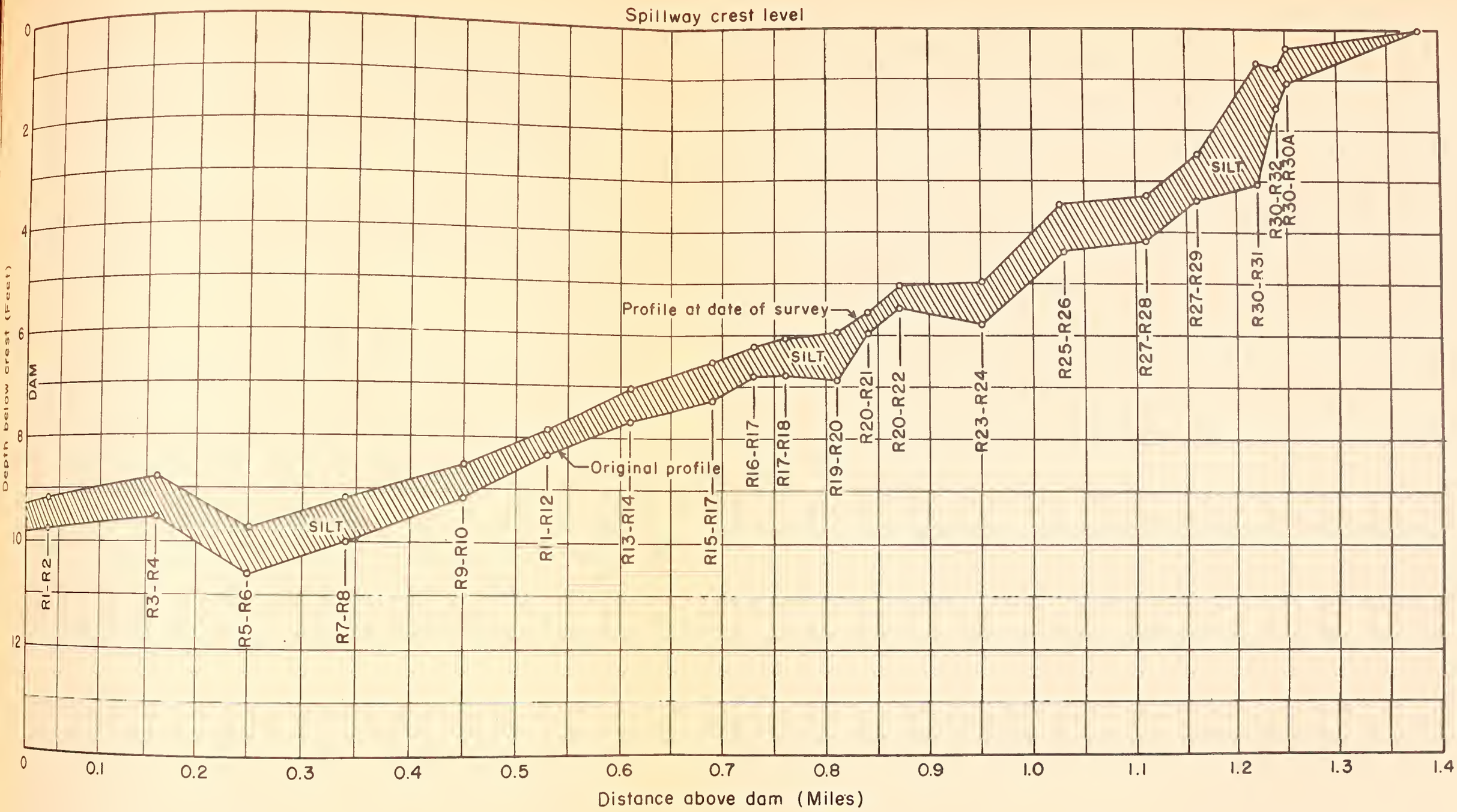

FIGURE 11. Average-depth profiles, Wellfleet Reservoir, Lincoln County, Nebraska.

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Erosion by wave action is occurring along the greater part of the shore line. Blocks of loess ranging from 1 foot to 10 feet in diameter occasionally fall into the reservoir. The loess is so fine in texture, however, that no distinctive shore and beach deposits have formed. Furthermore, the very steep slope of the basin immediately below crest level in most places prevents the formation of wave-built terraces. Bank material dislodged by waves along the shore is apparently quickly disintegrated and carried into deeper parts of the basin.

The lake level never falls far below spillway crest, because of the constant inflow supplied by springs. Consequently a large part of the run-off from each rainfall passes over the spillway and carries with it a considerable volume of the sediment contained in the inflow.

Origin of Sediment

Most of the sediment deposited in Wellfleet Reservoir is believed to be brought in by the main stream and the intermittent but very steep tributaries during the infrequent periods of heavy run-off. An appreciable amount, however, may be deposited directly by wind currents. Of the sediment contributed by streams, the greater part originates in the southeastern part of the area, where deep gullies are actively developing. In the remainder of the drainage area, that is, the sand-hills section, the surface run-off is negligible and gullies are entirely absent.

Much sediment that is carried into the upper part of the main valley becomes temporarily stabilized by grass and moves downstream only intermittently. Likewise much of the loess eroded from the uplands is deposited and stabilized for indefinite periods in the bottoms of the larger gullies and canyons. Very little material is carried into the reservoir during dry seasons either by the main stream or by tributaries.

Wind action, on the other hand, increases its proportionate contribution to the reservoir sediment during dry periods. Active dunes occur for about 6 miles along the north bank of the creek in the central part of T. 10 N., R. 31 W., and from them some sand and finer material is blown directly into the creek channel and the reservoir. The major contribution by wind action, however, probably comes from drifting of wind-blown material into ditches, gullies, and dry stream channels, from which it is subsequently swept on down to the reservoir by heavy run-off.

The coarse sand and gravel near the head of the lake probably originated in an outcrop of gravel on the north bluff, just above range end R33, which was worked as a gravel pit before construction of the lake. It possibly represents a remnant of the lower Pleistocene gravel deposits which are buried by loess elsewhere in the drainage basin. The ultimate origin of practically all the reservoir sediment is the loess and sand formations of the drainage basin.

CONCLUSIONS AND RECOMMENDATIONS

In spite of the fact that large quantities of sediment are eroded and moved from place to place in the drainage basin by water and wind, Wellfleet Reservoir has the relatively low annual rate of accumulation of 15.34 cubic feet per acre of total drainage area. This low rate is due in part to the temporary stabilization of eroded materials in gully bottoms and in the upper section of Medicine Creek valley, and in part to the fact that surface drainage from only one-third of the drainage area reaches the reservoir. If the sand-hill area is excluded, the annual accumulation amounts to about 45 cubic feet per acre of drainage area. Assuming the average dry weight of the reservoir sediment to be 65 pounds per cubic foot,[8] and that of the soil in the drainage area to be 95 pounds per cubic foot,[9] the measured rate of sedimentation indicates that the maximum time required to remove 1 inch of soil from the entire area with surface drainage is about 120 years.[10]

Extensive soil conservation measures in the drainage area, especially in the portion having surface run-off, would materially decrease the silting rate of the reservoir. Such a program would involve two major objectives: (1) Complete gully stabilization and reduction of run-off from the agricultural areas on the loess uplands, and (2) stabilization of dunes by development and preservation of grass cover. In addition, a considerable decrease in

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[8]See footnote 5 on page 16.

[9]Based on the volume weights of sandy soils (corresponding to those predominating in the Wellfleet drainage area) given by Middleton, H. E., Slater, C. S., and Byers, H. G. The physical and chemical characteristics of the soils from the erosion experiment stations--second report. U. S. Dept. Agr. Tech. Bull. 450: 21, 1934.

[10]This figure does not allow for the considerable but indeterminate amount of sediment that has been bypassed through the reservoir.

the silting rate might be obtained by the development of grass and trees on the gully and valley bottoms and stream banks near the reservoir in section 1, T. 9 N., R. 31 W., and sections 6, 7, and 8, T. 9 N., R. 30 W. This would tend not only to increase deposition in the gully bottoms and thus hold back much sediment which otherwise would be carried into the reservoir, but also to protect existing alluvial deposits and the stream banks against erosion by flood waters.

The development of good grass and tree cover around the lake shores and in the main valley immediately above the lake is another possible means of causing deposition and stabilization of sediment before it is carried into the reservoir basin.

The results of the sedimentation survey are summarized in the following tabulation.

Summary of data on Wellfleet Reservoir, Lincoln County, Nebraska

Item	Quantity	Unit
Age[1]	5.6	Years
Watershed area (approximate)[2]	43	Sq. miles
With surface drainage	15	Sq. miles
Without surface drainage	28	Sq. miles
Reservoir:		
Area at crest stage:		
Original	73.2	Acres
At date of survey	72.6	Acres
Storage capacity to crest level:		
Original	519	Acre-feet
At date of survey	464	Acre-feet
Capacity per square mile of drainage area[3]:		
Original	34.60	Acre-feet
At date of survey	30.93	Acre-feet
Sedimentation:		
Total sediment	55	Acre-feet
Average annual accumulation:		
From entire drainage area	9.8	Acre-feet
Per 100 square miles of drainage area[4]	65.9	Acre-feet
Per acre of drainage area[4]:		
By volume	44.86	Cubic feet
By weight (assuming 1 cubic foot of silt weighs 65 pounds[5])	1.46	Tons
Depletion of storage:		
Loss of original capacity:		
Per year	1.89	Percent
To date of survey	10.60	Percent

[1]Storage began October 1931; average date of survey, May 1937.
[2]Including area of reservoir.
[3]Including area of reservoir but excluding area without surface drainage.
[4]Excluding area of reservoir and area without surface drainage.
[5]Based on comparison with average dry weights of sediment in other Great Plains reservoirs. No samples suitable for volume-weight determinations were collected in this reservoir.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H.H. BENNETT, Chief W. C. LOWDERMILK, Associate Chief

WELLFLEET RESERVOIR
MEDICINE CREEK
LINCOLN COUNTY
NEBRASKA

SEDIMENTATION SURVEY OF MAY 10 TO MAY 19, 1937

G. C. DOBSON, Acting Head, Sedimentation Studies, Division of Research

500 0 500 1000 1500

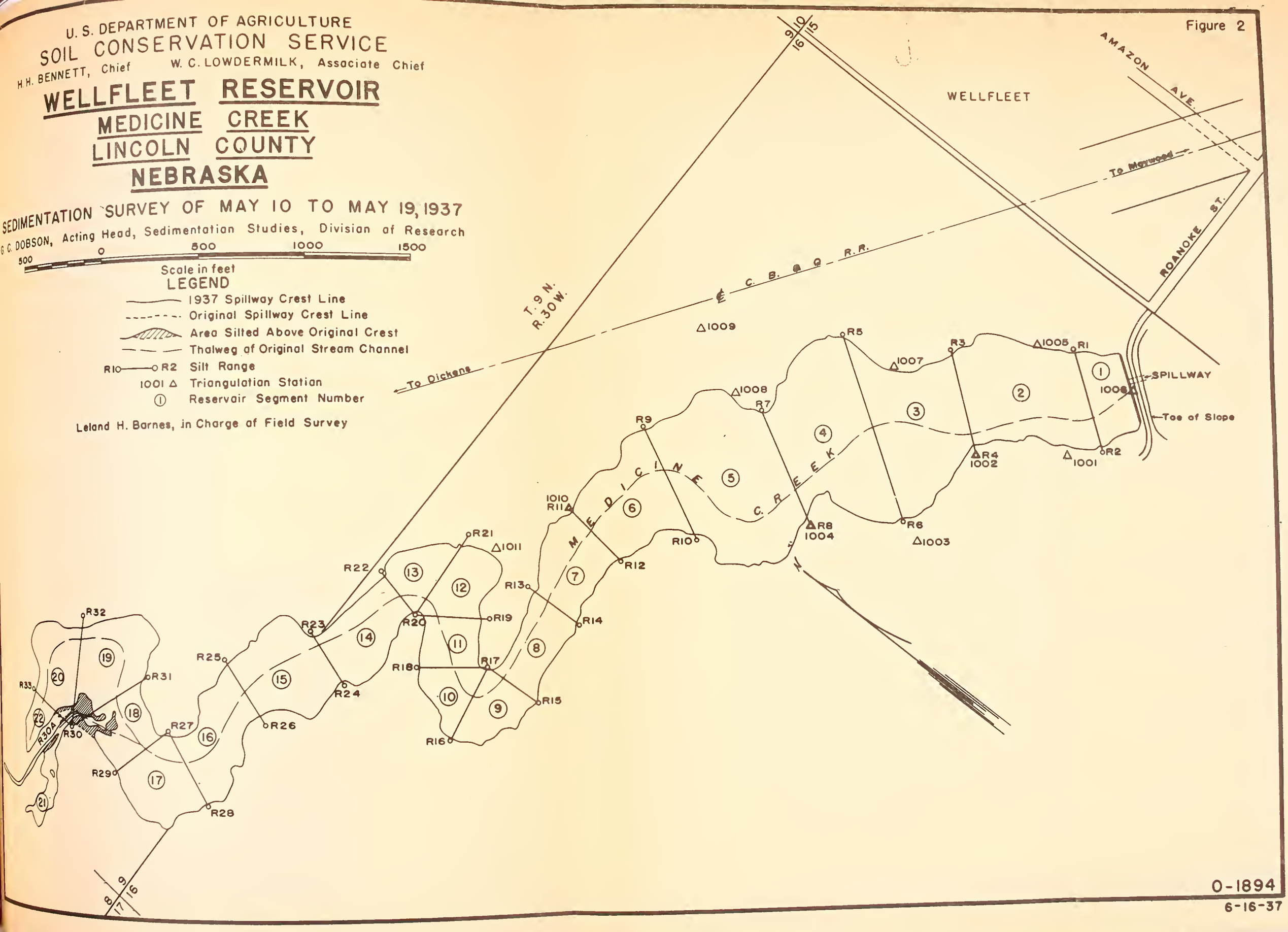
Scale in feet

LEGEND

- 1937 Spillway Crest Line
- Original Spillway Crest Line
- Area Silted Above Original Crest
- Thalweg of Original Stream Channel
- R10—R2 Silt Range
- 1001 △ Triangulation Station
- ① Reservoir Segment Number

Leland H. Barnes, in Charge of Field Survey

Figure 2



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