ECOLOGICAL STUDY OF WESTERN PAYNE COUNTY OKLAHOMA

LAND UTILIZATION PROJECT

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LAND UTILIZATION PROJECT

By

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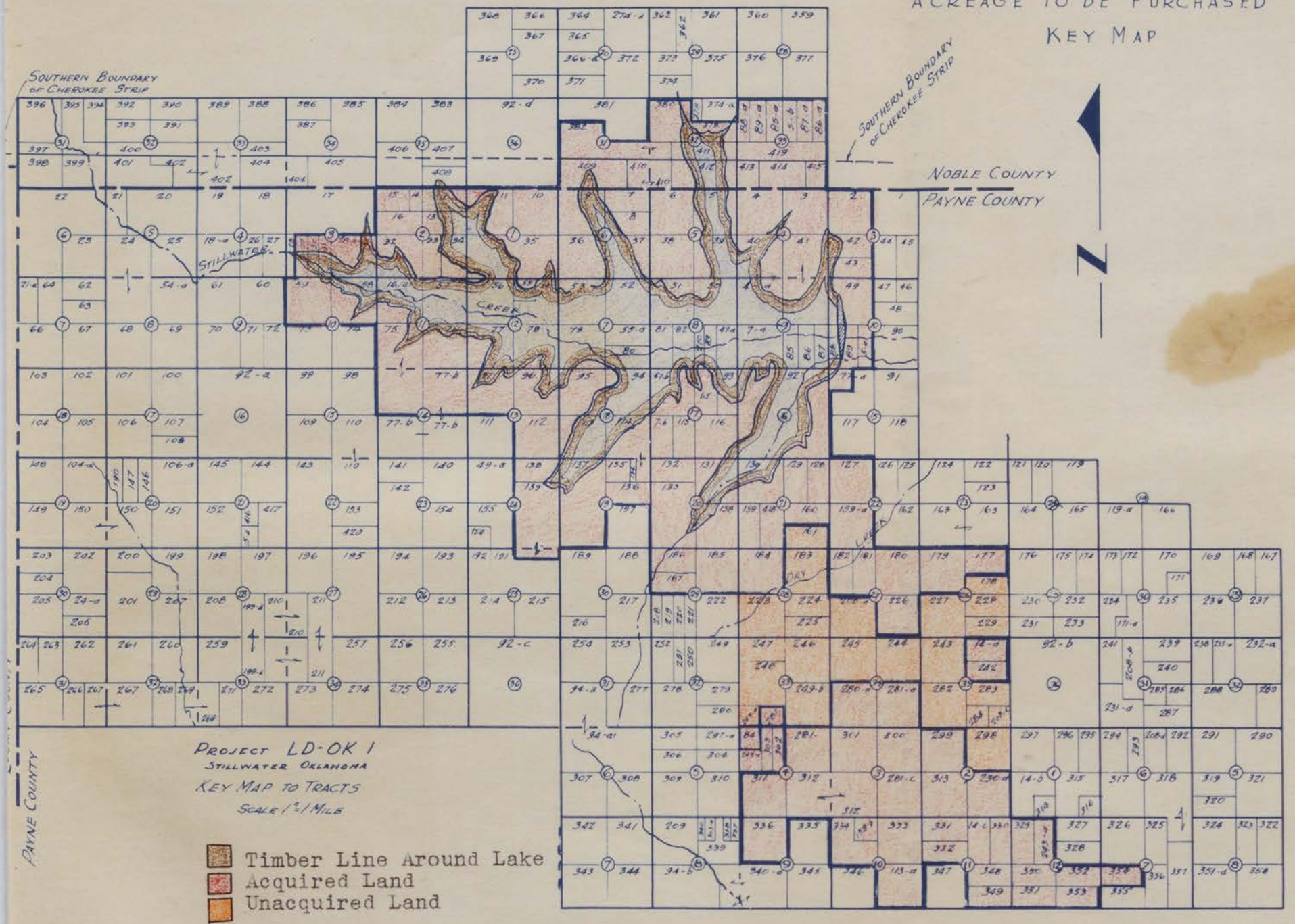
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ECOLOGICAL STUDY OF WESTERN PAYNE COUNTY OKLAHOMA LAND UTILIZATION PROJECT

INTRODUCTION

This treatise is the result of a desire for a brief, early history concerning the Payne County Land Utilization Project, located in the northwest part of Payne County, Oklahoma. The author has endeavored to portray in this thesis through a search of literature and personal investigation, some of the early conditions and activities carried out by the government in readjusting this so-called submarginal, land area.

The relation of this project area to other state experiment stations is that this project is conveniently located within the more central part of the state and is accessible to a greater portion of the state of Oklahoma. It is only a few miles' distant from the Oklahoma Agriculture and Mechanical College and Experiment Station. It borders on the area in Payne County, where the Soil Conservation Service of the United States Department of Agriculture is carrying on an extensive soil conservation practice in controlling erosion.

The various agricultural experimental farms located in the state are around or near the border of the state, whereas the project area is located more nearly in the center of the state.

The rural population within a one-hundred-mile radius of this tract includes a total of 42.4 per cent of the total farm population of Oklahoma. The demonstrations in land utilization will be readily accessible to the large numbers of farmers in

the state.

As a second phase to the submarginal land utilization demonstration project, a part of the area will be made into a recreational center. A 3,264 acre lake is being constructed in the north eastern part of the area on Stillwater Creek. Approximately eighty-three per cent of all urban population of Oklahoma is also within this radius as well as are many major cities of the state, including Oklahoma City, Tulsa, Muskogee, Bartlesville, Enid, and Ponca City. At the present time there are no major recreational parks in this part of Oklahoma. The relation of the soil types within the purchased area to the general soils regions of the state of Oklahoma is given in the Oklahoma Station Bulletin No. 205.[1] The area falls within the general soils regions known as the central prairies.

The purchased area could, in general, be classed in soil type as falling within the central prairies or central cross-timbers of Oklahoma. These two soil regions extend north and south through the east central part of Oklahoma. They are generally rolling lands which are low in organic matter. Because of the roughness of the land and the hard beating rains, characteristic to these regions, the soils have been eroded and depleted of their fertility, making it necessary for some type of adjustment in the utilization of these lands in order that further depletion of these soils may be checked.

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[1] Horace J. Harper, Easily Soluable Phosphorous in Oklahoma Soils, Experiment Station Bulletin No. 205.

Topographic Features

From the standpoint of topographic features of this area, it is in general surrounded by relatively level lands. But the project area, especially in the southern portion, is rough and hilly and is covered with scrub blackjack oak, together with limited quantities of elm, walnut, ash, white oak, and plum bushes. The area drains in two directions, one toward Stillwater Creek in the north part of the are and the remainder into Wildhorse Creek in the south part of the area.

HISTORY OF OKLAHOMA LAND DEVELOPMENT PROJECT

Early records show that the vegetation of this part of Oklahoma in which the project area is located is meager. Only where the early explorers and traders were accompanied by a biologist or writer were any records kept. Such records constitute the only source of information concerning conditions before the region was opened for settlement. According to Bruner,[2] probably the first expedition through the surrounding territory was recorded by Nuttell. The expedition traveled up the Arkansas River to the mouth of the Cimarron, then extended westward into Cimarron and Canadian Valleys. In the eastern part of the state, Nuttell makes mention of the heavy timber which he lists as savannah. As the expedition moved westward it traversed a country which Nuttell called the crosstimbers; the trees were listed as blackjack oak, post oak, and in some places, hickory and elm. These crosstimbers were mentioned as a fringe of the great prairies.

Prairie fires are assumed to be the main factor in keeping the more moist prairies free from trees, and even at this early date the expedition had observed the spread of forests into various grass land areas which were not subjected to fire. He also mentions the decreasing stature of the woody vegetation and its scarcity as they moved westward. The gypsum hills and the great sandy plains which lie west of this project area are features which were recorded at this time, and the vast area of

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[2] W. E. Bruner, The Vegetation of Oklahoma, Ecological Monographs, I.

country covered with "buffalo grass" (Buchloe dactyloides) and "grama grass" (Bouteloua species), together with numerous common herbs, shrubs, and trees are also pointed out.

In 1832 an expedition set out from Fort Gibson in early October, accompanied by Washington Irving.[3] The expedition crossed Pawnee, Payne, and Oklahoma Counties. On this trip Irving kept a written record of his findings and gives a brief description of his observations in this part of the country, which was then known as the Pawnee and Osage hunting grounds.

As the expedition moved along up the Arkansas and Cimarron Rivers, Irving recalled an abundance of wild game, such as turkey, deer, and antelope which were found in the heavy forest and small open glades. As the party moved westward and left the Cimarron, they soon found themselves entering a prairie like country where the hills were covered in part with a low and shrubby type of timber that gave way in the valleys and on the slopes to tall grasses, which resembled vast fields of grain.

When the party entered the territory of which Pawnee County is a part, the first buffalo tracks were cited; and as the expedition moved on in a southwest course into what is now Payne County, the trails of the buffalo through the tall grass became more and more noticeable and appeared to have been only made a few days previous. On a hill southeast of the town of Stillwater, the first wild horse was cited by the party. As they continued in a southwest course, a small stream was ap-

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[3] Washington Irving, A Tour on the Prairies.

proached. This stream was bordered with low spreading trees and dense thickets that made the crossing difficult. On the South bank of this stream the party encamped for the night.

Here Irving tells of a half-breed Indian's, who was accompanying the party as a guide, catching and bringing into camp a wild horse from which this stream received its name. Wildhorse Creek serves as drainage for the southwest part of Payne County and the southern part of the project area.

The expedition continued its travel until it came within the vicinity where Oklahoma City is now located. Here the buffalos were found grazing in large numbers on the dry and parched grass that appeared to have undergone a drought. After a few days of hunting and a large number of buffalos' being slaughtered, the expedition turned back in a northeast course toward Fort Gibson from whence the party had set out a month before. The history of these expeditions show that the native vegetation of this and surrounding territory was of the tall grass type and that it was subjected to burning by the Indians to furnish luxuriant grazing for the buffalo over their hunting ground.

REASON FOR GOVERNMENT CHOOSING STRATEGIC LOCATION

The Federal Government chose this location because of the similarity of land throughout an extended distance, north and south of the project area, making an ideal location for demonstrational purposes. Because sub-marginal land throughout the United States is increasing at such a rapid rate, and because many families who owned or occupied these lands find it impossible to make a living without some other source of income, the government established land utilization projects throughout such areas.

The project is located in a soil area in Oklahoma, according to the Oklahoma Bulletin No. 205 known as the central prairies. This land is a strip about sixty miles wide, running

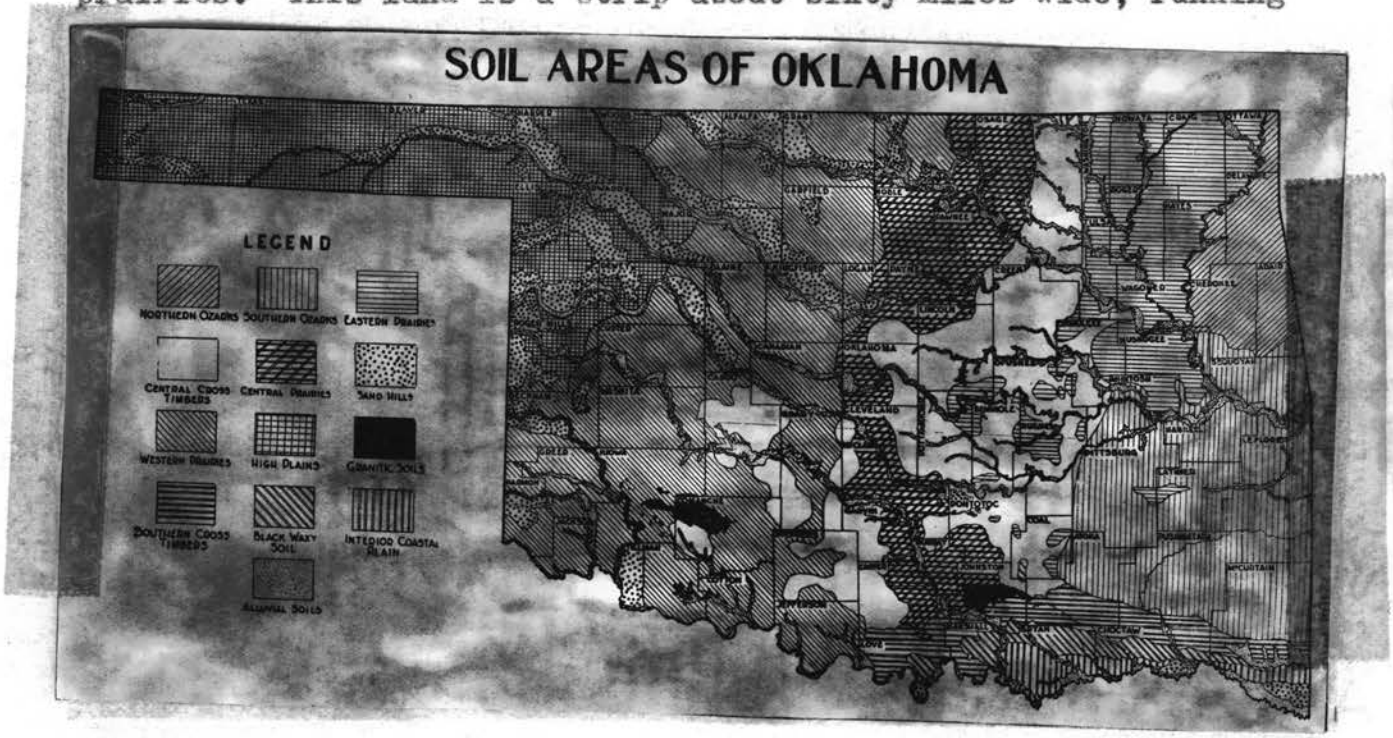

Fig. 1 Soil area map of Oklahoma showing major soil differences which have developed as a result of the combined influence of rainfall and natural vegetation (forest and prairie) in the parent material from which the soils were formed.

Indicates location of project area.

from north to south throughout Oklahoma, and extending north into central Kansas, and south into north central Texas. As the project is centrally located within the area, any experiment of proved value would be adaptable to other parts of the region.

The government's announced goal in such a set-up is to revegetate the land, control erosion, and provide recreational facilities.

Climate

The climate of Payne County in which the project area is located is mild and generally agreeable;[4] however, during the summer months, the days are sometimes extremely hot for periods of a week or more, and occasionally during the winter sudden changes of temperature caused by "northers" make the climate temporarily disagreeable. These severe cold spells are of short duration usually.

The mean annual temperature is about 59°F. Temperatures of 105°F. to 108°F. frequently occur during the months of July and August, and temperatures of 100°F. have been recorded in all the months from April to September, inclusive. The high temperatures are occasionally accompanied by hot winds, which damage vegetation.

The mean temperature of the winter months, according to Martin[5] is 37.8°F. The highest winter temperature on record, according to the U. S. weather bureau for Stillwater, Oklahoma,

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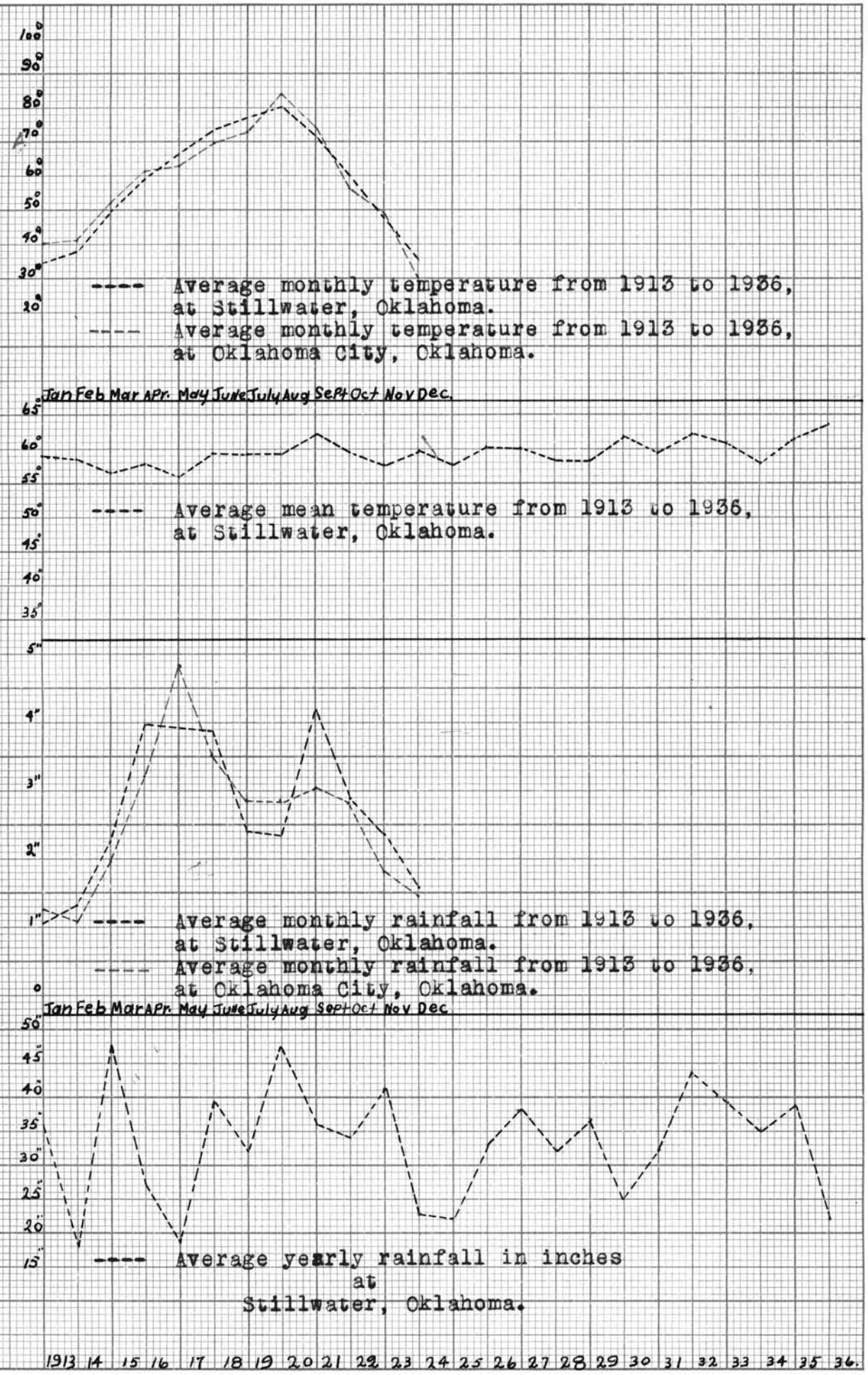
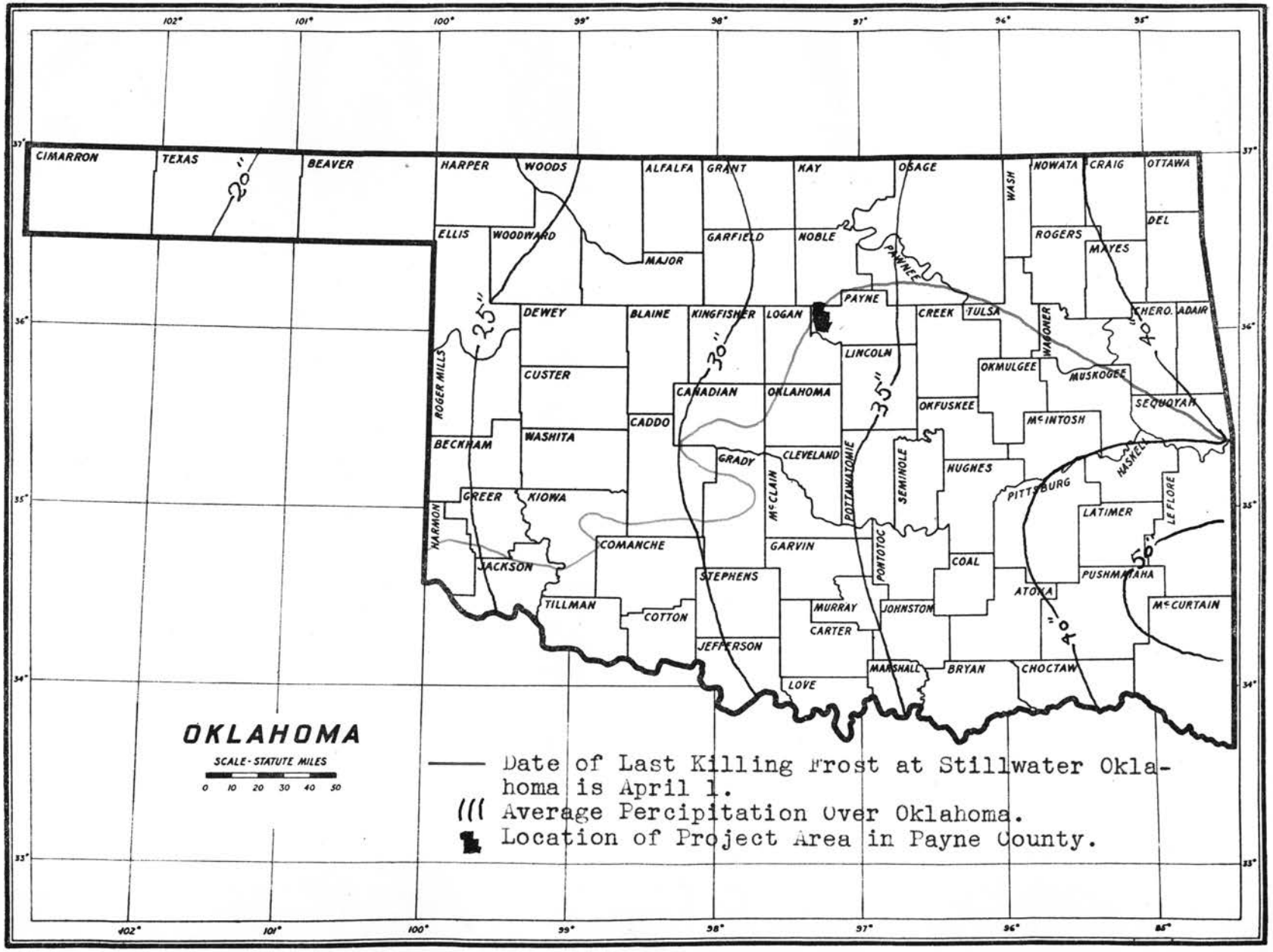
[4] W. B. Cobb and H. W. Hawker, Soil Survey of Payne County Oklahoma, U. S. D. A. Bureau of Soils.

[5] R. J. Martin, Climatic Summary of the United States, Section 43, Eastern Oklahoma.


100°
90°
80°
70°
60°
50°
40°
30°
20°
---- Average monthly temperature from 1913 to 1936, at Stillwater, Oklahoma.
---- Average monthly temperature from 1913 to 1936, at Oklahoma City, Oklahoma.
Jan Feb Mar Apr. May June July Aug Sept Oct Nov Dec.
65°
60°
55°
50°
45°
40°
35°
---- Average mean temperature from 1913 to 1936, at Stillwater, Oklahoma.
5"
4"
3"
2"
1"
0
---- Average monthly rainfall from 1913 to 1936, at Stillwater, Oklahoma.
---- Average monthly rainfall from 1913 to 1936, at Oklahoma City, Oklahoma.
Jan Feb Mar Apr. May June July Aug Sept Oct Nov Dec.
50"
45"
40"
35"
30"
25"
20"
15"
---- Average yearly rainfall in inches at Stillwater, Oklahoma.
1913 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36.


CIMARRON
TEXAS
BEAVER
HARPER
WOODS
ALFALFA
GRANT
KAY
OSAGE
WASH
NOWATA
CRAIG
OTTAWA
ELLIS
WOODWARD
MAJOR
GARFIELD
NOBLE
PAWNEE
ROGERS
MAYES
DEL
DEWEY
BLAINE
KINGFISHER
LOGAN
PAYNE
CREEK
TULSA
WAGONER
CHERO.
ADAIR
ROGER MILLS
CUSTER
CANADIAN
OKLAHOMA
LINCOLN
OKMULGEE
MUSKOGEE
SEQUOYAH
CADDO
OKFUSKEE
McINTOSH
BECKHAM
WASHITA
GRADY
CLEVELAND
POTTAWATOMIE
SEMINOLE
HUGHES
NASKEL
GREER
KIOWA
McCLAIN
PITTSBURG
LE FLORE
HARMON
LATIMER
COMANCHE
GARVIN
JACKSON
PONTOTOC
COAL
STEPHENS
PUSHMATAHA
ATOKA
TILLMAN
COTTON
MURRAY
JOHNSTON
McCURTAIN
CARTER
JEFFERSON
MARSHALL
BRYAN
CHOCTAW
LOVE
20"
25"
30"
35"
40"
50"
OKLAHOMA
SCALE - STATUTE MILES
0 10 20 30 40 50
Date of Last Killing Frost at Stillwater Oklahoma is April 1.
Average Percipitation Over Oklahoma.
Location of Project Area in Payne County.

is 90°F., and the lowest is -18°F., both of which occurred in February. Occasionally light snows fall in the winter, but snows do not remain on the ground for any length of time.

The average date of the last killing frost at the Stillwater Station is April 8, and that of the first killing frost in the fall is October 26. The normal growing season is thus nearly two hundred days in length, which is ample time for the maturing of all the common crops. The earliest recorded killing frost in the fall occurred on September 25, and the latest in the spring on May 1.

The average annual rainfall is nearly thirty-four inches. The total precipitation in the driest year on record (1914) was 16.79 inches, and the wettest year (1908) was 61.1 inches. The greater part of the rainfall comes during the late spring and summer and the early fall. The rainfall in this area is variable from locality to locality, with the amount from one varying in intensity from a mere drizzle to a thunder storm with an intensity of about one inch in ten minutes. The heaviest rainfall generally occurs in the late spring and early summer months. In years in which the precipitation is favorably distributed it is ample, but there is frequently a concentration of rainfall followed by long periods of drought, during which crops suffer.

Table I. Gives the normal and extreme monthly, seasonal, and annual temperature and precipitation as recorded by the Weather Station at Stillwater.

Table I

	Temperature			Precipitation		
	M	A-Max.	A-Min.	M	1	2
December	38.8	74	-2	1.14	1.34	.03
January	37.1	78	-10	1.19		1.23
February	37.4	90	-18	1.08	.65	5.00
Winter	37.8	90	-18	3.41	1.99	6.26
March	50.7	98	0	2.42	1.41	2.36
April	59.2	100	20	3.49	2.25	6.90
May	67.2	100	29	6.05	2.04	11.21
Spring	59.0	100	0	11.96	5.70	20.47
June	75.8	105	44	3.69	.51	7.28
July	79.9	108	51	3.16	.52	2.31
August	80.5	108	43	3.41	2.48	2.72
Summer	78.7	108	43	10.26	3.51	12.31
September	73.1	104	36	3.24	3.84	6.11
October	60.9	99	21	2.82	1.23	10.19
November	48.7	88	7	2.14	.52	5.76
Fall	60.9	104	7	8.20	5.59	22.06
Year	59.1	108	-18	33.83	16.79	61.10

M - Mean Temperature. A-Min. - Absolute Minimum Temperature.
A-Max. - Absolute Temperature.
1 - Total amount of precipitation the driest year (1914).
2 - Total amount of precipitation the wettest year (1908).

Range 1 West. | Range 1 East.

Noble Co.
Payne Co.

Twp. 20 N.

North.

19

Township 18 North.

Township

Range 2 East.

LAND USE IN PROJECT AREA BEFORE GOVERNMENT ACQUISITION.

Legend.

Crop Land.

Woodland or Woodland Pasture.

Unacquired Land.

Topography

The project area is in general surrounded by relative level lands. But they might be classed as hilly and rolling, except along the streams and branches that drain the area. The area drains in two directions, one toward Stillwater Creek in the north part of the area, and the other toward Wildhorse Creek in the south part of the area. Nearly all the land found along the streams is in cultivation and is capable of producing good crops.

The area lying north and west of Stillwater Creek is characterized by more prairie and open land that is free of blackjack timber. This area is quite rough and broken with many rock out-crops. A high percentage of the land in this area is under cultivation or at some time has been under cultivation and was then abandoned.

In the south part of the area, the topography is rough and shows much erosion which is due to the sandy nature of the soil. This area is mostly covered with blackjack oak with small strips of prairie interspersed. Much of the blackjack oak has been cleared for cultivation purposes until erosion forced the tiller to abandon the land for farming purposes. This area is characterized by the shallow beds of sandstone, which out-crop along the surface of the soil at frequent intervals.

Geology and Parent Material

The soils in the project and surrounding area are derived from the Permian and Pennsylvania Redbeds, according to Aurin. The name Redbeds are given because of the red color that is

characteristic of these soils which is due to high iron content. The redbeds extend from central Kansas, through Oklahoma, from north to south to or near the Pecos River in southwest Texas. In general the Redbeds consist entirely of red shales and sandstone. The soil generally shows a darker red color where the parent material was sandstone and a higher color where shale was the parent material, the organic matter adding to the depth of color.

The origin and source of the sediments comprising the Redbeds is a question which has not been satisfactorily answered up to the present time. The non-red Permian deposits in northern Oklahoma and north central Texas were laid down in an inland sea as the limestones of this series contain marine fossils, of which the project area is characteristic. However some of the Permian Redbeds appear to have been formed by an arm extending back from the sea and sediments deposited during a semi-arid climate. The gypsum deposits in the Redbeds west of the project area suggest that they were formed by evaporating of water in relatively shallow basins, which at least temporarily, had more or less connection with the sea.

Soil Types

The soil types of the project area, as determined by the Soil Survey of Payne County,[6] show that the stratas of sandstone and red shale constitute the parent material, and are exposed in considerable acreage throughout the area. These residual soils, prevailingly partake the color of the parent rock.

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[6] W. B. Cobb and H. W. Hawker, op. cit.

These parent rocks, being rather easily disintegrated from soils of both fine sand and clays, have practically no demarcation except for a transition which is due to the erosion of the sands over the clays and vise versa. The residual soils consist principally of two series, the Vernon and Kirkland.

The raw immature soils known as the Vernon series have a variable surface organic layer varying from four inches to eight inches of fine sandy loam, because of the severe erosion to which these soils have been subjected, either in cropped fields or in pasture. Most of the surface soil layer has been removed, and in places much of the "C" horizon* has been exposed and often seriously eroded. The surface soil remaining over the area ranges from two to four inches depending on the amount of erosion.

Under normal virgin conditions, the free carbonates in these soils have been leached to a depth of twenty-four inches to thirty inches, but because of the severity of erosion, both the sheet and gully types, the soil now shows a very irregular acid reaction. Even in the same fields the acid reaction varies from a Ph.** of 6 to 8.0. This marked differences have, no doubt, occurred since the fields have been placed under cultivation and subjected to sever erosion.

The Kirkland series include the mature soils of the area. Although they are very small in acreage in this area, their importance has been recognized by the farmers. The major part

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*Horizon is the layers of soil and mineral concentration extending from the surface downward.

**Is an estimation of the intensity of the soil.

of these series has at some time been under cultivation. The Kirkland soils occupy the more level and gently rolling divides with a slope from one to three per cent. They have a brown to dark brown surface of fine sandy loam, varying in depth from eight to fifteen inches over a heavy tenacious claypan development which in turn grades into a mottled brown to reddish brown parent material of "C" horizon.

In these soils the erosion is principally surface erosion. Because of the claypan these soils have very little ability to absorb surface moisture and often crack open for a depth of two feet or more during the dry seasons.

In many cases the parent material of weathered sandstone, which may be high in soluable salts, projects up into the "B" horizon and is now exposed, because of the removal of the surface soil by erosion. This has resulted in a very spotted condition to exist in the badly eroded and cropped fields. These spots occur in both the Vernon and Kirkland areas and are called alkali spots by some soils technologists, and by others, it is called buffalo wallows. In Irving's Tour on the Prairies, he makes mention of many depressions on the prairies in this part of the country and called them "buffalo wallows." He makes mention that the buffalos were like swine in their habits because they liked to wallow in the mud and water collected by these depressions.

The Yahola series are found along the small stream bottoms. The surface soil of the Yahola fine sandy loam consists of a brown or dark brown surface horizon which has depth from twelve to fourteen inches, grading into a brown fine sand somewhat

Plate 1. Buffalo wallow in north area. SE¼ of Sec. 33, in Noble County.

lighter in color and texture. This soil has been formed as a result of erosion from the surrounding upland in the area. Corn, alfalfa, cotton, and other seed crops are grown extensively on this soil, although the acreage is not large.

There is very little upland in this area of .3 per cent slope* that is not in cultivation. Many slopes in the project area approach a slope of twenty per cent. According to the appraisers on buying the land within the project area, twenty-three per cent of this area is badly eroded and gullied. Only thirteen per cent of the area, which is in the flat bottoms along the creeks, show none or slight erosion. Sixty-four per cent of the area has varying degrees of surface erosion.

Farm Set-up in the Project Area

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* Slope is the fall from the higher to the lower ground.

Data secured from Project Book No. 1[7] shows that out of the 144 families that lived in the area at the time purchasing of the land was begun, only forty-two or twenty-nine per cent were owners who occupied the land; sixty-two or forty-three per cent were tenants; and forty or twenty-eight per cent were living in the area but did no farming.

The housing conditions generally over the area were poor. The typical farm home in this area did not furnish adequate nor even comfortable facilities for its occupants. The houses were not kept in repair, and the furnishings of the homes met only the bare necessities. Practically all the houses were constructed of low grade lumber. Three houses were built of brick or stone on the area, and five were constructed of logs and other inferior materials. The inadequacy of the household in furnishings is plainly indicated by the extremely low insurable value of the houses. The average insurable value for the area is seventy-nine dollars per domicle.

To get an estimate of the modern conveniences in the project area, it was found that out of the 144 families, eighty-four owned some type of automobile, most of which were "out-of-date" models. None of the 144 families had electricity or running water. Thirty or about twenty per cent possessed telephones. Twenty-two of these 144 families enjoyed some kind of musical instrument, either a phonograph, piano, or organ. Twenty-nine of the families owned pressure cookers, and fifteen families had some type of washing machines.

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[7] Book I, The Personal Plan of the Project Area; Personal Property of the Farm Security Office Stillwater, Oklahoma.

The 1935 census of Payne County, which was taken to determine an estimate of the number of people on relief in the county and their location within the county, showed that the heaviest relief load in the county was in the purchased area. One of the big contributing factors for this is probably a lower standard of living which is due to low agricultural land values.

ACQUIRED LAND

The 22,243 acres of land acquired or in pursuit of acquisition is designated to be turned into grazing, recreation, forestry, and game areas.

In the south area the principal land use will be grazing and game production; while in the north area recreation, grazing, and game production will be carried on.

Grazing

Before the full benefit of land utilization can be accomplished from grazing, many acres of cultivated land must be retired from crop production, the land reseeded and returned to a relatively natural stage of vegetation. The natural revegetation of grasses over barren areas is slow in accomplishment, because of the low percentage of viable seed and the eroded condition of the land. It will require the aid of man to help reestablish these grasses if the maximum ground coverage is to be secured in the near future.

Also a carefully guarded system of range utilization after these areas have been reseeded must be carried out in order that the grass must be protected from over-grazing and thus insure desirable seed production. According to Sampson,[8] the range should not be grazed closer than seventy-five per cent of the palatable forage. This means that at least twenty-five per cent of the palatable or dominant vegetation should be allowed to seed on the range. Also early grazing in the spring should not be permitted in areas where the bluestem grasses

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[8] A. E. Sampson, Range and Pasture Management.

are the climax vegetation. The young tender blades should be allowed to gain enough growth, so that the animal grazing upon this grass can secure a good bite of forage without grazing the tender shoots close to the crown, which is very injurious to the plant.

Lake Area

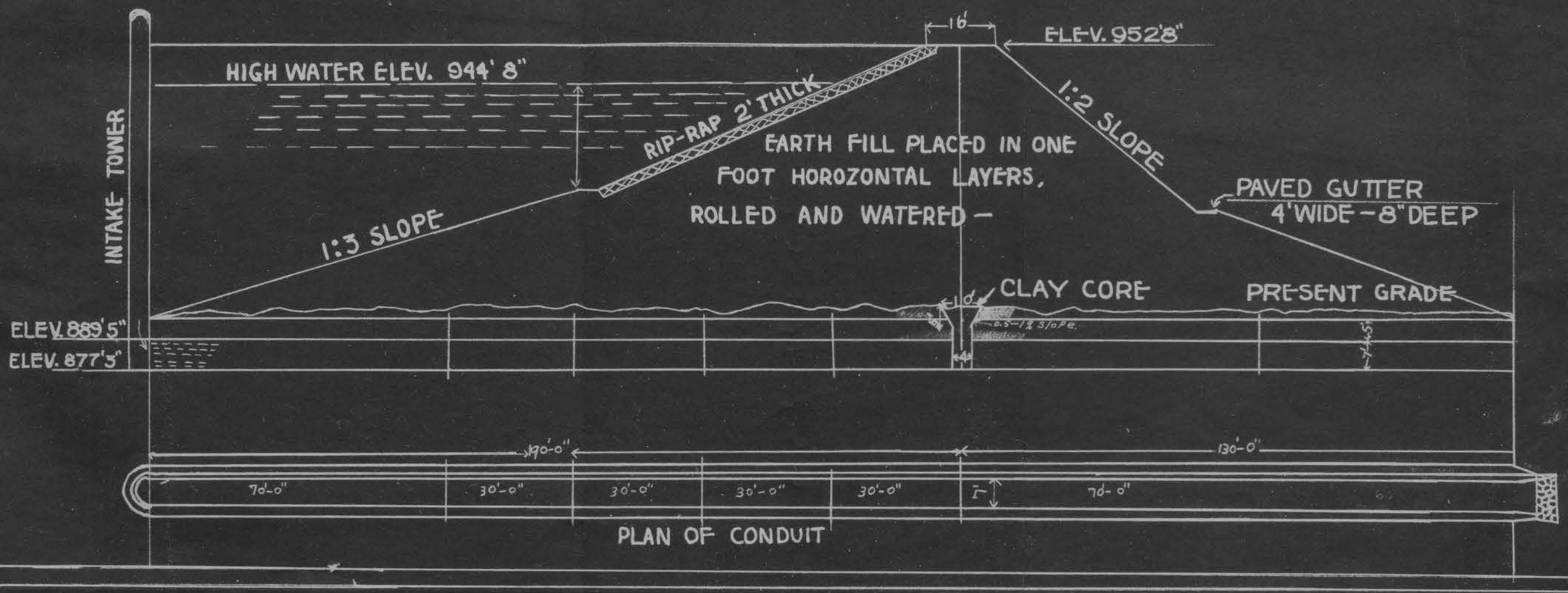
After land acquisition for a permanent project, about the first work to be started was that of the lake. Clearing timber on Stillwater Creek west of the dam was begun in the fall and winter of 1936. Many trees and stumps had to be cleared and brush burned where soil for the dam was to be secured. The dam when completed will empound a lake of 3,260 acre feet of water, and will have a shore line of approximately forty miles. At the dam, the water will be fifty feet deep at the conduit. A mile of timber has been cleared to the shore line and from the dam, and in a number of ravines along Stillwater Creek.

The lake when filled with water will hide many original topographic features. Map 2, shows that the greater part of land which the lake will cover was tilled land, many acres of which produced a good wheat crop in 1937; also, considerable areas of alfalfa land will be covered by water and silt brought down the stream from above. The land, both farming and pasture, has been either terraced or contour ridged on what forms a part of the lake's watershed in the project area. This, it is hoped, will cut down silting to a minimum and will prolong the life of the lake many years.

Dam Construction

The construction of the dam was started in the spring of

CROSS SECTION OF DAM AT CONDUIT.



1936. The first work was that of digging a core thirty feet wide and the length of the dam, going down to solid foundation where the center of the structure was to be built. The core was filled with puddled clay and was packed down to prevent seepage underneath the structure.

The width at the ground surface will be 300 feet, and will gradually narrow down to sixteen feet at the top when the dam is completed. Material for the construction was secured close by, the soil being taken out of the lake bed, west of the dam as illustrated in Plate II.

The soil for the construction of the fill was moved by trucks and was scattered in six inch layers with a grader and tractor. The soil then was dampened down and packed with a heavy roller. The dam on the empounding side was rip-rapped with a rock to a thickness of two feet; then it was covered with soil and was planted to rye grass to prevent rill erosion. The rock for the structure was secured from the spill-way,

Plate II. Removal of soil from lake bed. (Horizon is top of dam.)

Plate III. Construction of lake dam.
which was dug through a sandstone hill at the south end of the dam. The east side of the structure has been sodded to bermuda grass.

Located below the dam will be fifteen fish-rearing ponds to furnish fingerlings for keeping the lake stocked with game fish. The manual labor will be furnished mainly by W. P. A. laborers.

PERSONAL VEGETATIVE SURVEY OF THE AREA

The purpose of the survey over the project area was to study the ecology of the vegetation, both weeds and grasses as they appear at the present time, so that in future years, the vegetative changes brought about on these lands under restrictive grazing and methods of revegetation by the government throughout the project area may be compared and evaluated.

The survey was made by the author from October 15, to October 25, 1937. Each half-section within the area was walked over, and a list was made of the vegetation that was found more frequently growing under the three conditions, grazed pastures, cultivated fields, and meadows and land that had been once in cultivation, but was abandoned for farming purposes because of either soil erosion or low soil fertility. A list of grasses found throughout the area that make-up the greater part of animal forage is given in table II.

The pasture lands throughout the area show signs of heavy over-grazing. The climax vegetation, little and big bluestem, has been almost totally destroyed because of the continued close grazing. According to Clements and Weaver,[9] the bluestem grasses cannot stand continuous close grazing, because the short vegetative shoots cannot manufacture enough plant food to nourish the root system; therefore, the grass is starved out.

The native bluestem grasses have been replaced by grasses adapted to more arid soils. These grasses are the blue grama, side oat grama, and buffalo grasses, which are quite character-

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[9] J. E. Weaver and F. E. Clements, Plant Ecology.

Table II. Classification of the More Important Grasses as to Habitat, Vegetative Reproductive System, and Forage Value.

Scientific and Common Name	Habitat	Plant Type	Forage Value
1. Andropogon furcatus (Big Bluestem)	Good Soil	Bunch-short Rhizomes	Good
2. Andropogon scoparius (Little Bluestem)	Uplands	Bunch-short Rhizomes	Good
3. Andropogon saccharoides (Silverbeard Grass)	Waste Lands	Bunch-short Rhizomes	Of Little Value
4. Andropogon ternarius (Silverly Beard Grass)	Poor Land	Bunch-short Rhizomes	Medium Value
5. Triodia flava (Purple Top Grass)	Sandy dry soils	Tuft-short Rhizomes	Fair
6. Triodia stricta	Dry soils	Tuft-short Rhizomes	Poor
7. Bouteloua curtipendula (Side Oat Grama Grass)	Immature soils	Tuft-short Rhizomes	Good
8. Bouteloua gracilis (Blue Grama Grass)	Dry-mixed soils	Sod-stolons	Good all Season
9. Buchloe dactyloides (Buffalo Grass)	Heavy-dry soils	Sod-stolons	Good all Season
10. Sorgastrum nutans (Indian Grass)	Dry and moist soils	Tuft-short Rhizomes	Fair
11. Mulenberghia racemosa	Moist soil	Sod-scaly Rhizomes	Good
12. Paspalum stramineum	Sandy soil	Tuft-short Rhizomes	Good while Young
13. Paspalum floridanum	Sandy soil	Tuft-short Rhizomes	Questionable
14. Chloris verticillata (Windmill Grass)	Dry soils	Tuft-short Rhizomes	Fair to short Duration
15. Panicum scribnerianum	Sandy dry soil	Runners	Little Value
16. Panicum virgatum (Switch Grass)	Moist soils	Sod-rhizomes	Fair to good
17. Aristida purpurascens (Purple Three Awn)	Waste Lands	Tuft-short Rhizomes	Of Little Value
18. Aristida oligantha (Three Awn)	Poor soils	Tuft-short Rhizomes	Of Little Value

istic throughout the area. These grasses are very nutritious and make excellent winter grazing because of the fine leafy culms.

Many of the pastures have been so heavily over-stocked that the grasses have not had the chance to reseed, therefore the stand in many of the pastures over the area is thin and has been replaced mostly by weeds and grasses characteristic of grosly abused sub-climaxes. Some of the annual and perennial grasses in the north area that make up a greater part of the animal forage are sometimes designated as poverty grasses and consist of windmill grass (Chloris verticillata) (Paspalum stramenium) Aristidas, (oligantha) and (purpurascens) and (Panicum scribnerianum), the panicum and paspalum being observed more on sandy soils or moist hillsides. The windmill grass, Paspalum and Panicum are palatable grasses, but because of their short duration of growth, they are not recognized by the government as being of any particular value as range grasses.

The weeds most frequently found in the pastures were the ragweed (Ambrosia species), broomweed (Gutierrizia sarothrae), buffalo bur (Solanum rostratum), and False Blue Indigo (Baptisis bracteata); the latter is a wild leguminous plant. Such weeds, according to Weaver and Clements,[10] are indicators of over-grazing, with the broomweed being the dominant indicator.

Plate IV is a view of an over-grazed pasture in the northern part of the area, located in S.W.¼ of Section 33, in Noble County. This pasture is characteristic of many located in the northern part of the area. The vegetation in this pasture con-

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[10] Ibid.

Plate IV. Sparce vegetation in an over-grazed pasture. sists of close grazed oat grama, blue grama and windmill grass, as well as many False Indigo (Baptisia bractiata), flase flax (Camelia microcarpa), and scattering cacti (Opuntia) that have migrated eastward because of the dry periods and heavy grazing by livestock. An estimate of the palatable forage in the pasture where Plate IV was obtained would be approximately four or five per cent density.

Where the grasses have been protected from grazing a different type of vegetation is found. Plate V shows grasses growing in a cemetary protected from grazing, located in the SE. ¼ of section 32 in Noble County. The cemetary is located just across the road and a half mile south from the over-grazed area shown in plate IV. The grasses in the cemetary consist mostly of little bluestem, with some scattering clumps of big bluestem and Indian grass. A few broomweeds and sunflowers were noticed only around the tombs where the soil has been disturbed.

The palatable forage cover was estimated to be twenty-five per cent density in this area.

Plate V. Vegetation in cemetary protected from grazing, located in SE.¼ of Section 32 in Noble County.

Meadows and Abandoned Land

The few meadows found in the survey over the area show a rather low forage density. Some of the land that meadows now occupy was at one time cultivated and then was later turned back to natural revegetation because of erosion or poor soil for crop production. Since the climax vegetation of this project area consists of the little and big bluestem grasses, revegetation by nature is a slow process and takes many years to restore the dominant vegetation where it is left to be accomplished only by nature. A very small percentage of these grass seeds are viable. This is well demonstrated in the south area, on Section 12, tracts 352 and 353. This field was cultivated until soil erosion or a low supply of plant nutrients forced the farmer to retire this land from crop production.

The field, tilled parallel with the slope, caused severe erosion and was eroded to the bedrock in places. This field has been retired from cultivation for approximately twenty years; the last cultivation was given with a lister, plowing up and down the slope, the furrows still showing rather prominently today. The meadow has probably reached its climax vegetation, little bluestem (Andropogon scoparius) and silverly beard grass (Andropogon tenerius), the latter being a good indicator of poor soil. The vegetative cover being about twenty-five per cent density, evenly spaced over the field, with many scattered colonies of wild Lespedeza (Lespedeza capitata).

Plate VI. Revegetation of a retired field, showing lister furrows in the background made twenty years before this picture was taken (1917), Section 12, Tract 353.

Weeds of the Area

The weeds found most frequently in the heavy grazed pastures were the ragweeds, broomweed, buffalo bur, and the False Indigo which, according to Weaver and Clements,[11] are all true

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[11] Ibid.

Table III. Weeds Found Most Frequently in Area

Common Name	Scientific Name
Weeds Found in Over-Grazed Pastures	
Broom Weed	Gutierrizia sarothrae
Rag Weed	Ambrosia sp.
Yarrow	Achillea lanulosa
Milk Weed	Asclepias sp.
False Indigo	Baptisia bracteata
False Flax	Cameliana
Lead Plant	Amorphia canescens
Bear Grass or Yucca	Yucca glauca
Snow-on-the-Mountain	Euphorbia marginata
Buffalo Bur	Solanum rostratum
Three Seeded Mercury	Acalypha virginica
Common Weeds Found in Fields	
Sunflower	Helianthus sp.
Rag Weed	Ambrosia sp.
Croton	Croton sp.
Rosin Weed	Silphium
Lambs Quarter	Chenopodium album
Mares Tail	Proserpinaca
Snow-on-the-Mountain	Euphorbia marginata
Broom Weed	Gutierrizia sarothrae
Pig Weed	Amaranthus reteroflexus
Ground Cherry	Physalis longifolia
Common Weeds Found in Meadows	
Goldonrod	Solidago sp.
Aster	Aster sp.
Blazing Star	Liatris squarrosa
Wood Sorrel	Oxalis stricta
Salvia	Salvia azura
Wild Legumes Found Over Area	
Partridge Pea	Cassia chamaecrista
Wand Like Bush Clover	Lespedeza jrutescens
Red Bud (a shrub)	Cercis canadensis
Trailing Wild Bean	Strophostyles helvola
Wild Lespedeza	Lespedeza capitata
False Indigo	Baptisia bracteata
Kentucky Coffee Tree	Gymnocladus dioica
Prairie Acacia	Acacia angustissima
Lead Plant	Amorphia canescens

indicators of over-grazing. In the tilled fields, many different kinds of weeds were found, the greater numbers being of

the annual and biennial type, and the more numerous species consisting of common sunflower, resin weed, croton, ragweeds, crabgrass, and buffalo bur, which soon give way to other plant successions after cultivation has ceased for several years.

In the fields and meadows that have been retired from cultivation for a short period, the annual weeds appear only in occasional places, the majority of weeds being of the perennial type and mostly consisting of goldenrod, salvia, yarrow, and asters. Also many leguminous plants appear, the most noticeable being Lespedeza capitata and Partridge Peas. (Cassia chamaecrista).

Trees and Shrubs

Approximately thirty per cent of the project area is covered with some type of timber at the present time. The tree cover cannot be classed as a true forest, since our climate is not well suited to forest growth. At the present time some of the trees are dying from the effects of droughts, and those not showing the effects so greatly are stunted.

According to ecological standards, this land is classified as parkland which is composed largely of blackjack oak, post oak, and elm, the latter being confined to the stream banks. In the clearing of timber along Stillwater Creek, some fair oak timber has been cut and made into posts. Rough lumber to be used by the government for improvements throughout the area was also obtained here, along this stream (Stillwater Creek) and some of the smaller streams in the area, pecan and walnut trees are found, which produce some edible nuts and the latter some valuable timber. About the only use of the oak species is

for posts and fire wood.

The blackjack oak is the most common tree found in the area; although it seldom appears in pure stands because most of the trees are young and do not constitute a complete closed forest. Most of the trees appear to be thirty-five or forty years old and average perhaps about six inches (6") in diameter. However, older timber is found along the streams and more level slopes, the density of the under cover varying as to the thickness of the trees. Where the trees are thick a smaller amount of vegetation is found and where trees are thinner a vegetation is found to be more dense.

The blackjack oak differs from the post oak type, in that the former is dominant, and there are often older trees scattered through the stand, the under cover types being the same throughout.

The fringe forest is entirely different in its distribution. Usually the blackjack and post oak types are found on the more rocky and poorer lands, while the fringe forest follows the alluvial lands along the streams. The composition of the fringe forest is elm. Among the species represented are the White Elm (Ulmus americana), Slippery Elm or Red Elm (Ulmus fulva), and (Ulmus serotina). Most of these areas are of little value except where pecan, walnut, or post timber occurs.

In some cases the elm is found in almost pure stands with a woody under-cover; but in most cases, other trees such as ash, (Fraxinus species), Kentucky Coffee Tree (Gymnoclaudis dioica), cotton wood (Popolus deltoides), and Willow (Salix species) associated with them in some cases are only shrubs,

such as elder, (Acer negundo) dog wood (Cornus asperfolia), redbud (Cercis canadensis), and grapevines (vitis species).

There are other species of trees that appear to be adapted to this area which are not native. These are the black locust (Robinia pseudo-acacia), catalpa (Catalpa speciosa), Osage Orange (Maclura pomifera), and red cedar (Juniperus virginiana). These trees were found around the farmsteads where they have been planted for shade or fences. The Osage Orange and black locust appear to make good growth and are especially adapted for post materials.

In the south part of the area, red cedar was used in some farmstead yards for ornamental purposes. Seeds from these trees are being scattered over the project and neighboring areas by birds.

Plate VII and VIII show Juniper trees located on the southwest ¼ of section 10, range 1, east tract 346, in the south part

Plate VII. Juniper, or Red Cedar plantings around an old farmstead. SW.¼ of Section 10, Tract 346.

Plate VIII. Young Junipers scattered over farm by birds eating seeds from old Junipers shown in plate VII.

of the area. This tract of land does not belong to the project area, but borders it on two sides and the old Juniper trees from this farmstead are directly responsible for many young Juniper seedlings appearing over the project and neighboring area. The Juniper furnishes an abundance of seeds for bird food and also makes a desirable type of post.

Wild Life

The project presents almost an ideal set-up for certain species of wild life, especially squirrel, rabbit and quail. The game over the area was almost completely destroyed, before government occupation. In the fall of 1935, each quarter-section of land was walked over, using a bird dog to flush the quail so that some estimate might be arrived at as to the number of birds over the area. The survey showed that approximately 600 birds were found on the area; no estimate was made

on the squirrel population. In the spring of 1936, ninety pair of quail were turned loose, and in the summer of 1937, approximately 1800 additional young birds were turned loose in covies of about fifteen to twenty over the area.

Plate IX. Bird rearing pens, that will be used to restock the area with quail.

The hatchery and rearing pens are shown in plate IX where quail are being raised to restock the project area. The bird hatchery is located one-quarter of a mile ($\frac{1}{4}$) north of the lake dam. A pair of birds, male and female, is placed in each rearing pen before the laying season begins, and is kept in the pens until the young are large enough to be turned loose on the range, about the latter part July.

Conditions over the area approach nearly an ideal presentation since there are many springs throughout the area. Several ponds have also been constructed by the government to furnish water for wild life and livestock. The lake in the north part of the area will have approximately forty miles of shore line when filled with water, which will help to establish

wild life cover in the northern area. Plots have also been fenced and planted in grain sorghums near these watering places which will provide feed for the birds, the plots being permanent and will continue to be sown to food crops for birds according to the present plans.

PLANT SUCCESSION

The laws underlying the occupation of lands by vegetation from its earliest stages to the development of the highest type of plant life which the given habitat is capable of supporting, is a somewhat regular replacement of one type of plants by another. According to Sampson,[12] this phenomenon known as plant succession is explained on the basis of certain, more or less, distinct changes that take place simultaneously in the substratum and may be accounted for in various ways, probably the most influential and universal cause being the addition of humus. The plants, themselves, by adding humus to the soil through the decomposition of their tissue and in this way changing the physical and chemical composition of the soil, prepare the way for a new and higher form of life; and, therefore, different plant types are recognized on soils in different stages of formation.

Review of Literature

In the utilization of lands as grazing area, the higher types of vegetation is often prevented, especially where the species high in development are grazed with greater relish than those species lower in the succession. Thus the plants higher in the development of the type may disappear gradually or suddenly, according to the degree of disturbance caused by the adverse factors until the stage lower in the development predominates. If the reterogressive factor continues for an indefinite period, the vegetation will continue to revert until

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[12] A. E. Sampson, op. cit.

the first weed stage reappears or until practically all the soil is carried away and the pioneer stage returns.

The destruction of the entire soil formation and the exposure of consolidated rock occurs only in the worst possible cases. More commonly, the productivity of the soil is decreased to a point where it can support only vegetation characteristic of the first weed stage; in still more common instances, it may support an admixture of annual and perennial weeds of the first and second vegetational stages.

While changes in the ground cover from a, more or less, permanent (sub-climax) type of high forage value to an unstable or temporary one of low forage value may be brought about in many ways, over-grazing or other faulty management is usually accountable for the reterogression in the vegetation on range and pasture lands. The grazing by livestock may transform a pure weed consociation; or it may cause an entirely new plant cover to come in, as is invariably the case on denuded grazing lands. Where the fertility of the soil is not appreciably lowered, the higher types of vegetation reappear without the more primitive fore-runners, or the intervening successional stages are short lived and are, more or less, intermixed with the climax species. But on the hillsides or other exposed, readily, drained lands where the upper fertile layer of soil has been much depleted and its water-holding capacity greatly decreased, the plant cover is thrown back to shallow rooted, early maturing annual herbs, similar to those characteristic of the first weed stage. The time required for thorough revegetation of lands where reterogressive succession has taken

place is approximately in direct proportion to the degree of depletion of the soil. Therefore the best results in promoting progressive succession are obtained where the season of grazing is determined on the basis of the life history of the different species and notably upon the time of seed maturity.

Results Obtained in the Area

Since grazing is one of the big phases of the project area, many years will be required before maximum forage production can be reached if left only to nature to restore. This area presents one that has been well disturbed from a vegetative standpoint, as much of the tilled land is in the first ruderal stage, the plants consisting of lambs quarter (Chenopodium alba), common sunflower (Helianthus annus), croton (Croton capitatus), Pig weed (Amaranthus reteroflexus), and buffalo bur (Solanum rostratum). On the fields that have been retired from cultivation for a few years, the second or third ruderal stage appears; these plant stages consist of both annual and perennial weeds and grasses, with the dominant vegetation of these stages consisting of ragweed (Ambrosia species) broom weed, (Guterrizia sarothrae), snow-on-the-mountain (Euphorgia marginata), salvia (Salvia azura), aristida (Aristida species) windmill grass (Chloris verticilliata), drop seed (Sporobolus scriptangerius), foxtail (Setaria species). As the soil is built up, the lower weed stages give way to higher plant consociations.

The first and second weed stages or successions furnish little protection to the soil during winter; therefore, serious erosion occurs where some system of erosion control or pasture

management is not applied.

Table IV. Chemical Properties of Soil Supporting Bunch Grasses and Soil Supporting the Ruderal Consociation. U.S.D.A. Bulletin 791.

Soil	Lime (cao)	Potash (K_2O)	Acid (P_2O_5)	Total Nitrogen	Loss by Ignition (Humus)
	%	%	%	%	%
Bunch Grass	1.49	1.30	0.38	.488	14.65
Ruderal Weeds	1.26	1.53	0.22	.158	6.64

In the pastures the climax vegetation has been destroyed and many weeds appear, such as rag weed, broom weed, False Indigo, and plaintain (Plantago major). The climax bluestem grasses will be slow in revegetation if left to nature, because the bluestem grass seeds are low in viability and the vegetative spread is slow. Most pastures show considerable clumps of grama grass (Bouteloua species) and Buffalo Grass, (Buchloe dactyloides) which if given a chance to reseed should revegetate the pastures rapidly.

Forage Production and Palatability

The amount of forage produced on lands in the first or early weed stage is far less than that produced on lands supporting any of the higher stages of plant growth. The ruderal-weed cover is best suited for the grazing of sheep, but the carrying capacity is low and the forage distinctly inferior. The forage consumption by livestock during the first and second weed stage accoding to Sampson,[13] is cattle and horses a-

[13] Ibid.

bout eighteen per cent, either highly palatable or moderately palatable plants, and for sheep about sixty-five per cent palatable with no species being entirely rejected.

Table V.* Plant Utilization List for Oklahoma, by Agronomy and Botany Instructors, Oklahoma A. & M. College, 1937.

Scientific Name	Common Name	Palatability	
		Cattle and Horses	Sheep and Goats
	Grasses and Grass Like Plants	%	%
*Agropyron smithii	Bluestem or Western Wheatgrass	65	65
*Andropogon hallii	Turkeyfoot or Sand-bluestem	70	60
*Andropogon furcatus	Big Bluestem	75	60
*Andropogon saccharioides	Silver beard grass	40	20
*Andropogon scoparius	Little Bluestem	80	25
*Aristida (Species of)	Needle and Wire Grass	20	10
*Buchloe dactyloides	Buffalo Grass	75	40
*Bouteloua curtipendula	Side-Oat Grama	85	70
*Bouteloua gracilis	Blue Grama	75	55
*Bouteloua hirsuta	Hairy Grama	60	60
*Bromus (Species of)	Rescue Grass and Others	85	85
*Cenchrus	Sandbur	10	10
Calamovilfa gigantea	Giant Reedgrass	30	10
Carex planestachys	Sedge	40	50
*Cynodon dactylon	Bermuda Grass	75	75
Distichlis stricta	Carpet or Saltgrass	40	10
*Elymus canadensis	Wild Rye Grass	30	20
*Eragrostis cilianensis	Stink Grass	10	10
*Festuca	Fescue and Weedy Brome Grass	50	50
*Hordeum pusillum	Little Barley	50	25
Koeleria cristata	June Grass	30	30
Panicum obtusum	Vine Mesquite	50	20
*Panicum virgatum	Switch Grass	60	30
*Paspalum (species of)	Sand and Others	80	50
Poa arachnifera	Texas Bluegrass	80	30
Schedonnardus paniculatus	Tumble Grass	15	05
*Setaria lutescens	Foxtail Grass	70	30
*Sorghum halepensis	Johnson Grass	50	20
*Sporobolus airoides	Bunch Saltgrass	30	20
*Sporobolus asper	Prairie Dropseed	30	20
*Sporobolus cryptandrus	Sand Dropseed	30	20

*Species are found in project area.

Table V. Continued.

Scientific Name	Common Name	Palatability	
		Cattle and Horses	Sheep and Goats
		%	%
*Triodia flava	Purple Top Grass	40	20
*Triodia stricta		40	20
	Weeds		
*Allum	Onion	40	50
*Amaranthus (species)	Careless Weed	30	40
*Ambrosia (species)	Ragweed	10	20
*Asclepias	Milk Weed	0	0
*Chenopodium album	Lambs Quarter	20	30
*Solidago (species)	Goldenrod	0	0
*Gaillardia (species)	Indian Blanket Red	5	5
*Gutierrezia sarothrae	Broom Weed	0	30
*Helianthus (species)	Sunflowers	20	50
Ipomoea lepthophylla	Bush Morning Glory	0	0
*Lactuca	Lettuce all Kinds	60	60
*Lappula	Stick Seed	0	0
*Lepidium densiflorum	Pepper Grass	20	40
*Lespedeza (species of)	Lespedeza	50	40
*Liatris punctata	Blazing Star	0	0
*Lupinus (species of)	Blue-bonnet or Buffalo Clover	60	60
*Melilotus (species of)	Sweet Clover	80	80
*Monorda	Horsemint	20	40
*Oenothera	Evening Primrose	40	40
*Opuntia	Prickly Pear	0	0
*Oxalis	Sheep Sorrel	30	50
*Petalostemon compactus	Prairie Clover	20	50
*Phlox	Phlox	0	25
*Plantago (species)	Plantain (small)	0	10
*Plantago (species of)	Tallow Weed (large)	50	50
*Polygonum (species of)	Knot Weed	10	20
*Ranunculus	Butter Cup	10	50
*Salsola pestifer	Russian Thistle	35	35
*Solanum rostratum	Buffalo Bur	0	0
*Sophia pinnate	Tansy Mustard	10	15
*Verbena	Wild Verbena	0	10
*Vernonia marginata	Iron Weed	0	0
*Vicia	Vetch	60	60
*Xanthium (species of)	Cocklebur	0	5
*Zinna (species of)	Wild Zinna	20	20
	Shrubs		
*Celtis	Hackberry	10	10

Table V. Continued.

Scientific Name	Common Name	Palatability	
		Cattle and Horses	Sheep and Goats
		%	%
*Leptoglottis nuttallii	Sensitive Brier	0	0
*Populus	Cotton Wood	10	10
Prosopis chilensis	Mesquite	40	40
*Prunus (species of)	Plum Bush	0	10
*Quercus (species of)	Oak	20	10
*Rhus tribolata	Ill-scented Sumac	60	60
*Salix (species of)	Willow	10	10
*Symphoricarpos	Buck Bush	20	30
*Yucca glauca	Soapweed	5	5

GOVERNMENT WORK ON EROSION CONTROL

After work on the lake dam had begun, a second phase of work was that of combating erosion. As the greater part of the purchased area is, more or less, broken, it became necessary to terrace or contour much of the area.

On the cultivated land, level terraces have been extensively used, a gradient being used only on soils where water penetration would be slow and would cause the water to stand for some length of time. The terraces were built with a grader and tractor, necessitating only one or two rounds to build. The terraces are of the narrow base type but are built high enough to take care of the water runoff on the denuded soil until some type of vegetative cover can be established. On the steeper slopes where the terraces are emptied, diversion ditches have been constructed and the channels sodded to bermuda grass as a protection from erosion.

Terraces and Contours

On the pasture and meadow land where some types of vegetative covering appears, the work consist mostly of level contour ridges. These ridges were constructed with a walking plow and two horses. On the tighter soil and where a vegetative covering was more dense, only one furrow was used because the filling of the furrow by silting would be slower. On the more sandy and sparse vegetated land, two furrows were used, one thrown from above the contour line and one from below. This builds a higher ridge and will stand more silting before water breaks over the ridge. The contour ridge is turned up-

hill at each gully or depression where water concentration might appear so as to prevent the formation of ditches over the area.

Brush Dams

On some tracts of land in the south area, the blackjack timber has been cleared and the brush used to construct terraces as an experimental phase. These brush terraces appear to be of value at the present from an erosion standpoint, because grass and weeds are growing among the brush and are being protected from grazing animals; also, the brush terraces serve as a protection for wild life, but they are not as desirable where machinery is used to mow the weeds and sprouts. Wood rotting organisms soon decay the brush, limiting their value as a permanent structure. One of the tracts where brush terraces have been constructed is section 26, tract 177.

Plate X. Tract 177 showing brush terraces constructed, and goats being used as browsers.

GOVERNMENT WORK ON RE-VEGETATION

As a big part of the project area is set aside for grazing purposes, it is partly or completely denuded of its vegetation that might be considered of any value for livestock utilization. The recovery of the perennial grasses is very slow, due to the small percentage of viable seed produced and their slow manner of increase by vegetative spreading. Terraces and contour ridges have been sodded to native grasses to hasten the vegetative cover.

Terrace Sodding

The majority of the terraces and contours constructed throughout the area have been spot-sodded to some of the perennial grasses that are of value in this area as range grasses. Among the species used for revegetative work being blue grama (Bouteloua gracilis), side oat grama (Bouteloua curtipendula), buffalo grass (Buchloe dactyloides), little bluestem (Andropogon scoparius), bug bluestem (Andropogon furcatus), and Indian grass (Sorgastrum nutans). Sodding of these grasses was done during the fall and early spring while the grasses were in a dormant stage. The grasses were set on the upper side of the terrace or contour ridge, so as to benefit from any moisture that might collect along the furrow. Where sufficient moisture prevails, almost a hundred per cent of the turf plantings lived.

In the cultivated fields where terraces were constructed, the grass for sodding was secured from along the highway and consisted almost entirely of big bluestem, little bluestem,

Plate XI. Terrace sodded to little bluestem.

Plate XII. Narrow-base terraces constructed in cultivated field; Project Area, SW.¼ Section 3, Tract 312.

and Indian grass. On the contour ridges in the pasture land, the majority of the sodding was secured close at hand and consisted of the gramas, buffalo, bluestems, Indian, and occasionally bunches of dropseed grasses (Sporobolus species).

Plate XIII. Contour ridges constructed in pasture, NW.¼ Section 26, Tract 179.

These grasses will not only aid in protecting the ridges, but they, also, will produce heavy crops of seed, because of the accumulated moisture along the furrow, and will hasten the development of the climax stage several years.

The value of terrace and contour sodding may well be brought out from the work done on section 12, tract 329, in the southeast part of the area. The tract, formerally a cultivated field surrounded by blackjack oaks, shows the former method of farming by the gullies and the abandoned strips around the edges of the field. The land was terraced in the spring of 1936 and the terraces sodded to little and big bluestem grass, the clumps of turf being planted about six feet apart on the upper side of the terrace ridge. The bunches of sod settings have tillered and have produced large clumps of vegetation. When visited by the author in November, 1937, the grass had produced a heavy crop of seed. If protection from burning and over-grazing is given this field, it should soon be revegetated by the bluestem grasses.

Winter Cover

Because most of the cultivated land within the project and neighboring area is low in nitrogen and is almost devoid

Range 1 West. Range 1 East. Range 2 East.

TWP. 20 N.

Noble Co.
Payne Co.

NORTH

TOWNSHIP 19

TOWNSHIP 18 NORTH

GENERAL WORK BEING CARRIED ON WITHIN THE PROJECT AREA.

Legend.

- Forestry (Tree Plantings)
- Grazing.
- Complete Adjustment, (Seeding or Sodding) (Contouring & Terracing)
- Complete Except, (Seeding or Sodding)
- Complete Except Check Dams.
- Contouring and Terracing Only.
- Check Dams Only.
- No Adjustment.
- Recreation 48.6% Complete.
- Wildlife (76.3% Complete)
- Game Farm.
- Food and Cover Plots.
- Farm Ponds.
- Fish Rearing Ponds.
- Highway.

of organic matter, many acres of cultivated land in the project area to be revegetated to native grasses have been sown on the contour between the terraces with perennial rye grass (Lolium perenne) and hairy vetch (Vicia villosa), sowing five pounds of rye grass and ten pounds of vetch per acre. The sowing of these crops is intended to produce a cover crop to protect the soil from erosion and to add organic matter to the soil, which will aid in the establishment of a more desirable grass cover.

Clearing and Mowing

Experiments have been conducted on some of the land tracts in the south area on the rapidity of revegetation by grasses on blackjack oak land, where clearing and the sprouts were kept mowed. The experiment began in the spring of 1936, on section 4, tract 303, in the south area. The trees were removed by sawing the tree trunks level with the ground; the mowing of the stump sprouts was continued, mowing twice during each summer to keep down the sprouts. A visit on the tract by the author in November, 1937, where the experiment was conducted, showed that where the trees and shrubs are kept down, the grass soon revegetates the area. The vegetation consists of paspalum species and blue grama grass, with scattering bunches of little bluestem over the area. The experiment demonstrates that where the blackjack oak is cleared and the sprouts kept down, the number of animal units can be increased from the extra amount of grass that will occupy the area.

However, where clearing is done, continued mowing or pasturing the area with browsing animals must be done until the

Plate XIV. Grass grows where Blackjack Oak is cleared.

Plate XV. When mowing is discontinued, sprouts soon crowd out the grass.

stumps are killed. If, after clearing the sprouts from the tree, stumps are allowed to grow, the area will soon be re-occupied by blackjack saplings and the grass shaded out.

Goats

Another experiment carried out on the project area and

one that might be used on many other comparable acres is the use of goats as browsers for cleaning the blackjack underbrush, which will give more light and room for the production of grasses.

In the summer of 1936, five hundred (500) angora goats were placed on six hundred acres (600) of blackjack oak timber. The goats have been sheared once, producing 1,340 pounds of mohair, which sold for seven hundred dollars (700) and the greater part of the low browse within reach of the goats has been cleaned. The land is occupied with more grass now than it was when the goats were placed on the area. On brushy land where grass vegetation is sparse, probably, the utilization of shrubby forage by goats will produce a higher net income to the landowner and at the same time will encourage the growth of more grasses. Part of the area which is browsed by goats is section 26, tracts 177 and 179; and section 7, tract 354 in the southeast part of the area.

GOVERNMENT WORK ON RECREATIONAL ACTIVITIES

Because recreation is one of the main phases of the project area, the greater part is being planned around or near the lake site. The construction of a recreation lodge has been completed; the building consists of two stories; materials for the construction of the lodge and cabins were secured from the project area. The walls are built of stratified sandrock, and the floor beams and a veranda on the second story are constructed of oak timbers secured from the area. The lower floor is equipped with a combination bath-house for men and women. The second story is used for dancing or general recreation activities.

Plate XVI. Recreation lodge, east view over-looking lake.

Cabins

Located conveniently adjacent to the lodge are eight modernly constructed cabins. These cabins are also of native sandstone which was secured two miles south of the lodge.

RANGE 1 WEST

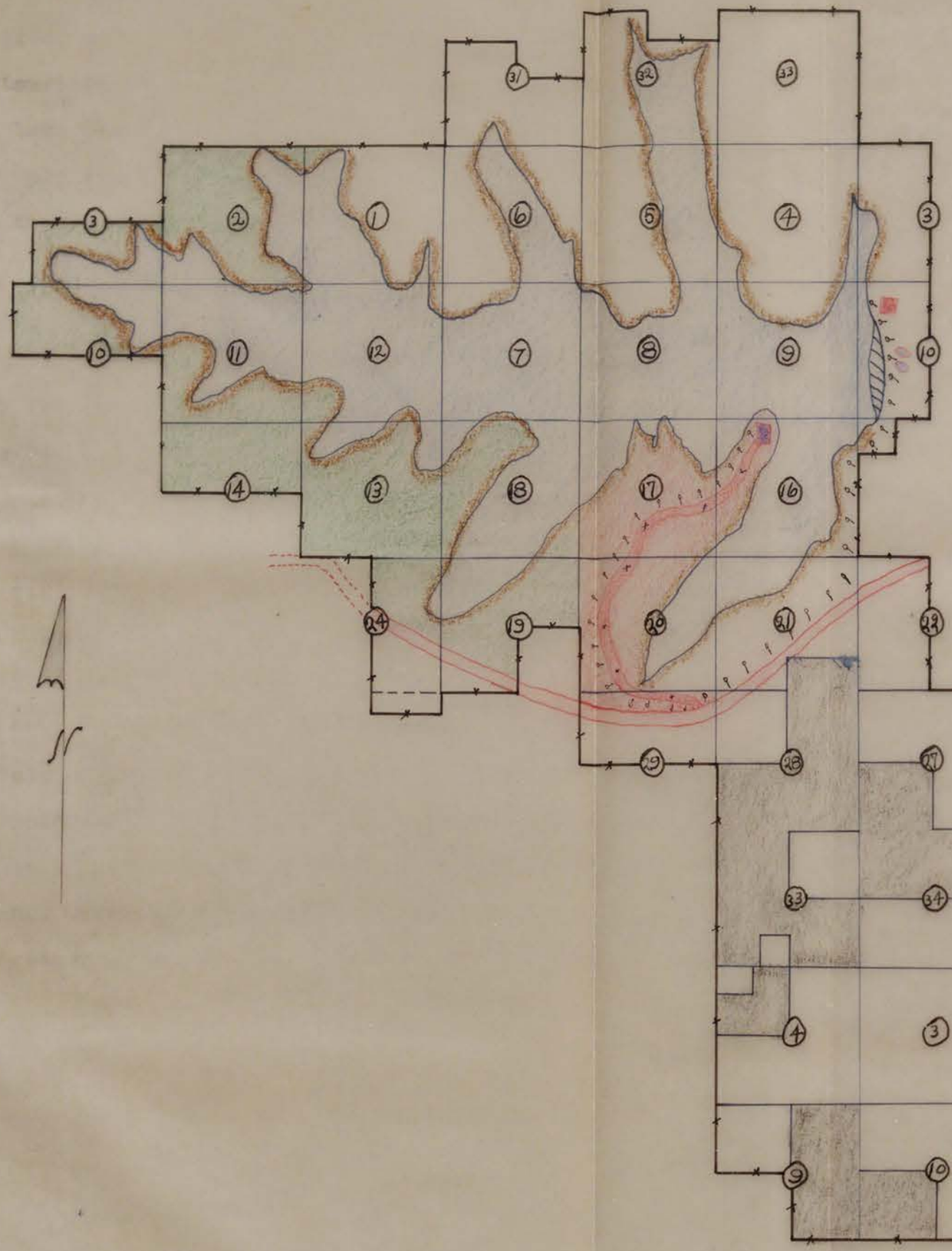
RANGE 1 EAST.

RANGE 2 EAST.

TWP. 20 N.

Township 19 North

Township 18 North



Noble Co.
Payne Co.

Map Showing Major Developments, Complete or to Be Completed in Project Area.

Legend.

- Game Farm.
- 15 Fish Rearing Ponds.
- 6.5 Miles of Power Line.
- Fence of Intire Boundary. "Note" Boundary around blacked-in area contingent upon land acquisition.
- Impounding Dam for 3,264 Acre Lake.
- RECREATIONAL AREA. (containing)
  8 Stone Overnight Cabins.
  1 Combined Lodge and Bath-house of Stone.
  2 Sewer Disposal Systems.
  25 Picnic Fire Places.
  15 Picnic Tables.
- 4.4 Miles of Gravel Road to Lodge.
- Proposed New State Highway.
- Timber Boundary Around Lake.
- Wild Life Area.
- Grazing. (with wild-life and forestry as incidental use)
- Boundary Of Land Contingent Upon Acquisition.

This number of cottages is not adequate to take care of the expected tourists that will visit this spot during the summer, after the lake has been filled with water and stocked with fish. The plans are to increase camping facilities as the demand from tourist patronage warrants further construction.

Camp Ground

Located around the lodge is a public camp ground that covers approximately five acres. Fifteen (15) tables have been built from native timber and distributed over the grounds and twenty-five (25) picnic fire-places constructed of stone to accomodate the tourist and neighboring public. Four-and-one-half (4½) miles of electrified high-line have been built into the area to furnish lighting facilities for the cabins and lodge. Construction of the recreation center was supplied mainly by Workers Progress Administration labor.

Work Completed

A tabulated listing of work accomplished by the project personnel prior to February 1, 1938, is included in the following pages. The work consists of the removal of old fences and buildings over the area, and the construction of new fences, necessary for combining the area into one large unit.

WORK COMPLETED ON PROJECT AREA TO FEBRUARY 1, 1938

Symbol	Tract No	Work Completed
A	2	2640 Feet fence obliterated
		55 Acres of seeding
		105 Acres of sodding
		3585 Feet fences built
		39 Check dams
		125 Acres of contour ridges
		300 Shrubs and trees planted
		Food and cover plot
B	3	6 Acres of seeding
		11 Acres of sodding
		71 Acres of contour ridging
C	4	9140 Feet of fence obliterated
		5 Acres sodding
		18 Check dams
		420 Feet of diversion ditch
		98 Acres of contour ridges
		1 Acre of clearing and cleaning of reservoir site
D	4a	10560 Feet fence obliterated
		17.2 Acres clearing reservoir
		16 Check dams in road
E	5	6930 Feet fences obliterated
		21 Acres seeding
		29 Acres sodding
		31 Check dams
		54 Acres contour ridges
		6 Acres clearing reservoir
F	5a	2640 Feet fence obliterated
G	5b	15 Check dams in road
		35 Acres contour ridged
H	6	19 Check dams in road
I	7	31 Check dams
		70 Acres contour ridged
J	7a	11880 Feet fence obliterated
		1 Acre sodding
		6 Acres seeding
		59.4 Cleaning reservoir
K	8	65 Acres contour ridges
		5 Acres clearing reservoir
L	9	47 Check dams

		11 Acres clearing reservoir
		42 Acres contour ridged
M	11	2170 Feet fence built
		24 Check dams
		8 Acres clearing reservoir
		300 Shrubs and trees planted
		Food and cover plot cultivated
		7177 Feet of fence obliterated
H-3	12	12 Check dams
		19288 Feet fence obliterated
N	14-c	10 Acres cleared
		1 Farm pond built
		1050 Feet fence built
O	35	200 Acres contour ridges
P	38	30 Acres cleared
		1 House obliterated
		1 Barn obliterated
		23 Acres seeding
		33 Acres sodding
		1863 Feet fence built
		48 Acres contour ridges
		6 Acres cleared and cleaned
		300 Shrubs and trees planted
		1 Food and cover plot cultivated
Q	39	2 Acres cleared
		7 Acres contour ridged
		28.5 Acres clearing reservoir
		31 Check dams in road
R	41	1 House obliterated
		1 Barn obliterated
		1 Shed obliterated
		28355 Feet obliterated
		21.5 Acres clearing reservoir
		32 Check dams
S	43	85 Acres clearing reservoir
		18 Check dams
T	49	17.75 Acres clearing reservoir
		18 Check dams
U	52	28 Acres clearing reservoir
V	56	29 Acres clearing reservoir
		12605 Feet fence obliterated
W	58	40 Clearing reservoir
X	77a	6 Acres clearing reservoir

Y	78	6 Acres clearing reservoir
Z	79	44 Acres clearing reservoir
A-1	84	2640 Feet fence obliterated 5 Check dams in road 15 Acres contour ridges
B-1	85	3500 Feet fence obliterated 8.5 Acres clearing reservoir
C-1	85a	11 Check dams in road 53 Acres contour ridged
D-1	86	7 Acres clearing reservoir
E-1	86a	4 Check dams in road 53 Acres contoured ridged
F-1	87	11 Acres clearing reservoir
G-1	87a	9 Check dams in road 20 Acres contoured ridges
H-1	88	6840 Feet fence obliterated
I-1	88a	161 Acres clearing reservoir 28 Check dams in road 38 Acres contour ridged
J-1	89a	18 Check dams in road 50 Acres contour ridges
K-1	92	79 Acres clearing 3 Acres seeding .3 Acres sodding 12 Check dams in road 350 Feet diversion ditch 12 Acres clearing reservoir 650 Feet fence obliterated
M-1	113	11.7 Acres clearing reservoir 1150 Feet fence built Feed and cover plot cultivated
L-1	97	75 Acres sodded 1128 Feet fence built 68 Check dams 75 Acres contour ridges 1800 Shrubs and trees planted Feed and cover plot cultivated 19305 Feet fence obliterated
N-1	113a	4 Acres contour ridges

		5 Acres seeded
		2400 Trees planted
O-1	127	1 House obliterated
		1 Barn obliterated
		2 Sheds obliterated
		10570 Feet fence obliterated
		24 Acres sodding
		2640 Feet fence built
		24 Acres contour ridges
P-1	133	33 Check dams
		32 Acres contour ridges
		16 Acres sodded
		2700 Trees and shrubs planted
		1500 Feet fence built
		Feed and cover plot cultivated
Q-1	137	22 Acres contour ridges
		22 Acres clearing reservoir
R-1	139	2050 Feet fence built
		25 Acres contour ridged
		300 Shrubs and trees planted
		1 House obliterated
		1 Barn obliterated
		Feed and cover plot cultivated
S-1	159	18 Acres cleared
		3960 Feet fence obliterated
		15 Acres seeding
		32 Acres sodding
		1000 Feet diversion ditch
		32 Acres contour ridges
		200 Trees planted
		1 Farm pond constructed
		Food and cover plot cultivated
T-1	159a	25 Acres cleared
		2640 Feet fence obliterated
		25 Acres sodding
		3570 Feet fence built
		600 Feet diversion ditch
		27 Acres contour ridging
		300 Trees and shrubs planted
		1 Farm pond constructed
U-1	159b	12 Acres contour ridges
V-1	160	1550 Feet diversion ditch
		25 Acres contour ridges
W-1	177	45 Acres cleared
		1 House obliterated
		1 Barn obliterated

		8530 Feet fence obliterated
		6905 Feet fence built
		12 Check dams in road
		1850 Feet diversion ditch
X-1	179	10 Acres cleared by goats
		12895 Feet fence obliterated
		8700 Feet fence built
		778 Check dams built
		1 Farm pond built
Z-1	184	6 Acres cleared
		6 Acres seeded
		10 Acres sodding
		61 Check dams
		45 Acres contour ridged
		1500 Shrubs and trees planted
		Food and cover plots cultivated
A-2	185	7 Acres seeding
		7 Check dams in road
		67 Acres contour ridged
		400 Shrubs and trees planted
		1 Farm pond built
B-2	186	1800 Feet fence obliterated
		12 Acres seeding
		27 Acres sodding
		56 Check dams
		36 Acres Contour ridges
		715 Shrubs and trees planted
C-2	226	10560 Feet fence obliterated
		9570 Feet fence built
		1 Farm pond built
D-2	242	1300 Feet fence built
		1 Farm pond built
E-2	281	15 Acres sodding
		18 Check dams in road
		33 Acres contour ridges
F-2	281a	30 Acres cleared
		1 House obliterated
		2 Sheds obliterated
		1970 Feet fence obliterated
		300 Shrubs and trees planted
		Food and cover plot cultivated
G-2	281b	5280 Feet fence obliterated
		12 Acres cleared
		4 Acres sodded
		11 Check dams in road
		63 Acres contour ridged

		1 Farm pond built
		1 Food and cover plot
		5 Acres clearing reservoir
		1450 Feet fence built
H-2	281c	1 Barn obliterated
		2 Sheds obliterated
		2500 Feet fence built
		22 Check dams in road
		1500 Feet diversion ditch
		3 Acres contour ridges
		300 Shrubs and trees planted
		Food and cover plot cultivated
		1 Farm pond built
		29 Acres cleared
		6 Acres sodded
I-2	299	1000 Feet diversion ditch
		2 Acres cleared
		30 Acres contoured ridged
		30 Acres sodding
		1 Farm pond
		92 Check dams
J-2	300	18 Acres cleared
		10 Acres sodded
		19 Check dams in road
		10 Acres contour ridged
K-2	301	23 Check dams in road
		44 Countour ridges
		2640 Feet fence obliterated
L-2	311	44 Acres cleared
		8 Acres sodded
		1580 Feet fence built
		12 Contour ridged
		311 Trees planted
		Food and cover plot cultivated
M-2	312	88 Acres cleared
		1 House obliterated
		2 Sheds obliterated
		1 Barn obliterated
		690 Feet fence built
		19 Check dams
		1500 Feet diversion ditch
		72 Acres contour ridged
		300 Shrubs and trees planted
		Food and cover plot cultivated
		1 Farm pond built
N-2	313	1 House obliterated
		1 Shed obliterated
		20 Check dams
		6.2 Acres contour ridges

		36000	Trees planted
		6.2	Acres sodded
O-2	329	.5	Acres clearing reservoir
		10	Acres cleared
		9	Check dams
		300	Trees and shrubs planted
P-2	331	1550	Feet fence obliterated
		2100	Feet fence built
		3	Check dams in road
		12	Acres contour ridges
		12	Acres sodded
		8700	Shrubs and trees planted
			Food and cover plot cultivated
Q-2	332	1	Barn obliterated
		1	Shed obliterated
		25	Acres sodded
		7	Check dams
		25	Acres contoured ridged
		32500	Shrubs and trees planted
		9045	Feet fence obliterated
R-2	333	17	Acres cleared
		11	Acres sodded
		10	Acres contoured sodded
		500	Trees and shrubs planted
S-2	336	50	Acres cleared
		6600	Feet fence obliterated
		19	Check dams
		36000	Shrubs and trees planted
			Food and cover plot cultivated
		2700	Feet fence built
		5.2	Acres contour ridges
T-2	348	1	House obliterated
		1	Barn obliterated
		5840	Feet fence obliterated
		7	Acres sodding
		6	Acres contour ridges
		1	Acre clearing reservoir
		1250	Trees planted
U-2	349	1	House obliterated
		11	Acres sodded
		8	Check dams
		12	Acres contour ridged
		800	Shrubs and trees planted
V-2	351	10	Acres sodded
		930	Feet fence built
		12	Check dams

		12 Contour ridges
		500 Shrubs and trees planted
		Food and cover plot cultivated
W-2	352	20 Acres sodded
		33 Check dams
		25 Acres contour ridges
		350 Shrubs and trees planted
X-2	354	1 House obliterated
		1 Barn obliterated
		1 Shed obliterated
		25 Acres sodding
		42 Check dams
		25 Acres contour ridges
		800 Trees and shrubs planted
Y-2	379	1 House obliterated
		1 Barn obliterated
		25 Acres contour ridges
Z-2	380	6600 Feet fence built
		12111 Feet fence obliterated
A-3	382	8760 Feet fence built
		50 Feet diversion ditch
		12586 Feet fence obliterated
B-3	409	36 Check dams in road
C-3	410	8780 Feet fence obliterated
		13 Check dams in road
D-3	411	14 Check dams in road
		25 Contour ridges
E-3	412	2 Houses obliterated
		34 Check dams in road
		45 Acres contour ridged
		15 Clearing reservoir
F-3	413	16 Check dams in road
G-3	419	4 Check dams in road

SUMMARY AND CONCLUSIONS

The experimental work being carried on within the project area, if proved to be successful, might be easily duplicated on many acres throughout central Oklahoma and neighboring states. The main phase of work that is being carried on within the project area is the development of the sub-marginal land and the removal of the farm population from this area to land that is more productive.

Farmers who wished to be resettled were removed from these lands and were settled on farms by the Social Security Administration on government land near Ponca City, Oklahoma, that at one time belonged to the famous "101 Ranch." Other farmers who were financially able after selling their land within the project area to the government purchased farms where ever they chose to do so.

The main work being done by the government in reestablishing the sub-marginal land area has consisted of three phases, grazing, wild life, and recreation.

To establish a grass cover over the rougher and more eroded area, terraces and contour ridges were constructed on the pasture land with the ridges sodded to native grass to aid the reestablishment of the more desirable ones. When the grass reaches its maximum coverage, rotation grazing with livestock is to be practiced by the surrounding farming public, paying a monthly rental per animal unit.

The wild life phase of the project consist in planting wild life cover, developing ponds over the area, and establishing permanent food plots to be planted each year. Approximately

2,500 quail have been liberated and a bird hatchery has been established to further the increase in quail population. When the bird population is built up in numbers to warrant hunting, charges will be made to hunt in the project area.

The recreational facilities should bring in a fair revenue after the lake is opened, as charges for fishing, boating, and over-night rentals of the cabins and lodge are to be made.

The project if properly managed and carried out to completion should be a success and of value, not only to the immediate generation, but to many future generations. Figures on charges to be made on grazing and recreational activities are not ascertained at the present time and are, therefore, not yet available. However, it has been estimated that the charges from grazing, wild life and recreational activities will retire the expended debt within twenty years.

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