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DISTRICT OFFICE
3550 Pan-American Freeway, N.E.
Albuquerque, New Mexico 87107

July 18, 1975

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Dear Sir:

ADDENDUM

The following pertain to the Southeastern Oklahoma Coal Region Environmental Analysis Record, Albuquerque District, April 16, 1975, EAR No. 30-010-5-56:

1. Page 43, Table 5, ENDANGERED WILDLIFE SPECIES IN SOUTHEASTERN OKLAHOMA LISTED BY U.S. FISH AND WILDLIFE SERVICE.
   Delete the following two species from the list:
   Western chicken turtle (Deirochelys reticularia miaria)
   Scarlet snake (Cemophora coccinea copei)

2. Page 130, Stipulation #3, change "The Oklahoma Game and Fish Commission" to, Oklahoma Department of Wildlife Conservation.

3. Page 131, Stipulation #3, after "...the provisions of Endangered and Threatened Species Act, 1973 (Public Law 93-205, 87 Stat. 884, December 28, 1973)" add The Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et. seq.).

4. Page 136, add the following:
   5. U. S. Fish and Wildlife Service - Albuquerque, N.M., Regional Office
      Contact should be made concerning impacts on fish and wildlife and for specific impacts on endangered species.

Sincerely yours,

R. Keith Miller

R. Keith Miller
District Manager

EAR No. 30-010-5-56

SOUTHEASTERN OKLAHOMA COAL REGION
ENVIRONMENTAL ANALYSIS RECORD

ALBUQUERQUE DISTRICT

April 16, 1975

TABLE OF CONTENTS

Page

I. Introduction

A. Purpose: The purpose of this Environmental Analysis Record (EAR) is to provide for the orderly leasing of federal coal reserves in Oklahoma, by assessing the adverse impacts of anticipated coal development activity as a result of coal leases and prospecting permits, and applying mitigating measures to protect the environment.

B. Objectives:

(a) To assess the adverse impacts of anticipated coal development activity as a result of prospecting and leasing.

(b) To ensure maximum environmental protection.

(c) To provide for orderly and timely resource development.

C. Scope

This analysis describes the existing environment on federal coal reserves in southeastern Oklahoma and the anticipated impacts from prospecting, strip mining, underground mining, and coal preparation plants and the mitigation of adverse impacts as a result of these activities.

Specific details of each prospecting plan and mining plan for strip and or underground mining operations will be analyzed during the evaluation of the proposed plan. Since specific details of each mining or prospecting plan are not available they are not discussed in this analysis.

Technical reports will be written for each specific action as it is proposed and will not be included here. The technical report will contain all stipulations to be made a part of the lease or permit, including those developed as a result of this EAR which apply to the particular action.

Present uses of the coal as well as foreseeable future uses will be discussed in a general way, however, no attempt is made to analyze the different environmental impacts involved in the various methods of using coal (i.e. production of electrical energy, coking, etc.).

D. Present Status of Federal Coal Reserves

1. General

Base Map - ½" mi. scale, shows county boundaries, federal coal reserves boundaries, major rivers, streams, and lakes, location of old abandon strip mine pits (orphan mines), major highways and township grids. (See Attachment 1 for copy).

Information On Overlays

1. Existing Coal Leases
2. National Resource Lands (Surface) within Federal Coal Reserves
3. Competitive Lease Areas (Tracts)
4. Preference Right Lease Applications
5. Competitive Lease Applications
6. Funded Bureau of Outdoor Recreation Projects
7. Proposed Corps of Engineers Projects
8. Archeological - Identified Sites Only
9. Historical - Identified Sites Only
10. Paleontological - Identified Sites Only

2. Existing Leases and Mining Operations

a. Existing Leases

At the present time there are fifty-three (53) existing federal coal leases in southeast Oklahoma distributed among twelve companies. Garland Coal Company of Fort Smith, Arkansas holds a majority of these leases, twenty (20). Evans Coal Company has eight (8) coal leases, Lone Star Steel holds six (6) leases and American Smelting and Refining has five (5) areas under lease. Three (3) coal leases each are held by Petroleum International Inc., and Cameron Coal Company. Midwest Mining Company and A. James Gorden hold two (2) leases apiece. The following companies each have one (1) coal lease: S.E. Evans Inc., The Pacola Company, Paul Rees Coal Company and United Electric Coal Company. On the following page is Table 1 which lists each coal company and their respective leases.

TABLE 1. - EXISTING FEDERAL COAL LEASES
Southeastern Oklahoma

1. Garland Coal Company

-A.	BLM-C-018983	(160 ac.)
-B.	BLM-C-022999	(1,384.78 ac.)
-C.	BLM-C-028369	(1,000 ac.)
-D.	BLM-C-027239	(880 ac.)
-E.	BLM-C-030765	(2,217.84 ac.)
*-F.	BLM-C-030953	(960.92 ac.)
-G.	BLM-C-031135	(1,180 ac.)
-H.	BLM-C-028370	(240 ac.)
*-I.	BLM-C-035068	(1,830.37 ac.)
*-J.	BLM-C-035069	(1,640 ac.)
-K.	BLM-I-018074	(325.54 ac.)
-L.	NM 025632	(2,266.34 ac.)
-M.	NM 029132	(2,553.59 ac.)
-N.	NM 029179	(2,553.21 ac.)
-O.	NM 029180	(1,923.89 ac.)
-P.	NM 033508	(641.35 ac.)
-Q.	NM 033866	(2,047.71 ac.)
-R.	NM 034521	(2,543.51 ac.)
-S.	NM 0556624	(4,374.67 ac.)
-T.	NM 0557450	(880 ac.)
	Total	31,603.72 ac.

2. Cameron Coal Company

-A.	BLM-I-017683	(2,560 ac.)
-B.	NM 029891	(960 ac.)
-C.	NM 029892	(944.46 ac.)
	Total	4,464.46 ac.

3. Evans Coal Company

-A.	BLM-C-028799	(640 ac.)
-B.	BLM-C-029794	(2,478.96 ac.)
-C.	BLM-C-030584	(2,550.52 ac.)
-D.	BLM-C-031611	(2,530.20 ac.)
-E.	BLM-C-032224	(400 ac.)
-F.	BLM-I-017612	(1,868.65 ac.)
-G.	BLM-I-022012	(793.50 ac.)
-H.	BLM-I-017564	(1,360 ac.)
	Total	12,621.83 ac.

4. S. E. Evans, Inc.

-A.	NM 059996	(718.88 ac.)
	Total	718.88 ac.

5. A. James Gorden

-A.	NM 023555	(2,560 ac.)
-B.	NM 023556	(1,686.73 ac.)
	Total	4,246.73 ac.

6. Lone Star Steel

-A.	BLM-C-018125	(2,560.33 ac.)
-B.	BLM-C-018820	(915.16 ac.)
*-C.	BLM-C-021851	(1,500 ac.)
-D.	NM 050405	(1,116.17 ac.)
-E.	NM 050406	(2,400.13 ac.)
-F.	NM 059992	(1,680 ac.)
	Total	10,171.79 ac.

7. Midwest Mining Co.

-A.	NM 0141015	(360 ac.)
-B.	NM 0161332	(2,560 ac.)
	Total	2,920.00 ac.

8. Petroleum Int. Inc.

-A.	NM 957	(3,342.43 ac.)
-B.	NM 3172	(2,927.45 ac.)
-C.	NM 3174	(2,839.86 ac.)
	Total	9,109.74 ac.

9. The Pacola Company

-A.	BLM-I-018108	(960 ac.)
	Total	960 ac.

10. Paul Rees Coal Co.

*-A.	BLM-I-017902	(680 ac.)
	Total	680 ac.

11. United Electric Coal Co.

-A.	NM 0536361	(560 ac.)
	Total	560 ac.

12. American Smelting & Refining Co.

-A.	BLM-C-031985	(1,844.30 ac.)
-B.	BLM-C-032614	(1,000 ac.)
-C.	NM 033722	(2,552 ac.)
-D.	NM 033723	(2,520 ac.)
-E.	NM 036953	(1,160 ac.)
	Total	9,076.30

Grand Total	87,133.45 ac.

* Leases on which coal mining is in progress

b. Mining Operations

Currently, there are four (4) mines operating on federal coal leases in the production phase. Garland Coal Company is operating two of these mines. One is located two miles north of Stigler (BLM-C-030953) in T.9N.,R.21E., and T.10N.,R.21E. Since the mining operation was started prior to any federal requirement for a mining plan no such plan exists, however, mining and restoration is being conducted under the Oklahoma State Law "The Mining Lands Reclamation Act." See Attachment #2 for the contents of this Act. Some of the coal from this mine is hauled 6 miles north by truck to a barge loading station on the Arkansas River Navigation System and shipped to New Orleans. The other producing Garland mine is located two miles south of Bokoshe in T.8N.,R.24E. Two lease areas are involved in the operation of this mine BLM-C-035068 and BLM-C-035069. The mining operation is being done under an approved mining plan. This coal is being shipped by rail to Colorado Fuel and Iron Company in Pueblo, Colorado. Another producing mine is operated by Lone Star Steel. It is located approximately 3 miles north of McCurtain (BLM-C-021851) in T.8N.,R.22E. This mine was also opened prior to the requirement of an approved mining plan and is being operated under the Oklahoma State Law, "The Mining Lands Reclamation Act." The coal removed from this mine is hauled by truck to their wash plant constructed on an adjacent coal lease held by Evans Coal Company. It is then shipped by rail to the Dallas, Texas area for use in Lone Star Steel's Manufacturing Plant. Paul Rees Coal Company currently is mining on its lease (BLM-I-017902) located two miles southwest of Milton in T.8N.,R.23E. The mining is done under an approved mining plan.

3. Applications and Leases Awaiting Action

a. Prospecting Permits

At this time, there are no new prospecting permits which have been filed. Those which have already been filed have been accepted and preference right leases have been applied for and are pending at this time.

b. Preference Right Leases

Presently, five (5) preference right lease applications have been filed on which further action is pending. Midwest Mining Company has filed three of these applications which are adjacent to each other in T.7N.,R.25E. Garland Coal Company has submitted one preference right lease application for an area located in T.6N.,R.26E. The remaining preference right lease application was filed by Kerr-McGee Corp. This lease area is located in T.8N.,R.21&22 E.

c. Competitive Leases

Currently, there are nine (9) competitive coal lease applications which are awaiting action since being submitted to the Santa Fe State Office, Bureau of Land Management. Three of these applications have been filed on competitive lease areas. The Public Service Company of Oklahoma has filed one of these which includes the following competitive lease areas: Spiro Tract, Wilburton Tract, and the Rock Island Tract. Another competitive coal lease application was filed by Southwestern Coal Company for the Rock Island Tract. The third competitive coal lease application filed on a competitive lease area was by the Sierra Coal Corporation for the Blocker Tract.

The remaining six competitive coal lease applications have been submitted by the following coal companies: Cavanal Coal Company (2), Lone Star Steel (1), P. M. Campbell (1), Charles D. Roye (1) and Great National Corp. (1).

d. Lease Modifications

No lease modifications need action at the present time. USGS will determine if such action is needed and advise the BLM accordingly. All future lease modifications will be processed using this Environmental Analysis Record.

e. Lease Readjustments

Six (6) lease readjustments will require action subject to the completion of this Environmental Analysis Record and a technical report. Garland Coal Company has four leases for readjustment; whose 20 year anniversary dates are July, 1972, August 1973, and October, 1973 and two for October, 1973. Evans Coal Company has one lease needing readjustment. This lease readjustment date is March 1, 1974. The remaining lease is owned by Lone Star Steel; the readjustment date being August, 1971. All future lease readjustments will be processed using this EAR.

The following page is Table 2 which lists all applications and leases awaiting action.

E. Description of Federal Coal Reserves and Its Uses

The coal resources of eastern Oklahoma are in beds of Middle and Late Pennsylvanian age. They are located in the southern part of the Western Region of the Interior Coal Province of the United States. The federal coal reserves in the above area are located in the Arkoma Basin of eastern Oklahoma. All of the federal coal reserves are in Atoka, Coal, Haskell, Latimer, LeFlore and Pittsburg Counties and lie within the following five coal districts; (1) Stigler-Poteau, (2) Lehigh, (3) Wilburton, (4) Howe, and (5) McAlester.

There are 24 bituminous coal beds covering 1½ million acres in eastern Oklahoma all of Pennsylvanian age. The estimated reserves are 7.2 billion short tons of which 2.3 billion tons are not recoverable. There are about 684 million tons of strippable coal. Approximately ½ billion tons have been removed or lost in mining over the last 100 years of commercial coal development in Oklahoma.

There is about 150,000,000 tons of federal coal reserves that are recoverable by stripping to a depth of approximately 100 feet in the six counties listed above. Most of this federal strippable coal is located in Haskell, Latimer, LeFlore and Pittsburg Counties. In Haskell County, most of the strippable federal coal is found in the Stigler and Hartshorne beds. In Latimer County, all of the strippable federal coal is found in the Upper and Lower McAlester and Hartshorne beds.1/

In LeFlore County most of the strippable coal is found in the Upper and Lower Hartshorne beds. In Pittsburg County most of the strippable federal coal is found in the Cavanal, McAlester and Upper and Lower Hartshorne beds.

Below is a list of the beds containing federal strippable coal along with some of the essential characteristics of each bed.

1/ This reference and all other references shown in this Environmental Analysis Record are listed on page 154.

TABLE 2 - APPLICATIONS AND LEASES AWAITING ACTION

Preference Right Lease Applications

1. Midwest Mining Co.
   - -A. NM 11574 (OK)
   - -B. NM 3235 (OK)
   - -C. NM 3099 (OK)

2. Garland Coal Co.
   - -A. NM 0557931 (OK)

3. Kerr-McGee Corp.
   - -A. NM 0558062

Competitive Coal Lease Applications

1. Lone Star Steel
   - -A. NM 1420

2. Great National Corp.
   - -A. NM 24005

3. P. M. Campbell
   - -A. NM 17906

4. Cavanal Coal Co.
   - -A. NM 16521 (OK)
   - -B. NM 16522 (OK)

5. Roye Development Co.
   - -A. NM 11876

6. Southwestern Coal Co.
   - -A. NM 22487 (OK)

7. Public Service Co. of Oklahoma
   - -A. NM 22353 (OK)

8. Sierra Coal Corp.
   - -A. NM 23674

Lease Readjustments

1. Lone Star Steel
   - -A. BLM-C-021851

2. Garland Coal Co.
   - -A. BLM-C-027239
   - -B. BLM-C-028369
   - -C. BLM-C-035068
   - -D. BLM-C-035069

3. Evans Coal Co.
   - -A. BLM-C-032224

Lower Hartshorne coal.--The Lower Hartshorne coal is 0.7-7.0 feet thick. It has been mined recently in LeFlore County in underground mines, where it is 3.0-3.7 feet thick. Strip and auger methods have also been used in southeastern Haskell County. This coal recently has been shipped to Texas and overseas markets for coke manufacture. The Lower Hartshorne coal bed contains 0.4-5.1 percent sulfur and averages 1.0 percent (raw). Because of a thin shale parting and its sulfur content, this coal requires cleaning for use in coke manufacture and metallurgical processes.

Upper Hartshorne coal.--The Upper Hartshorne coal has been extensively mined from slopes and drifts in Haskell, Latimer, and LeFlore Counties. It is 2-4 feet thick and is low or medium volatile in rank on the east side of the Arkoma Basin and high volatile on the west side. This coal is being mined in a small strip mine at McCurtain, Haskell County (March 1974), and is shipped mine-run for coke manufacture. It contains 0.8-2.6 percent sulfur and averages 1.6 percent.

McAlester coal.--The McAlester coal was extensively mined in the past by underground methods at McAlester in central Pittsburg County and in southeastern Coal County, where it had been called the Lower McAlester. Significant coal resources remain in these areas and are favorable for underground mining. The McAlester coal bed is 1.5-5.0 feet thick and mostly high volatile in rank. It is not mined at present but is suitable for use in electric-power generation, for blending with higher rank coal for coke manufacture, and for gasification and liquefaction (coal processed into liquid hydrocarbons). The McAlester coal bed contains 0.8-4.8 percent sulfur and averages 2.1 percent. In places, where it is high volatile in rank and also high in sulfur content it requires cleaning.

Stigler coal.--A correlative of the McAlester coal, the Stigler coal has been mined by surface methods in Haskell, LeFlore, Muskogee, and Sequoyah Counties. Of low and medium-volatile rank, the Stigler coal is used in coke manufacture in Texas and in overseas markets. At present, this coal is strip mined by three companies where it is 1.0-2.7 feet thick. The overburden consists of 30 to 90 feet of medium or dark-gray shale. Most of the coal from these mines is transported by truck to preparation plants at two loading docks, where it is crushed and loaded onto barges which leave the State on the McClellan-Kerr Arkansas River Navigation System. The Stigler coal contains 0.4-5.2 percent sulfur and averages 1.5 percent. At one of the three active mines, it requires cleaning to reduce the sulfur content before being shipped for coke manufacture and metallurgical use.

Cavanal coal.--Reserves for the Cavanal coal have been determined in LeFlore and Pittsburg Counties. The Cavanal coal is strip mined at Cavanal Mountain south of Bokoshe in LeFlore County (March 1974), adjacent to an area that had been mined previously by surface and underground methods. It is 1.2-2.2 feet thick, has a high (-100) Hardgrove grindability index, and is mostly medium volatile and in part high volatile in rank. The Cavanal coal is overlain by 20-50 feet of shale and sandstone, at the top of which another, thinner coal is present at some places. The Cavanal coal contains 2.1-4.8 percent sulfur and averages 3.3 percent. It requires cleaning to reduce sulfur and ash before being shipped for use in elctric-power generation, cement manufacture, and paper manufacture.

Of the total net recoverable reserves 60% is suitable for coke manufacturing, 29% is suitable for electric power generation, and 11% is suitable for gasification.

Of the total net recoverable reserve suitable for coke manufacturing (60%, as described in the preceding paragraph) it is estimated that about 12% is strippable. Forty-three percent of the coal suitable for electric power generation is strippable. Nineteen percent of the coal suitable for gasification is strippable.

There are additional reserves of coal suitable for gasification which could be stripped mined if the present limitations on sulfur and ash impurities are ever raised.

F. Mining and Processing Procedures

Coal mining began in the early 1870's in Oklahoma and in 1873 one hundred percent of the coal being mined was by underground methods. It was about 1914 when the first surface mining occurred and this type of mining increased until by 1973 one hundred percent of the coal was being mined by this method. (See Figure #1). By the end of 1973 there were nine coal mines and twelve active coal pits operating in Oklahoma. (See Table #3).

The following information is condensed and a more detailed description of this section can be found in Draft EIS, Proposed federal coal leasing program, Vol. 1.3/

Exploration, development, production, and restoration, are the four operations executed during the life of a coal mine. If the coal mined contains excessive impurities, it is cleaned before being marketed. The cleaning process is termed beneficiation.

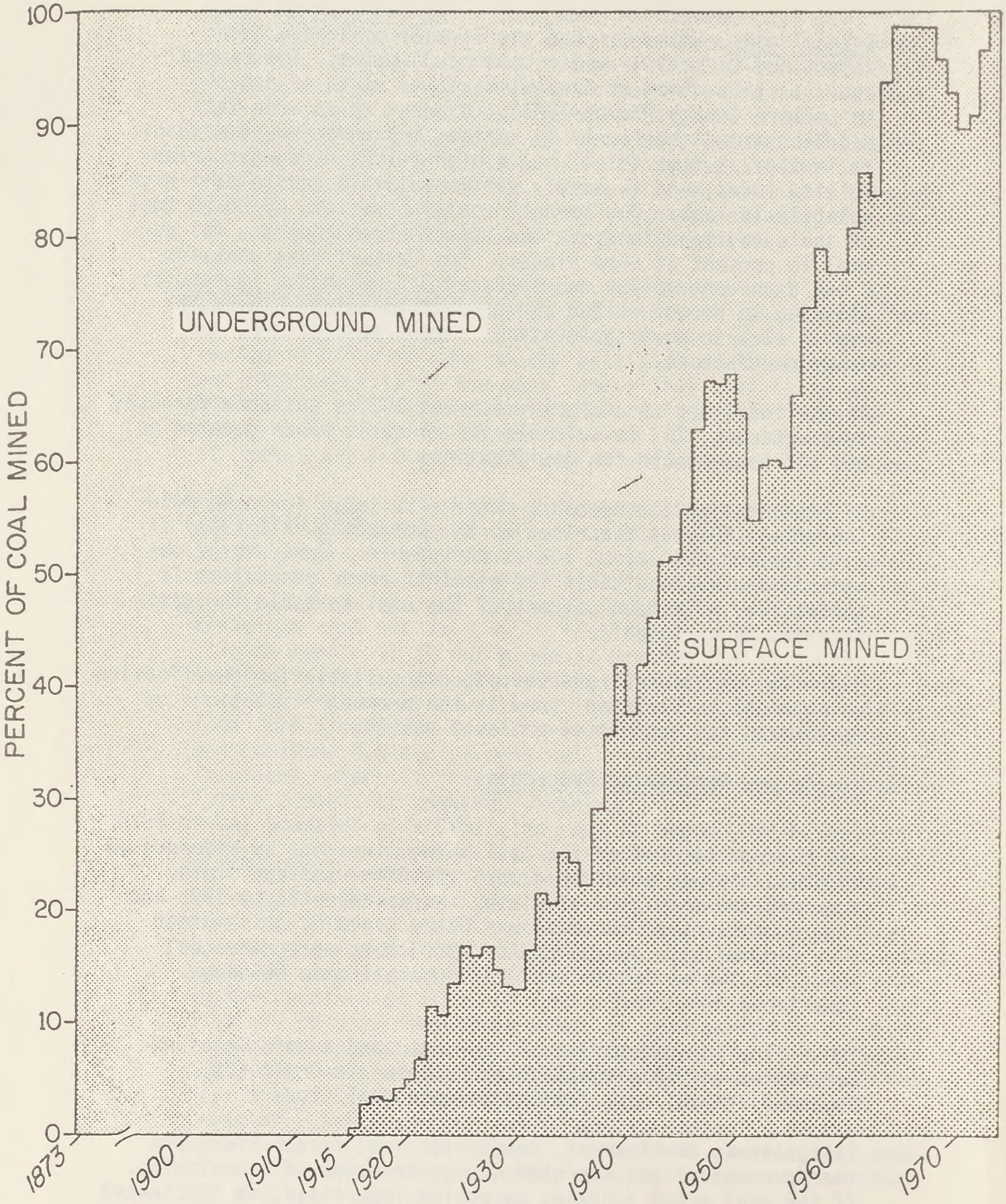


Figure 1. Histogram indicating annual percentages of coal mined by surface and underground methods in Oklahoma from 1873 to 1973. 1/

Table 3 -- Active Coal Mines in Oklahoma, February 1, 1975

1. Choctaw mine, Kerr-McGee Coal Corporation, underground, idle.

2. Shady Point strip mine, Okar Energy Corporation.

*3. Stigler strip mine, Garland Coal and Mining Company.

*4. Bokoshe strip mine, Garland Coal and Mining Company.

*5. McCurtain strip mine, Lone Star Steel Company.

6. Whitefield strip mine (inactive), Briartown Coal Company.

7. Porum strip mine, Sierra Coal Corporation.

8. McCurtain strip mine, Great National Coal Company.

9. Cattosa strip mine, McNabb Coal Company.

10. No. 2 strip mine, Bill's Coal Company.

11. Rogers County No. 1 strip mine, Peabody Coal Company.

12. Rogers County No. 2 strip mine, Peabody Coal Company.

13. Rebecca strip mine, United Coal Company.

*14. Milton Strip Mine, Paul Rees Coal Company

* Located on Federal Coal Reserves

1. Exploration

Exploration aims at locating the presence of economic deposits and establishing their nature, shape, and grade. The investigation may be divided into two parts, (1) preliminary or prospecting, and (2) final exploration, which often overlap. In general, locating the presence of a coal deposit is considered as preliminary exploration. Then establishing whether or not it is an economic deposit by its nature, shape (size), and grade is considered as final exploration.

2. Development

Gaining access to the coal seam(s) where mining is to be accomplished by a surface method is part of the development phase. It includes construction of haul roads from the tipple to the mining area, roads from the haul roads to the working face, electric power lines from the substation to the mining area, gasoline and diesel fuel storage, and installation of portable chemical toilets near working places. It also includes the assembly of large equipment such as bucket-wheel excavators, draglines, and shovels; and removal of the initial overburden from the coal so mining may begin. Closer spaced drilling to define mining limits or mining problems is often part of development. As mining progresses, development mainly consists of extending the haul roads and power lines and constructing new roads to provide access to the working face.

3. Production Methods

Production is defined as the yield or output of a mine. However, this phase or cycle depends on many factors. For a mine to succeed it must operate at a profit, and a profit cannot be made without production. Production is obtained thru either surface or underground mining.

a. Underground Mining

In underground mining after the initial development has gained access to the coal seam, one of three methods, room-and-pillar, longwall, and shortwall, are commonly used to extract the coal. Regardless of the underground mining method used, surface subsidence generally will result. It can occur immediately after the coal is removed or at any time thereafter. It has been known to occur as long as 50 years after coal was mined.

b. Strip Mining

Strip mining is accomplished by two techniques, area stripping and contour stripping. Where coal seams are relatively flat and near the surface, as in much of the west, area stripping is the dominant technique.

In area strip mining, which is the method generally used in Oklahoma, overlying material (overburden) is removed from a seam of coal in long narrow parallel bands, or strips, followed by removal of the exposed coal. With the exception of the first cut (box cut), overburden from each cut is discarded in the previous cut from which the coal has been removed. These parallel cuts continue across the coal seam until the thickness of the overburden becomes too great to be removed economically or until the end of the coal seam or property is reached.

4. Site Rehabilitation

Three types of sites -- underground mines, surface mines, and coal processing plants--must be considered when describing site rehabilitation.

No industrial operation can restore a site to exactly the condition that existed before the operation began. Therefore, rehabilitation of the site consists of prevention of erosion, revegetation, making it safe, acceptable in appearance, and available for other uses, including improved uses according to plan.

In the past, when a coal operation ceased, equipment of value was removed and the site was virtually abandoned. That practice is no longer acceptable. Federal coal leases require rehabilitation of mines and plant sites. In addition, Oklahoma has a very strict mined-land reclamation law that requires rehabilitation of private lands, as well as federal lands where coal has been mined.

Section 5 of the Federal coal lease and 43 CFR 23 gives the mining supervisor or his agent the authority to approve or disapprove a lessee's surface protection plans, and the mining supervisor is responsible to see that the plans are carried out and the rehabilitation plan is completed.

G. Oklahoma's Unreclaimed Mined Lands ("Orphan" Mined Lands)[4/]

Prior to passage of the Reclamation Acts of 1968 and 1971, Oklahoma companies were not obligated to devote any effort toward restoring mined land, and the need for low-cost production of minerals in a highly competitive field caused most companies to minimize their expenditures on land reclamation. About 35,400 acres has been disturbed by surface mining for coal through June 30, 1973; 3,384 acres has been reclaimed, 4,961 acres has been partly reclaimed, and 27,079 acres remains unreclaimed (Table 4).

Unreclaimed land is distributed in 16 counties, with three-fourths in Rogers, Haskell, Wagoner, Craig, and LeFlore Counties. These areas are commonly marked by ridges and piles of spoil that consist of unweathered rock and clay heaped upon or thoroughly mixed with a small percentage of original topsoil. Spoil ridges left by mining operations prior to 1960 are generally 20 to 30 feet high (trough to crest) and 40 to 60 feet wide (crest to crest); large, modern shovels and draglines now pile spoil banks up to 60 feet high and 120 feet wide.

In general, soil textures and structures in spoil are inferior to the original topsoil. Spoil commonly is deficient in organic matter and other usable plant nutrients and may be somewhat acidic. No single treatment or vegetative covering is applicable for reclaiming all mined land in Oklahoma. Variations in geology and soil condition as a result of physical and chemical characteristics, different climates, orientation of spoil ridges, steepness of slopes, presence or absence of toxic substances, and seed sources all play a part in determining the rate of revegetation and the type of vegetation that succeeds in a given area.

Most of the spoil in old mine areas has been allowed to revegetate on its own. As a result, weeds, grasses, and shrubs commonly have appeared shortly after mining, with trees such as sycamore, cottonwood, and sassafras becoming conspicuous after several years. In most cases, the steep slopes and ridge crests have been less than 50 percent covered 10 years or more after mining and some spoils are so toxic and steep that they do not accept natural revegetation for 20 years or more.

Tracts of disturbed land in Oklahoma are typically long and narrow, particularly where contour mining is necessitated by hilly terrain or by coal beds dipping into the ground at an angle greater than 5^{o}. The average width is less than 0.2 mile, and a length of one to several miles is not common.

Ponds which have remained from past strip mine operations, are critical for recreational or livestock development of "orphan" mined lands. In Oklahoma, ponds constitute 5 to 17 percent of the acreage in most tracts of area-mined land and average about 11 percent of the acreage at each site. These figures were determined by measuring total pond area in each of 20 randomly chosen area-mined tracts comprising 65 to 300 acres. Ponds make up a greater percentage of mined tracts, ranging from 10 to 25 percent of the acreage at most sites and averaging about 17 percent (determined using 20 randomly chosen tracts, each of which is only 200 to 500 feet wide and comprises 20 to 100 acres). Of course, some mined sites are without water, while others, such as those at which only one or two cuts were made, may be 40 percent pond area.

The quality of water in Oklahoma mine ponds varies, but at most sites it is nearly neutral (pH 7.0). Doerr (1961, appendix) in one report indicates that 21 to 24 water samples from all parts of the coal field had a pH of 6.8 to 8.4, and that the remaining 3 samples (collected at Henryetta, east of Checotah, and west of Vinita) were acidic with a pH of 3.0 to 4.0. (Note - None of the 3 acid water samples collected are within the Federal Coal Reserves).

Table 4 –Acreage Disturbed and Reclaimed by Surface Mining in Oklahoma Coal Field Through June 30, 1973

COUNTY	LAND DISTURBED AND UNRECLAIMED[2] (ACRES)	LAND DISTURBED AND PARTLY RECLAIMED[1] (ACRES)	LAND DISTURBED AND RECLAIMED[1] (ACRES)	TOTAL (ACRES)
* Atoka	95	–	–	95
* Coal	595	–	–	595
Craig	2,744	1,212	529	4,485
* Haskell	4,699	434	975	6,108
* Latimer	850	–	–	850
* Le Flore	2,556	104	11	2,671
Mayes	112	–	–	112
McIntosh	699	–	–	699
Muskogee	996	–	72	1,068
Nowata	129	136	416	681
Okmulgee	1,148	31	114	1,293
* Pittsburg	321	–	–	321
Rogers	6,770	2,904	1,140	10,814
Sequoyah	1,321	–	–	1,321
Tulsa	1,380	–	75	1,455
Wagoner	2,664	140	52	2,856
Totals	27,079	4,961	3,384	35,424

* Contains Federal Coal Reserves

H. BLM and U.S.G.S. Responsibilities

The responsibilities for Administration of the Onshore Mineral Leasing Laws are outlined in Secretarial Order 2948 (See Attachment #3). This Order details: (1) Purpose (2) Agency Responsibility (3) Procedures in Issuance of Mineral Leases, Permits and Licenses (4) Preparation of Minerals Reports (5) General Relationships between BLM and U.S.G.S. The procedures outlined in the Secretarial Order are used in processing documents and administration of activities on the Federal Coal Reserves in southeastern Oklahoma.

Briefly U.S.G.S. is responsible for actions occurring on the permit or lease area after the permit or lease is issued. The BLM is responsible for issuing permits or leases.

In addition, a set of Guidelines (Attachment #4) have been developed to assist in carrying out Secretarial Order 2948. These guidelines include: (1) Permit and Lease Actions, (2) Prospecting and Mining Plan submissions, (3) Compliance, and (4) Cancellation Termination and Abandonment. The guidelines list responsibilities of both agencies in each of four broad categories. They are intended as a quick reference and can be used by the agency in dealing with the flow of responsibilities, ideas and documents between agencies.

I. History - Aquisition of Coal in Oklahoma By U. S. Government

The Federal Government obtained the coal rights to these lands by buying them from the Choctaw Indian Nation. In 1911, legislation was introduced in Congress to purchase these coal rights. This legislation was kept in Congress for several years until 1934. At this time, the United States Geological Survey was directed to appraise the coal bearing lands in Southeastern Oklahoma. No specific criteria was used in appraising these lands. Apparently, the coal was appraised from its many outcrops to a depth of about 1000 feet, and certain lands were segregated out for purchase.

It took the U.S.G.S. approximately three years to appraise these lands, and upon completion submitted a report to Congress (Senate Document #390, 31st Congress, 2nd Session). This detailed report gave account of the various drill holes made in the appraisal and maps of their location.

Finally, in 1949, the Federal Government bought the coal and asphalt rights to those lands segregated out by U.S.G.S. Originally, 375,000 acres were purchased at approximately $22/acre, amounting to about $8.5 million. These lands that were bought apparently were old tribal lands. Other lands of the Choctaw Nation were sold to private investors, including surface, oil and gas, and other mineral rights.

II. Description of the Proposed Action and Alternatives

A. Proposed Action

The proposed action is to continue the orderly leasing of the federal coal reserves in southeastern Oklahoma, in compliance with and consideration of the National Environmental Policy Act (NEPA) and 43 CFR Part 23. This EAR will assess impacts and determine mitigating measures in conjunction with a technical report. The technical report will be prepared separately on each action and will provide for proper disposition and utilization of the coal resource under: (1) prospecting permits, (2) preference right leases (3) competitive leases (4) lease modifications, and (5) lease readjustments.

Listed below is the basic description of each of the above actions:

1. Prospecting Permits - Are issued only on suspected coal land not under a Known Coal Leasing Areas (KCLA) classification for coal. These permits are issued for a period of two years with an opportunity to extend them for an additional two years if the permittee does the required prospecting work. With the issuance of this permit, access and drill pad construction, core drilling and other exploratory activities are anticipated. In the event coal is discovered in workable quantities, the permittee has the opportunity to apply for a preference right lease on part or all of the acreage.

2. Preference right leases - Are issued for a period of twenty years after discovery of coal under a prospecting permit (above). Execution of this type lease could involve development activities such as a strip mine, underground mine and/or a coal processing plant. The U. S. Geologic Survey (USGS) is responsible for determining the rental and royalty rate to be applied to the lease, and the Bureau of Land Management (BLM) is responsible for determining adequate surface and environmental protection stipulations to be applied to the lease.

3. Competitive leases - Are also issued for a period of twenty years. These leases can be issued on all areas classified as KCLA (coal lands) by the U.S.G.S. This is the only way lands so classified can be leased. Those development activities mentioned under preference right leases can also be involved here. The rental and royalty and also a minimum bonus bid are determined by the USGS. The tracts are advertised and leased to the qualified bidder who submits the highest bonus bid.

4. Lease modifications - Are issued after U.S.G.S. determines that the lessees application for fringe (adjacent) acreage does not include sufficient coal to support an independent

mining operation. Generally, the coal in these areas would be lost if the lease is not modified to include the additional acreage. Should a lease modification be issued, coal development activity is anticipated.

5. Lease readjustments - Occur upon the 20th year anniversary date whereupon the federal government has the opportunity to readjust or change the lease conditions and terms.

B. Procedures:

The above list of possible actions are, for the most part, processed under similar procedures. Each action is first adjudicated in the BLM State Office, at Santa Fe. It is then referred to U.S.G.S. for their comments and input, and to the respective District Office (Albuquerque District for Oklahoma) for their input. This input consists basically of determining the mitigating measures necessary to provide proper protection, rehabilitation, and restoration and to adequately protect the environment. This analysis is meant to cover the district input for all the above listed actions in the Oklahoma Federal Coal Reserves. If any such action has a special significance or an unusual situation, a separate analysis may be prepared depending on the degree of the unusual circumstance.

C. Location

This analysis is to cover approximately 372,325 ~~269,900~~ acres of land containing federal coal reserves in Oklahoma. The area lies within the following counties: Atoka, Coal, Haskell, Latimer, LeFlore and Pittsburg. See Attachment #1 Status Map which shows exact location of federal coal reserves in each county. Within this area approximately 1400 acres of surface land found in four counties, is under administration of the BLM. (Haskell Co.-1242ac., LeFlore Co.-80ac., Pittsburg Co.-3ac., Latimer Co.-80ac.)

D. Authorities

Statutory authority for leasing all federal coal deposits and federal coal lands is contained in: (1) The Act of February 25, 1920, referred to as the "Mineral Leasing Act" (41 Stat. 437, as amended: 30 United States Code (USC) 181 et seq.) for leasing all lands other than acquired lands. (2) The Act of August 7, 1947, referred to as the Mineral Leasing Act for Acquired Lands (61 Stat. 913; U.S.C. 351-359), for leasing acquired lands.

E. Alternatives

There are several alternatives to the proposal of leasing coal. They fall into three basic categories all of which include the alternative of no leasing and are as follows: (1) substitution of energy source (2) administrative modification in existing programs and (3) conservation of energy.

The above three alternatives are for the most part are beyond the scope of this analysis, however, they are covered in detail in the following references:

1. Draft Environmental Impact Statement - Proposed Federal Coal Leasing Program "Int. DES 74-53, 1974".

2. "Energy Alternatives and Their Related Environmental Impacts" USDI-BLM, 1974.

   Copies of these documents are available in the BLM District Office at Albuquerque, New Mexico.

   Copies of Reference #1 above are also available at the BLM State Office at Santa Fe, New Mexico, and U.S. Geological Survey Office at McAlester, Oklahoma.

(1) Substitution of energy sources could be made by the following:

1. Imports of both oil and natural gas and coal
2. Outer continental shelf production
3. Oil shale
4. Onshore oil and gas
5. Hydroelectric power
6. Nuclear power
7. Geothermal steam
8. Tar sands
9. Hydrogen
10. Biological energy
11. Solar energy
12. Tidal power
13. Wind energy

(2) Administrative alternatives to federal coal leasing could involve: (a) issuing prospecting permits with limited criteria or without criteria for environmental protection, (b) controlling development of federal coal by curtailment of federal leasing, leasing only areas suitable for underground mining, leasing only areas where surface and subsurface are federally owned, acquiring outstanding leases which fail to meet EMARS (Energy Minerals Activity Recommendation System) criteria and modifying regulations to control development of leases or (c) federal development of coal.

(3) Conservation of energy would put the responsibility directly on the consumer or user to reduce the need for coal produced energy.

III. Description of the Existing Environment

A. Non Living Components

1. Air

Air movement patterns and the climate of Oklahoma are greatly influenced by the continental air mass to the north and humid air over the gulf area to the south. Within the subject area moist air currents from the Gulf of Mexico influence the weather during the greater part of the year, although cool, moist air masses from the Pacific and cold, dry air masses from Canada are the predominating air masses that influence the weather during the winter months.

Prevailing winds across the region are from the southeast, although northerly winds prevail during January and February as the colder air masses from the north move southward across the area. Average yearly wind velocity ranges from 9 to 13 miles per hour with stronger winds of 25 to 40 miles per hour being reported during late winter and early spring. Spring is the most windy season as storm systems move out of the Texas Panhandle and eastern Colorado toward the northeast.

Thunderstorms of varying degrees frequent the area during the spring and early summer months. May and June are the months usually when most of this activity occurs. Some of the more severe thunderstorms to hit the region have produced damaging hail (as well as high winds) and tornadoes.

General climatic conditions (see Figure 2) in the area range from sub-humid in the western part of the region to humid in the central and eastern parts. The summers are long and hot, whereas the winters are short and mild. Seasonal changes occur gradually, but daily variations can be abrupt with temperatures changing 40 to 50 degrees F within a few hours.

The mean annual temperature of the region is 62.5° F (See Figure 3). Average daily maximum temperatures range from about 52 degrees in January to 95 degrees in August. Average daily minimum temperatures range from about 29 degrees in January to 70 degrees in July. Temperatures of 90 degrees or higher occur, on the average, about 3 months out of the year. Freezing temperatures occur about 75 days per year, with temperatures of zero or below being rare. The length of the growing season averages about 212 days in the subject area.

Average yearly precipitation (See Figure 4) in the area varies from approxmiately 42 inches in the western and northern sections to nearly 56 inches in the southeast corner of the region. May is the wettest month, receiving 14 percent of the yearly precipitation. Spring is the wettest season, receiving 32 percent of the year's total. Winter is the driest season, with 19 percent of the total.

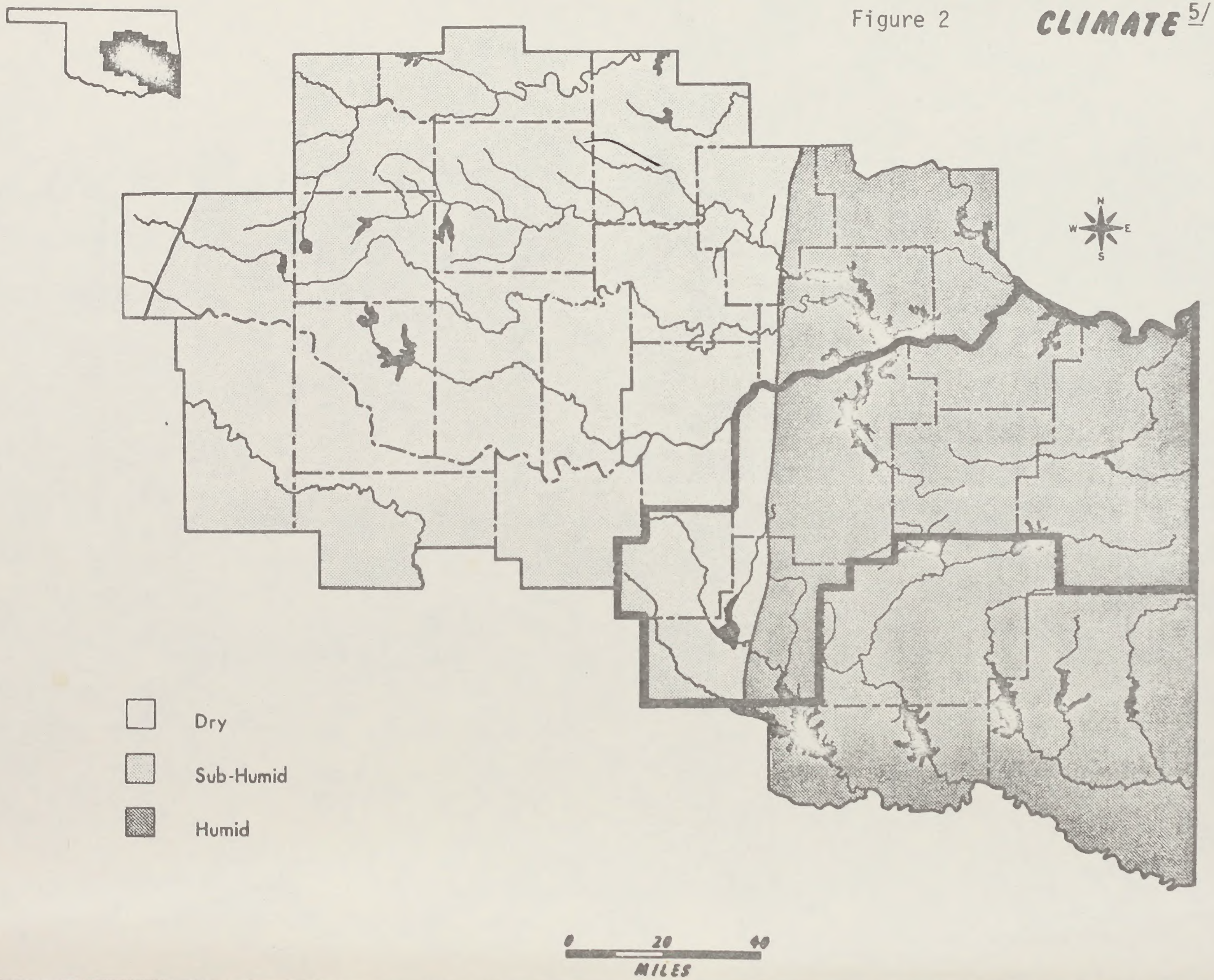
Air movement and temperature are affected to a certain degree by the presence of "orphan strip mines". "Orphan strip mines" are classified as past strip mining operations that occurred in the unit which did not include any degree of surface rehabilitation after mineral extraction. Most of these orphan areas contain spoil piles which have not been leveled or graded, nor has topsoil been replaced such that adequate revegetation occurred. These spoil piles are made up of black shale overburden which can increase air temperature above the surface.

The black coloring of the ground surface will absorb the sunlight, warming the ground, and through conduction will transfer some of this heat to the air layer above. In conjunction with air movement, these spoil piles present a "windrow" effect on the land surface, thus affecting wind patterns locally.

There are four actively producing coal strip areas on federal leases. Two are owned by Garland Coal Company. They are presently stripping coal in an area approximately two miles north of Stigler, Oklahoma (BLM-C-030953) and also in an area one mile south of Bokoshe, Oklahoma (BLM-C-035068 and BLM-C-035069).

The third area is Lone Star Steel Company (BLM-C-021851, Oklahoma), which is located approximately 2½ miles northwest of McCurtain, Oklahoma. The remaining area is located approximately three miles west of Milton, Oklahoma and is operated by Paul Rees Coal Company (BLM-I-017902). The spoil piles present in these four areas will have the same

Figure 2 CLIMATE 5/



MEAN ANNUAL TEMPERATURE[5/]

1931 - 1960

Figure 3

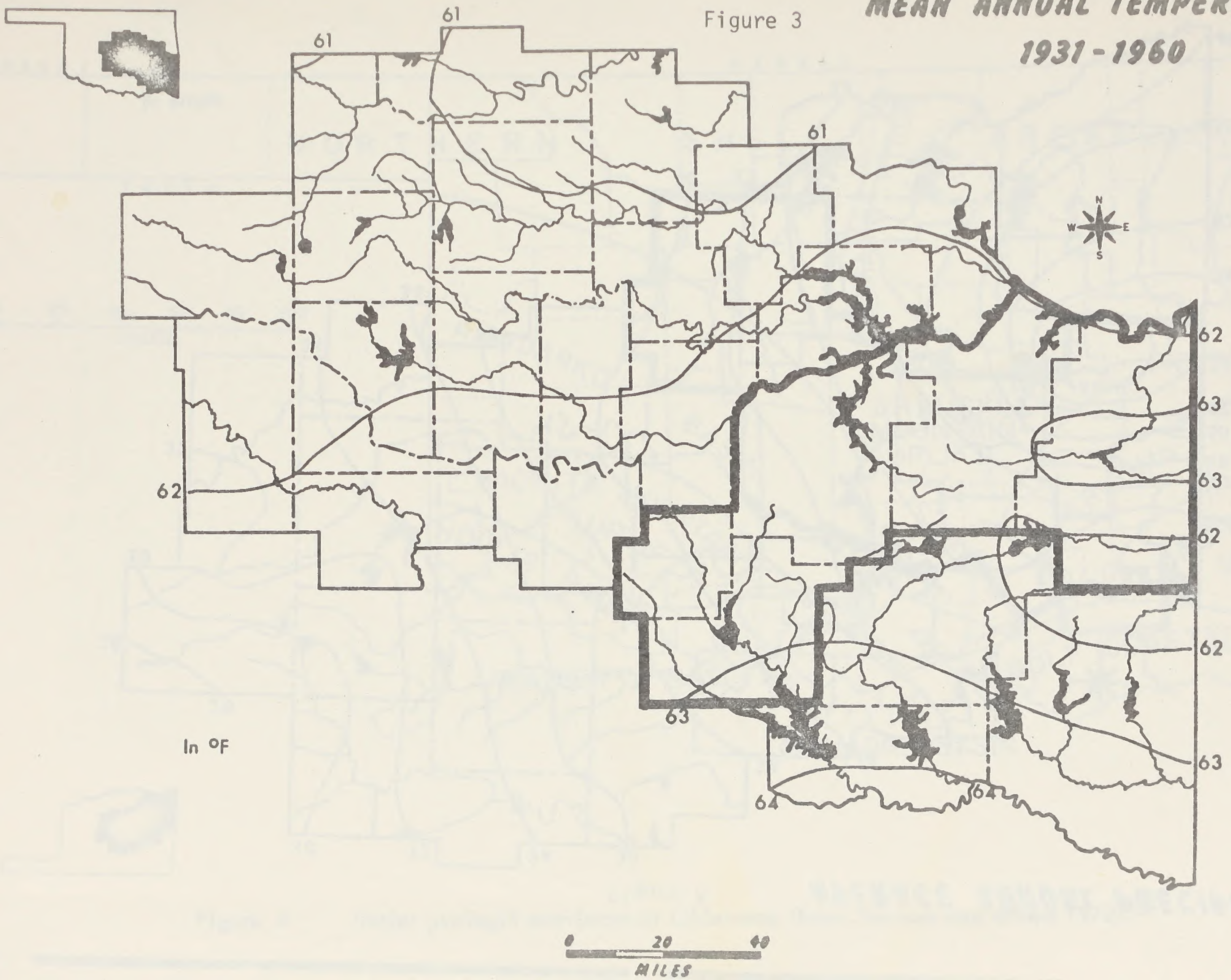
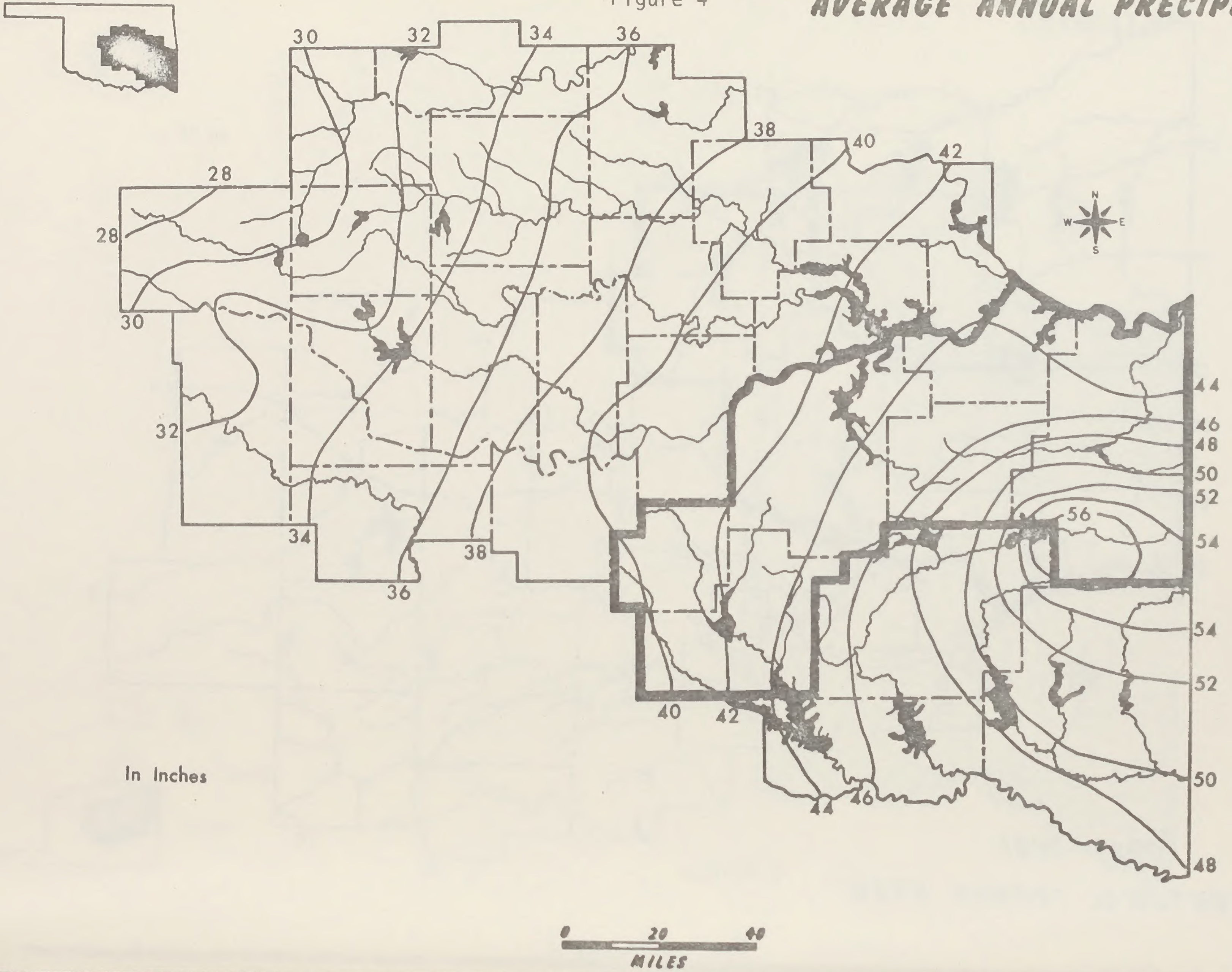


Figure 4

AVERAGE ANNUAL PRECIPITATION 5/



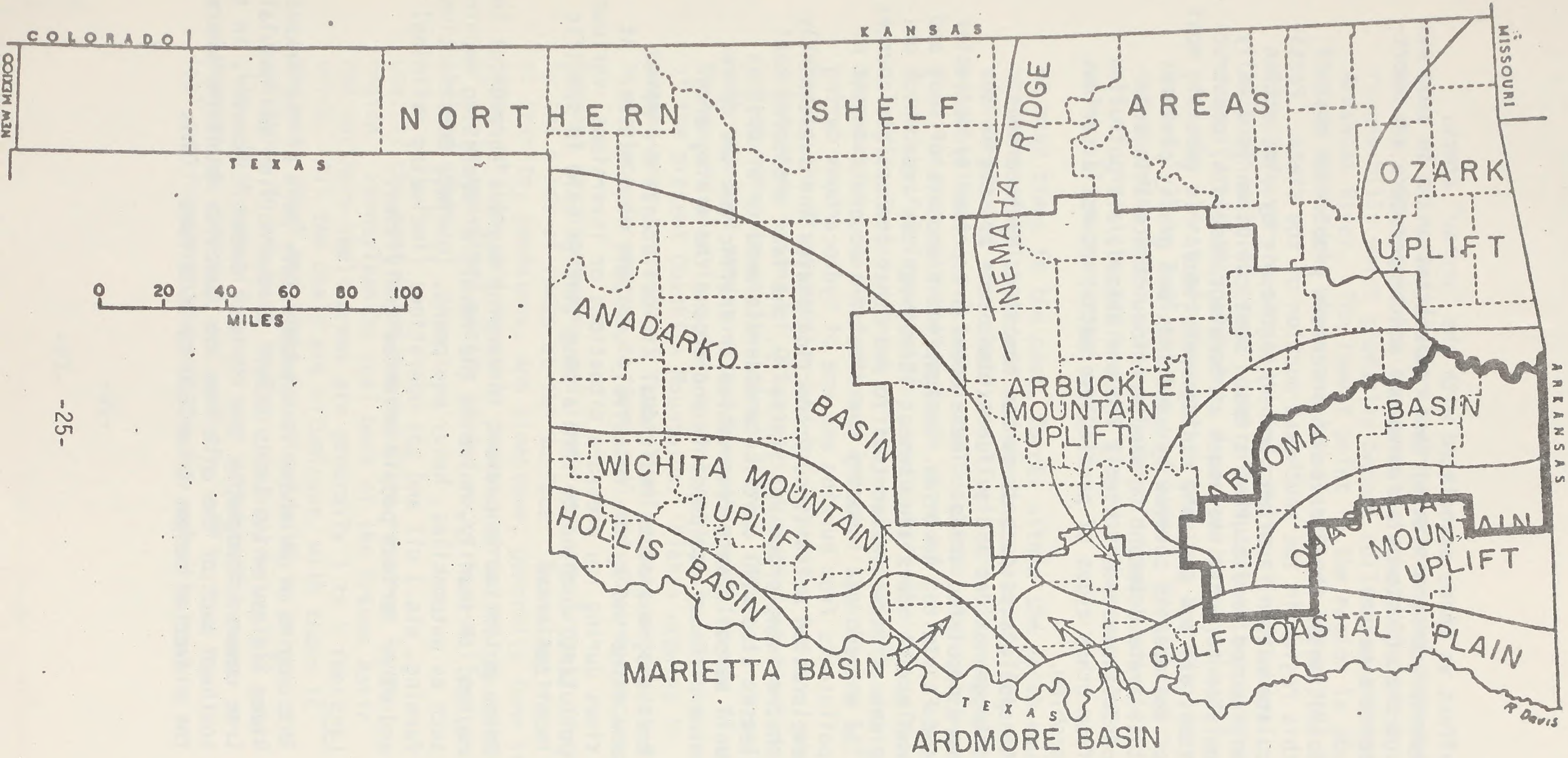


Figure 5 Major geologic provinces of Oklahoma (from Johnson and others 1972).5/

effect as those associated with the "orphan" areas; however, progressive surface rehabilitation is in progress and the effects on air movement and temperature are short-term in nature.

Pollution of the air is not a serious problem in most of this region in the southeast portion of the state. Particulate matter is often blown into the air by wind action on exposed or disturbed sites. Dust pollution is usually related to activities such as farming, feedlots, construction, oil and gas, and mining operations. In general, most of the area is covered by woodlands and grassy pastures that are a deterent to wind erosion. Since this area of Oklahoma is not highly industrialized, air pollution from other types of particulate matter is not a serious problem.

Air pollutants such as carbon monoxide, hydrocarbons, nitrogen oxides and sulfur oxides occur as smog in the more populated areas. These areas are primarily McAlester and Ft. Smith, Arkansas. Insignificant amounts of smog and unpleasant odors are present throughout the area which originate from vehicular traffic and other combustible sources. The oil and gas industry contributes a moderate amount of pollutants from burning and use of hydrocarbons during exploration activities, production phases and subsequently the refining process. Similarly, the four producing coal leases also will contribute moderate amounts of dust as well as pollutants from vehicular traffic and the operation of heavy equipment in and around the mining area.

Most smog and other individual air pollutants are moved and dispersed by the relatively constant wind action. At times during low pressure situations or inversions, various pollutants combine to form a smog that is held in specific localized areas.

Noise pollution is present in varying degrees throughout the region. Primarily, noise is the result of operating machines such as automobiles, heavy equipment, (mining, construction, farming, etc.) oil and gas operations (including refining) and other various people oriented activities.

2. Land

This region of Oklahoma is predominately part of the Arkansas River Plains, which lends itself to the rolling and undulating tree covered topography that is most common. However, in the southern part of the unit lies the Ouachita Mountains where the elevation ranges from 1800 to 2600 feet. This area is characterized by steep terrain and rough rocky breaks. Further north the terrain is made up of low, rugged hills which gradually become rolling toward the Arkansas River. The lowest point in the region is 366 feet above see level, where the Arkansas River leaves the state.

Rocks of every geologic period crop out in Oklahoma. Although most of these rocks are of sedimentary origin, consolidated from sediments deposited during the Paleozoic era, the oldest are precambrian granites and rhyolites formed 1.35 to 2.05 billion years ago. Precambrian and cambrian igneous and metamorphic rocks underlie all of the state and are the floor or "basement" upon which all younger rocks rest.

At many times in the past, forces within the earth caused portions of Oklahoma and surrounding states to alternatively sink below and rise above sea level. The three principal mountain belts of Oklahoma-the Ouachitas, Arbuckles and Wichitas-occur in the southern third of the state and were formed by folding, faulting, and uplift during the Pennsylvanian Period. North of the mountain uplifts are two deep basins, the Anadarko and Arkoma. (See Figure 5)

During the Mississippian and Pennsylvanian Periods, the sedimentary basins of Oklahoma sank much deeper and more rapidly than in earlier times. Thick sequences of shale with imbedded sandstone and limestone were formed in these basins and also in a deep basin that existed in the area of the present Ouachita Mountains. Plants growing in swamps near the edge of Pennsylvanian seas were buried and have since decomposed to form coal and other hydrocarbons.

Present day topography and land forms are largely controlled by the kinds of rocks at the surface. Resistant rocks such as granite, sandstone, and limestone, generally form high ridges, hills, and mountain peaks; whereas nearby outcrops of shale and other easily eroded rocks form valleys and lowland areas.

Coal is the best known non-metallic resource in the region. Pennsylvanian coal beds of the Arkoma Basin and northern shelf areas are generally 1 to 5 feet thick. All the coals are bituminous, with those in the west (Coal and Atoka Counties) being high volatile and those in the east (LeFlore County) being low volatile. High volatile coals are suitable for power generating, heating, and probably well suited for coal gasification; whereas the low volatile coal is prized as metallurgical-grade coking coal. Early production in the region was mainly by underground methods, but much of the recent work has been by strip mining.

More specifically, the subject area includes parts of four physiographic provinces: (1) The Ozark Plateau, (2) The Arkoma Basin, (3) The Ouachita Mountains, and (4) The Prairie Plains Homocline. The Ozark Plateau is composed of thin, flat-lying Silurian to Pennsylvanian limestones, sands, and sandstones, with many block faults downdropped on the south. The frontal Ouachita Mountains on the south are composed of imbricate thrust blocks of Devonian and Pennsylvanian siliceous shales and sandstones forming parallel ridges and valleys. The Arkoma Basin comprises many open folds of Pennsylvanian sandstones and shales containing coal beds, with some thrust faults in the center of the basin. The Prairie Plains Homocline is composed of Pennsylvanian shales and sandstones dipping gently northwestward.

The soils of the state vary considerably but are mostly sedimentary in origin. Soils range from rich bottomland to sandy hillside loams. The prevailing soil is a dark red loam, made up of decomposed sandstone and limestone; the river valleys often have rich deposits of alluvium. In the southeastern part of the state, the soils are often rocky in contrast with central Oklahoma where the soils are clay and sand. Dispersed throughout the eastern part of the state along drainages, river bottoms and valley bottoms are the deep rich soils that result from alluvium deposits.

The soils of the southeastern region are more developed in relation to soil depth and structure than those soils in the western region due to increased precipitation and vegetative cover.

Two main soil groups occur in the subject area, which incidently, coincide with the type of topographic features present; the Ouachita Highlands soil group and the Cross Timbers soil group. (See Figure 6)

The soils belonging to the Ouachita Highlands belong to the red-yellow podzolic and lithosol suborder soil groups. The soils of this area were developed from gray and brown shales and sandstones. They are strongly leached. Surface soils are generally light-colored. Soils developed from shales have silty surfaces and clayey, mottled subsoils.

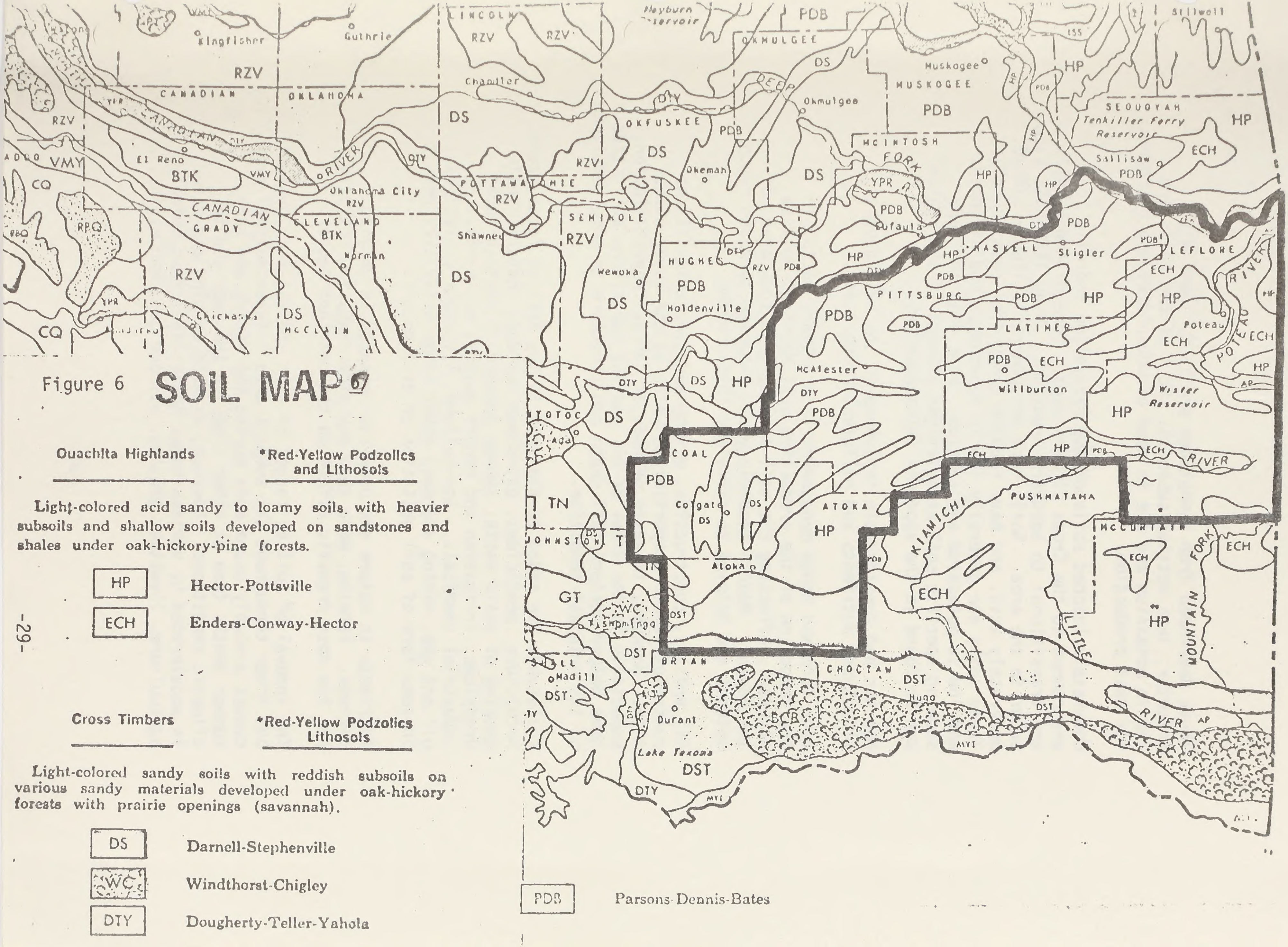


Figure 6 **SOIL MAP** 6/

Ouachita Highlands — ***Red-Yellow Podzolics and Lithosols**

Light-colored acid sandy to loamy soils with heavier subsoils and shallow soils developed on sandstones and shales under oak-hickory-pine forests.

HP	Hector-Pottsville
ECH	Enders-Conway-Hector

Cross Timbers — ***Red-Yellow Podzolics Lithosols**

Light-colored sandy soils with reddish subsoils on various sandy materials developed under oak-hickory forests with prairie openings (savannah).

DS	Darnell-Stephenville
WC	Windthorst-Chigley
DTY	Dougherty-Teller-Yahola
PDB	Parsons-Dennis-Bates

Those developed from sandstones are sandy loams with brighter, less mottled subsoils. Most of the soils are low in potassium and are in need of phosphorus and nitrogen for best production.

Moderately leached soils of the red-yellow podzolic zone are common to the Cross Timbers area. Some of these soils are transitional to southern brunizems. Many lithosols also occur in the area. Soils here are generally light-colored, moderately acid, and have reddish sandy clay loam subsoils. These soils are generally low in phosphorus and nitrogen, and low in potassium and calcium. More detailed maps showing specific soil associations present in the region can be found in the appendix (Attachment #5).

Man has had considerable influence on the soil depth, structure, nutrients and pollutant properties.

Poor farm and ranch management is a primary factor in the reduction of the productive soil depth as well as adversely affecting the soil structure in some areas of the region. Modern technology and improved farm and ranch methods are helping to alleviate this problem.

Oil and gas, construction, mining and timber activities contribute their proportionate share to the above situation. However, improved methods of surface rehabilitation, especially in the areas of oil and gas and mining activities, have helped restore soil depth and structure to some semblance of its original condition.

Pollutants are added to the soil in the form of fertilizers, herbicides, pesticides, petroleum residue, indiscriminate dumping of solid waste, sewage seepage, livestock fecal droppings, irrigation and runoff waters, and various industrial chemicals. Agriculture, livestock operations, oil and gas, mining and many other human activities result in some form of soil pollution or disturbance.

Nutrients in nature are used and replaced in varying degrees. Farming, more than any other existing activity, has the most dramatic affect on the nutrient factor.

The removal of soil by forces of wind and water is present but minor throughout the subject area. These natural processes probably occur more during the spring and early summer months than at other times in the year due to climatic conditions. However, erosion by wind and water is accelerated by various human activities, most notably agriculture, livestock grazing, oil and gas, and mining.

The geologic structure has no doubt been affected to some undetermined extent as a result of past and present oil and gas activities, strip and shaft mining, water well drilling and various other industrial activities.

The land in the region is suitable for and capable of supporting a variety of resource uses. Those activities which cause extensive surface disturbances and pollution (air, land and water) are the least suitable even though the land is capable of supporting them. Land uses such as recreation, agriculture, transportation systems, communities (both urban and rural), wildlife habitat, watersheds and other related uses seem to exist in relative harmony.

Activities such as coal mining and exploration and production of oil and gas have left scars on the land. These surface disturbing activities are not always compatible with other uses of the land and viceversa.

Fossil fuels such as coal, oil and gas that are locked in the underlying geologic structures make the land capable of supporting an active mineral extraction activity. The moderate terrain, relatively high rainfall and good soils in the area provide for reclamation of disturbed areas. In this area, it is possible for coal mining companies and others involved in disturbing the surface to extract the desired mineral and reclaim the area to a suitable form so that the mining activity becomes compatible with some other uses of the land.

In the past, strip miners have extracted coal from exposed seams and left their spoil in unaltered waste dumps. These waste dumps of shale materials have weathered but usually have not revegetated. Waste dumps are viewed by some people as a by product of progress and by others as ugly scars on the land. Presently, as stated before, there are four active coal strip mines on federal leases in southeastern Oklahoma. All companies involved are reclaiming the mined area by smoothing their waste dumps, replacing the topsoil, and revegetating the disturbed area. This practice makes coal stripping compatible over long-term periods, with most other uses in the area. In this case, the key to compatibility between coal mining and other uses of the land is proper, timely reclamation of the disturbed area.

3. Water

Precipitation is the source of all surface waters in the region and of virtually all ground water. Part of the precipitation falling on the land surface runs off in the form of streams and rivers and to fill ponds and lakes. The remainder either evaporates directly or through transpiration or soaks into the soil and eventually percolates into the underlying water table.

Three main rivers - The Arkansas, Canadian and Red provide major drainage ways for the numerous rivers and streams which cross the area.

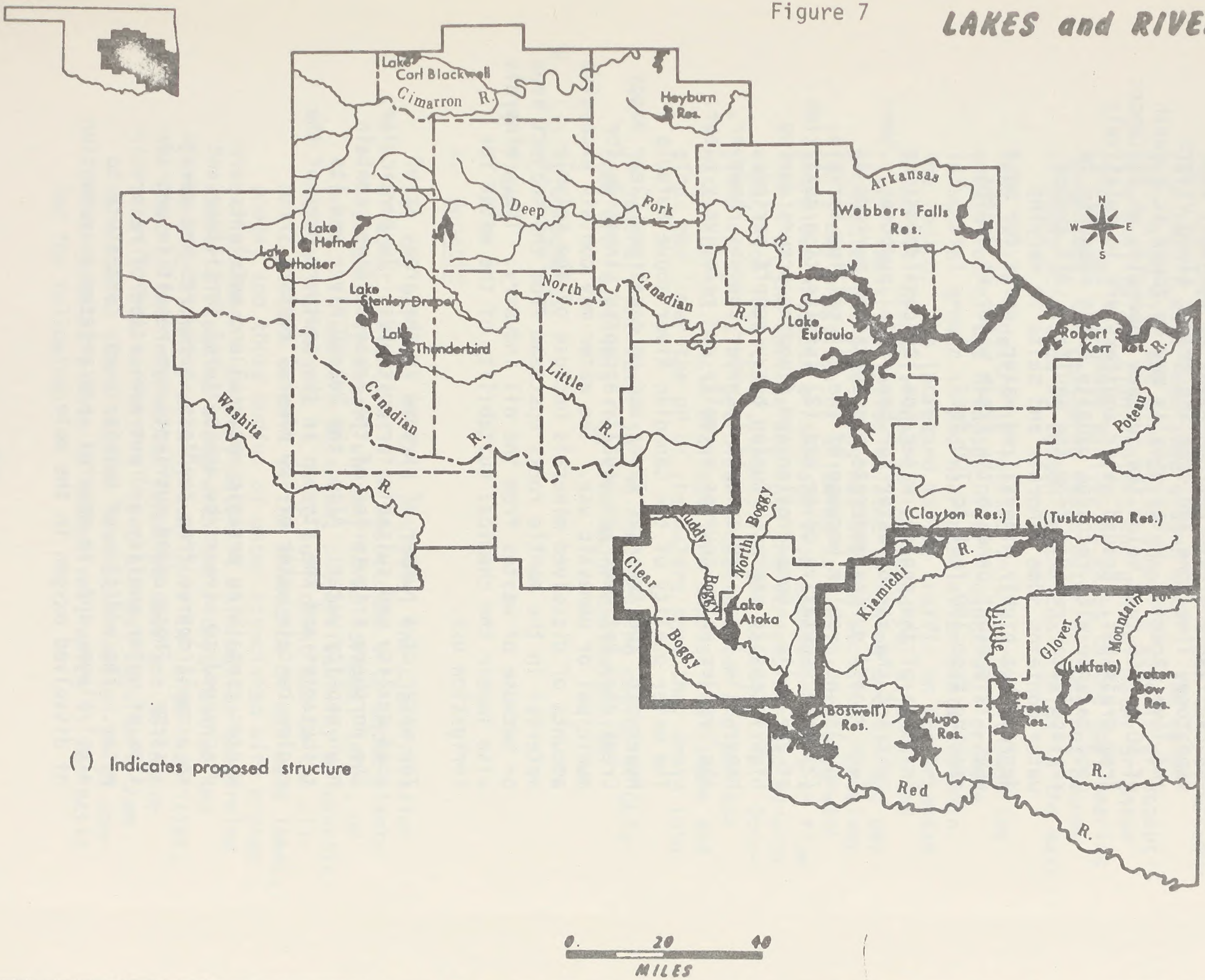
Other large rivers and streams flowing into the three main rivers are the Poteau, Fourche Maline, Blue Muddy Boggy, Clear Boggy, North Boggy, Kiamichi, Little and the Mountain Fork (See Figure 7 for location).

Streams present in the eastern and southern parts of the subject area are characterized by clear swift flow of alternating pools and riffles. Gravelly substrates, mostly of chert fragments, are common. Springs persist throughout this area which significantly influence stream-water temperatures and discharge rates during submodel flow. Those streams found in the northern and western parts of the subject area are generally clear, with moderate gradients and gravel/sand substrates.

The eastern part of the Arkansas River, from the lower end of Robert S. Kerr Reservoir to the state line, drains approximately 300,000 square miles and has an average yearly discharge of 20 million acre feet. The Canadian River, which flows into Eufaula Reservoir and joins the Arkansas River in northern Haskell County, has an average yearly discharge of about 2 million acre feet and drains 75,000 square miles. Forming the southern boundary of the state, the Red River, from eastern Choctaw County to the southeast corner of the state, drains approximately 40,000 square miles and discharges about 3.5 million acre feet annually. For more detailed information concerning volume and flow rates of these three rivers plus their major tributaries (see Attachment #6).

On some of the larger rivers, dams have been constructed as sources of hydro electric power, irrigation water, municipal-industrial supplies, flood control, navigation and for recreation. Four major federal reservoirs are located in the region-Lake Eufaula, Robert S. Kerr Reservoir, Lake Atoka, and Wister Reservoir-which range in

Figure 7 **LAKES and RIVERS** 5/



( ) Indicates proposed structure

surface size of 4,000 to 102,500 acres. In addition to these major reservoirs, the region contains some 40 private lakes with surface areas of ten acres or more and about 15,000 smaller farm ponds.

Generally ground water may be found in aquifers of sandstone, limestone and sand and gravel along rivers and live streams. Water usually may be found at a depth of 50 to 150 feet below the surface depending on distances from drainages. Ground water aquifers are in relatively good balance with recharge usually being adequate to replace water removed from the aquifer. All ground water contains some minerals and salts in varying degrees but highly mineralized water, unfit for most uses, is present beneath the fresh water at depths ranging from 150 feet to 700 feet.

In parts of the region, water quality considerations restrict the use of water for beneficial purposes. Surface runoff during moderate precipitation periods is usually no problem because of the (1) rolling terrain, (2) good vegetative cover and (3) infiltration qualities of the soils. Some erosion and flooding occurs during high intensity storms. During heavy runoff periods, heavy silt loads are evident in water courses, however, the smaller water courses normally run relatively clear.

The water quality of the Canadian River above Eufaula Reservoir, the Arkansas River and on occasions Clear Boggy Creek does not meet the usually accepted standards for municipal or domestic use. The water may contain excessive amounts of dissolved minerals because of the soluble material in the mantle rocks upstream from the subject area or because of wastes from the oil industry. These minerals also impair the chemical suitability of the water for irrigation use.

The water of a number of streams in the area, is of good quality and suitable for most uses. In particular, the northern tributaries of the Arkansas River contain high-qaulity water. Also, the Poteau River and its tributaries and the streams in the southern part of the region contain water of low mineral content.

Wastes containing organic material and nutrients are discharged to streams by agricultural fertilizer and to a small degree from feedlots, barnyards and sewage systems. These added nutrients can result in degradation of water quality and eutrophication of reservoir water. The addition of nutrients may contribute to algal blooms and, in general, are related to reduction of dissolved oxygen in the water.

Much of the area is underlain by sandstone and shale that yield limited amounts of ground water. Quality is variable and may be too highly mineralized for use in places. The open trenches in abandoned coal strip mines tend to accumulate runoff water and some ground water. The water associated with the mine waste dumps is usually of acceptable quality for fish habitat and general water oriented recreation. Although pyrites do exist in the coal bearing formations, the weathered waste material does not become strongly acidic as is common in the coal fields in the east.

Very little industry is located in the area although the completion of the Arkansas River Project will promote industrial growth in and near population centers within the region. The increased marine traffic on the Arkansas River will probably lead to increased pollution of the river. Water pollution related to mining and oil and gas production and processing has created occasional problems. Early day practices of allowing salt water produced with petroleum products or seepage from abandoned wells to flow freely on the surface and into the streams has had adverse impacts on local soil, vegetation and aquatic life. Occasionally spills of petroleum products enter and pollute water courses. Acid drainage from exposed coal seams and mines may lower the pH of the waters that they drain into.

In general, the water in the coal bearing region of Oklahoma are relatively free from major contamination.

B. Living Components

1. Plants

a. Aquatic

For the purposes of this analysis, the classification of aquatic plants will be associated with those plants that occur in water, whether it be streams, lakes, or ponds. In eastern Oklahoma, the availability of aquatic habitat for plants is quite sufficient due to the climatic factors as well as the abundance of man-made lakes, ponds, and those bodies of water associated with orphan strip mines. However, detailed information concerning number of species along with their distribution and density is not presently available in large quantities. Most of the information compiled does not delineate aquatic from terrestrial species, but considers them as a whole. Some studies have been located which consider aquatic plants by themselves, which is the basis for the following.

The aquatic plant community of southeastern Oklahoma is classified into three major types of species: (1) emergent, (2) floating, and (3) submerged.8/ All three types are part of the fresh water herbaceous plant community. Those aquatic species common to the eastern part of the state and the subject area are found either in the recession zone or the continuous water zone of the above plant community.

Those aquatic plants classified as emergent species are found in the recession zone with an aeroperiod of short duration or none at all. Emergent, aquatic communities occur lakeward from the summer pool level to a depth of about four feet provided recession is slight or of short duration. Of the eight communities present in this classification, the water willow and southern cattail associations are the most numerous. Water willow extends into fairly deep water (average maximum, 3.8 feet), whereas southern cattail occurs in water of intermediate depth (average maximum, 2.2 feet).

The emergent aquatic communities usually consist of a single dominant, usually without secondary species. However, the squarestem spikerush association comprises Eleocharis quadrangulata crassior (no common name available) as the major dominant, with common spikerush, common rush, or softstem bullrush as prominant secondary species in certain areas. Dominants of the cutgrass-lizardtail association include rice cut-grass, which often forms pure stands in seepage areas, swamp smartweed, and common lizardtail. Both of these associations occur in shallow water. The southern cattail association sometimes includes common cattail as a codominant, but usually occurs in nearly pure stands.

Other emergent species in the recession zone known to the area are water millet, which occurs in fairly deep water, and the bigroot smartweed and curltop smartweed associations. These two associations have been encountered in water at least ten feet deep and yet the dominants flower and set seed when stranded by recession in this particular zone.

The remaining two aquatic plant types, floating and submerged, are found in the continuous water zone of the fresh water herbaceous community. The floating plants, for ease of identification, have been divided into three subgroups; pleustonic species (minute free-floating plants); floating mat plants (relatively large plants which form mats on the water surface); and floating leaf species (with leaves typically attached to rhizomes in the substratum). In discussing the subgroups of the floating species, only one pleustonic plant community occurs in the subject area, the duckweed association. The dominants are little duckweed and big duckweed. During the spring months when water levels are higher, watervelvet which grows in the mud, may be an important component in this association. Floating leaf aquatic communities are not abundant in lakes in eastern Oklahoma, but are fairly numerous in the small ponds which occur. The water chinquapin association is present in these small ponds, with it as the sole dominant, but an understory of submerged plants is usually present. The spatterdock-waterlilly association is not common in this region. Spatterdock occurs in slightly shallower water than American waterlily and may occur separately in pure stands. But both are considered as dominant members of the same community. Floating mat communities, like floating leaf communities, are not abundant in eastern Oklahoma. The only association present is that of smooth water primrose.

The submerged aquatic aggregations are fairly numerous in the eastern section but these communities decrease in number to the west. The fanwort and water star-grass associations are found in abundance in the small lakes and ponds in the area. The coontail and muskgrass associations are also widespread in the region, but found in larger bodies of water. The muskgrass aggregation sometimes includes Chara hartensis, (no common name available) although each often occurs in pure stands. The most important submerged community is the common pondweed association, which contains more submerged leaves than floating leaves. Since the cover area of the floating leaves is considerably less than that of the submerged leaves, the pondweed is considered to be part of the submerged plant community. The remaining community found in the region, though not abundant, is Fennell-leaf pondweed.

A more complete list of the aquatic plant species occurring in the region can be found in Attachment #7. Those species not specifically mentioned in this section occur in relatively low abundance, but are part of the aquatic community.

b. Terrestrial

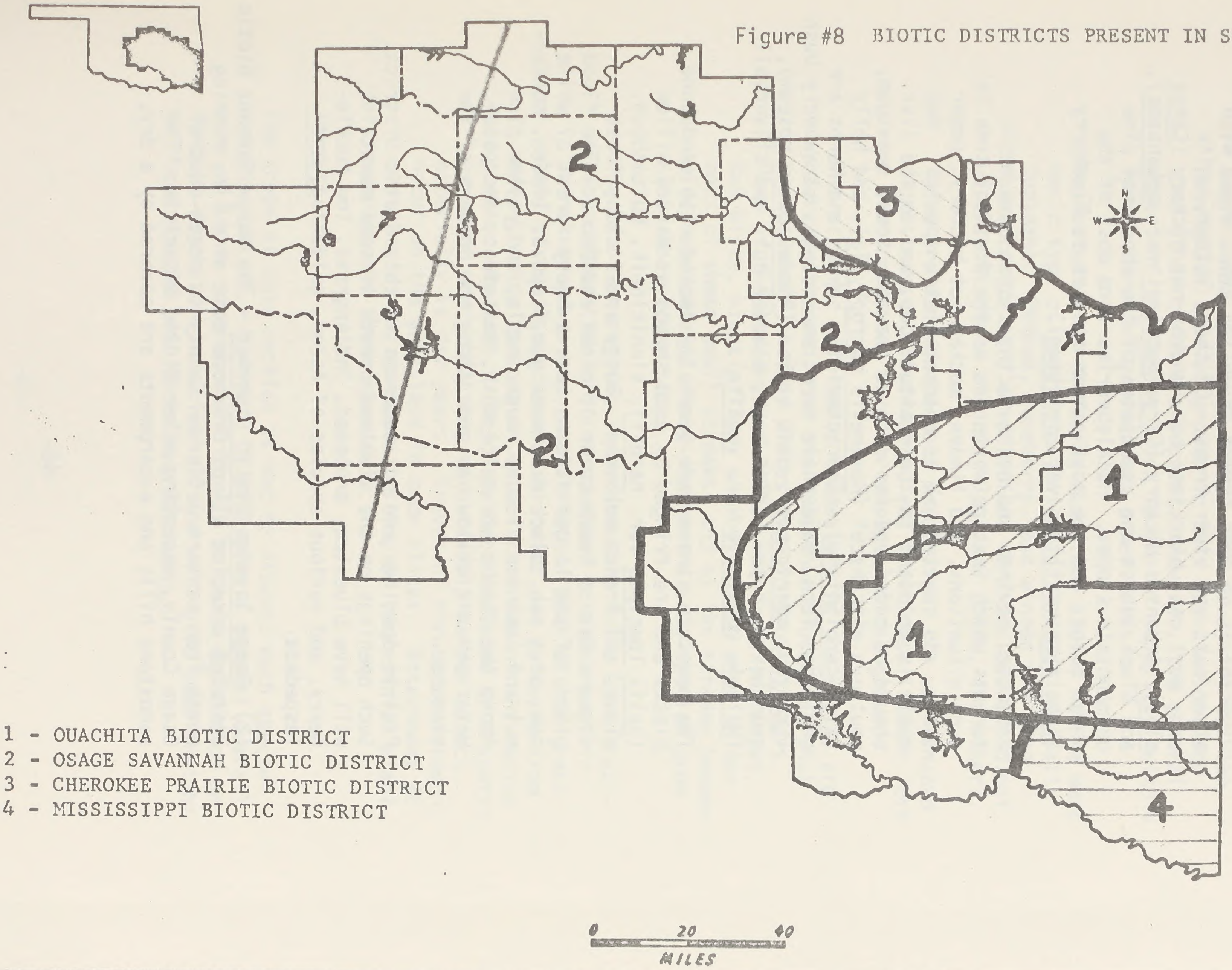
This region, as shown in recorded history, was primarily an agricultural area from the time of its settlement. By 1920, a total of 17,000 farms of all sizes flourished in the area. That number has steadily decreased since then, but in turn the size of farms has increased. Today, only about 7,000 farms exist in the area, but nearly two-thirds of them are 100 acres or more. Cropland in the region, although decreasing, is used for production of peanuts, cotton, grain sorghums, and fruit crops such as peaches. Although there is a definite trend toward more industry, agriculture will probably remain a basis for growth of the economy in this region.

Within the State of Oklahoma ten biotic districts are distinguished (Blair & Hubbell, 1938).9/ Most of these districts extend beyond the limits of the state, but only those parts of the districts lying within the subject area will be considered. A biotic district is a geographical unit distinguished by the presence of unique ecological associations, or more often by the presence of a unique assemblage of widely distributed associations.

Two Biotic Districts occur in the region: The Ouachita and the Osark Savanna. See Figure #8 for the location of both Biotic Districts. In gaining a more complete list of plant species which are common to the area, two sources of information were used (Reference #9 and 10). The vegetational map prepared by Duck and Fletcher (1943) divides the state of Oklahoma into 14 vegetational types. Five of these, (1) bottomland, (2) oak-pine forest, (3) oak-hickory forest, (4) post oak-blackjack oak forest, and (5) tall grass prairie, occur within the area of consideration. In conparing these habitat type with the biotic districts, associations 1,3,4 and 5 occur in the Ouachita Biotic District and association 2 occurs in the Osage Savanna Biotic District.

Blair and Hubbell delineated out habitat types for the state within these biotic districts. (See Attachment 8). The delineations set forth by Blair and Hubbell will be referred to since the biotic districts will be the same for different groups of mammals discussed in the following sections and for ease of distinguishing the ecological interrelationships between mammals and their habitat type.

Figure #8 BIOTIC DISTRICTS PRESENT IN SUBJECT AREA 9/



(1) *Ouachita Biotic District* - This biotic district corresponds to the Oklahoma part of the Ouachita Mountains, and extends with the mountains into southern Arkansas. The most extensive plant association of the Ouachita Biotic District is an open forest of yellow pine, mixed with other oaks and other trees. Of these latter, white oak, post oak, blackjack oak, mocker-nut hickory (*Carya alba*), Arkansas Hickory (*Carya buckleyi* var. *arkansana*), and black locust are associates of the shortleaf pine on mountain slopes. Huckleberries form most of the shrub cover, and the most common species is Blueberry (*Vacciniam vacillans* var. *crinitum*).

Protected ravines and north-facing slopes have mesic forests which feature white oak as the dominant tree in such situations, and linden, mocker-nut hickory, sugar maple, and spotted oak as characteristic species. Red maple is abundant in these situations, and to the list should be added species such as cucumber tree, sweetgum, southern witchhazel (*Hamamelis macrophylla*), and holly (*Ilex caroliniana*). Characteristic shrubs and herbs are christmas fern, maidenhair fern, mockorange, strawberry bush (*Eronymus americanus*), pink azalea (*Rhododendcon roseum*), gooseberry, papaw, spice bush, bladder nut, and silverbell (*Halesia monticola* var. *vestita*).

The mountain streams are generally choked with sandstone blocks and are fringed by such shrubs as Ward's willow (*Salix longipes* var. *nardii*), kinnikinnik, buttonbush, alder, and french mulberry. Boggy areas along these streams have a heavy cover of herbs and ferns. The flood plains of the larger streams have a heavy forest of white oak, post oak, black oak, sweetgum, tupezo, linden, mocker-nut and Arkansas hickory, sugar maple, and yellow pine. Among the shrubs are spice bush, sassafras, and papaw. Water oak and willow oak grow along the borders of the streams.

Prairie openings are not numerous in this Biotic District. Such openings on the side and crests of some mountains will have bluestem, dropseed, Indiangrass, low huckleberry, and various species of Aster, goldenrod, and lespedeza.

(2) *Osage Savanna Biotic District* - The Osage Savanna Biotic District occupies all of Oklahoma east of a line running north from eastern Jefferson County to north-central Osage County, excepting other Biotic Districts. The sandstone hills and escarpments are covered by a dry,

scrubby forest mostly composed of blackjack oak, post oak, and black hickory. There are many second-growth sprouts of the two oaks, with which are often mixed dwarf sumac and coral berry. The bluejoint has the bunchgrass type of growth in this association, and some other herbs are present. However, the general aspect of the forest floor is one of sandy soil with a sparse cover of grasses and other herbs.

Protected or north-facing sandstone bluffs have a more mesic type of vegetation, with spotted oak generally dominant. Redbud, juneberry, and winged elm also characterize this association. Grasses are broadleaf uniola, Virginia wildrye, Japanese chess, and others.

There are many herbaceous mesophytes. On well-shaped slopes mosses, liverworts, and fruiticose lichens form a continuous mat over the surface of the ground.

The streams, near their headwaters in the hills, are choked with sandstone and limestone blocks, so that pools remain in many places even in drought years. Many of the streams are filled with aquatic masses. Red birch, black willow, and buttonbush grow in the beds of these small streams, and as the streams become wider and develop flood-plains the same species grow along the stream banks.

The level or rolling areas on shale soils have grassland communities similar somewhat to other prairie and mixed-grass biotic districts. Much of the grassland of the Osage Savanna District has suffered from over-grazing to such an extent that few of the native grasses are left. They have been replaced by a sparse cover of weeds that has an extremely barren aspect, especially in dry years. Groves of shrubby persimmons occur on the grassland in some places. Attachment #9 contains a more complete listing of terrestrial plant species and their abundance.

2. Animals

The scope of this section is not to discuss each species and its habitat. However, it will give a general overall view of known species with respect to their dependence on certain vegetative associations and will give some insight to these species and their habitat needs.

Information on endangered species is very limited and inadequate for complete analysis. Only brief descriptions of habitat requirements for endangered and other wildlife species were available for this report. Further library and field research are needed to fully evaluate the habitat for mammal, bird, reptile, amphibian, invertebrate, and fish fauna.

A list of endangered wildlife species covered under the Endangered Species Act of 1973 and found in southeastern Oklahoma is included as Table #5.

A list of rare and uncommon wildlife species found in southeast Oklahoma is included as Table #6.

a. Aquatic

(1) Mammals

Generally, the presence of water and associated vegetation habitats largely control the distribution of some aquatic mammalian species. Water permits the distribution of some semi-aquatic mammals along stream systems, bogs, lakes, ponds, etc.

The mammals that inhabit the wet habitats of the forest are limited in the Ouachita and Osage Savanna districts to mesic flood-plains (mud flats, ponds, lakes, etc.) and ravines. The flood-plain forests extend westward beyond the climatic limits of the eastern deciduous forest into the great plains grasslands. These relatively narrow strips of forest in an area that is predominantly grassland are highways by which some of the eastern forest mammals extend their western limits. Rocky bluffs bordering many of the streams are highways for the distribution of the species that are tied to rocky areas (refer to discussion under terrestrial mammals).

Wildlife species that are tied to soil characteristics find that the soils of the flood plains and around lakes and swamps are suitable habitat. The soil of these areas are more moist and loose, and, therefore, more easily worked by burrowing mammals. Some mammals, such as the eastern mole are distributed along stream flood plains.9/

Table 5

ENDANGERED WILDLIFE SPECIES IN SOUTHEASTERN OKLAHOMA

LISTED BY U.S. FISH AND WILDLIFE SERVICE

Indiana Bat	(*Myotia sodalis*)
Red Wolf (thought to be extirpated)	(*Canis niger*)
Peregrine falcon	(*Falco peregrinus*)
Southern Bald eagle	(*Haliaetus leucocephalus Leucocephalus*)
Whooping crane	(*Grus americana*)
Eskimo curlew	(*Numenius borealis*)
Bachman's warbler	(*Vermivora bachamanii*)
Ivory-billed woodpecker	(*Campephilus principalis*)
Red-cockaded woodpecker	(*Dendrocopos borealis*)
Western chicken turtle	(*Deirochelys reticularia miaria*)
Scarlet snake	(*Cemophora coccinea copei*)

Note: Spp. will be added or deleted as their status and/or habitats and populations are found.

Table 6

RARE OR UNCOMMON WILDLIFE SPECIES IN SOUTHEASTERN OKLAHOMA LISTED BY OKLAHOMA GAME AND FISH COMMISSION

Black-capped vireo	(*Vireo atricapilla*)
Brown-headed nuthatch	(*Sitta pusilla*)
Anhinga	(*Anhinga anhinga laucogaster*)
Swainson's warbler	(*Limnorthlypis swainsonii*)
Greater sandhill crane	(*Grus canadensis tabida*)
Wood-ibis	(*Mycteria americana*)
Roseate spoonbill	(*Ajaia ajaja*)
American osprey	(*Pandion haliaetus carolinensis*)
Red-backed salamander	(*Plethodon cinercus serratus*)
Dwarf salamander	(*Manculus quadridigitutus*)
Four-toed salamander	(*Hemidactylium scutatum*)
Western lesser siren	(*Siren intermedia nettingi*)
Three-toed amphiuma	(*Amphiuma means tridactylum*)
Rich Mountain salamander	(*Plethodon ouachitae*)
Mole salamander	(*Ambystoma talpoideum*)
Alligator snapping turtle	(*Macroclemys temmincki*)
Western glossy water snake	(*Regina rigida sinicola*)
Sauger	(*Stizostedion candense*)
Paddlefish	(*Polyodon spathula*)
Shovelnose sturgeon	(*Scaphirhynchus platorynchus*)
Smallmouth bass	(*Micropterus dolomieui*)

Table 6 (continued)

Wheeler's pearly mussel	(Arkansia whelleri)
Keen Myotis	(Myotis keeni)
Black bear	(Ursus americanus)
River otter	(Lutra canadensis)
Spotted skunk	(Spilogale putorius)
Cougar	(Felis concolor)

The bottomland timber type discussed as a "game type" by Duck and Fletcher is broadly similar to the aforementioned flood-plain forests within the Ouachita and Osage-Savanna biotic districts of Blair and Hubbell. These two biotic districts have an aquatic mammalian fauna of about 16 species and races. This bottomland type offers some of the better game habitat condition in Oklahoma and is capable of supporting many different species. The more common game species include: *bobwhite quail, *gray and *fox squirrel, cottontail, pheasants and such furbearers as *raccoon, opossum, skunk, *mink, *muskrat and *beaver (*denotes game species of major concern to the Oklahoma Game and Fish Commission).

Duck and Fletcher stated that the fur trade has never been among the important industries of the state.10/ Of the annual total value of pelts, the aquatic mammals furnish a relatively small amount of which the important ones are mink, muskrat, and raccoon. Mink is found associated with all major water systems of the state, and does very well in areas of watershed improvement such as pond building and lake construction.10/ Raccoon populations have been increased considerably through such management practices as protection of woodland from grazing and burning, construction of small dams on creeks to increase food supply, protection of natural den trees and construction of artificial dens. Most of the muskrat pelts come from the northern two-thirds of the state. The most unfavorable factor of otherwise suitable muskrat habitats is the unstable water level. This variable water level prevents the ecesis of muskrat food plants, such as species of Scirpus and Typha, and interferes with the home activities of the muskrat. With the greatly increased water surface in the state, there is no doubt that a tremendous increase in aquatic mammal population could be affected if reasonable management practices could be instituted.8/

One of the smaller aquatic habitats are those that exist on mud flats along the streams and around some of the ponds. Some of the stream tributaries have steep banks and others are gently sloping and muddy or sandy. A few of the mammals that depend upon these areas will be discussed.

The red bat feeds in the air over this association and other littoral zones. Occasionally, it touches the surface of the water either to drink or to capture insects. The muskrat burrows in the streams and pond banks.

The swamp-rabbit ranges along the littoral zone from areas of heavier cover and occasionally enters the water. The raccoon feeds along the banks of streams and ponds. The mink frequents the littoral zone and often enters the water. The river otter lives mainly in the streams and rivers. It was at one time common in most of the live streams of the state. Presently, it is absent or only rarely present in the state along major rivers.

In small flood plain ponds vegetation may be lacking except for the sedge marsh association, which includes smartweeds and sedges. Around the pond margin, willow is usually common. In summer, the shallower ponds become dry with sun-cracked earth bottoms.

The cotton-rat is the most abundant mammal of this habitat type. The swamp-rabbit is concentrated here, and the cottontail ranges through the area. The wood-mouse ranges into this association from the oak-elm association, but it probably does not make its home here.12/

A species list has been included in Attachment #10 which presents a listing of the mammalian fauna by name, general habitat, biotic districts and occurrance. A limited amount of information was avaiable on aquatic mammals so that a complete analysis cannot be made without additional field research and investigation. Much of the information contained here is extracted from the existing literature which is considered to be out-of-date and incomplete.

(2) Birds

The aquatic areas which include bogs, marshlands, shores, swamps associated with rivers, creeks, lakes, reservoirs, ponds, seeps and springs occur mostly in the low bottomlands. Many species of birds depend on the various habitats that exist. Some species are closely tied to the limits of these wet lowlands while others pass through, seek temporary refuge or water. The following is a discussion of the avifauna that inhabit the subject area. There are far too many birds to discuss all the species, their habitat requirements and needs. A list of birds is included in Attachment #11. The following is a discussion of the common, endangered, rare, and uncommon birds known to depend on the aquatic areas.[a]

Some of the avifauna (birds) that is most dependent upon bodies of water and associated vegetation include the loon, cormorant and duck families. These are among the most common aquatic birds. The common loon is particularly dependent upon water (large open bodies) for food and nest sites (along the water's edge). The double-crested cormorant is primarily a fish eater and spends its whole life in the water. The Anatidae or duck family (13 species) depend on open water bodies, shallow water and shorelines of rivers, lakes and reservoirs for feeding and nesting (shorelines or islands). One species, the wood duck, is arboreal.

Two powerful ecological factors are now influencing the distribution of the Anatidae in Oklahoma - the impounding of water throughout the state and the planting of grains at various wildlife refuges. Many of Oklahoma's rivers have become less attractive to waterfowl as they become shallower, more laden with silt and more polluted. However, the great reservoirs (including some lakes created from strip mines) and farm ponds that have come into being have provided both resting places and feeding grounds. Many species have become more common within recent years.[13]

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[a] The occurrence of birds, both aquatic and terrestrial is limited by the interdependent factors of habitat, climate, availability of food, and the presence or absence of natural enemies. Probabilities of occurrence can be inferred by the existence of the above factors, but definite information is gained by sightings and collecting specimens.

None of the subject area have been well researched in this respect. Two of the counties have had virtually no research (Coal and Haskell). Of these, Haskell is the least known, ornithologically, in the state. In Atoka County only very limited research has been done. The avifauna of the six county area for the report was compiled from Sutton and the recent environmental inventory compiled by Mid Continent Environmental Center. Other publications were used to supplement these sources and to document records and species status.

Shore birds and deep and shallow water wading birds depend on the water's edge, swamps, tules and shore areas for feeding and nesting. One species from the family Anhingidae, the Anhinga (Anhinga anhinga), occurs only along the low-lying river bottoms where the swampy habitat is similar to the Gulf Coast Region. LeFlore County is the only place in Oklahoma where the Anhinga is found.

The deep waders consist mostly of the herons and ibis which nest in trees. Cranes, on the other hand, wade in marshes and wet fields for food and nest along the edge of marshes. Herons and ibis feed mostly on fish, frogs, crayfish, other aquatic animals, insects, small mammals and non-aquatic snakes. Nesting usually occurs in trees (herons) while others (bitterns) nest in reeds and cattails above water.

The whooping crane (Grus americana), is listed as endangered and is known as a rare transient in the study area around open low-lying shores of large impoundments, broad riverbeds and salt plains and in rain soaked wheat fields and pastures. The population decline has mainly been attributed to breeding, range restriction and overshooting. Two other cranes, greater sandhill crane and lesser sandhill crane occur in the report area in similar habitat. The former is low in numbers and is only a rare fall and spring migrant. Its decline has been the result of the cranes intolerance to human disturbances of nesting areas.14/

Another group called the shore birds that typically feed along the water's edge include members of the Rallidae which are very diverse in their habits. Most species are inhabitants of marshes and some in sandy places. Nesting places of these species are usually above or immediately surrounded by water, while some (i.e., American coot) builds its nest on floating cattail leaves or debris. One species that summers widely in Oklahoma (the king rail) is so tolerant of water level fluctuation that it nests in impoundments that are continuously marshy, weedy margins of riverbeds, low-lying fields where ponds form in spring, and close to highways in the deep grass of ditches and borrow pits that dry up by the end of summer.

Of the forty eight species from the order Charadriiformes that occur in Oklahoma, about 23 species of shorebirds occur in the report area as regular transients. Seven species nest in the state. Some nest in trees, cliffs, islands, and along shorelines. One of these species, the Eskimo curlew is listed as an endangered species- a formerly abundant spring transient but now close to extermination. This bird is said to be closely associated with the golden plover while migrating; hence to be looked for with flocks of these birds in plowed fields, heavily grazed pastures and burned over grassland. Reason for declining is presently unknown. The bird was formerly heavily shot.

A very common bird, the kingfisher, frequents every water hole, bog, stream, lake, pond, and reservoir in the report area. It thrives on aquatic organisms including lizards, snakes, centipedes, small birds and fruit of plants. Commonly, these birds nest in natural cavities in trees, excavations in rotten wood or in termite nests, or burrows in the ground. For the most part, nesting requires a vertical bank of soil that does not become impossibly hard when dry.

Many other birds visit aquatic areas, nest nearby, or occasionally hunt or feed within the zone. Among these, to name a few, are the swallows that nest in bridges, barns, culverts, and pipes as well as embankments, crevices and burrows. The habitat characteristics are very specific for the cliff swallow which depends on the mud supply in an area for nest building.

Some birds are ecologically tied to the bottom land hardwoods in wet lowland swamps. These include the Bachman's warbler (Vermivora bachmanii), ivory-billed woodpecker (Campephilus principalis), Swainson's warbler, and the worm-eating warbler. The former two species are listed as endangered. It is reported that the decline of these four species is mainly attributed to the loss of suitable wet lowland swamps and the cutting of hardwood timber that occurs in swamp situations. The decline of the ivory-billed woodpecker is not clearly defined in the available literature except that competition for nest sites and food with the pileated woodpecker could be partly responsible.

Other birds that depend in some way on aquatic areas include: the long-billed marsh wren which is limited to the cattails, sedges, rank grass and low-lying fields; rock wren which is dependent upon rocky areas; and the water pipit which favors bare shores and sandy riverbeds.

(3) Fishes (Aquatic)

The fishes inhabiting waters of the report area are composed of approximately 99 species. In Attachment 12 the species are listed in reference to their presence or absence and apparent level of abundance within each of two biotic districts which occur within this area. Habitat associations of each species are also noted. The following discussion will be limited to those species that live within the tributaries and mainstream of the Arkansas River drainage.

Occurrence and temporal dispersion of fishes are related to habitat structure and environmental stability. Differences in habitat structure are associated with physiographic and climatic variations that directly influence the composition of stream-substrate materials, surface and subsurface drainage, and the permanency of stream systems. Induced changes in habitat structure, e.g. intensive landuse for agricultural, industrial, and residential purposes; drainage of natural lakes, sloughs marginal to large rivers, swamps, and prairie marshes; pollution by industrial and domestic wastes; construction of impoundments that modify the depth, width, and rate of stream discharge; species interactions with exotic fish introductions, etc., can also modify, significantly, the occurrence and distribution of fishes.5/

Distribution patterns displayed by Oklahoma fishes suggest the existence of several more or less distinctive faunal groups. Because fishes are limited by their dependence on water that has a specific physical or chemical makeup they cannot fit into the faunal regions or biotic districts 9/ that have been discussed in the previous sections. The fishes do not correspond to the physiographic regions either. When we consider that fishes are limited to streams, rivers and lakes it is worth noting that there is a great amount of overlap in the distributions of fishes in other areas. This similarity is due primarily to the physiographic and climatic factors, whereas the divergences in a strictly aquatic group such as fishes are more nearly associated with the geographic inhibitions imposed.17/

Interpreting data on distribution and abundance for fish is difficult. It is compounded by the influence of the many recently created artificial impoundments. Along the major stream and river systems large impoundments have been or are being completed and others have been authorized for construction. Since many stream and river-inhabiting species cannot survive the altered conditions of impounded waters while others seem to do better in large lakes, the present distributional patterns of Oklahoma fishes are certainly different from those of some fifteen or twenty years ago. Many of the distributional records are based on specimens collected by the Oklahoma Biological Survey or by individuals from various institutions prior to the period of accelerated dam construction. Since many of these impoundments have been completed only recently, evaluations of their impact on associated flowing water systems have not yet been conducted. For this reason some of the species shown on Attachment #12 may not actually occur in the report area due to the changed habitat conditions.

Analysis of fish distribution and abundance reveals that none of the fish are restricted to the report area. All of the fishes mentioned are known to inhabit a portion or all of the waters in the report area. Few species are found statewide. Most of the species in this category are extremely adaptable river and stream fishes like the gizzard shad, black and yellow bullheads, channel catfish, and red shiner, or widely stocked as are many sunfishes (Lepomis) and the largemouth bass. These fish appear to have wide tolerances with respect to climate, physicochemical, and soil-type requirements and are to be found wherever habitat needs (quiet or flowing waters, adequate food supply, appropriate gradient and bottom type, etc.) are met or wherever they are stocked in permanent water.17/

Another group of species seems to be associated with the larger rivers and several of them also have done well in many of the impoundments of these rivers. This group includes the shovelnose sturgeon, paddlefish, alligator gar (in the east), American eel, speckled chub, flathead chub, river shiner, silverband shiner (in the east), sand shiner (in the west), highfin carpsucker, blue sucker, black buffalo, blue catfish, river darter, sauger, and walleye.

A related group of fishes, including the two crappie species, may be found in all of the major impoundments of the state. Some that are inhabitants primarily of the eastern half of the state include species like the gars (except the alligator gar), the goldeneye, stoneroller, golden shiner, smallmouth and bigmouth buffalo, flathead catfish, blackstrip topminnow, white bass, spotted bass, orangethroat darter, logperch, and others. Although some of these species can survive or even thrive in many of the western impoundments or like the stoneroller inhabit a few western creeks with appropriate substrates and relatively low silt levels, most are unable to maintain viable populations in the western plains of the state. Miller and Robinson 17/ state that some combination of the heavy silt loads carried by the mud-bottomed streams of the central redbed plains region and the more extreme variations of temperature, salinity, and flow in western streams can largely account for the limited distribution of the above mentioned group.

They also explained that a smaller group including the rosyface and steelcolor shiners, frecked madtom, blackspotted topminnow, bluntnose darter, channel darter, and possibly the spotted sucker seem to occur in about the eastern third of the state.17/ Although the preferred habitat types may be distinctive among these species, most of them seem to be associated with either limestone or uplifted areas or both. The fact that they occur in both the Red River and Arkansas River basins suggests that they have been inhabitants of this region for a fairly long time. The two systems have been separated for a long period of time allowing for the differentiation of a number of species (such as the leopard darter in the Little River and the longnose darter in tributaries of the Arkansas) and subspecies (in the redfin shiner and orangethroat darter, for example).

When fishes of the Poteau River are compared with those of the Ozarks and those of the streams draining the Ouachitas (Red River system) some interesting relationships emerge. Although there are ten species found in both the Red River tributaries and the Poteau and only seven in the Ozarks and the Poteau, most of the latter are headwater or mainstream forms (slender and brindled madtoms; greenside, least redfin, banded, and longnose darters), whereas most of the former are baselevel or large-river inhabitants (bowfin, grass pickerel, silvery minnow, pugnose minnow, Kiamichi shiner, tadpole madtom, scaly sand darter, harelquin darter, Johnny darter, and dusky darter). The greater similarity in the fishes of river systems in different drainages can probably be best explained by assuming that most of the fishes found mainly in the Poteau and Ouachita-draining streams are essentially lowland fishes which moved up the Red and Arkansas rivers only to the eastern edge of the state and were unable to find suitable habitats in the major tributaries of the Ozark region.17/

Several species of the fishes are exotic to the Oklahoma fish fauna, being introduced by man. These exotic forms were primarily introduced into impoundments as bait, forage or for sport-fisheries. Such species include the carp, redear sunfish, white bass and yellow perch. Some forms such as the carp and white bass have become common, while others, e.g. the goldfish, only appear occasionally in the fish fauna of Central and Southeastern Oklahoma.5/

There are some fishes that are of particular concern to certain agencies and interest groups. During a Transactions of the American Fisheries Society meeting, Hubbs (1972) reported that the shovelnose sturgeon, Arkansas darter and leopard darter (the latter is only known to occur in that portion of the Little River system located outside the report area) are considered as endangered species for Oklahoma (only one the leopard darter is listed as endangered in the federal register by Fish and Wildlife Service in January 1974 Vol. 39, No. 3). Other fishes of concern to the Oklahoma Game and Fish Commission include: the sauger, paddlefish, shovelnose sturgeon and smallmouth bass.

Populations of several species of fishes have declined appreciably, through time, within this region. Such forms as the alligator gar, shovelnose sturgeon, highfin carpsucker, paddlefish, American eel, and skipjack herring, are typical. Characteristically, these species possess similar habitat requirements (ie., large rivers). Reduction of population numbers for the paddlefish, highfin carpsucker and skipjack herring is related to increased turbidity, and siltation of substrates utilized as breeding and feeding areas. The alligator gar and shovelnose sturgeon; however, are quite tolerant of such conditions. Since these two species require several years before becoming sexually mature, removal of adults, either by fishing efforts or natural mortality drastically reduces the population stability and biotic potential for recruitment through natural reproduction. Factors responsible for decline of the American eel are related to interference of its breeding migration, as the eel returns to the sea to reproduce. 5/

Recreational fisheries are of significance within the report area. Sport fishing in natural streams of the area is popular. Species which are commonly found in the creel of such anglers include: the largemouth bass, spotted bass, smallmouth bass, green sunfish, redear sunfish, longear sunfish, channel catfish, and flathead catfish. These provide substantial sport fishing in streams. Impoundments in or adjacent to the report area include Thunderbird, Stanely Draper, Eufala, Atoka, Robert S. Kerr, Broken Bow and Pine Creek which concomitant with proposed reservoirs (Tuskahoma, Lukfata, Hugo, Boswell, Albany, Parker), have significantly increased recreational fisheries within this region, and have added diversity to the angler's creel. The inherent capacities for growth and reproduction for such species as largemouth bass, redear sunfish, bluegill sunfish, white crappie, black crappie, blue catfish, channel catfish, flathead catfish, flathead catfish, white bass, buffalo, and drum, in a lake habitat have enhanced a tremendous increase in their numbers. Under lake conditions, smallmouth bass accumulate in large numbers during the early years of impoundment, but their innate preference for stream habitats reduce lake populations, substantially, within a decade. Spotted bass maintain sizeable population numbers in large lakes, but do not exceed the largemouth bass in population density. Farm ponds and city lakes are numerous within the report area, and have provided substantial sport fishing for such species as bluegill sunfish, redear sunfish, green sunfish, largemouth bass and yellow bullhead. Such areas have also increased local abundance of the above named species within the region.5/

The fresh-water commercial fisheries of Central and Southeastern Oklahoma are unexploited. The fresh-water commercial fisheries in greatest need for exploitation is that which could be provided by the reservoirs now in existence, and including those that are proposed. From studies of the fish populations or of yields of commercial fishing in reservoirs it is evident that most are quite productive with large annual crops of fishes of actual and possible commercial value. Contributing species are the carpsucker, buffalo, carp, flathead catfish, blue catfish, drum, gizzard shad, white bass and gar.5/

b. Terrestrial

(1) Mammals

The domestic fauna include livestock such as cattle and calves, and other livestock which produce some of the state's agricultural wealth. Livestock represents more than 75 percent of the agricultural income. Oklahoma ranks 7th nationally in income from cattle and calves but 5th nationally in number of head.

Oklahoma, with over 2.2 million head of beef cows, is second only to Texas in beef cow-calf type ranching operations. Oklahoma's cattle industry was valued in excess of $1 billion on January 1, 1972.

Within the six-county region, there are approximately 105,000 people, almost a third of which are situated in the major population centers of McAlester, Poteau, Heavener and Wilburton. The remainder of the population is distributed throughout the counties in towns of 2500 or less and smaller, rural communities.

Three major wild mammalian faunas are represented in Oklahoma, one of them centering in each of the major biotic areas in the state. Within the general vicinity of the subject area, there are two biotic districts which are the Ouachita and the Osage-Savanna districts as defined by Blair. In these biotic districts, the mammals (about 58 species) present are mostly those characteristic of the eastern deciduous forest. Some of these species also depend upon the riparian and aquatic vegetative types.

The mammalian fauna of each biotic district indicate that some differences exist from the fauna of every other biotic district. These biotic districts as well as those that are adjacent have many species of mammals in common.

All of the mammalian fauna in the Ouachita district, except one, originated with the fauna of the eastern deciduous forest. The exception originated with the southern great plains fauna. For example, the brush mouse, is associated with rocky areas in brush and wooded ravines of the southern great plains and extends its distribution into the Ouachita district in similar habitat types. Examples of those species originating from the eastern deciduous forest and extending into Ouachita district include: the long-eared bat, the cotton mouse, eveningbat, golden-mouse, and the eastern chipmunk. 9/

The mammalian fauna of the Osage-Savanna district also originated from the eastern deciduous forest and fewer had their origin in the great plains grasslands. One species, the beaver, is widely distributed, and one race of shrew is endemic to the southern part of the district. Within this biotic district, those mammals associated with the eastern deciduous forest occupy the blackjack association on the sandstone ridges and the oak-elm association of the stream systems. Some species occur in the grassland areas.12/

In the flood plains and rolling terrain of the eastern deciduous forest, the predominate trees are oak, hickory, maples and a scattering of pine. Forest openings created by thinning now have an abundance of shrubby and herbaceous vegetation, so that in much of the forest there is an alternation of large trees with weed patches, shrub thickets, or clumps of young trees.

The eastern deciduous forest can be generally divided into the post oak blackjack (good game and fur producer), oak-pine (supplies major portion of Oklahoma's habitat for white-tail deer), and oak-hickory habitat (principal producer for small game) types.10/ These game types generally occur within the Ouachita and Osage-Savanna biotic districts discussed.

The most common game species found in the three game types include bobwhite quail, fox squirrel, cottontail rabbit, and white-tail deer. The oak-pine game type which corresponds to the Ouachita biotic district of Blair and Hubbell 9/ harbors the only remaining native stock of wild turkey.

Other species that occur within the eastern deciduous forest and lowland and flood plains include the following: The woodmouse, gray-squirrel, and fox squirrel are the most abundant semi-arboreal mammals in this association; while the flying-squirrel, red bat, opossum, and raccoon occur in fewer numbers. The eastern mole and pine vole are among the most abundant small mammals of the forest floor. The swamp-rabbit, and cotton-rat frequent situations in which there is heavy cover. The striped skunk, spotted skunk, and mink are wide-ranging predators in this association.12/

The great plains element within the Ouachita and Osage-Savanna biotic districts is usually confined to the stream borders and adjacent lands. The badger, striped skunk, and coyote are the principal species utilizing the true tall grass uplands. This tall grass type gives way to the mixed grass plains. Tall grasses are limited to small pockets of deep soil between the limestone fragments and the short grasses exist on thin soil sites. A mixture of clumps of tall grasses with the more extensively distributed short grasses exists in the association. Extending out into this mixed grass type along dry water courses, is the sumac-grama vegetative type.

Some of the wildlife species characteristic of these associations will be discussed. The plains pocket-mouse and deer-mouse are the most abundant small mammals of the grama-beardgrass association. The thirteen-lined spermophile and harvest-mouse are less abundant. The cotton-rat occurs in this association in times of great abundance. The black-tailed jack-rabbit and coyote range throughout the area, and the eastern cottontail rarely enters it from other associations. The striped skunk lives beneath the larger limestone fragments, and the spotted skunk ranges through the association.

Blair describes certain ecological interrelationships that are similar to conditions within the report area.12/ In some areas, ravines that are steep walled or sloped and heavily forested are important habitat. The rim rock of these ravines usually occurs where limestone, sandstone and granite outcrop. Much of the vegetation was described in the vegetation section. Some of the mammals which are generally associated with the soils and vegetation in these areas are discussed.

The brush-mouse and woodrat are associated with the rim rock, and to a lesser extent with the rock masses on the ravine slopes. The striped skunk and cottontail find refuge in crevices in the rim rock. The eastern mole occurs in limited areas of deeper soil on the ravine floor. The eastern pipistrelle inhabits caves in the outcropping limestone. The cotton-rat is a rare inhabitant of situations with heavy cover. The gray-squirrel, fox-squirrel, and wood-mouse are semi-arboreal forms that are associated with the trees in the ravines.12/

There are about 15 mammals (found in Attachment #10) which are listed as rare (R) which must be interpreted to be either actually occurring in low densities in suitable habitat, or that the species has not been collected widely or abundantly, and thus, is assumed to be rare. Until more is known of these mammals, great care must be taken to maintain a status quo with the environment. Suitable studies can be undertaken eventually, and knowledge of the biology (such as reproduction potential, ability to adapt to a different habitat, and ability to adjust to man) will be ascertained. Only then can a valid judgement be made as to the suitability of changing the environment through such devices as building dams, strip coal mining, channeling water, developing artificial forest preserves, and allowing discharges of industrial by-products.5/

Vertebrates which are or were formerly a part of Oklahoma's native fauna and which are officially listed as endangered on the List of Endangered Fauna taken from the "Federal Register" dated Jan. 4, 1974 include: Indiana bat and the red wolf (Table #5); very little information was available for these species.

The red wolf formerly was in southeastern Oklahoma, but is now thought to be extirpated. A few are still known to occur in southeastern Texas and the adjacent counties in Louisiana. Persistant pressure by man and direct competition of the more adaptable coyote probably account for its decline in numbers. A recent article (Natural History, January, 1972) places the present range of the true red wolf only as in the big thicket country of southeast Texas and southwest Louisiana. Large coyotes outside of this range are considered red wolf coyote hybrids or coyote-dog crosses.

The Indiana bat lives in caves during the winter and man-made structures and hollow trees during the summer. The summer habits are unknown. The occurrence of caves in Ozark region of northeast Oklahoma is the most important reason for its range into the state. The animal is endangered probably because of habitat loss when caves are molested and are commercially developed. The two collections from Oklahoma were made, one of which was from LeFlore County in mountainous areas.

Other species that are considered by the Oklahoma Game and Fish Commission to be unique enough within Oklahoma to warrent consideration include the spotted skunk, keen myotis, Mississippi myotis, gray myotis, black bear and cougar.

The spotted skunk was only recently a common animal around rock piles and under farm buildings. For some unknown reason in recent years, it has been declining drastically in numbers (Unknown, SCS).

The bats (Myotis) range into the report area and live mostly in caves, mine tunnels, hollow trees, and buildings. The black bear and cougar are only occasional visitants in the eastern portion of the report area.

(2) Birds

The southeastern and south central portions of Oklahoma offer three distinct types of habitat to the avifauna: oak-pine woods, oak-hickory woodlands, and open tall grass prairie. The oak-pine woods found in LeFlore and Latimer Counties have recorded certain avifauna which do not occur in any other part of the state. They are the red-cockaded woodpecker, brown-headed nuthatch, pine warbler, and Bachman's sparrow. The oak-hickory woodlands occupy the remainder of the eastern counties: Haskell, Latimer, Pittsburg, and some eastern parts of Hughes, and the northeastern corner of Coal County. Birds commonly associated with the woodland areas include the black vulture, red-shouldered hawk, barred owl, pileated woodpecker, acadian flycatcher, eastern wood pewee, black and white warbler, scarlet tanager, and chipping sparrow.

The remaining counties consist of tall grass prairies mixed with blackjack oak and post-oak woodlands. Birds more characteristic to these open areas include Swainson's hawk, killdeer, mourning dove, yellow-shafted flicker, red-headed woodpecker, scissor-tailed flycatcher, western kingbird, loggerhead shrike, eastern meadowlark, dickcissel, and lark sparrow. Of particular interest in the grassland habitat of Pittsburg County is the greater prairie chicken, listed as "uncommon" in North America.15/ Sutton stated that it has been restocked "more or less successfully" in this county.13/

The more central Oklahoma counties have both eastern woodland and central grassland habitats, which results in a great diversity of avifauna. This diversity is compounded by the presence of several large reservoirs which attract migrating waterfowl and shorebirds. Some of the birds do not nest in the area because of the fluctuating water level.

Several species of avifauna have limits of their breeding or wintering ranges within the report area. Western species such as Swainson's hawk, whip-poor-will, black-chinned and rufous hummingbirds, mountain bluebirds, lazuli bunting, rock wren, Bullock's oriole and others have the eastern limits of their ranges in the area. Rufous-crowned sparrows are known to breed in the rocky areas of Atoka and Latimer Counties.

Eastern species such as the rose-breasted grosbeak, indigo bunting, Baltimore oriole, whip-poor-will, acadian flycatcher, prairie and pine warblers and others are within 150 miles of the western limits of their ranges. An area of young oak saplings near Dustin in Hughes County is a nesting area for yellow-breasted chat and prairie warblers. The only nesting population of red-cockaded woodpeckers (listed as an endangered species) is the diseased trees of the extensive pine forests of Latimer County. Observations of this species have been documented in LeFlore and Latimer Counties. Typically eastern species such as summer tanagers, whip-poor-wills, and yellow-throated vireos occur as transients, summer residents or nesting species (summer tanager), and scarlet tanagers and pine warblers are known to breed in the report area.13/ In Leflore County, pine woodlands contain the western limits for many of the eastern species: pine warblers, prairie warblers, Kentucky warblers and wood thrushes. Many other warblers have been observed here during migrations. The fact that Oklahoma lies in the central flyway for bird migrations provides even more diversity to the avifauna.

Two birds of prey, the southern bald eagle (Haliaeetus leucocephalus) and the peregrine falcon (Falco peregrinus) are listed as endangered species and are known to occur in the report area.

The bald eagle is an uncommon or rare winter resident along major streams and impoundments with large mature woody vegetation. It is not known to nest in a particular area for years but nesting is possible. The bald eagle is decreasing because of increasing human population on nesting areas and possible reduced reproduction resulting from pesticides ingested with food by adults. The peregrine falcon is a rare winter resident and transient from September to May. It frequents large water areas and marshy areas or cliffs. Its decline is due to molesting of nests, shooting and cumulative effects of pesticide poisoning affecting reproduction. Perch sites for the bald eagle as well as the golden eagle include powerline poles. Other birds such as the turkey and large water birds (herons) may use these pole structures. The osprey, the only species belonging to the family Pandioidae, is dependent upon water only for its food. It is considered a regular transient and its numbers have been increased through recent water impoundments.

The avifauna in Attachment 11 is listed in phylogenetic order using ordinal, generic, species and common names as given by Sutton. The presence of a species on the list in no way reflects its relative abundance. Other species that occur are generally listed in Table 7.

c. Reptiles and Amphibians

The information concerning reptiles and amphibians has been collected from only a few available publications. The primary sources were Webb,20/ Bragg,19/ and M.E.C.A.5/ A list of reptiles and amphibians was adapted to the report area from the publications mentioned (Attachment #13). The list may be inadequate due to the limited amount of literature used.

The reptiles and amphibians of Oklahoma represent a zone of change between the eastern and western species. This mixture occurs within the ecotone indicate by the meeting of the eastern deciduous forest and western grassland. Due to the location of this ecotone the eastern and western ranges of certain species are found within the report area. In addition to the eastern and western forms, and those species that have broad ranges extending across the state, some species originate from the southeast gulf coast fauna and extend into the southernmost portions of the report area.

There are about 53 amphibians of which 24 species are aquatic and 29 are terrestrial species; there are also about 48 reptiles of which 9 species are aquatic and 39 are terrestrial species. Many of these reptiles and amphibians occur in both aquatic and terrestrial habitats. Therefore, the numbers of species indicated above are only approximate.

Some species (species with ranges that extend from east and southeast) within Oklahoma are limited to this area. Their numbers and limited ranges have caused some concern among research biologists. These include some seven species. They are the Rich mountain salamander (*Plethodon ouachitae*) which occurs only on wooded slopes and crests in the immediate vicinity of Rich Mountain in LeFlore County, Although not considered an endangered species, any activity around the mountain that affects the vegetation may limit this species further. Those species that are considered as rare or uncommon (Table #6) include six species. The Ouachita red-backed salamander (*Plethodon cinereus serratus*) occurs mostly in the southeastern woodlands.

TABLE 7

BIRD SPECIES FOUND IN THE STATE WHEREVER SUITABLE HABITAT IS AVAILABLE

Open Country	Woodlands
(Prairie grasslands, pastures, brushy places)	
Turkey Vulture	Red-tailed Hawk
Bob-White	Cooper's Hawk
Road-runner	Yellow-billed Cuckoo
Eastern Phoebe	Screech Owl
Horned Lark	Great Horned Owl
Barn Swallow	Chuck-will's Widow
Bewick's Wren	Hairy Woodpecker
Mockingbird	Downy Woodpecker
Bell's Vireo	Crested Flycatcher
Yellow Warbler	Carolina Chickadee
Orchard Oriole	Tufted Titmouse
Cardinal	Red-eyed Vireo
Painted Bunting	Summer Tanager
Grasshopper Sparrow	

Four species inhabit the lowland swamps, ponds, and shallow water areas: the dwarf salamander (Manculus quadridigitatus) barely extends into the report area along the eastern border of LeFlore County in low swamp areas; four toed salamander (Hemidaetylium scutatum) occurs mainly in "mossey" areas adjacent to woodlands and old shallow ponds; western lesser siren (Siren intermedia nettingi) and the three-toed amphiuma (Amphiuma means tridactylum) are found in the debris of shallow water bottoms and among aquatic plants; and the mole salamander (Ambystoma talpoideum) lives underground and utilizes shallow water depressions for breeding.5/

The majority of the amphibians and certain reptiles are limited to areas of water, wet areas, damp spring areas, or lowlands, and thus are quite restricted to particular habitats which, if altered would be unsuitable for survival. Some authorities state that some species of amphibians and reptiles within Oklahoma should be listed as endangered or rare. Those amphibians which should be considered endangered are the Rich Mountain salamander and the dwarf salamander. None of the amphibians of the area are known to be rare. The only endangered reptiles are the western chicken turtle and the scarlet snake. Two reptiles, the Alligator snapping turtle and the western glossy water snake, are considered rare in the report area.

d. Invertebrates

Anyone familiar with the invertebrates will realize the impossibility of providing an adequate or comprehensive coverage of these organisms within a cubic foot of soil or a single small pond, so the prospect of a meaningful inventory for the report area may well seem absurd. Even if the necessary information were available, which is obviously not the case, the mountain of data could not be presented in a digestible manner, nor could a valid assessment of the value of these creatures be made. Nevertheless, the information presented may be useful. It is derived from the M.E.C.A.5/ report. Many references were used initially to accomplish the attached list.

Since the vast majority of invertebrates known to science (and many are yet to be discovered and described), are known to but a handful of specialists, it is not surprising that few invertebrates have been given common names. For the most part, such common names as are used apply not to a particular species as is the case with larger animals, but to a genus, a family, an order, a class, or even an entire phylum. Furthermore, the person who recognizes the common name usually also knows the scientific name, which is less subject to local variation, so virtually no common names are used in this section except those widely recognized.

The information and species list were compiled from M.E.C.A.5/ and adapted for the report area under consideration. Many species thought to be common within the report area are included in the species lists (Attachment #14), while others were not included due to a lack of information.

Only those invertebrate groups of greatest significance are discussed in this section.

Note: In the following discussion on invertebrates several page numbers are shown in parenthesis. These pages are found in Attachment #14.

Other groups of invertebrates which are not discussed and do occur in the report area do not play a major economic or ecological role. These include: sponges (Page 4, aid in filtering water), Coelenterates (Page 4), worms (Pages 4,5), Bryozoans (Page 4), Tardigrades (Page 4), leeches (Hirudinea) slugs (Page 5), terrestrial snails (Page 5). All of these are important in the food chains of some mammals and birds and serve a hosts for parasites.

Though no data are available concerning the protozoa (Pages 1,2) of areas other than Cleveland County, it is probable that the list would be quite similar, at least for ponds and lakes, throughout the region. With further study, the list would probably be doubled. The more humid southeastern woodlands undoubtedly have a much richer fauna of Mycetozoa (slime molds). The protozoa of greatest economic importance from the standpoint of public health are not listed; they would include such parasitic species as Plasmodium vivax, which causes malaria, or Toxoplasma gondii, and toxoplasmosis in man and all sorts of domestic animals. Many of the protozoa listed would be of significance either as food for larger organisms which in turn serve as food for fish, or as agents for the removal of bacteria in "cleaning up" polluted water. None of the species are endangered.
The free-living flatworms, most of which are microscopic, such as Cura foremani and Dugesia dorotocephala may well occur only in the counties listed, but the rest, including the planarian Dugesia tigrina, are likely to be found anywhere in the region. Phagocata would be in temporary woodland pools, Dugesia chiefly in streams, and the rest in almost any pond or lake. They are predatory upon other small animals.

Rotifers (Page 4) are microscopic animals of rather diverse habits. Almost all of those listed were found in association with algae in ponds or small lakes. The distribution shown reflects primarily the localities from which samples were taken. If collections had been made in any of the other counties, each would have yielded a large list. Some rotifers thrive in damp soil, others in temporary puddles. Some are relatively important components of the plankton of lakes and ponds, while others are attached to the substrate. Many are filter-feeders, and since they occur in great numbers are of importance in cleaning the water below sources of pollution. Also, because of their numbers, they are significant in the food chains of fishes.

The distribution of annelids (Page 5) reflects not the rarity of these worms in other counties, but the fact that no one has examined and published material concerning other regions. It is likely that the list for every county would be at least this large. To illustrate, the only earthworm or fishing worm listed is _Allolobophora_, which certainly occurs in every county. Members of this genus are important in aerating the soil and rendering it readily permeable to rainwater, in converting plant material into soil, and in bringing mineral nutrients up toward the surface. There are other unlisted genera in the region which play similar roles. All of the genera listed are aquatic, and some provide fish food in considerable quantity. _Tubifex_, which is useful in cleaning the water, is so characteristic of sewage-polluted streams as to serve as a classical indicator of pollution.

For the most part the aquatic snails (Page 5) are of importance in proportion to their numbers--chiefly as fish food--and their numbers are rather closely proportional to their distribution, the widespread species also being locally most abundant. This is especially true of the pond dwellers such as _Physa_ and _Lymnaea_ and _Helisoma_. A possible exception to this generalization concerning importance might be mentioned in the case of _Lymnaea columella_, which is a potential intermediate host of the liver flukes _Fasciola hepatica_ and _F. gigantica_, which may be of medical or veterinary importance.

In recent years, commercial harvesting has been limited (Pages 7,8) to sale of local shellfish to Japanese pearl-growers, who insert small cores of clamshell into the mantles of pearl oysters to serve as nuclei for pearl formation. Harvesting for this purpose has been rather sporadic. Some of our native mammals such as raccoons and muskrats make regular use of clams as food. Except for the fingernail clams, the distribution of mussels (or clams) is dependent upon the presence of appropriate species of fish, in which the young clams (glochidia) are parasitic for a time. Thus such species as Quadrula pustulosa which parasitize common and widely distributed hosts such as channel catfish, are in turn, common and widespread. Rare and highly localized species are likely to be so restricted because of their dependence upon very localized fish, although few such life histories have been worked out. As more streams are impounded and rocky riffles reduced, the fish and associated clam populations have shifted from stream to lake-dwelling forms. This, of course, is equally true of most other aquatic groups. The existence of Wheeler's pearly mussel (Arkansia wheeleri) is thought to be in peril along the Kiamichi River because of dam construction and lowered oxygen levels. This species was submitted by Oklahoma Game and Fish Commission for inclusion in the endangered species list (Table 6).

In contrast with most of the other aquatic groups, the crustaceans are important components in food chains. The phyllopod crustaceans (Page 8) are not as numerous in eastern counties. These organisms typically occur in temporary pools, leaving eggs that withstand desiccation, heat and cold. Migratory wading birds may use them extensively as food in the more western portions of the report area. Copepods (Page 8) such as the Diaptomus species are most abundant in the larger impoundments and provide a major source of food for small fish. Another very important group of microcrustaceans are the Cladocera or water fleas (Page 8), which are food for small fish and plankton feeders in virtually every pond and lake. The aquatic isopods and amphipods typically occur in cold flowing water. The terrestrial isopods are the pill-bugs or rolly-pollies (Armadillidum) and sowbugs (Oniscus, Porcellio and Porcellionides).

Among the decapod crustaceans, the small freshwater shrimp (Palaemonetes) are sometimes used as live fishbait, but the crawfish (crayfish) are far more familiar as food or bait, and much more widely distributed in the region. Most roadside ditches with standing water, as well as ponds and streams, have a crawfish population, and lowland fields with the water table near the surface often contain many mud chimneys of burrowers such as Cambarus diogenes. These and other burrowers can be a nuisance to local farmers. But on a positive note crayfish often constitute a significant portion of the diet of fish and of certain birds and mammals, such as raccoons.

All spiders (Pages 9,10) are predators upon small invertebrates, chiefly insects. With few exceptions, they might be considered beneficial, since most of their victims are insects we might call pests. Mimetids are among the exceptions, since they prey upon other spiders, and some might classify our dangerously venomous species as liabilities, since they are potential hazards. Of these venomous species we have two: Loxosceles reclusa, the fiddleback or brown recluse, and Latrodectus mactans, the black widow. Both are common around human habitations as well as in the wild, and both are certainly far more generally distributed than one might gather from the table. As with most of the tables, the recorded distribution reflects not so much the actual range of the species as the localities in which collectors happen to work. In an over-all assessment, the spiders are abundant and constitute major allies in the human contest with insects.

The recorded distribution of the other arachnids (Pages 9, 10, 11) is even less representative of their actual range than is true of the spiders. For example, the phalangids are relatively abundant and diverse in McCurtain County, though no species is recorded. Phalangids feed chiefly on small invertebrates, but play a far less significant role than do the ubiquitous spiders. They are most common in humid places. Psedoscorpions are also rather small, but can feed upon a variety of soft-bodied invertebrates. Perhaps they are significant predators, however, only upon such ectoparasites as lices and mites in the nests of birds and small mammals. Comments upon the mites and ticks are included in Attachment #14. Some of them are of considerable importance as pests in this region.

The recorded list of millipedes is as incomplete as that of the centipedes. Millipedes are common--often abundant--in the forests, especially of the more humid eastern counties. Most feed upon decaying plant matter, but some eat leaves. None in this region appear to be of appreciable significance. The list of millipedes reported from caves (Page 11) is more complete than the previous list, but does not include forms yet to be described, which have been sent to specialists for determination and description.

Some organisms important as fish food are discussed. Mayflies are of considerable importance in freshwater food chains, often constituting major food sources for fish. No thorough study of the group has been published for this area, but every county probably has at least several genera.

Some such as Hexagenia, become tremendously abundant in impounded waters. A study of the stoneflies of Oklahoma has been underway, but results have not yet been published. A small fraction of the species inhabiting the region are listed. Stonefly naiads, dragonfly and damselfly larvae, Hellgrammites (Page 11) and caddisflies are prominent and abundant in the fast-flowing streams of the eastern counties and are significant as fish food.

Another group of invertebrates eaten by fish include the Odonata (Pages 12, 13) which have been more throughly studied than most other aquatic insects in the state. The list of species is probably relatively complete, though the ranges of most species within the region are greater than shown. Among both dragonflies and damselflies, some of the widely distributed species are of considerable importance. The naiads are eaten by fishes. Both as naiads and as adults the fishes consume quantities of other insects, including such undesirable forms as mosquitoes.

The list of grasshopper (Page 14) and the long horned grasshoppers (Page 15) are based primarily upon pasture-dwelling species of the counties near the middle of the state. Because of their numbers and the fact that they compete for food with domestic grazing animals, grasshoppers are ecologically significant throughout the region. They also serve as food for many birds and other animals. The praying mantis (Page 15) is common and ecologically significant in checking populations of undesirable species such as grasshoppers.

The imported or exotic cockroaches are by far most important to man. All those shown in Attachment #14 are pests in homes and other buildings. The native species, which occur in leaf litter or decaying logs or beneath rocks, are widespread and of little ecological significance. Of the crickets (Page 15), the common field cricket, <u>Acheta</u> <u>assimilis</u>, is the most abundant and important.

A number of insects live on plant juices and are of economic importance. This group includes: aphids; locusts which cause considerable damage to deciduous trees; scale insects; tree-hoppers which are sap-feeders that cause direct injury or indirect injury by inducing a virus or bacteria into the plant; coreids, lygaeids, stilt bugs, stink bugs, red bugs and stainers (Page 17).

The reduvioid bugs (Page 18) are almost all predators upon other insects, and thus beneficial to man. Many are capable of inflicting painful bites if handled. The whell bug, Arilus cristatus, is probably best known for such bites. Some, like the thread-legged bug, Emesaya brevipennis, commonly feed upon such human allies as small spiders, so their claim as benefactors might be dubious. Some are not beneficial. For example, Triatoma sanguisuga feeds upon mammalian blood, rather than that of insects, and serves as vector of the trypanosome protozoans which cause Chagas' disease. As yet, this disease has posed no threat in Oklahoma. Other predatory beetles include: the carabid; long-horned beetles, which bore into wood and may be economically important; leaf beetles which are primarily leaf eaters; and the tiger beetles, which are so common that they play an appreciable role ecologically; (Pages 19, 20). Other species include the languriid beetles (Page 20) and the scarabs (Page 20) which are very common.

The riffles beetles and water penny beetles (Page 20) are common in fast-flowing streams, where they either graze upon the unicellular algae that coat the rocks and pebbles or consume waterlogged wood. Their chief importance lies not in what they eat or by what they are eating, but in the fact that many of them can be used as rather sensitive indicators of water quality. Since they are confined to flowing streams, they are of no help in evaluating the quality of impounded water. With the elimination of riffle habitats by construction of dams, as well as with the increase of pollution, the numbers and distribution of these beetles are being greatly reduced.

Of the remaining groups of aquatic and shore-dwelling beetles (Page 20) whirligig beetles (gyrinids), along with the predatory larvae of the water scavenger beetles (hydrophilids), are probably most significant to man because they are abundant and feed upon other small animals --including such pests as mosquitoes (as larvae).

The only family for which any sort of check list or distributional data has been published is the Family Arctiidae (Page 20), which includes the tiger moths and salt marsh caterpillar (Estigmene acrea). Included here are butterflies and moths which are common to abundant.

The aquatic dipterans (Page 21) represent many families. Only the larvae are aquatic. Some, such as the blackflies (Simulium), are characteristic of flowing streams, while others, such as the phantom midges (Chaoborus), occur in lakes or ponds. The adults of Chaoborus are harmless; the larvae being useful in destroying mosquito larvae. These larvae, along with those of the abundant midges (e.g., Tendipes), are important as fish food in lakes and ponds. On the other hand, adults of Simulium, Culicoides (biting midges), Chrysops (deerflies), Tabanus (horseflies), and the various mosquitoes are common and unwelcome pests.

Mosquitoes, of course, are of major importance. Attachment #14 indicates the distribution and relative importance of the species of mosquitoes reported for the region prior to 1952. Construction of impoundments or other devices that impede stream flow provide breeding places for many species of mosquitoes, some of which are disease vectors. It is important from the standpoint of public health that this factor be taken into account.

There are many other families of flies in the region, some present in great numbers. A few of economic importance include such widespread pests as screw-worm flies, stableflies, and houseflies. The only group for which a distributional check list has been published is one subfamily of the robberflies (Page 22). These flies are predatory upon other insects, and probably assist to a minor extent in keeping their numbers in check, though a few are unwelcome in that they may prey upon desirable insects such as honeybees.

Attachment #14 is believed to inadequately represent the hymenopterans (bees and wasps) of the region; however, nothing better is avaiable. Honeybees and bumblebees could certainly be added, as well as many others, to the list, and the list is probably minimal for every county in the region. On the whole, these hymenopterans are very helpful to man. The vast majority of the species listed are parasitic upon other insects--chiefly upon immature stages--and they play a major role in checking the numbers of many potential pests.

For groups not covered by any of the accompanying tables, appropriate data are not presently available. Enough information is incorporated in the tables, however, to provide a useful--if not an adequate--assessment of the invertebrates of the region.

C. Ecological Interrelationships

As in any action involving physical disturbance of a natural environment, coal mining and processing operations will produce chain effects on both the micro-and macro-ecological interrelationships such as nutrient cycles, hydrological cycles, (See

Figure 9), energy flows (See Figures 10 and 11) and overall community relationships. Specific impacts will vary greatly with the intensity of the operation. Basic to all requirements for animals is the need for energy. Thus, a satisfactory combination of food for growth, maintenance and reproduction must provide all of these essentials, in proper balance. Surface conditions have the most significant impact on ecological interrelationships as will be discussed under the Impacts Section.

Ecosystems of the coal bearing region, both aquatic and terrestrial, are very complex. The most diverse populations of wildlife with the most complex interrelationships thrive within the aquatic areas.

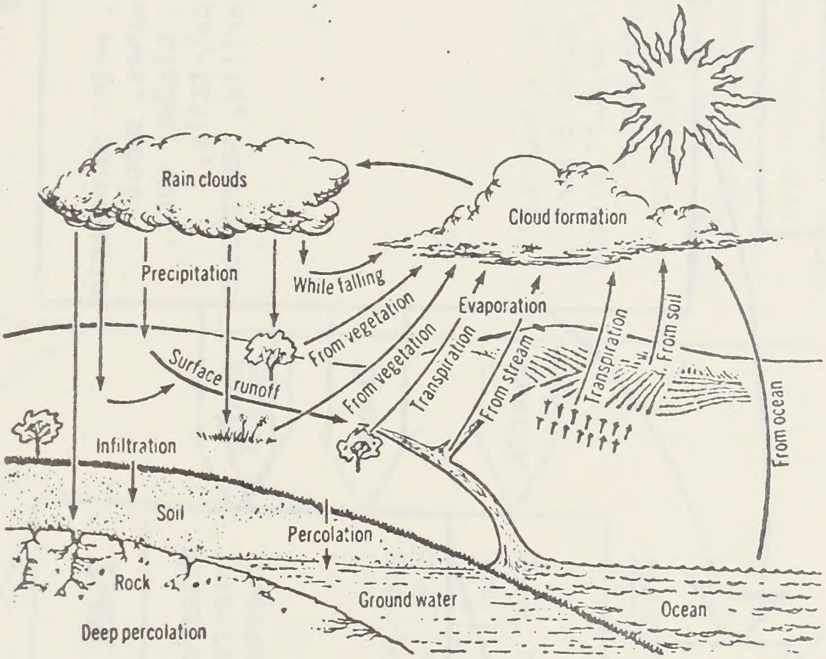
In the ecosystem of the subject area, there are four basic energy levels which include: nutrient sources, producers, consumers and decomposers.

Energy is transferred from one level to the next by the plants using water, minerals and sunlight to grow; by animals eating plants and animals. The amount of energy transferred decreases from one level to the next as each level uses energy for growth and respiration. The energy used at one level is not transferred, but lost to the next level.

Plants, insects, animals and birds all return to the energy source through the decomposers. All levels will return waste and dead organic matter to the land. Decomposers (bugs, worms, larvae) break down the dead matter into simple substances. This is then returned to the energy source and made available for reuse. Each plant, plant eater or meat eater is dependent upon the energy level preceding it for the special food, water, and cover required by each species. The removal of any component (insect, plant, or animal) results in a loss, to the next level, of the energy contained in that organism. As a result, a population may diminish through a decrease in food supply. The ecosystem can be altered by removal of vegetation, rock ledges, etc. The affected areas become uninhabitable to existing species so other plants, animals, etc., move into the area to replace them. Sometimes the replacement population is desirable or undesirable depending upon the value placed upon the existing situation. Therefore, surface disturbance can obliterate historic sites, decrease environmental qualities, and advance or retard natural succession by many thousands of years.

Water moves through an ecosystem in a different way than nutrients. This movement of water from the ocean to atmosphere to land and back to the ocean is known as the hydrologic cycle.

Figure 9



Diagrammatic representation of the hydrologic cycle6/

Figure. 10

AQUATIC - ECOLOGICAL INTERRELATIONSHIPS

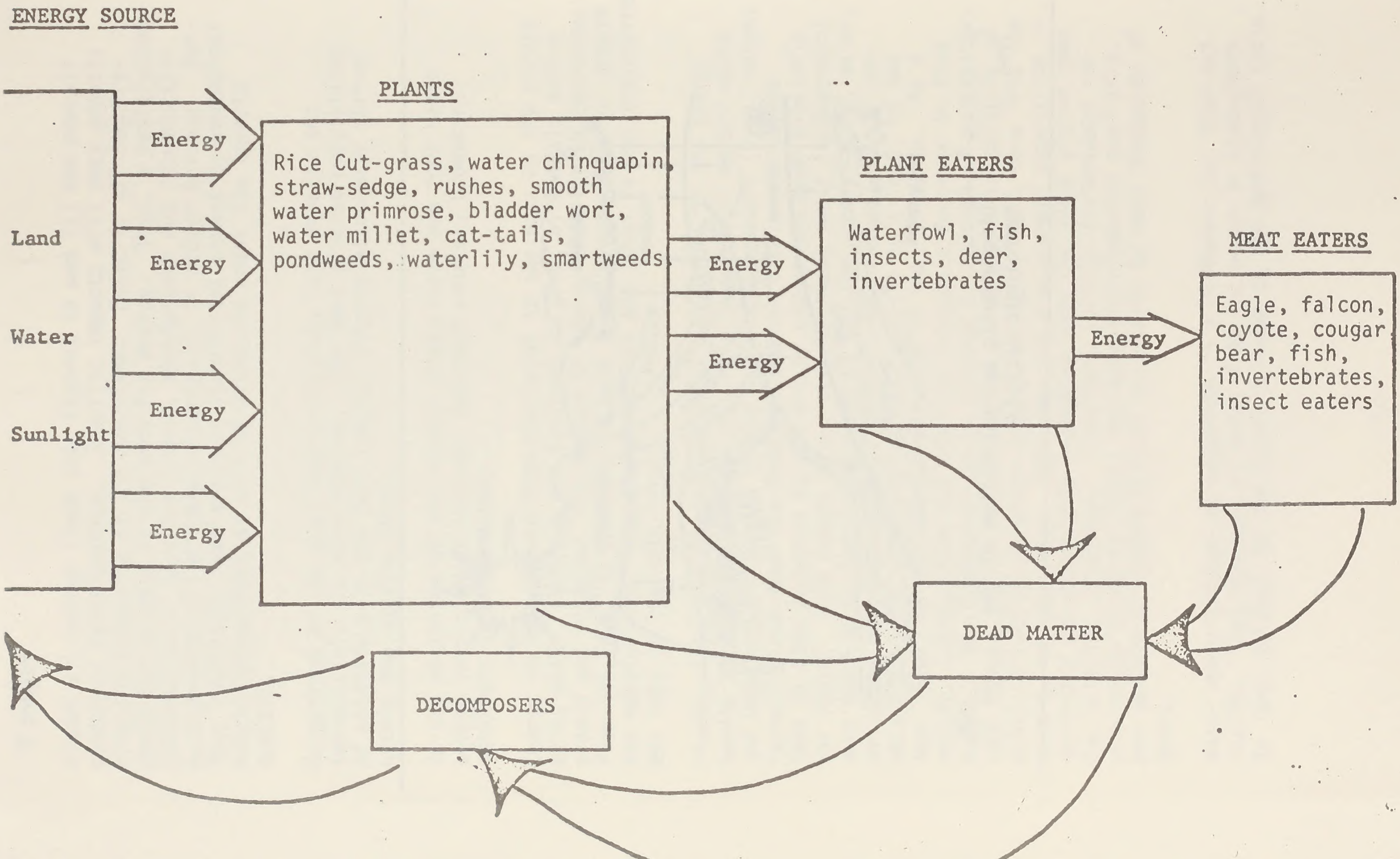
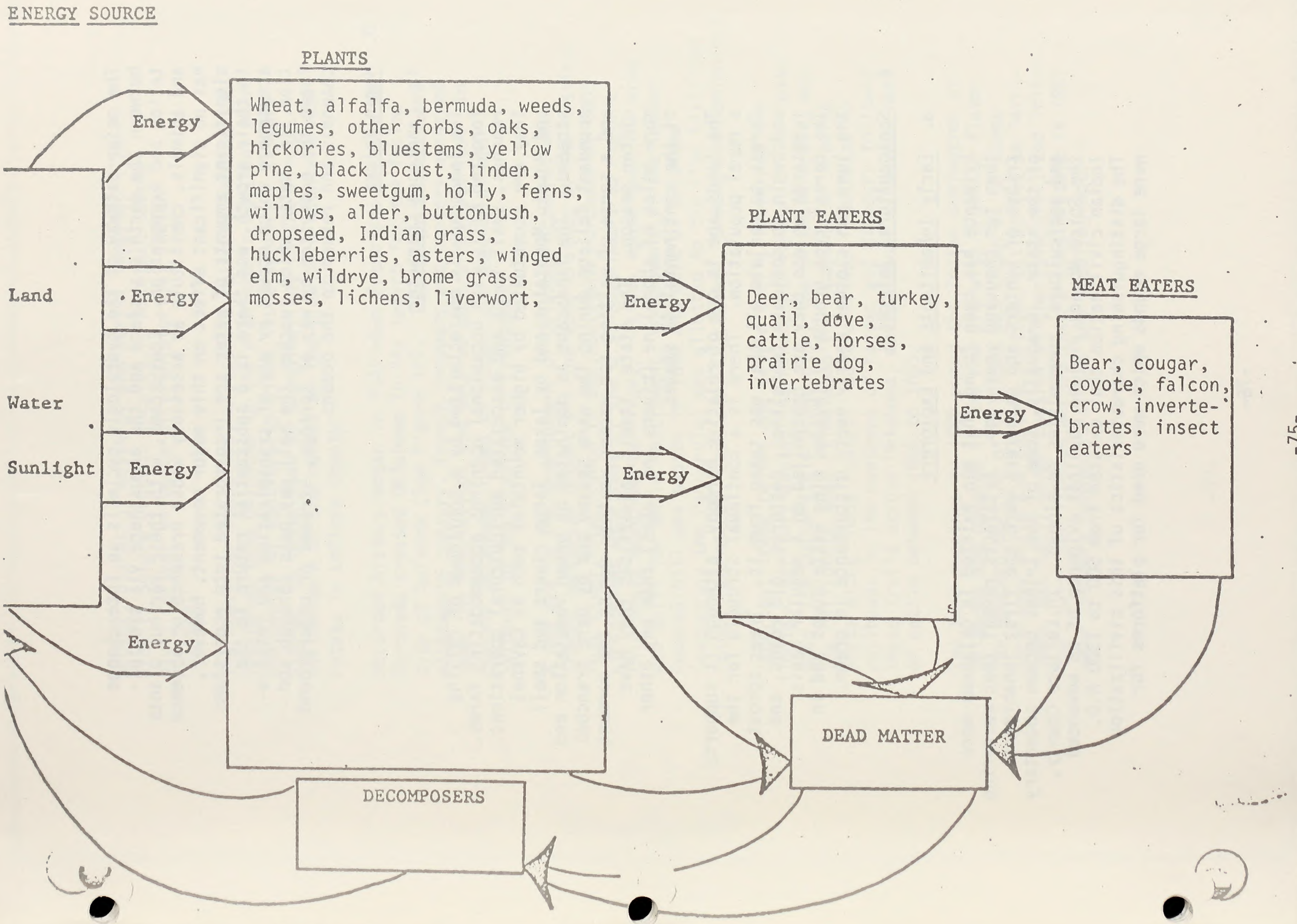


Figure 11

TERRESTRIAL - ECOLOGICAL INTERRELATIONSHIPS



The major pathway of the hydrologic cycle is an interchange between the earth's surface and the atmosphere via precipitation and evaporation. Ecosystems, with their various plants and animals, constitute an accessory whose presence or absence has no significant effect on this major movement; however, significant amounts of water are incorporated into ecosystems in their growth, and there is a substantial return to the atmosphere which occurs by way of transpiration and respiration.11/ Water which reaches the soil may pass through and leave the ecosystem by way of springs, streams or underground channels and return to the oceans.

D. Human Values

1. Landscape Character

The landscape is characterized by a continuum of rolling forested hills with occasional openings accommodating farms, ranches, small towns and associated agricultural operations. They are accentuated by higher mountains such as Cavanal and Poteau Mountains and by lakes, large rivers and small streams. The landscape is dominated by green vegetation and abundant foliage during the warm season and by bare branches and a sense of waiting for warmer weather during the dormant winter season. The state, itself, advertises they have more miles of shoreline (rivers and lakes) than any other of the continental 48 states.

The landscape is one of relative harmony, although it supports a rural population. There is a continual struggle for the forest to reclaim all that was taken from it. Trees sprout and begin to dominate fencelines, pastures, old roads, and farmlands unless they are controlled on a regular basis. The forest type gradually invades mine waste dumps and in the long run clothes nearly every disturbance in green.

2. Sociocultural Interests

a. Early Inhabitants and Explorers

Evidence has been found that man existed in Oklahoma more than ten thousand years ago. Artifacts reveal that wandering tribes of hunters and gatherers were the first inhabitants of the state. Gradually, some of the tribes became sedentary and agricultural communities developed. In LeFlore County, the Spiro Mounds yielded physical evidence of an advanced Indian civilization that existed from 500 to 1300 A.D. The distinguishing characteristics of this civilization were large mounds which were used for platforms for houses, places of worship, and burial temples. The Hichiti Square Ground, located in McIntosh County, gives further evidence of prehistorical Indian Culture.

The Heaverner Runestone, a possible relic of Sandinavian incursion into Oklahoma in the prehistoric age, has been the center of controversy since its discovery. Letters similar to those used by Scandinavians in the first millenium A.D. are carved on the side of a mountain near Poteau in LeFlore County.

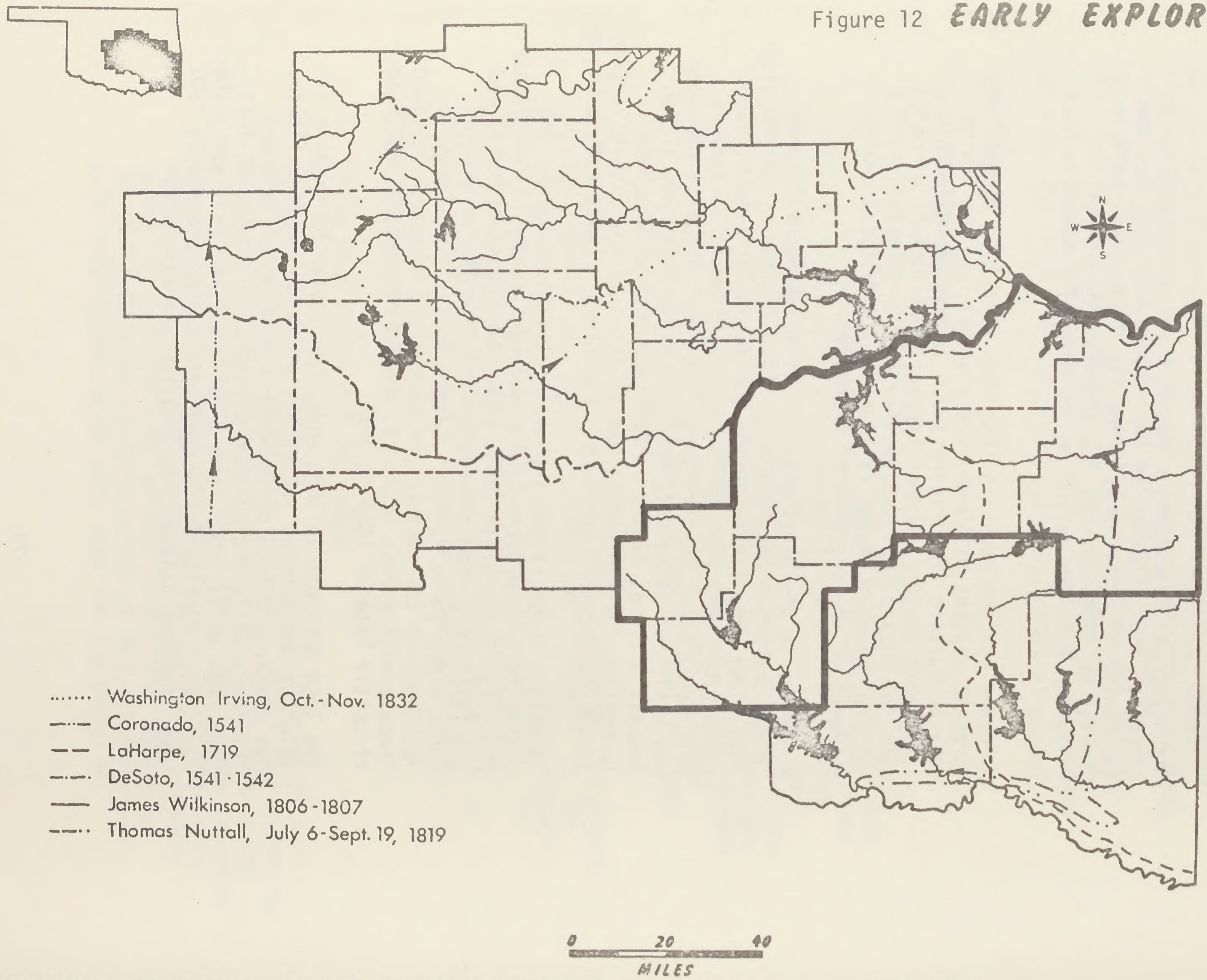
Recorded history began in 1541 when Francisco Vasquez de Coronado crossed Oklahoma in his search for the fabled city of Quivera (See Figure 12). In the seventeenth and eighteenth century, French trappers and hunters wandered down the Mississippi and settled on its tributaries. In Eastern Oklahoma, names of rivers and mountains bear evidence of the presence of Frenchmen.

A new era in the development of Oklahoma occurred when Thomas Jefferson bought all the land drained by the Mississippi River from France in the Louisiana Purchase of 1803. Expeditions were sent by the U.S. Government to explore this newly acquired territory. It was found that the area was unfit for white settlement, consequently, the Indian Removal Bill was passed in 1830 and most of Oklahoma (excepting the Panhandle) was allotted to the Five Civilized Tribes (Cherokees, Choctaws, Chickasaws, Creeks and Seminoles).

Important trade routes and cattle trails traversed the Indian Territory during the nineteenth century. The Texas Road, the Butterfield Stage Line, the Chisholm Trail, and the California Road stimulated the founding of trading posts along these routes. Cattle drives from Texas to railheads in the cowtowns of Kansas and Missouri followed these trails across Oklahoma, moving about 6,000,000 head of cattle between 1866 to 1885.

The land openings in 1889 ended the Indian Domination of Oklahoma and ushered in the new era with frontier flavor. The western portion of Oklahoma was known as Oklahoma Territory while the eastern portion, called Indian Territory, was still under control of the Five Civilized Tribes. The "twin" territories merged into a single state in 1907 when Theodore Roosevelt signed the Enabling Act.

Figure 12 **EARLY EXPLORERS**5/



Numerous historic sites exists in the area (See Figure #13). Those sites on or within one mile of the Federal Coal Reserve are shown on Table 8.

b. Archaeology

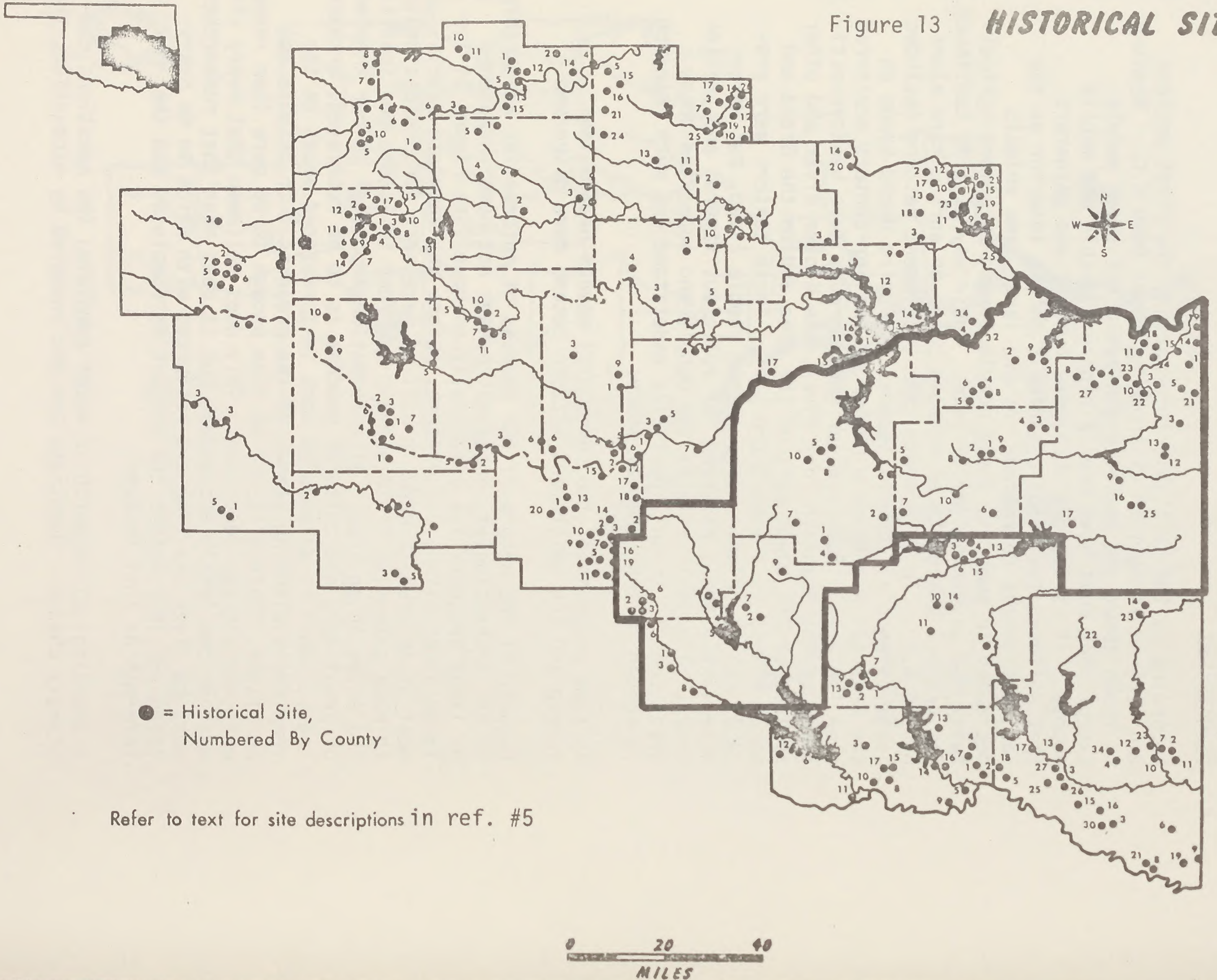
According to the available information, the first ancient men arrived in eastern Oklahoma by about 9000 B.C.. Nothing is known about the social organization of these people except they must have been a highly flexible and mobile people. It is thought they were hunters and gatherers that followed the herds of animals to the interior as the last ice sheets retreated. As the large game animals decreased in numbers, these people turned to a more agricultural and gathering way of life. Their way of life continued its gradual change to an economy based on agriculture alone by 900 A.D.. In this state, the settlement pattern included large ceremonial centers such as the Spiro Mound Group on the Arkansas River and a number of smaller centers scattered over the area. Such smaller mound groups have been investigated on the Mountain Fork River, the Glover River and other systems in the south part of the area and on the Grand and other rivers in the northern part. These centers were probably not the places where common people lived, but were more likely areas reserved for religious figures and aristocracy. The daily life of the people who supported these great centers is only partially understood and much research is needed in that area of study.

As time progressed, the ceremonial mounds became less common and the settlement pattern became more dispersed.

Because of the nature of the sources of information accessible to the archaeologist, areas which have not been threatened by large projects are essentially unknown (See Figure 14 for location of sites). Therefore, before any accurate assessment of an area is made it will be necessary for professionals to make extensive field surveys in order to locate and identify the sites in an area. If information important to our knowledge of prehistory and cultural process is to be retrieved, archaeologists must be allowed to work in threatened areas in the very early planning stages of the projects. If this is not permitted, there will not be time enough to do more than repeat what has already been done. This does not mean that every site must be completely excavated, but it does mean that researchers must be given the time and resources with which to do everything possible before the project is completed and the information lost forever.

Archaeological research is never complete; the questions constantly change. Questions are not answered by excavation, they

Figure 13 **HISTORICAL SITES**5/



● = Historical Site,
Numbered By County

Refer to text for site descriptions in ref. #5

Table 8

Historic Sites On Or Within One Mile of the Federal Coal Reserves

oka County

Choctaw Courthouse - In Atoka

Coal County

Chief Ben Smallwood Homeplace - West of Lehigh
Hurley Birthplace - West of Lehigh on Smallwood farm
Lehigh Field - At Midway

Haskell County

Camp Pike - ?
Cooper Creek - ?
Iron Bridge - 3 miles SW of Keota on San Bois Creek
✱McCurtain Home - 4 miles east, 1 mile north of Kinta
McKee King Grave - ½ mile south of Kinta
Old Trail (Trail of Seminoles from Florida in 1835) - Traces near McKee King Burial plot, South side of ridge ½ mi S. of Kinta.
Pleasant Bluff - Sec 28, T11N, R22 E
San Bois County Courthouse & Jail - Next to McCurtain home
San Bois Creek Engagement - ?

Latimer County

Choctaw Nation Courthouse - 21 T5E R 20 N
Civil War Confederate Camp - Graves about 1 mile east of Panola
✱Edward's Store - 15 T6N R 22E, near north section line
✱McLaughlin Mound - State Archeological survey
✱Riddle Station - 12 T5N R19E

LeFlore County

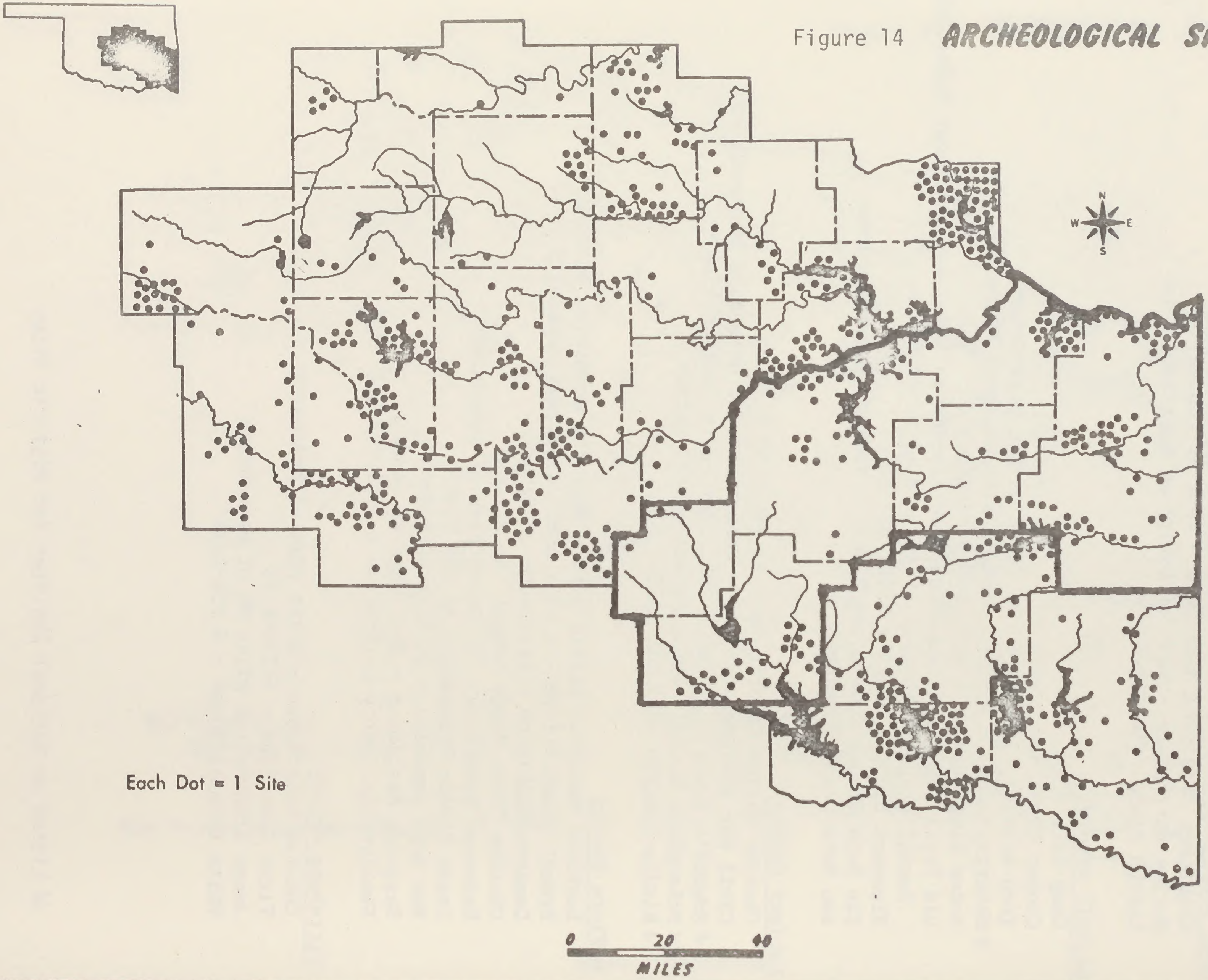
Backbone Mountain Battle Site -"Near the mountain, on road"
Brazil Creek Bridge - ½ mile north of Brazil community
Cameron Institute - East edge of Cameron
Choctaw "Pine Ridge School" at Milton
Heavener Runestone - in State Park of same name
Jesse Riddle Tollgate - 31 T9N R26E
New Hope Seminary - 2½ East of Spiro
Reynolds Residence - East edge of Caneron
Skullyville County Courthouse & Jail - 7 T8N R25E

Pittsburg County

Choctaw Courthouse - North Edge of McAlester
First Coal Mine - 4-T5N-R14E
Jones Academy - 2 miles NE of Hartshorne
White Chimney House - 8 T5N-R12E

✱ Listed on National Register for Historic Sites

Figure 14 **ARCHEOLOGICAL SITES**5/



are posed. The destruction of an archaeological site is like the burning of the last copy of a book. Once it is done the information is lost forever. Although the material recovered is still available, data recovered to answer one question may not be applicable to another, and there is always information in a site which is not recovered, no matter how extensive the excavation. For example, it is not always the practice to collect soil samples from each level dug in a square, or from different areas of stratigraphic deposits since storage of the samples and funding of soil analyses are problems.

If this information is needed to answer future questions and the site has been completely excavated, the information is gone.

Archaeologists live with the idea that they are destroying their sources of information. It is for this reason that investigations by many salvage operations are purposefully not complete excavation but only testing. An effort should be made to avoid disturbance of archeological sites. Refer to reference 5 for a list of known archeological sites in the area.

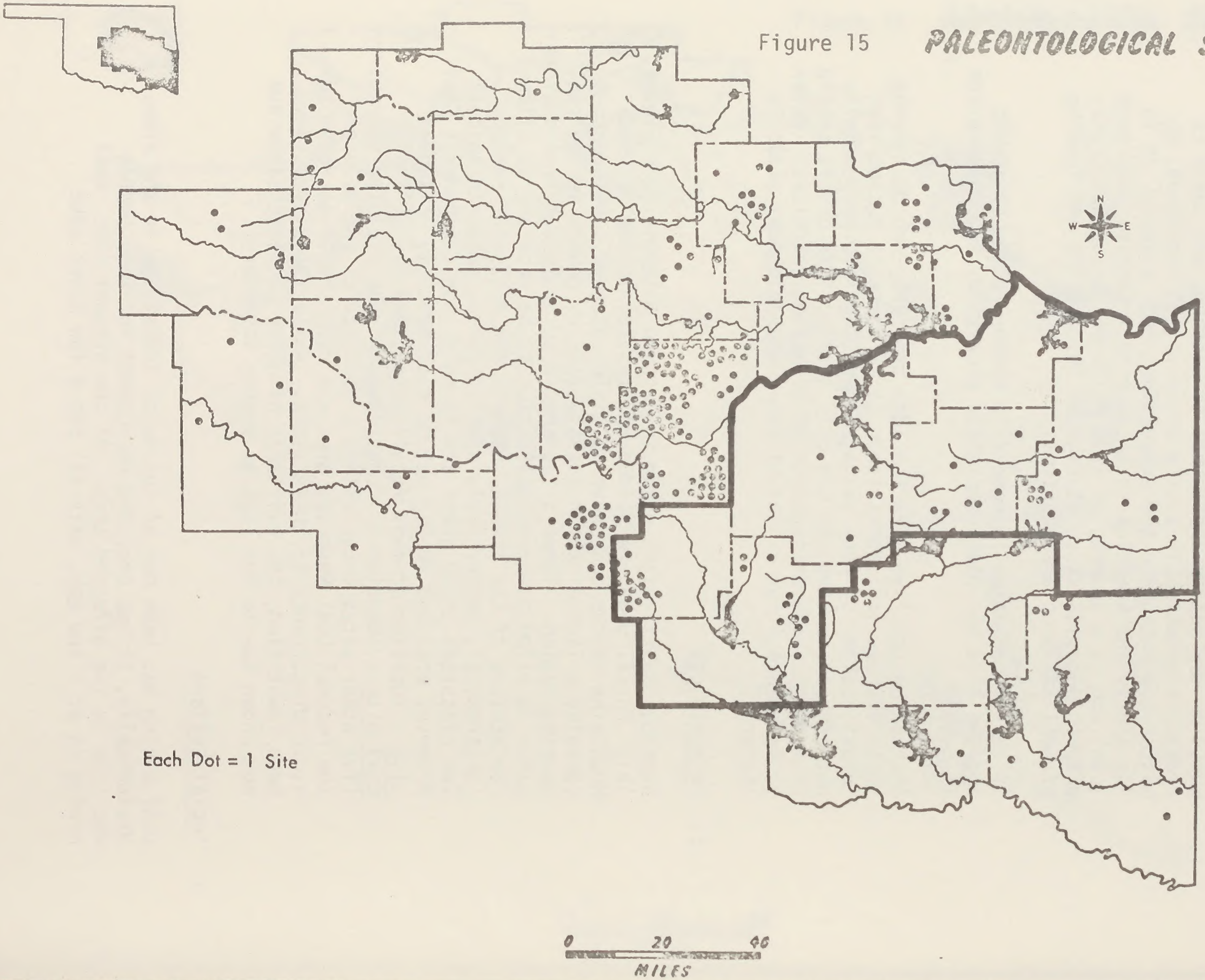
c. Paleontology

Numerous fossil sites occur in eastern Oklahoma (See Figure 15). Fossil beds are folded and faulted in the Ouachita Mountains so the beds have multiple outcrops. Reference 5 contains a list of known fossil sites by county in the coal bearing region. These sites should be protected from disturbance to allow adequate collection to be made and to allow for restudy of the area by experts for different reasons (geochemical, geophysical, stratigraphic, paleontologic). Two classical study areas are found within the Federal Coal Reserves area and should not be destroyed (1) whitehead site - location of many fossilspores, and (2) McAlester Coal Site - location of Pennsylvanian rock yielding spores. Five other sites occur within a distance of one mile of the Federal Coal Reserves area and care should be taken to avoid disturbance of these sites. While these sites have been identified, the existance of other possible sites are not known due to the lack of proper inventory.

3. Social Welfare

Coal mining has been one of the major industries in the area. Historically, it has provided employment for many people who live in the affected area. At the present time, coal mining is at a low ebb, with all but a few mines shut

Figure 15 **PALEONTOLOGICAL SITES** 5/



down. There are expectations in this area that more mines will reopen as the result of the energy crisis and higher prices for coal. Since the economic welfare of a considerable number of local people is either directly or indirectly affected by coal mining, a positive attitude toward coal mining is evident in the area.

However, due to the destructive after affects left by old mining operations, the generally positive attitude breaks down when a land owner becomes aware of plans to mine his land. Because of the drastic effects on owners of the surface of mined lands, their attitudes are generally very negative.

IV. Analysis of the Proposed Action

A. Environmental Impacts

1. Anticipated Impacts

The impacts of leasing coal reserves for development are many and varied. For the purpose of this Environmental Analysis Record it must be assumed that each lease will be mined. This document should be consulted for detail in assessment of the general environmental impacts of all phases of coal mining. This includes (a) prospecting permit, (b) strip mining, (c) underground mining including both new mines and the re-entry of old mines should the economic conditions be favorable, and (d) the processing of the coal removed from these mines. The anticipated impacts associated with each phase is discussed below.

a. Non-Living Components

(1) Air

(a) Prospecting Permits

Activities resulting from the issuance of prospecting permits will involve some air flow disturbances. The type of roads involved in access for drilling will, in most cases, require very little clearing of vegetation. Prospecting crews, for ease in conducting their drilling operations, will use existing trails or roads for travel. Only when their drill pattern requires core samples from specific areas where there are no existing routes, will removal of vegetation occur. Should this removal occur in dense vegetation, a nominal affect on air movement patterns may result. Similarly, the impact on air temperatures will be insignificant unless removal of vegetation occurs in dense areas. Such removal will result in the reduction of ground cover, allowing surface temperatures to increase during the day and decrease during the night. Through conduction of heat to the air layers above the ground, local air temperatures could be affected. Dust and particulate matter from construction and use of roads, drilling operations and restoration activities will be blown into the air in minor amounts.

Restoration of disturbed areas will result in negligible impacts on the environment. Temporary dust problems may arise when restoration procedures are taking place.

(b) Strip Mining

Minor disturbances on air movements will result from construction of access routes (roads and railroads) and site preparation for operation facilities associated with strip mining. However, the removal of vegetation and overburden in conjunction with actual stripping will increase this disturbance. Local air patterns will be altered if a forest-type vegetation of sizeable acreage is removed for the strip site. Spoil piles within these cleared areas will create a "windrow" affect, disrupting the laminar flow of air across the landscape.

Removal of vegetation, leaving the surface devoid of ground cover, will increase local air temperatures over the entire strip mine site during the day and decrease them during the night. The dark color of the overburden removed during stripping will further increase local air temperatures through conduction of heat to lower air layers. Particulate matter from use of roads, site preparation, vegetative removal and restoration activity will be present in the air in moderate amounts within the vicinity of the work area. During operation of the drag line in the removal of overburden, the amount of dust and particulate matter in the air will be excessive. Operation of trucks, drag lines, and heavy equipment because of the comparatively small size of the mining operations will contribute negligible amounts of carbon monoxide and hydrocarbons to the air.

Restoration of the disturbed site may create a temporary dust problem and contribute minute amounts of carbon monoxide and hydrocarbons to the air as the site is redisturbed.

(c) Underground Mining

The affects upon air movement patterns from construction of access routes and site preparation for facilities in conjunction with underground mining will be similar to those associated with strip mining. Surface air temperatures will be affected in the cleared areas around the mine shaft and from coal storage areas and waste dumps. These areas will be of a darker color and void of vegetation, causing an increase in surface air temperatures during the day and a decrease during the night.

On the surface, dust from roads, parking areas, and loading facilities will be blown into the air in moderate amounts. Finely pulverized coal in the storage and loading areas can create a dust problem unless it is controlled. Coal dust resulting from the actual mining process presents serious safety hazards to miners and is usually kept at a low level by using water in conjunction with mining.

During the excavation process, as the coal face is removed, methane gas may be produced. Ventilating systems in the mine force fresh air underground and exhaust methane and other hazardous gases. These gases are expelled into the above-ground atmosphere, but concentrations and volumes should not be great enough to cause adverse impacts. Additions of carbon monoxide and hydrocarbons to the air from trucks and heavy equipment is expected to be minimal. Some particulate matter will be blown into the air during seedbed preparation prior to revegetation.

(d) Coal Processing Plants

The construction of access routes and operation facilities associated with coal processing plants and loading stations, including those on the Arkansas River, will cause minor disturbances on the local air movement patterns. Vegetative removal, coal storage facilities and plant processing units will cause some local wind turbulence, but will have a minimal affect on the overall air flow. Surface air temperatures will be increased during the day and decreased during the night as a result of vegetative removal for construction of the plant and access routes. The dark coloring of the coal storage piles and waste dumps will add to this affect.

In the vicinity of the work area, particulate matter and dust will be blown into the air in relatively moderate amounts from use of roads, construction and operation of the plant, and waste dumps and open coal storage facilities. Processed coal, which is finely pulverized, can create a dust problem if it is not stored in closed facilities. The problem of dust in the air will be present throughout the operation of the plant. Increased levels of carbon monoxide and hydrocarbon concentrations in the air from vehicular traffic in the work area will be negligible. This problem will occur on a very small area at barge loading stations on the Arkansas River. Plant operation may contribute some concentrations to the air from combustion engines within various processing units; however, the addition of carbon monoxide and other hydrocarbons to the air from coal processing itself is unknown, but is expected to be minimal.

During plant salvage and restoration of the disturbed areas, some dust and particulate matter will be blown into the air. Minute amounts of carbon monoxide and hydrocarbons may also be added to the air.

(2) Land

(a) Prospecting Permits

The anticipated actions upon various soil properties resulting from prospecting permits will be adverse, but low in relation to other phases of coal mining. Some alterations in the soil structure will occur from construction and use of roads and in the preparation for drilling core samples. Soil erosion will be generated from soil compaction associated with the above activities, and will be of greater magnitude should the disturbance occur in rough terrain. Depending upon the type of drilling mud used, soil nutrients or pollutants could be affected.

Some types of drilling mud contain nutrient materials that can increase soil productivity.

No significant adverse impacts on the geologic structure from core drilling are anticipated.

It is possible that coal exploration could conflict with farming, ranching, wildlife, recreational and urban uses of the land. Fences, cattleguards and other surface improvements may be damaged through prospecting and construction of access roads and drill sites. Prospecting crews most often will use existing roads or trails that are a reasonable distance from where core samples are to be taken. However, if no convenient useable access routes are available, then new access must be constructed. Consequently, fences may have to be cut or lowered to allow for passage of equipment. Normally the fences, or other range improvements, are replaced in good condition. Exceptions, though, could cause considerable hardship and loss to other land users.

In areas where federal coal reserves are present in or under towns or communities, conflicts with urban, commercial and industrial uses of the land are anticipated. Access to drilling sites and actual drilling may not be compatible with nearby land owners. Noise pollution and debris on the site while core drilling is in progress may disrupt the natural setting and conditions of the area. These impacts will also be associated with existing coal leases which include coal reserves in or under towns or communities.

In most cases, intended use of the site will be of a short-term nature, normally two or three days. During this time, compatibility with wildlife, recreational or urban uses would result in conflict. Wildlife habitat will be disturbed during construction of access and drill sites, and noise pollution as a result of drilling will not be compatible with urban or recreational uses. However, these adverse affects are of short duration.

Erosion of replaced topsoil on restored sites could occur should sufficient precipitation cause runoff prior to establishment of a ground cover. Other adverse impacts from restoration procedures are not anticipated.

Certain benefits are also derived which should not be overlooked. In areas having dense vegetative cover (hardwood trees, shrubs or grasslands) where vegetation is removed for exploratory holes, edges and voids favorable to some wildlife species are created.

(b) <u>Strip Mining</u>

During the development and operation of a strip mine, drastic disturbance of the land surface is involved. The construction of access routes and preparation for operation facilities usually requires cut and fill operations which will result in loss of vegetation and exposure of mineral soil to wind and water erosion. The steep slopes of cut banks and the loose soils in fills are highly susceptible to erosion. Rearrangement of the soil depth and compaction will alter the productive capabilities of the soil in the disturbed areas. This redistribution of soil over the site could also affect its nutrient level. The use of herbicides along railroads and roads for vegetation control will add pollutants to the soil.

Removal of the vegetative cover on the mining site will leave the ground surface bare, allowing overland flow of water on the surface with little percolation or water take up occurring. The presence of spoil piles will accelerate this flow, loosening soil particles and transporting them downgrade. Often, the strip pit will accumulate water from precipitation or ground sources. This water is usually pumped out onto the ground or into natural drainages which may increase the erosion process in these areas. Acid pollution from weathering of spoil piles and the pumping of water from the strip pit onto the ground originates from the chemical reaction of water with sulfur bearing rock strata and shales.

Drastic impacts upon the geologic structure on the site will result from the removal of both overburden and coal. Rearrangement of the geologic structure occurs from overburden removal and its replacement into the strip pits during restoration processes. The coal resource for commercial and industrial uses is removed from the geologic formation entirely and cannot be replaced.

Here again no adverse impacts are anticipated from restoration procedures except for some soil erosion occurring. The area of disturbance in strip mining is much larger than that involved in prospecting permits. Should sufficient precipitation fall on the unprotected topsoil prior to establishment of ground cover, soil erosion may result.

The site, once occupied by access routes, operation facilities and strip mining, will be devoted exclusively to mining coal. Other uses of the impacted land will not be compatible.

(c) Underground Mining

The development of an underground mine involves both surface and subsurface disturbances. Access routes, buildings, headframes, coal storage and loading facilities, waste dumps, etc., must be constructed on the surface. Road construction and building site preparations involves grading and leveling that will alter the soil depth and cause compaction of the soil surface as well as loss of vegetation. The exposure of loose mineral soil to the forces of wind and water will render the soil susceptible to erosion. Waste material from construction of mine shafts, drifts and tunnels will be transferred to a mine waste dump in the vicinity of the operation. This dump may have steep slopes which are susceptible to erosion and increase the velocity of surface runoff. Coal storage piles could produce the same erosional affects.

The preparation of the site for buildings and operation facilities may lower the nutrient level of the upper soil horizon as a result of redistribution of the soil surface and removal of the vegetative cover. Weathering of waste dumps and indiscriminate dropping of coal on the surface generated from development of the mine could add pollutants such as pyrites or acids to the soil.

It is possible that eventual surface subsidence may occur if the mined area caves in. As a result significant problems may arise in areas of towns, communities, lakes, ponds, rivers and other areas where there is a surface oriented activity generated by man. Most coal beds have a down dip that results in the coal being mined at such depths that surface subsidence may occur only near the outcrop.

During restoration activities, similar erosional impacts can occur as discussed in the preceding prospecting permit and strip mining sections. No other adverse impacts from these actions should occur.

Development sites associated with underground mining activities will not be compatible with other uses of the land while the mining operation is in progress. The site will be used only for underground mining. The impacts upon the surface land will not be as great as those associated with strip mining; but the impacts will be present during a longer period of time. Underground mines are located in one place for several years, consequently, restoration of the site cannot be accomplished until the mine is closed.

(d) Coal Processing Plants

The development and construction of a coal processing plant will have adverse impacts upon the land surface. Soil depth and structure will be affected by construction of access routes and site preparations for the building of the plant. Compaction and disturbance of the soil profile from grading and leveling will alter its productive capabilities and leave the surface susceptible to erosion. Waste material generated from processing may be transported to a waste dump; the form of which may be waste piles or the filling of a drainage. These waste dumps will contain loose material which is susceptible to erosion by wind or water. Coal storage piles containing finely pulverized coal will also be susceptible to erosional processes. Impurities such as pyrites, which weather to form acidic materials, may be added to the soil profile through weathering of these waste piles and drain into nearby water courses.

Similar to strip and underground mining, the site occupied by the coal processing plant will not be compatible with other uses of the land. The site will be exclusively devoted to coal processing and transportation. Restoration of the site cannot proceed until there is no further need of a coal processing plant in the area. Similar to the prior three actions, erosional processes associated with replacing topsoil on disturbed areas can occur. No other adverse impacts from restoration procedures is anticipated.

(3) Water

(a) Prospecting Permits

Plants in the ecosystem incorporate significant amounts of water in their growth and return a substantial amount to the atmosphere. Their presence and affect, though, on the overall hydrologic cycle is supplemental. The amount of vegetation removed for access routes and drill sites in prospecting actions will have a minimal affect on the overall hydrologic cycle.

Downstream water courses and water bodies may experience a slight increase in sediment load from the disturbed areas. This will probably occur if new access routes must be constructed for drilling in specific areas. However, sediment loads may further be increased and wildlife habitat diminished if construction of roads and drill sites occurs in the proximity of streams or ponds. Surface runoff carrying sediment will not have the opportunity to percolate into the soil profile should this erosion occur close to stream banks or pond edges.

The type of drill mud used in core sampling may contribute additional dissolved solids to aquatic systems. Prospect drilling in this region may encounter underground aquifers. These ground water sources can be contaminated by improper drilling techniques, and transported from one water bearing strata to another. This contamination is usually caused by careless operation or by accident.

The impacts on chemical levels and acid balance of the water from dissolved solids are unknown but are expected to be minimal.

Water temperatures may increase should prospecting operations occur in the vicinity of water courses or ponds. Removal of vegetation for construction of roads or drill sites may involve cutting of trees and shrubs which provide shade for these water bodies. Without shade, direct sunlight will raise the water temperature. Vegetation that extends out over the water surface supports insect life. Many of these insects drop into the water and become a primary source of food for sight-feeding fish. Removal of this bank vegetation reduces a food source.

Restoration activities can cause some slight sedimentation of nearby water courses. Replaced topsoil that is unprotected (prior to establishment of ground cover) is susceptible to erosion and may cause an increase in the sediment load of water bodies. As a result, this may cause an additional affect on water temperature.

(b) Strip Mining

This operation usually involves a considerable amount of vegetative removal for access routes, facilities and mining areas. The effects of such vegetative removal will have negligible impact on the overall hydrologic cycle, but will disrupt the local, on site cycling of water. The affect of this vegetative removal will expose mineral soil to wind and water erosion. In conjunction with soil disturbance, the sediment load and mineral pollution of streams or ponds in the vicinity will be increased. Water passing through and over the minerals in active mine workings, spoil banks, and mine roads produces a chemical reaction which produces substances such as ferric sulfate, ferrous sulfate, ferric hydroxide (coats stream bottoms) and sulfuric acid into these water courses. This waste water produced mostly from low sulfur coals and other sediments can contaminate surface water if pumped out onto the ground or into natural drainages. Acidic mine water may also contaminate aquifers through cracks and fissures. This waste or runoff water collects in ponds, depressions and drainages. This acidic water can dissolve and hold more minerals in solution than can neutral water and thus increase the dissolved solid content. Underground aquifers may be similarly affected from seepage of waste water from the bottom of strip pits. Water nutrient levels may be affected by removal of vegetation and topsoil in proximity of streams or ponds. Water temperatures will increase from vegetative removal in the vicinity of water sources and from the addition of acidic materials.

Water pollution has been the major problem from surface mining. Damage to the quality of surface water results from silt, sediment, chemical and physical alternation. While damages such as vegetative removal and soil disturbance associated with the immediate mining area occur, the effects on water pollution may be apparent many miles from the mining operation.

Replacement of topsoil, as part of the restoration action, can cause moderate affects on sediment loads in water bodies. Until a ground cover is established on the site, the topsoil is unprotected and susceptible to erosional processes. Water temperatures may experience an increase as a result of sedimentation.

(c) Underground Mining

The construction of access routes and site preparations associated with underground mining involves removal of vegetation and grading and leveling of the surface.

The impacts upon the hydrologic cycle from these actions will be similar to those mentioned in the previous section on strip mining preparations.

Water courses and water bodies downstream from disturbed areas may experience an increase in sediment load from eroding materials associated with mine waste dumps and access construction. Eroding waste material may contribute additional dissolved solids to aquatic systems. As pyrites in the waste dump weather and acids are leached and drained into water courses, the acidity of the local streams may increase to a point where whole ecosystems are altered to more acid-tolerant ones.

The underground excavations may encounter water-bearing strata. Depending on the characteristics of the aquifer, excess water may be pumped to the surface and wasted. Mine dewatering may result in drainage of aquifers containing high quality water. Underground mining utilizes large quantities of water to combat coal dust problems and other safety problems. Subsidence of mined areas could increase infiltration rates and create mine drainage problems. The collapse of underground mine workings could cause extensive damage to aquifers.

Similar to those impacts mentioned under strip mining, replacement of topsoil may cause an increase in sediment load in nearby water courses. However, this impact may not be as great because of the limited area disturbed. Again, adverse affects on water temperature may result from sedimentation.

(d) Coal Processing Plants

The impact upon the hydrological cycle as a result of vegetative removal in conjunction with road construction and building site preparation for coal processing plants is similar to those stated in the two previous sections ((b) strip mining, (c) underground mining).

Loose soils resulting from cut and fill operations are susceptible to erosion and could cause sediment problems in nearby streams or ponds. Finely pulverized coal found in coal storage piles can lend minute particles to runoff water adding to sediment loads. Other dissolved solids may be picked up by surface runoff waters and add to the contamination of these water bodies. Weathering of waste dumps can contribute pollutants to the water through acid leaching and drainage. Nutrient levels of streams or ponds may be affected through chemical interaction with dissolved solids.

Waste water used in processing coal is usually kept in settling ponds constructed near the plant. Fine coal particles and other suspended solids in waste water filter to the bottom of these ponds such that relatively clean water can be recycled into processing. Improper construction of these ponds could result in contamination of downstream water courses should spillage occur. Seepage from these ponds into underground water systems could contain contaminants that have settled and damage the quality of water in aquifers. Water tables may be lowered locally depending on the amount of water needed in coal processing (coal beneficiation).

Surface water temperatures could be increased through vegetative removal, eliminating shade affects, and from the addition of pollutants contained in waste water or surface runoff.

Actions associated with restoration of coal processing plants may have similar impacts upon nearby water bodies as discussed in the previous sections on strip and underground mining.

b. Living Components

(1) Plants

(a) Aquatic Plants

As discussed in part III of this Environmental Analysis Record, Description of the Existing Environment (III. B. 1. a.), there are three major types of aquatic plant species. All three types of species occur in a water environment. For this reason, they will not be discussed separately, but as a group, in relation to the environmental impacts upon them. In the previous section on non-living components, the anticipated impacts from the four phases of coal mining on each sub-component were discussed separately. This format will not be followed in this section. The anticipated impacts on the aquatic plant habitat from these four actions are similar in nature and for this reason are discussed below as a group.

The construction of access routes involves surface disturbances such as grading (cutting and filling) which can loosen the soil profile and render it susceptible to erosion. Site preparation for facilities will have a similar affect. Sedimentation of streams and ponds can result from these actions and affect the aquatic plant environment. Sediment added to water bodies may increase the abundance of some aquatic plant species by settling to the bottom and forming a soft silty organic mud. This condition is favorable for establishment and growth of rooted aquatic plants. However, increased levels of sediment found in streams or ponds can reduce the life of these water bodies, eliminating suitable habitat for growth. The quality and quantity of the aquatic plant species found in a particular stream or pond can be affected by the amount of sediment present. Should sufficient quantities of sediment be released into these habitats, the higher species of plants may regress in quantity and lower forms emerge in lesser numbers.

It is likely that small streams and gullies may be present in the area of road construction. If these streams are not bridged, loose material will be pushed into drainages causing adverse impacts upon the aquatic habitat. Bridge construction can also cause some stream sedimentation. Sedimentation will result from the loose material eroding into the water course. A more significant impact will occur in alteration of the water level of the stream, changing the type of habitat present. This could result in destruction of the present plant community or change its composition entirely to those species more suited to the new water level.

Exploratory drilling from issuance of prospecting permits could have some impacts on the aquatic environment. Depending on the type of drill mud used in core sampling, degradation of surface and subsurface water could occur. Surface runoff may include contaminants from drilling mud which could empty into water courses. This may cause a decrease in nutrient levels through chemical interaction. Water-bearing strata encountered during drilling activities may also be contaminated. Should degradation of underground aquifers occur, this could affect the habitat of small lakes or ponds fed by them.

In eastern Oklahoma, most of the aquatic plant communities present are found in streams or ponds with a pH that is circumneutral. Surface runoff or underground water containing acidic materials leached and drained from waste dumps and coal storage piles could lower the pH level of these water bodies. Should this occur, the result would be deterioration of present plant communities to other acid-tolerant ones or eradication of these plant communities altogether.

Stream diversion may occur due to location of mining sites. Stream diversion will seriously affect the aquatic plant habitat and destroy the present aquatic plant community. New habitat characteristics such as water depth, substratum conditions and nutrient levels will be established in the new stream channel. These characteristics will determine whether aquatic plant species will revegetate in the new habitat and of what type and abundance.

Restoration activities associated with any type of coal activity may result in adverse impacts upon aquatic plant habitat. Unprotected topsoil (prior to establishment of ground cover) is susceptible to erosion and could result in an increase in sediment load and water temperature of nearby aquatic systems. Should this occur, changes in the type and distribution of aquatic communities present in the affected area may result.

(b) Terrestrial Plants

Consistent with the previous section, the same format will be used in discussing impacts on terrestrial plants for similar reasons.

Exploratory drilling, development of strip or underground mines, or construction of coal processing plants may not affect the majority of the lease area. However, sites chosen for roads, railroad spurs, drill areas, mine operations facilities, mining areas, storage areas and waste dumps will be altered beyond recognition. Access roads, sites for mine operation facilities, mining areas, coal storage piles and mine waste dumps require that a large area be cleared of vegetation. Site preparation for these areas involves considerable surface disturbance, removal of all vegetation, shaping and rearranging of the soil and landscape. All forms of vegetation from micro-organisms to forest species will be destroyed in the areas used for developing the surface aspects of mining. These organisms, which comprise a very important part of the soil are destroyed when soil is removed and stockpiled, reshaped, compacted, or covered with a surfacing material. In addition to removing vegetation, stripping operations may cover existing vegetation in other areas where the initial strip material is stockpiled.

Undisturbed areas should not be adversely affected and the existing plant communities should continue to perpetuate themselves. Dust blown into the air during the construction and use of various facilities could be a problem. Leaves of remaining vegetation can become caked with particulate matter and affect transpiration and take up of essential gases from the air. If subsidence occurs as the result of underground mining, the vegetative species occupying the subsided area will be disrupted. Acidic conditions could develop from surface runoff and cause deterioration of sites supporting existing vegetation. This problem could also be associated with mine waste dump areas making revegetation difficult to attain. Most species are not tolerant of highly acid soil conditions.

Actions associated with restoration may have a slight affect on remaining vegetation present on the peripheral edges of the disturbed area. Dust blown into the air during restoration activities may become caked on the leaves of the remaining vegetation. This could affect transpiration and takeup of essential gases from the air.

(2) Animals

A full analysis of the impacts related to the proposed actions cannot be made here. Information and inventory is not adequate to analyze all impacts properly and adequately for actions that will be devastating for some wildlife habitats and species. Conspicuously lacking is the information on endangered species that could occur within the report area. Impact on these species can not be fully analyzed in this report.

All species cannot be discussed with respect to species impacts on its particular habitat. Therefore, this section will limit discussion of impacts to endangered species and other wildlife species that are known (from available data) to occur within the report area. It is recognized that there are unknown impacts on many wildlife species and their habitats which for obvious reasons cannot be fully discussed here.

Powerlines are usually associated with most phases of coal mining with the exception of prospecting and exploration. As these powerlines are constructed within the federal coal reserves, these power poles are often used and regarded as favorite perches for the numerous perching birds including eagles, other large birds of prey, herons, cranes and turkeys.

In general, large birds especially predatory birds, select and perch on those poles that give them the best view of the habitat of their quarry. Therefore, the poles selected often are the most elevated poles in areas heavily populated by ground squirrels, other rodents, or near and/or over water and aquatic wildlife.

Certain inherent hazards and problems are associated with these lines. Occasionally, through contact with wiring and fixtures on distribution line poles (usually lines carrying less than 70 kv) birds are electrocuted. Such contact also causes momentary or sustained outage of the powerline. Both of these incidents are undesirable. Reports indicate that the birds are most likely to make contact between energized parts and the ground wire on transformer poles and single and three phase tangent poles.

(a) Aquatic fauna

(1) Prospecting Permits

The issuance of prospecting permits in aquatic areas will have moderate impacts from drill sites, access routes, vegetation and soil disturbance on most aquatic wildlife communities. The effects of some local impacts will include soil compaction and vegetation removal (loss of habitat, burrowing animals, and some micro organisms, and displacement of some species). Other impacts are expected to be small downstream such as displacement of soils and debris, sedimentation of streams, stream substrates, ponds and other waters (in disposition zones), increased turbidity, and elimination of some food organisms.

Impacts will vary from low to moderate on all forms of wildlife depending on the mobility of the species, time of year, amount of disturbance and available habitat. These impacts include destruction of cover, nesting sites, feeding areas, mud burrows and dens, increased water temperatures and acidity, displacement of debris, destruction of stream banks and other sheltered places (used by amphibians, reptiles, fish, and invertebrates).

The impacts from exploration (drill sites and access) may be felt by man as an economic necessity or as a temporary intrusion to his favorite fishing hole or hunting area.

Restoration of the site vegetation naturally as well as seeding will be beneficial. The process should occur rapidly and diminish the overall impacts of the action. Impacts regarding overhanging banks, sediments, food organisms and soil compaction will diminish over a much larger period of time. Impacts resulting from restoration of disturbed sites as in grading, landscaping, top soil replacement may result in some siltation, sedimentation, and pollution from runoff into aquatic and terrestrial habitats.

(2) Strip Mining

These operations disrupt aquatic habitats in the valley bottoms and areas adjacent to low wetlands. While damages such as denuding the land, loss of wildlife habitats, and destruction of soil structure and texture are usually associated with the immediate mining area, the effects of pollution on aquatic habitats may be apparent many miles from the mining operations. Fish and other aquatic wildlife within the stripped area are destroyed. The land that remains after surface mining is not immediately capable of supporting most forms of life. It must go through a weathering period which may take a few years before it becomes suitable habitat for fish and wildlife. The full effects of strip mining are not known to many species, particularly the invertebrate groups, zooplankton, as well as other species.

Changes in ecological successions of plants and animal populations routinely occur with surface mining. With the removal of food, nesting and escape cover the area becomes useless for wildlife as long as this condition persists.

The effects of silt and sediment on aquatic wildlife vary with the species and amount of pollution. These pollutants can kill fish directly, bury spawning beds, reduce production of aquatic organisms, reduce light transmissions, alter temperature gradients, fill in pools, and spread stream flows, etc.

The presence of toxic waste materials in aquatic habitats as a result of pollution and drainage from surface mined areas can impact wildlife by reducing habitat and by causing direct reduction. Lesser concentrations can suppress productivity, growth rate, and reproduction of many aquatic species.

Acids, dilute concentrations of heavy metals, and extreme alkalinity can cause severe wildlife damage in some areas.18/

In situations where the strip mines are planned in or near surface drainage channels, stream diversion, if completed, will completely destroy the aquatic flora and fauna. The stream bed will dry up, some fish will remain to die in isolated pools, aquatic vegetation will wilt and return to organic matter, mud flats will become parched, and aquatic organisms such as frogs, crayfish, may flies, larvae, salamanders, etc., will be destroyed. Returning this streambed to its original condition will take many years.

The new river channel is sterile and lifeless. Excessive streambank erosion and sedimentation may result as the stream tries to return to its original streambed. If the stream returns to the areas of waste coal or carbonaceous shale, surface water could be contaminated, water quality lowered and aquatic habitats downstream altered to more tolerant species or eliminated.

Some species of particular concern to the Oklahoma Game and Fish Commission include the sauger, paddlefish, shovelnose sturgeon and smallmouth bass.

Changes in water quality or habitat would have adverse effects on these species. Other fish such as paddlefish, highfin carpsucker, and skipjack herring have decreased in numbers due to increased turbidity and siltation of breeding areas. However, as the environment degenerates for one species the new conditions will be favorable to more tolerant species such as the alligator gar and shovelnose sturgeon.

Devastating impacts to most reptiles and amphibians will result. Most amphibians and certain reptiles (Attachment 13) are limited to wet lowlands, springs, seeps and other wet areas. If these areas are altered, survival for these species is unlikely. Of particular significance is one reptile, the chicken turtle, which is listed as an endangered species and two amphibians, the alligator snapping turtle and the western glossy water snake (noted as rare in Oklahoma). These species would not survive the habitat alterations of strip mining activities.

Eastern or western movement and species distribution are impaired by strip mining. Wildlife is displaced or restrained from former habitats. Some of the animals that could be affected are: brush mouse, golden mouse, eastern chipmunk, turkey, white-tail deer, swamp rabbit, moles, mink and others. As these animals seek new habitats, overcrowding and further degradation of habitat may result. Endangered species are an exception.

As aquatic habitats are destroyed or altered birds, will seek other areas. These birds include: the cormorant, herons, ducks, kingfishers, cranes, rails and others. Nesting places, feeding sites, food (frogs, crayfish, small mammals, insects, etc.), cover and water quality have been destroyed and offer unsuitable conditions to these birds. Other birds such as the bald eagle, peregrine falcon, the whooping crane, Eskimo curlew, Bachman's warbler, ivory-billed woodpecker are all endangered species. All of these species will be forced out of their present habitat areas and will experience further diminution of habitat. All of these species are tied ecologically to some element of a wet lowland habitat. Birds such as the anhinga, and possibly others exist in habitats that are presently limited. Further degradation of these wetland habitats may cause concern for their existence.

The impacts from restoration processes can cause adverse affects upon aquatic systems and alter the habitats of aquatic animals. Siltation, sedimentation and increases in water temperature may result from erosion of unprotected topsoil and cause a reduction in fish populations and their habitats as well as affect other aquatic animals indirectly.

But some communities lack the facilities to accommodate increases in the labor force and local population. This influx will cause varying pressures on the school systems and public services such as sewage systems, etc. Other impacts include an increase or decrease in recreational fisheries, and possible protection of cultivated fields by levies created by spoil banks.

(3) Underground Mining

The effects of underground coal mining occur both underground and at the surface. The major impacts are a result of mine drainages, waste pile erosion, mine dewatering, subsidence and access.

Water pumped from underground mines or drained, from waste piles, is often acidic and may contain concentrations of trace elements and/or dissolved solids. Water in streams, ponds, swamps, bogs, etc., deteriorates in quality when this mine water reaches these surface waters. Acidity may be neutralized, but concentrations of trace elements may persist over miles of stream, or the discharge water may increase the dissolved solid content of the receiving stream.

Species of mammals, birds, reptiles, amphibians fish and invertebrates would be adversely affected particularly the latter four groups mentioned. (Refer to Attachments #10, 11, 12, 13 and 14 for listing of aquatic forms). These particular impacts have been discussed in the strip-mining section. Some wildlife communities would be destroyed due to the drastic changes in water quality, substrates, vegetation, and food species. The change may only be temporary as in acidic pollution. But as aquatic organisms (fish; invertebrates such as mayflies, caddis flies and protozoa; small mammals; etc.)

move into the area and survive for a few months, they may be destroyed by the first runoff that brings an acid discharge. Some pollutants may be of a more permanent or extended nature which would result in changes of floral and faunal communities depending on the duration and extent of the damage.

Subsidence can have a beneficial or adverse effect on wildlife populations. Changes in surface flows and runoff patterns due to subsidence can alter available moisture or wet situations which can influence plant distribution and wildlife habitat. Lakes, springs, ponds, and marshes capable of supporting various aquatic species can be either created or destroyed. Increased soil erosion from subsidence would adversely affect downstream aquatic habitats subject to sedimentation and siltation. Spawning beds, feeding areas, and pools, could be degraded, and aquatic habitat altered or reduced in productivity.

Habitat will be altered in areas of acidity, dissolved solid and trace element pollution for various species. The tolerance levels of many species is unknown. Generally, however, muskrats (inhabiting pond and stream banks), river otters, raccoons, aquatic birds, reptiles, amphibians, and some fish and invertebrates would not frequent the polluted shores and littoral zones. The habitat would no longer be suitable for nesting or feeding. Many of the food organisms may vanish or fluctuate greatly and vegetative communities may change. However, certain species of fish such as gizzard shad, black and yellow bullheads, channel catfish, and red shiner, sunfishes, and large mouth bass have wide tolerances with respect to physiochemical and soil type requirements. The alligator gar and shovelnose sturgeon are tolerant to conditions of increased turbidity and siltation of substrates.

It is unlikely that certain species of amphibians would survive in aquatic areas undergoing changes in vegetation, substrates, and physiochemical alterations of the water environment due to pollution from mining activity. These species would include: the dwarf salamander, four-toed salamander, western lesser siren, and the three-toed amphiuma. These species reportedly inhabitat those lowland swamps, ponds and shallow water areas. The western chicken turtle is the only known reptile that is listed as endangered. This species' survival depends upon small shallow and wooded streams and ponds. Any alteration of these habitats may limit or eliminate the species.

Access construction is particularly damaging to aquatic environments. As wet lowlands are filled with road materials, nests, burrows, stream or pond cut banks, substrates and vegetation can be damaged or eliminated. In areas where small streams, ponds, slow moving rivers, are not bridged, graded loose material is pushed into the drainage, vegetation is destroyed and aquatic environments are impaired or drastically altered.

Actions associated with restoration of underground mines may have similar affects upon the aquatic habitat as those discussed in the previous section on strip mining. However, these affects may not be as large as those associated with strip mining because the area of disturbance is reduced.

(4) Coal Processing Plants

Construction of coal processing plants and other facilities near or adjacent to aquatic areas will have many of the same impacts already discussed in the previous sections. Construction of coal mine facilities affects wildlife by displacement and destruction of their habitat. Displacement is due to the intolerance of wildlife species to man's activities and diminished habitat. Aquatic areas adjacent to these construction sites are mostly devoid of aquatic wildlife. Other species are destroyed because their mobility is extremely limited. Generally, however, extensive removal of vegetation and the soil disturbance that is associated with construction may accelerate erosion, channelize streams and cause sedimentation of aquatic habitats within the drainage, thus reducing food production, spawning areas, bank cover, and increasing turbidity, and water temperature. Other areas such as mud flats, bogs, sandy beaches and cobble stone benches may be covered with graded or eroded materials. All species associated with these environments would be adversely affected.

Restoration of disturbed areas associated with coal processing plants may cause similar impacts upon aquatic systems as those described above. Food production, spawning areas and increased turbidity can result from sedimentation.

Construction of facilities could require large amounts of sand and gravel. Some of the available supply is contained in or adjacent to rivers or streams. Removal of this material will generally have five effects: alter the stream bottom and widen the channel; spawning sites are destroyed; spawning riffles become too deep or too shallow for fish, and the widened stream channel and reduced water velocity causes higher water temperatures; habitat used by important aquatic insects is lost; increased silt and sediment destroy aquatic flora and fauna downstream.

(b) Terrestrial

(1) Prospecting Permits

Prospecting permits in forested, shrubby, and grassy areas are expected to have relatively low intensity impacts. Little soil displacement is expected except in the area of the drill hole. Primarily nests, den sites, burrows and individual species of birds, small mammals, reptiles, amphibians may be destroyed by surface vehicles travelling crosscountry. Some range lands for domestic livestock may be diminished while others (small sites) may be improved through removal of brush or tree overstory.

As a whole, these disturbed sites are expected to be small and relatively unobtrusive to man. Wildlife will generally benefit where areas of thick brush and tree cover is removed. However, the site ecology will be totally changed to a dry, open and park-like condition. Soil organisms and other fauna tolerant of these conditions will thrive. Natural regeneration and artificial restoration will increase the diversity of plant species especially in wooded areas and grass and shrub cover will return. As a result, a greater number of birds, small mammals and reptiles will be attracted to these small open areas.

Impacts from restoration actions are expected to be minimal. Erosion of unprotected topsoil may cause slight sedimentation in low areas, possibly affecting smaller terrestrial animals such as moles, shrews, ground squirrels and invertebrates.

(2) Strip Mining

Strip mining activities destroy and displace both domestic animals and wildlife species, eliminates wildlife habitat, and creates barriers to normal wildlife movement. The activities associated with strip mining also contribute to the displacement of certain species.

Populations of bacteria are highest in the surface soil. Strip mining will dislocate top soil and will destroy these bacteria. Heterotrophic micro-organisms depend upon organic matter for food. These organisms cannot live when the supply of organic material is cut off. Stripping the soil of vegetal cover stops the supply.18/

Surface mining of coal causes extensive direct and indirect impacts to wildlife. The impact on wildlife generally come from disturbing, removing and redistributing tremendous volumes of the land surface. Some impacts are long-term and others are short-term. The direct effect on wildlife is the destruction or displacement of all species in the areas of excavation and spoil piling. The more mobile forms like domestic livestock and game animals (white-tail deer, squirrel), birds (bob-white quail, turkey, hawk, etc.), and predators (fox, coyote, bobcat, raccoon, weasels), will leave these areas. The more sedentary animals such as invertebrates (slime molds, protozoa, planarians, snails, worms), many reptiles (turtles, snakes, lizards), amphibians (salamanders, toads, etc.), burrowing rodents (mice, rats, gophers, moles, etc.) and others may be destroyed. Animal populations displaced or destroyed can eventually be replaced from emigration of populations in adjacent habitats, but only if suitable habitat is restored. An exception to this are the endangered, rare, and uncommon species. After restoration has occurred (1-4 years) disturbed sites are usually very suitable for domestic livestock (brush or forested areas that were reseeded to grassland varieties of forage).

Endangered, rare and uncommon wildlife species could be adversely affected by strip mining.

Until further research is done on these species (Tables 5 and 6) judgments as to impacts of changing environments through coal strip mining cannot be made. Although their habitats and used areas are not well defined, their populations and habitats are in danger of being further diminished by strip mining. The red-cockaded woodpecker may be affected if the pine forests (including the diseased trees) are removed. Feeding areas, possible nesting sites and wintering areas may be diminished for the bald eagle and peregrine falcon. Little information is available for the scarlet snake.

Extensive and long-lasting impacts on wildlife are caused by habitat impairment. The life requirements of many animal species do not permit them to adjust to disturbances created by man and machines. Tolerance that a species or individual animal will have for man's activities will vary. Some species will tolerate very little such as endangered species. Big game and other animals, birds, reptiles, and amphibians displaced from their home ranges may be forced to use adjacent areas already stocked to carrying capacity. This overcrowding usually results in degrading remaining or adjacent habitat, lowering carrying capacity, reducing reproductive success, and increasing interspecific and intraspecific stress. The latter usually results in increased losses to the population over and above the animals already displaced.

In some situations, surface mining may have a beneficial impact on wildlife through restoration. Where large, continuous forest, brush and grasslands are broken up during mining, increased edges and openings are created. Preferred food and cover plants can be established in these openings to benefit a wide variety of wildlife such as whitetail deer, bobwhite, dove, songbirds, birds of prey, small mammals, and some reptiles. To make an accurate evaluation of the net positive or negative impact on wildlife, where positive impacts appear possible, one must be sure to relate the benefits or damages to kinds of benefits and species involved.

The highwall pits created by the strip mining activity are both beneficial and detriemntal to wildlife. Proper sloping and grading of these highwalls can produce a pond or reservoir that can be highly productive for aquatic flora and fauna.

On the other hand, these high walls extending for great distances are barriers to certain terrestrial wildlife forms (impeding movement). They are also potential hazards to both wildlife, livestock and man.

Due to the amout of disturbance associated with strip mining, sedimentation of downgrade areas from erosion of topsoil can cause adverse affects upon terrestrial animals. Invertebrate populations may fluctuate through the addition or reduction of topsoil. Burrowing animals could be adversely affected by the filling of burrows or dens with sediment or debris. However, these affects are expected to be minimal.

(3) Underground Mining

Actions of underground mining occur both underground and at the surface. The major impacts to terrestrial animals are: vegetative disturbance, surface facilities and activity, and subsidence.

The effects upon wildlife will include displacement or destruction of most animals and their habitat on the surface land areas disturbed as a result of underground mining. In some areas where mine air vents are constructed, the impact to wildlife would be limited to a smaller disturbed area. Areas used for access routes, buildings, mine entrance, mine dumps and waste sites, loading facilities, etc., are much larger and are totally committed to development. Livestock ranges as well as wildlife habitat (dens, burrows, nests, cover and food sources) may be completely destroyed for most animals except for some species of mice and rats, flies, mosquitoes, etc. The animals that once existed have either been destroyed or displaced. Displacement has usually been the result of the low tolerance of mammals, birds and some reptiles for man's intense activities and habitat destruction.

Some areas are particularly significant for wildlife and their survival. Many species are highly dependent upon the vegetation of natural drainages, heads of draws and canyons, rock-out crops, caves and areas adjacent to water. The head-of-the-hollow fill method is of particular significance to the destruction of some endangered species and other wildlife habitat. The narrow, V-shaped, steep-sided hollow near ridge tops are frequently inhabited by potentially endangered or rare, uncommon, or restricted animal and plant species. Because of the unique character of these sites they often offer the only conditions suitable for a wide range of species. Spoiling into these canyons or over the edge would eliminate important habitat for many species especially endangered ones.

Some of the wildlife that would be displaced include: squirrels, spotted skunk (limestone outcrops), white-tail deer, fox and brush mouse. These are all mammalian residents of these outcrop areas. Of the birds the red-cockaded woodpecker, brown-headed nuthatch, pine warbler, Bachman's sparrow all occupy oak-hickory woodlands and are limited to two counties. Habitat delineation for the red-cockaded woodpecker has not been done. Only general information is available. Other endangered species which are likely inhabitants include the Indiana bat which requires undisturbed caves, peregrine falcon, (cliffs and ledges, outcrops) bald eagle, (tall snags, trees, other view points) and scarlet snake (oak-woodlands and secretive-little else known). (Refer to existing environment for brief habitat description.)

Subsidence can have an adverse affect on terrestrial animals. Some surface holes and cracks resulting from subsidence of mined-out areas will be direct hazards to certain forms of wildlife. Small animals and some large animals such as domestic livestock, deer, etc., are particularly prone to falling into openings. Burrowing animals such as ground squirrels, snakes, mice, lizards, etc., could be harmed. Loss of lakes, ponds, springs and other water sources could be disasterous to many terrestrial species.

Impacts upon terrestrial animals from restoration of underground mining areas are expected to be minimal; being similar to those associated with strip mining as discussed in the previous section.

(4) Coal Processing Plants

Processing plants in terrestrial habitats can cause displacement and/or destruction of wildlife species. Many species will simply move out due to their inability to tolerate human activity. Plant facilities will cause adverse impacts to wildlife species for an extended period of time or until the plant is removed and the site is rehabilitated.

Construction and maintenance of access, etc., creates various kinds of impacts. Roads, railroads, rights-of-way that have deep cuts, fence and powerlines can obstruct normal movement, and migration of wildlife and domestic livestock or place serious hazards in their path. Should chemical spray be used on railroad beds to keep the vegetative growth to a minimum, it may have adverse impacts upon wildlife with regard to food and cover. Fences must be carefully located since they often cause mortality especially in winter. Many animals (usually wildlife) are killed on roads such as armadillos, rabbits and some deer in areas of high winter animal concentration or along migration routes. Powerlines (especially distribution lines less than 70 kv.) may endanger flying and perching birds through collision with wires while flying and electrocution during perching.

Spoil or waste piles containing sulfur compounds, coal fragments and other trace elements cover over existing habitats (cover, dens, burrows, nests, etc.), smother micro organisms in top soil, and destroy the site for little else except waste materials. As water erodes these waste piles or escapes from settling ponds it transports these dissolved solids, leached acids and suspended elements and solids to adjacent habitats. Destruction of these adjacent areas as well as those within the drainages and down drainage are destroyed or inhibited.

In the open space areas common in the coal producing areas railroads, roads, powerlines and processing plants are all major esthetic intrusions. Large trestles, overpasses or fills, towering buildings, coal chutes and spoil piles are features that have unpleasing visual impact. Other impacts to man are the jobs created by the operation of these facilities. Influxes of a temporary population can be expected for large operations and may be a negative impact. These influxes can affect all public services and schools, outlying areas (mobil home towns), and sanitation facilitites. Other business related activities are generated which may have far reaching effects on the environment.

Building operation facilities and processing plants requires large amounts of sand and gravel. Many of the available sources are located on hillsides, river terraces, dry washes, etc. Removal of this material and vegetation (forage, cover, etc.) affects domestic livestock and various species of wildlife which include: amphibians (frogs, toads, salamanders), reptiles, shorebirds (plover, sandpiper, godwit, stilt, and others), doves, many small mammals and invertebrates.

Sedimentation from erosion of topsoil replaced during restoration will have a slight affect on terrestrial animals. These affects will be similar to those described in the two previous sections.

c. Ecological Interrelationships

Any industrial action, such as coal mining, that alters the abiotic environment or biotic community can influence ecological interrelationships to some degree. Disturbances upon the natural environment will produce chain effects on both the micro and macro-ecological interrelationships. Whether the impact occurs on the successional progress, nutrient cycles, hydrological cycles, energy flows or community relationships of an area, the affects will be transferred to almost all aspects of the local environment. The specific impacts, and their degree, upon these processes will vary greatly depending upon the severity of the disturbance.

Actions that pollute the air, alter the landscape, destroy vegetation, disturb soil and degrade water quality will cause disruption of aquatic and terrestrial ecosystems.

Addition of pollutants to the air may affect the nutrient cycle of the local environment. Gases, containing pollutants, absorbed by plants and animals can affect their vigor and productivity. These contaminants along with nutrients together will be cycled through the food chain, possibly affecting organisms at all levels.

Alterations of the landscape involve both vegetative removal as well as soil disturbance. Whenever soil is disturbed, eroded or contaminated, soil organisms will have their life cycles interrupted and populations will decline for an unknown time. There will be shifts in population numbers among species as food and energy levels are changed. Impacts upon nutrient cycling, profile development and organic matter cycling will remain as long as the site is used for the intended purpose.

Regardless of the amount or area of vegetation removed, plant succession, nutrient cycling and the hydrological cylce of the disturbed area will be disrupted. Removing vegetation from an area results in the elimination of a particular seral stage of development in plant succession. Consequently, the nutrient levels and water concentrations of the site will be changed. The main food source for countless organisms is reduced significantly as well as the amount of water available in the area. This will result in the reduction of food and water cycling as energy sources are altered.

These two changes, disruption of soil and vegetative removal, coupled with alterations in the landscape will have a drastic influence on wildlife and community relationships. The ecological niches present in the area will change drastically. Consequently, the types of wildlife which would be able to survive in this situation would vary greatly. Along with this change, community relationships would also be altered, disrupting the entire ecological system. This type of interruption will continue for the duration of the operation.

Degradation of water quality will produce similar affects upon the aquatic ecosystem as those impacts discussed above. Sedimentation and contamination of the water will affect nutrient cycling thus changing food and energy sources. Changes in population numbers will result from this change, affecting community relationships.

In summary, areas receiving substantial surface damage also incur disruption of ecological relationships. When restoration procedures are used to mitigate the adverse impacts, it is possible to stabilize the site such that ecological processes can resume. The community that is reestablished is only the first step which must be followed by a chain of natural processes that must continue for a long time before former equilibriums are restored. However, the sites that are restored establish a more advanced successional stage than those on unreclaimed areas.

d. Human Values

(1) Landscape Character

(a) Prospecting Permits

Coal prospecting will have a low negative impact on both the harmonious and accentuating elements, primarily through sight and sound and from any clearing associated with roads or drill sites if dense vegetation is removed. There will also be adverse affects upon these elements from the noise and dust associated with any coal prospect drilling.

(b) Strip Mining

Access to any strip mining operations or the support facilities of the federal coal reserves in Oklahoma will generally have a moderate or high impact on the harmonious and accentuating elements. Any clearing associated with strip mining access would disrupt the visual harmony of the landscape by the removal of vegetation, creating open areas. Also adverse affects upon the harmonious and accentuating elements would arise from the noise and dust associated with travel along these routes. However, new areas would be open to access by the construction of these routes.

The impacts on the harmonious and accentuating elements from the phase of actual mining itself would be high. Removal of vegetation in preparation for mining and the removal of overburden during mining itself would create undesirable impacts upon the landscape. The presence of spoil piles would disrupt the visual harmony of the topography in most areas and create an eyesore upon the landscape. Noise associated with the strip mining operation will also be an undesirable impact for some. Some people, though, would consider this type of disturbance necessary for economic progress in the local area. The removal of coal for energy reasons would seem to justify the disturbance of the landscape.

(c) Underground Mining

Access to any underground mining operation or its support facilities will mostly have a moderate impact on the harmonious and accentuating elements. Similar impacts (to those associated with strip mining) upon the visual harmony of the landscape would result. Here again, removal of vegetation would create open areas; however, fewer access routes to the mine site would be required. Noise and dust problems would result from travel along these routes, disrupting the rural setting of the area.

A moderate to high impact as a result of underground coal mining is anticipated. The removal of waste material from the mine to a waste dump would create an adverse impact on the visual and accentuating elements. The stockpiling of coal would have a similar impact upon the visual character of the landscape. Noise from surface operation of an underground mine is considered detrimental, however, the scope of surface disturbance associated with an underground mine is not as great as that involved in strip mining. Much of the landscape included in the mining area is not disturbed, allowing some other uses of the land to continue in harmony. To some people the removal of the coal resource may justify the amount of surface disturbance involve in the operation.

(d) Coal Processing Plants

Access, via road or railroad, to any coal processing plant is expected to have a moderate to high impact upon landscape character values. Few access routes would be required for this type of operation, however, clearing of vegetation is still involved. This again, will create scars on the landscape and disrupt the visual harmony of the area. Noise and dust arising from travel along these routes will similarly affect the harmonious and accentuating elements. New areas, though, will be open to access once the processing plant has been salvaged.

Any operating facilities on the federal coal reserves in Oklahoma will have a moderate to high impact on the harmonious and accentuating elements. Clearing associated with coal processing plants, for site preparation, would have an adverse impact upon the visual aspects of the area. The area of vegetative removal could be quite large, depending on the size and type of processing plant, which would lower the harmonious value of the landscape. The noise and dust problems associated with this type of operation would have adverse affects upon both the harmonious and accentuating elements, and would continue until the plant is salvaged.

Additional site preparation and construction of any processing plant would have a low impact because most of the surface disturbance involved in the operation has already occurred.

(2) Sociocultural Interests

(a) Prospecting Permits

Any coal drilling would produce a desirable impact from the scientific information obtained concerning subsurface geology. Most of the impacts on other educational, scientific and cultural values are expected to be moderate to high but cannot be ascertained at this time due to the lack of a proper or complete inventory of the area for cultural resources (archaeology, history and historical architecture) and paleontology. Should construction of access routes to the drilling location damage archeological, paleontological or historic sites, the impacts could be very detrimental. The social welfare of the immediate areas would experience a favorable impact due to the increase in money which would benefit the local economy.

The impacts on attitude, expectations and local regulatory structures would depend on the thinking of the individual person. Some individuals would favor coal prospecting with the anticipation of further coal development in the area. These activities would favor economic growth and a higher standard of living than was present in the past. However, others may view these operations as detrimental to the surface environment. This could include damage to improvements on the land such as fences or farm ponds. Furthermore, possible disruption of the rural environment can take place.

(b) Strip Mining

Concerning access to any strip mining site, the impacts on educational, scientific, and cultural values would be varied. High adverse impacts upon these values could result should construction of access and haul roads damage or destroy archaeological, historic or cultural features of importance. Disturbance of these features not considered of importance would result in a moderate or low impact. In either case, the lack of an inventory of these values leaves the determination of the impact difficult. The social welfare and local regulatory structure would have positive impacts due to the money generated locally and the added tax base supervised by the local officials. The attitudes and expectations of the sociocultural interest would have a moderate impact. Local people may favor the construction of new roads for easier access to areas that were previously unused. These people may include ranchers, farmers or recreationists. Others, though, may be of the opinion that more scars are being put on the land and that increased travel will upset the rural setting of the area.

The impacts upon the educational, scientific and cultural interests associated with mining would be unfavorable when the process is considered in its entirety. Drastic impacts upon these values can result from their destruction through vegetation and overburden removal, landscaping and restoration actions. The social welfare and the local regulatory structure would experience a positive impact value. This is because of the large economic input to any area from a strip mine operation and the fact that the Oklahoma strip mining regulations are among the best in the nation. The attitudes and expectations developed under the sociocultural interests are generally moderate. Local citizens may be alienated to the amount of disturbance to the land and the environment associated with strip mining. Their opinion might be that strip mining will render the land unsuitable for any beneficial use upon completion of the operation. They may consider the mining area as waste land. However, others may feel that strip mining is a consequence of progress and it may well improve their economic welfare as well as the welfare of the nation.

(c) Underground Mining

Impacts upon educational, scientific and cultural values associated with the access phase of an underground mining operation are similar to those identified with prospecting permits and strip mining. Drastic impacts upon these values would result from destruction of archeological, historic or cultural features. The social welfare and local regulatory structure would have positive impacts due to the money generated locally and the added tax base supervised by local officials.

The educational and scientific interests associated with underground mining itself would be affected in a negative way when the process is considered in its entirety. These impacts would be similar to those associated with strip mining, however, the amount of surface disturbance in an underground mining operation is on a smaller scale. Nevertheless, the destruction of these values can occur on those areas disturbed. The impacts on the culture values will be similar to those mentioned above. The social welfare and local regulatory structure would experience favorable affects because of the large economic input into the area from mining and the fact that Oklahoma has rigorous safety regulations. The attitudes and expectations developed under the sociocultural interests are generally moderate. People's attitude toward underground mining may be more favorable than that towards strip mining due to the amount of surface disturbance involved. Some present uses can exist on the area concurrent with the mining operation. Here again, though, those areas that are disturbed may not be of any future beneficial use in the minds of some individuals, upon completion of the operation.

(d) Coal Processing Plants

In access to any coal processing plant, the educational, scientific and cultural values would experience similar impacts as those discussed under this phase in relation to prospecting permits, strip, and underground mining. Although fewer access routes may be involved in this operation, detrimental affects can result. The social welfare and local regulatory structure would have positive moderate impacts due to the money generated locally and the added tax base.

The attitude and expectations of the sociocultural interests would have a medium impact. Disturbances resulting from the construction and operation of the processing plant will remain for a period of several years; as long as coal is being supplied to the plant.

For this reason, impacts upon attitudes and expectations could be detrimental. Furthermore, there may be periods of intermittent use of the plant; in which case no productivity is resulting from this particular use of the land. However, while the processing plant is in operation, economic progress of the community may justify its presence.

2. Possible Mitigating or Enhancing Measures

Mitigating measures should be designed to minimize the impacts of coal mining and its related activities and facilities and to insure the disturbed area is reclaimed. The Bureau's draft environmental impact statement (DES-74-53) on federal coal leasing contains a comprehensive list of mitigating measures for all types of surface disturbing activities involved in coal mining. Enhancing measures can be included as part of the prospecting or mining plan, and can be added as a result of future land use planning efforts. This document should be consulted for detailed coverage of possible mitigating measures.

a. Non-Living Components

(1) Air

Restoration actions should follow any surface disturbance as quickly as possible to restore the albedo of the ground surface. The preparation of a seedbed and subsequent establishment of vegetative cover will reduce the conduction of heat from the ground to surface air layers. If possible, existing vegetation on drill sites for exploratory drilling should be left alone. In the vicinity of long-term disturbance areas such as coal processing plants and barge loading stations, disturbed areas of non-use during their operation should be revegetated to reduce local air temperatures as well as improve the appearance of the site.

Dirt roads should be wet down during drought periods to reduce the amount of particulate matter blown into the air from vehicular travel. Areas adjacent to coal storage piles, waste dumps and surface work areas should be wet down routinely during dry seasons to prevent dusty conditions. Revegetation of disturbed sites will reduce the amount of dust blown into the air through establishment of a ground cover to trap dust particles.

Mitigation to protect against underground fires is covered by existing laws. To prevent fires in coal storage piles, the coal should be layered and compacted in piles with gentle slopes. Conical piles should not be formed; these tend to develop spontaneous heating.

(2) Land

Deep mine facilities, processing plants and exploration sites should be designed to utilize the least amount of soil surface. This will minimize the impact of changing the land uses.

Use of existing access routes and disturbed areas in all phases of coal mining is desirable such that minimal surface disturbance occurs. Should the need for road construction arise, roads along with surface facilities should be planned and located so they are screened by topography or vegetation. Highly erosive terrain (steep slopes) should be avoided to minimize cut and fill operations. Cut banks and fill slopes should be reduced to a slope that can be revegetated and is not subject to erosion. Roads should be constructed to a proper grade, drained and surfaced with a non-eroding material. Travel on roads during wet conditions should be limited if they are not surfaced to reduce erosion from rutting. Newly constructed roads need not be restored should it be determined that permanent access is needed into the area for other land uses.

All drill holes should be plugged and drill cuttings scattered. If the cuttings contain toxic materials, they should either be buried to reduce contamination of other areas or removed from the site altogether.

Mine waste dumps should be located to minimize conflicts with surface resources. They should be shaped to a slope that is not subject to erosion such that acidic materials are not carried downgrade to contaminate other areas. Topsoil should be removed and stored for later use during restoration. Stockpiled topsoil should be revegetated to maintain as much of the living component of the soil as possible and to deter erosion.

If major subsidence should occur, the void should be backfilled with borrow or waste material and the site revegetated to blend with the surrounding area.

Reshaping of overburden piles and mine waste dumps and the high wall from strip mine operations helps return the area to an aesthically pleasing state. Restoration of these areas should follow mining as soon as possible. Slopes should be reduced to 3:1 or less and the area should be reshaped to conform with the surrounding terrain. Replacing topsoil and revegetating disturbed sites will restore some soil depth and structure to the soil profile. Upon completion of the restoration process, compatibility with other land uses should be renewed; possibly to a more beneficial state depending on the site. For example, the construction of landing strips on restored strip mines sites would render the disturbed site to a beneficial use. This operation could be the culmination of the restoration process.

(3) Water

Proper drilling techniques should be used in the exploratory phase in order to reduce the danger of contamination of surface and subsurface water. Underground aquifers should be identified to determine their location as well as the quantity and quality of water present. Once underground aquifers are contaminated they cannot be re-established, although water from them may be salvaged and put to beneficial use.

Contamination of underground aquifers from underground mining can be mitigated to some extent. Underground mine waste water can be pumped out to keep it from mixing with other subsurface water. Chemicals can be added to mine water to neutralize its acidity before being pumped out onto the surface. Should waste water remain in the mine after abandonment, the mine should be sealed off to prevent seepage into underground aquifers.

Settling ponds, mine waste dumps and coal storage piles should be placed in areas where they cannot be easily eroded. If pollution from drainage or seepage is a problem on sites where these facilities are to be located, berms should be placed around each to help combat drainage from them. Topsoil should be removed on these areas and surfaced with some type of sealant such as bentonite. This would render the soil impermeable and reduce contamination of underground water from seepage.

Should streams, ponds, lakes and wet lowlands be present in the vicinity of coal mining activities, sediment basins should be constructed to reduce sediment loads in downstream water courses. Acids leached by surface runoff will also be caught in these basins and reduce further downstream contamination. Specific fertilizers can be added directly to streams or ponds to increase nutrient levels and/or reduce acidic conditions.

Restoration of disturbed areas should proceed at the same pace as mining whenever possible to reduce degradation of water resources. Excavations resulting from strip mining or underground mining can be left and used as permanent water impoundments for wildlife, ranching and recreational uses. The side slopes of these impoundments should be reduced to a gentle slope (less than 3:1) that will provide easy access to the water edge by animals and people.

b. Living Components

(1) Plants

(a) Aquatic

If streams or ponds have to be crossed for road or site construction, they should be bridged in such a way as to maintain the existing environment in these water bodies and shoreline areas. In some cases, rechanneling of small streams may occur as a result of strip or underground mining activities. In such situations, a study of the present aquatic species and their environment should be made before mining occurs in order that modifications can be made in the anticipated new channel that will simulate the prior environment. This may include reseeding of plant species, addition of nutrients directly to the water and alterations in the channel itself (for more detail refer to reference Wildlife and Water Management; Striking a Balance, Soil Conservation Society of America, 7515 Northeast Ankeny Road, Ankeny, Iowa 50021).22/

Aquatic habitat areas can be formed from excavations left after mining. These areas left for water impoundments may be suitable for aquatic plant species. Seeding and addition of nutrients to the water may create an aquatic plant community which will help stabilize the site. The same effect can result from daming small streams void of aquatic plant growth which create areas where levels can be altered such as to provide suitable habitat for the generation of various plant communities.

(b) Terrestrial

The majority of the existing coal leases in Oklahoma have private ownership of the surface lands. In these cases, the plant species to be reseeded on disturbed sites is at the discretion of the land owner. However, restoration and establishment of a vegetal cover should be completed as quickly as possible after the particular phase of coal mining is finished. In this manner, viable seed, live root stocks and nutritive properties contained in the soil may still exist and aid in stabilizing the site.

On those leases where surface disturbance encompasses public land, a study of the plant species and soil properties present on the site should be made before any vegetative removal occurs. With this information, restoration of the area will be an easier and less time consuming task. A BLM representative should be consulted as to the type of species to be reseeded on the site. The vegetation established should be compatible with other uses of the land such as wildlife, ranching or aesthetic. Fencing may be required to protect the seeded area until a good ground cover and good plant vigor is attained.

Specific fertilizers should be added to the soil to aid in the establishment of a vegetative cover. Incorporating organic materials, especially litter and manure, in the re-distributed topsoil will accelerate organism population growth. This will increase soil productivity and increase the vigor and growth of the reseeded plant species. Here again, restoration should follow the surface disturbance as soon as possible.

(2) Animals - Aquatic and Terrestrial

Information for wildlife is too inadequate to properly mitigate the impacts that will occur with any of the proposed actions. It is essential that habitat be delineated and population data be obtained for endangered species, and those that are rare, uncommon or of concern to the Oklahoma Game and Fish Commission prior to any further mineral activity. Further crucial habitats for other wildlife species should be delineated also. The need for omission of these habitats from permits, leases and mining plans should be weighed against the need for mineral extraction.

If mineral activity does take place without the additional information mentioned above, then the following mitigating measures will only deter some impacts. Some impacts affecting endangered, rare and uncommon wildlife species can be mitigated with proper planning.

All new access routes should be reviewed by BLM utilizing specialists in mining, wildlife, range, watershed, forestry, recreation and archeology. Visual and physical impacts upon the environment should be the overriding factors on which the final routes and sites are selected. Roads, railroads, and rights-of-way can be planned in non-crucial habitat areas and the impacts to wildlife reduced. The impact upon endangered, rare and uncommon fish and wildlife habitat, especially if drainages must be crossed, should be considered.

Pre-planned road location and construction practices with concern for aquatic environmental protection will reduce interference with animal movements and the need for rehabilitation and follow-up maintenance. Adequate use of culverts, water bars, ditches, seeding, and bridge or culvert stream crossings will further protect aquatic habitat from siltation damage. Road and culverts should be designed and installed to allow fish and other aquatic wildlife movement. Spoil pile and waste dump sites should be limited to areas that have the least impact to wildlife, especially endangered species.

All surface disturbance should avoid sensitive vegetative areas such as aquatic environments (including a buffer zone), canyons, steep slopes, ravines, rock-out-crop, ledges and talus slopes. Cutting of vegetation, especially brush and trees, should be avoided except where important for wildlife habitat, access, drilling sites or facilities or operations.

Impacts from subsidence can be reduced several ways: (1) backfilling underground mined areas, (2) collapse mined area uniformly or at a predetermined rate, (3) leave adequate support in the mined area, (4) do not mine where subsidence is a problem especially where subsidence would eliminate or impair an endangered species or its habitat.

All abandoned shafts, drifts, or portals should be sealed or caved in to prevent unsafe conditions for humans, wildlife and domestic livestock. Any holes or pits caused by subsidence should also be safely and quickly covered.

Where surface mining would destroy or render unusable large acreages of wildlife habitat, the impact can only be mitigated to the extent that the habitat be avoided or restored. Crucial habitats may be withheld from leasing, especially if coal reserves of similar minability and less conflict are available within the same area or region. In some areas, rehabilitation of habitats to more open ones with greater "edge" can be beneficial for wildlife. But rehabilitation of crucial habitat has not been too successful. Of greatest importance is the exclusion from leases and permits or protection by special lease stipulations of habitat for endangered species and other rare, uncommon species identified in previous sections. Restoration of other land areas should be initiated within 1-2 years or sooner.

Certain wildlife population and habitat rehabilitation efforts can be termed "mitigation" measures only in the broad sense that they establish some forms of wildlife and habitat desirable to man in general. In this case, impacts on many species affected by surface mining may not be mitigated at all, but after mining, new habitats, new species and new populations in the impact area may be established. An endangered species may be lost, or other wildlife species formerly present may be missing from the fauna, but, from the broad viewpoint, their loss may have been mitigated by replacement with other species.

Aquatic habitats in the form of lakes are often created within strip mined areas. If properly designed, constructed and managed, these waters can provide good aquatic habitat for fish, waterfowl, amphibians, reptiles, various mammals and invertebrates. Aquatic habitat should be rehabilitated by proper landscaping, improving water quality and restoring riparian vegetation.

Silt, acid drainage and other pollutants should be retained on the mine or facility site. In the event that sedimentation of streams cannot be avoided after land based efforts fail, the advice and concurrance of agencies involved must be obtained before in-stream devices for accelerating and directing silt and sediment are used. Shifting streambed loads can be stabilized and food production and spawning areas will be protected or improved while further downstream damage is reduced.

The channelization, relocation of a stream or crossing of a stream without a proper bridge or culvert will not be allowed until a proper study of the situation has been made. Impacts from this action cannot be adequately mitigated where valuable wetland and aquatic habitat and wildlife would be lost.

The highwalls which are created from strip mine activity and which inhibit animal movements should be shaped to a 3:1 slope or less to allow sufficient free natural passage and habitat utilization throughout the area for wildlife and livestock. Lakes created within the highwall area should be occasionally divided by earth filled crossways to allow free movement of all animals.

Impacts to man can be minimized through site location (screening) or the coloring of structures such that they blend with the surrounding vegetation. This reduces the visual impacts of structures, mine operations, spoil piles and waste dumps. Associated rights-of-way should be restricted to established corridors or screened whenever possible. Rapid rehabilitation of disturbed sites is essential.

Powerline's (usually less than 70 kv) have inherent hazards for large perching birds. These hazards can be mitigated or minimized by relatively inexpensive modifications in distribution, structure design and fixtures by the power supplier. The structure modifications discussed in REA Bulletin 61-10 (Attachment #16) identify hazards of standard construction and offer suggestions of modification.

Inspection of existing powerlines can be made to determine those favorite perch poles. These can be identified by either the presence of dead birds or the droppings of birds and their castings.

c. Ecological Interrelationships

Mitigating measures cannot be entirely effective when the abiotic environment or biotic community is altered. The amount of surface disturbance involved in a particular phase of coal mining will determine to what extent the succession and food and community relationships of an ecosystem are affected. Despite all feasible precautions that can be taken, the natural balance of ecosystems will be upset temporarily. However, restoration procedures can help restore this balance to some degree.

Succession, the orderly process of community change, will be altered when vegetation is destroyed, soils are disturbed and degradation of water quality occurs. Replacing topsoil and revegetating disturbed sites should aid in achieving equilibrium in the ecosystem. This balance is attained only through a chain of natural processes occurring over a long period of time. Establishment of some form of plant community on the disturbed area will hasten this natural process as opposed to no revegetation at all.

The species selected for revegetation should be those of as high a seral stage in the successional process as possible and still attain good establishment. This can be achieved by making a study of the finished site and making a determination of species to be seeded based on other similar areas. Those species selected should be of high value in relation to the particular food chain that was present prior to disturbance. Furthermore, action should be taken to reseed specific species necessary to establish suitable habitat for wildlife in the vicinity.

d. Human Values

(1) Landscape Character

Sites selected for road construction and operation facilities, where extensive surface disturbance will occur, should be planned such that areas of natural beauty are avoided. If possible, these facilities should be located in areas that are less frequently seen by the public. Should this be infeasible, these structures should be constructed in areas screened by topography or vegetation. All structures of a permanent nature should be painted to a color that blends with the surrounding area. All buildings and surface mine facilities should be dismantled and removed when they are no longer needed. Occasional powerline poles may be left standing for raptor perches.

The goals of revegetation should to be to arrest erosion, provide habitat for wildlife and livestock, and to return the area to an aesthetically pleasing state. The site should conform to the surrounding landscape such that harmony with undisturbed areas is achieve.

Planning of these areas of disturbance in conjunction with restoration procedures can result in the creation of such beneficial uses as airstrips, dragstrips, golf courses, recreation areas, etc.

(2) Sociocultural Interests

Prior to any surface disturbance, whether in the exploratory phase or mining itself, an inventory of cultural properties in the project area should be conducted. Upon the completion of this inventory, a mitigation program based upon a professional research design will be implemented.

The economic conditions of this region have been in poor health for several decades. In recent years though, some economic progress has been achieved. The presence of coal mining activities in this region can provide a vast influence not only on the economic progress of southeastern Oklahoma, but upon the state and the country as a whole. Coal mining can bring an influx of population into the area, which could demonstrate an improvement in the economic conditions. With this influx, a larger amount of capital is in circulation; affecting income levels, labor markets, state and local tax revenues, and the standard of living.

3. Recommendations for Mitigation or Enhancement (Stipulations)

The following stipulations are recommended as applicable for inclusion into a technical report prepared on any of the proposed actions. The mitigating measures recommended in this section are general in nature. However, they are designed for use as applicable on any application relating to the proposed actions on coal. Specific stipulations can be developed as necessary during preparation of a technical report on a specific application or review of the mining and reclamation plans when more details are available.

General - In order to control conditions causing or contributing to water pollution, soil erosion, hazards to health, safety, and property damage, and for the conservation of the resources and the preservation of natural beauty, the lessee or permittee will design and perform all operations with a view of the prevention of pollution and erosion, and so far as reasonably possible, restore the leased land to its former condition.

1) The lessee will be required to comply with all state laws and regulations concerning coal mining, including such laws and regulations pertaining to the protection of air and water, and to the reclamation of surface resources.

2) At the time of submission of a mining or prospecting plan a study of cultural resources (Archeology, History and Historical Architecture) shall be included as part of the plan. The study shall identify the presence of such resources in the lease (s) involved and propose mitigation actions for impacts on these resources. The study shall conform to the requirements of historic and cultural resource preservation as provided in PL 89-665 and Executive Order 11593 and in 36 CFR Subpart 800. This will include the comments of the State Historic Preservation Officer. The responsibility and cost of this survey and salvage will be that of the lessee. (Note: The State Historic Preservation Officer can provide information on the institutions qualified and available to accomplish the required study).

3) At the time of submission of a mining or prospecting plan, a study of endangered species and critical wildlife habitat shall be made. The study should identify such habitat in the lease area and describe the habitat components as they relate to habitat requirements. Limiting factors and impacts from the actions on the species and their habitat will also be described along with recommendations for mitigation of impacts. The completed study attached to the prospecting or mining plan shall have the concurrence of: (1) The Oklahoma Game and Fish Commission (2) U.S. Fish and Wildlife Service and comply with

the provisions of Endangered and Threatened Species Act, 1973 (Public Law 93-205, 87 Stat. 884, December 28, 1973). (Note: The Oklahoma Game and Fish Commission can provide information on qualified personnel available to accomplish the required study).

4) Removal of vegetation will be kept to a minimum on the drill site.

5) Surface disturbance will be confined to the area and to the degree shown in an approved prospecting or mining plan.

6) Vehicular travel on unimproved roads will be prohibited during wet conditions when rutting occurs.

7) Major access roads and parking areas will be sprinkled with water as needed for dust control.

8) Utilization will be made of any existing access routes and disturbed areas within the area designated by the prospecting and/or mining plan.

9) Drilling on steep slopes or highly erosive soils will be restricted.

10) All access, haul, and other support roads shall be constructed and maintained in such a manner as to control and minimize channeling and erosion. Roads shall be located, when practicable, to be of beneficial use to the other multiple resource uses in the leased and contiguous areas.

11) Drill holes shall be protected at all times so as to prevent injury to persons, livestock and wildlife. They will be covered or filled after drilling and testing is completed.

12) Drill cuttings will be disposed of as directed by the authorized officer.

13) All existing improvements including, but not limited to gates, cattleguards, fences, roads, trails, pipelines, bridges, public and private land survey movements, and water development and control structures, shall be replaced, restored, or appropriately compensated for as soon as practicable, in the event they are damaged or destroyed by company operations.

14) Heavy machinery and trucks will be routed away from recreation sites to minimize the impact of noise and odor.

15) On areas where BLM has control or ownership of the surface and where compatible with operations conducted by the lessee or permittee, the area shall be available for other public uses including but not limited to livestock grazing, hunting, fishing, camping and hiking.

16) For major access routes which must cross streams or drainages, bridges or culverts will be constructed to minimize impacts to aquatic and adjacent habitats and to control erosion. The bridges and culverts will be located and designed to allow free movement of all aquatic animals and fish in the area.

17) Small drainage access crossings will not be filled in with any soil, dirt, rock or other type material. Such crossings will be level with the drainage bottom. Excavated material will be deposited in such a location that it will not easily erode into any stream channel.

18) Roads, surface buildings, supporting facilities, and other structures within the boundaries of the lease will be planned and located so they are screened by topography or vegetation.

19) Should contamination of water courses occur as a result of coal prospecting or activities on the coal lease, the permittee or lessee will take immediate responsible action to eliminate the source of contamination. The permittee or lessee will, to the extent practicable, restore the affected area to its original condition prior to contamination.

20) Abandoned or unneeded roads will be closed off, reshaped and reseeded as specified in the approved prospecting, mining, or rehabilitation plan.

21) The species to be seeded on those prospecting permits or leases involving private surface lands will be at the discretion of the surface owner. In the case where BLM lands are involved, the authorized BLM official will be contacted as to what species are to be seeded.

22) In areas where trees and/or brush are cleared, woody material is to be (a) buried (b) scattered at random along the cleared area (c) placed in drainages and worked down for erosion control.

23) Proposed prospecting and mining plans will include considerations for protecting any water bodies which will be affected or could be potentially affected by the proposed plan.

24) At the discretion of the State Department of Mines, review comments from local or other state agenices relating to the environmental impacts resulting from a prospecting or mining plan, will be considered.

25) All operations shall be conducted so as to prevent range and forest fires and spontaneous combustion. Open burning of carbonaceous materials shall be in accordance with state laws and regulations and conducted with suitable practices for fire prevention and control. The operator shall take immediate steps to extinguish any fires in piles of coal wastes, slack or an exposed face of in-place coal.

26) All spoil banks, waste dumps, and disturbed areas will be reshaped to conform with the surrounding terrain and slopes will be reduced to 3:1 or less, unless otherwise specified. They shall be so deposited that they do not block the flow of water in its natural drainage nor produce sediment in drainages. Final grading or backfilling of other unconsolidated materials shall be performed so as to present a surface suitable for revegetation.

27) All slacked coal and other wastes shall be returned to the excavation and covered with topsoil to a depth of not less than 6", except when the authorized BLM official determines that it would be desirable to use an excavation for the permanent impoundments of water or for other beneficial use.

28) Settling ponds will be constructed so they are impermeable and no water seepage to underground sources occurs.

29) Water quality samples will be taken of water which has accumulated in strip pits or underground mines. If the pH of this water is such that it will harm native plant or animal life, it will be hauled away to a suitable disposal location or chemically treated to neutralize pH prior to removal.

30) Upon the completion of an underground mine in which contaminated water is present, chemicals will be added to neutralize its pH.

31) Berms or similar water control structures will be constructed downgrade from mine waste dumps, coal storage piles and settling ponds to prevent erosion and reduce degradation of water courses and aquatic habitats.

32) Sediment basins will be constructed to reduce sediment loads or floating debris in downstream water courses.

33) Where an excavation is to be left for permanent water impoundment, access will be provided at suitable intervals for persons, wildlife and livestock. Highwall areas will be graded and passes will be constructed at frequent intervals to allow free movement and access.

34) Chemical analysis of waste piles and overburden will be made to find out what nutrients should be added during revegetation and what toxic materials are present.

35) Prior to abandonment of all or a portion of the mining operation, the disturbed surface areas will be landscaped and reclaimed.

36) In those areas used for operation facilities, the topsoil will be removed and stockpiled for final reclamation of the site. This stockpile will be revegetated to ensure minimal loss of topsoil as a result of erosion. Backfilling, final grading and revegetation will be completed as soon as possible following the termination of a particular phase of the operation such that advantage can be made of viable seed or live root stocks present in the topsoil that has been stockpiled.

37) No livestock grazing will be allowed on revegetated areas, following restoration, until sufficient plant growth has been established to support livestock operations.

38) Should it not be possible to locate surface buildings and supporting facilities such that they are screened by topography or vegetation, they will be painted so they harmonize with the surrounding terrain. After they have served their purpose, they shall be removed and the area graded and revegetated.

39) In areas of significant subsidence, determined by the authorized officer, borrow or waste material will be used to fill the area which will be shaped to conform to the surrounding landscape. These areas will have topsoil replaced and will be reseeded.

40) The mining premises shall be posted and fenced or otherwise protected where necessary to minimize injury to persons, livestock, and wildlife.

41) Within a permit or lease area, any project in which the Bureau of Outdoor Recreation has expended funds will be excluded from any prospecting plan or mining plan unless approval is received from the Bureau of Outdoor Recreation to include such project in the proposed plan.

42) All new access routes will be reviewed and a selection made cooperatively with representative from the lessee, USGS, Oklahoma Game and Fish Commission and BLM.

43) Surface disturbance from prospecting, strip mining, deep mining and processing plants should be kept the distance required to prevent drainage of polluting materials (acids, suspended sediments and trace elements, dissolved solids) from entering aquatic and riparian habitats.

44) Streams and aquatic areas will not be channelized, relocated, diverted or otherwise disturbed from its natural and existing location unless it is included in an approved mining plan.

45) All spoil banks, waste dumps, waste piles and stockpiles will be located in areas where the least disturbance to animal movement and the natural environment will occur.

46) Subsidence should be a consideration in developing an underground mine plan. Do not mine where subsidence would eliminate an endangered animal species. Hazardous areas should be fenced against people and animals.

47) Refuse must be cleaned and disposed of to prevent solid waste pollution on and off the site.

48) Portable chemical toilets will be provided on all drilling (should a camp be present in the vicinity), strip mine, underground mine and coal processing plant sites. Sewage will be disposed of in a manner that meets state and federal regulations.

49) When powerlines are necessary the construction will be such that they will not be a hazard to or cause electrocution of raptors. Construction according to REA Bulletin 61-10 or Idaho Power Company Report dated April 22, 1974, and titled <u>Powerlines and Birds of Prey</u> (Attachment #16) is recommended. The protection required for wildlife species in the Bald Eagle Act 1940, as amended, Migratory Bird Treaty Act 1918, as amended, and the Endangered Species Act (1973) shall be carried out by the lessee.

The following recommended stipulations are not intended for inclusion on a coal lease or mining plan review but are reminders to Bureau of Land Management personnel to make contact with other agencies which have specific knowledge of plans, proposals, or on the ground situations of locations described in a proposed lease or mining plan. Input from these agencies may or may not result in a need for modification or additional stipulations.

1. Bureau of Outdoor Recreation-Albuquerque, New Mexico

   Contact to determine if Land and Water Conservation Funds have been expended on or near the proposed lease or mining plan area. Present BOR regulations prevent changes in use on such lands unless authorized by the Director of BOR (See Attachment #15 for response from BOR).

2. Army Corp of Engineers-Tulsa, Oklahoma

   Contact to determine affects of proposed lease or mining plan on any existing Army Corp of Engineers projects or any proposed future projects.

3. Oklahoma Game and Fish Commission-Oklahoma City, Oklahoma

   Contact to determine any on the ground affects of a proposed lease or mining plan on wildlife species within a three mile radius of the area to be affected. Such comments would be on species not included on the endangered species list.

4. Chief Mine Inspector, State Capitol Bldg.-Oklahoma City, Oklahoma

   Contact should be made to insure coordination of proposals between State and Federal governments and to provide a channel for flow of information and ideas.

4. Residual Impacts

This section discusses impacts that will remain despite application of mitigating measures. These anticipated residual impacts are those that may accrue from orderly systemized leasing, exploration or processing of coal.

a. Non-Living Components

(1) Air

Even with good cooperation by the coal companies involved in Oklahoma, impacts upon air quality cannot be completely mitigated. Federal and state regulations cannot entirely eliminate pollution of the air during coal operations.

Air quality, at least temporarily and locally, will be degraded by engine emissions from vehicular travel, drilling site operation, pit and underground mine construction, coal processing and restoration actions such as landscaping. Furthermore, unavoidable additions of dust and other particulate matter to the air will result from these same operations.

Gases produced through excavation of coal in underground mines and pumped out the surface by ventilating systems can also cause a temporary degradation of air quality which cannot be totally mitigated. Accidental coal fires will occasionally add toxic vapors and particulate matter to the atmosphere, increasing the load of materials already present.

(2) Land

Surface mining alters the topography of the area despite mitigation measures. Landscaping spoil piles will reduce their effects, however, the spoil cannot entirely be replaced in its original location in steeper topography. Spoil mounds may be present in areas that were once nearly level as a result of restoration procedures.

Soil properties are altered any time surface disturbance occurs involving the protective cover or soil mantle. Productivity of the soil will be reduced by the removal of vegetation and the redistribution of topsoil from one location to another. The original natural soil arrangement cannot be reconstructed after it is moved or altered during construction of coal mining or processing plant facilities.

Compaction and soil depth can significantly affect the growth of natural vegetation and determine the success of revegetation efforts. Erosional processes are accelerated by the disturbance of the soil, and mitigating efforts may never totally eliminate it. Waste material from mining operations and coal processing plants may cover existing vegetation or fill a drainage or small valley. This material may cause acid leaching to enter the soil profile even after restoration. This problem cannot always be mitigated.

The major underground mine characteristic that cannot be completely avoided is subsidence. Degree of subsidence depends on mining methods, thickness of seams, and depth from the ground surface. Old or new workings can collapse at any time and it is not always possible to predict the rate of subsidence. It may affect the water table, crack foundations of surface structures and cause land areas to sink.

Coal mining activities will not be compatible with other uses of the land while they are in progress and cannot be totally mitigated. These sites will be used only for that particular phase of coal mining. Restoring areas of disturbance can mitigate some of the adverse impacts upon the environment, but not necessarily those land uses which existed prior to disturbance. Wildlife habitat and recreational areas which may have existed prior to coal mining activities will be destroyed and cannot be restored to their original condition. However, it is possible that other, more beneficial uses of the land can be created by restoration actions.

(3) Water

Some sediment may be produced by all coal mining activities which may adversely affect water quality. The amount of sedimentation produced after mitigation from any one action on a specific area will vary with conditions. Like erosion, this effect may not be entirely eliminated. Actions which change the topography of an area change the surface drainage patterns, possibly adding to the sediment load of water bodies in the area.

It is possible that some acid leaching to streams or ponds from waste material can occur. This problem cannot always be mitigated, even after restoration. There is a possibility of damage to aquifers from subsidence and collapse of underground mine workings. The quality of water in these aquifers could be damaged and would present a situation that is virtually impossible to rectify.

Stream crossings, as a mitigating measure, are designed to decrease the amount of sedimentation in water courses. The act of constructing adequate stream-crossing structures will increase sediment load temporarily in the construction phase. However, unexpected peak flows may cause stream-crossing structures to fail. These climatic events may also cause failure of earthworks that contain settling ponds of protective berms and allow sediment and toxic material to reach streams, ponds and lakes.

Diversion of stream channels as a result of strip or underground mining may create a situation that cannot be mitigated entirely. Studies can be made to determine the environmental components present in the stream prior to diversion. These components can be added to the new channel but the original habitat conditions cannot be completely reestablished.

b. Living Components

(1) Plants

(a) Aquatic

Despite mitigative measures during all phases of coal mining, erosion and sedimentation of surface waters will occur from roads, drilling sites, strip and underground mining activities and construction of coal processing plants. Some damage to aquatic habitat will occur, the magnitude depending upon variables such as soil type, terrain and degree of development.

Some aquatic vegetation will be destroyed or buried by road construction at streams, marsh or lake crossings. The loss in productivity would depend on the magnitude of destruction and would be long-term in nature. This impact can be mitigated to some extent by replacing a similar amount of vegetation elsewhere in the local area.

Sedimentation of aquatic habitats may be increased above natural levels despite all mitigative efforts to prevent it.

(b) Terrestrial

Most impacts upon terrestrial plant life can be mitigated due to the climate, soil and terrain present in the region. Revegetation of areas disturbed as a result of great compaction, such as roads, operation facility sites and areas around processing plants, may require varying treatments and a longer length of time. This effect is usually temporary, but can become prolonged depending upon the amount of disturbance. The same is true in areas underlain at very shallow depths by materials not capable of supporting plant growth.

Impacts upon relatively small terrestrial habitat areas cannot be mitigated if lost. Restoration of sites damaged by mining activities will mitigate the long-term effects but use of these areas during or soon after rehabilitation may cause permanent damage.

(2) Animals

(a) Aquatic

The hazards to aquatic life from sediment pollution cannot be completely mitigated. After the initial facility construction period, erosion control measures and revegetation of unused areas will decrease the accelerated erosion. Sediment loads from the original construction will already be moving downstream and sediment from road drainages, poorly revegetated areas and additional construction activities will continue to cause some sediment pollution.

Disturbance of natural surface waters such as springs, ponds, lakes, marshes, and streams can adversely affect a variety of associated wildlife species. Some of these impacts will not be subject to mitigation. Heavy sedimentation can degrade spawning areas for certain species of fish. Stream crossings or other activity which introduce sediment into these water bodies could have the same effect. Leekage of toxic substances into these waters can occur and degrade their chemical and physical qualities. These impacts can diminish the overall habitat of the aquatic system by affecting small, localized habitat areas necessary to non-mobile species.

Any disruption of aquifers caused by the removal of coal will result in an unmitigated impact.

Changes in the habitat of endangered aquatic species as a result of coal mining activities cannot be mitigated entirely. Reduction of populations and carrying capacity may occur due to the increases in sediment load or toxic substances. This will degenerate their habitat and new conditions will exist which may be favorable to more tolerant species.

(b) Terrestrial

Depending on the type of action and severity of disturbance associated with it, some impacts upon terrestrial animals cannot be mitigated.

A temporary loss of wildlife and domestic livestock habitat is unavoidable during exploratory procedures. Most impacts, though, can be reduced by implementing mitigating measures. Travel on roads, drill site construction and movement of exploration equipment may cause displacement of wildlife. These losses will be relatively insignificant because of the extent and duration of the operation.

The impact on wildlife from mine facility development cannot be mitigated in the immediate area of the facilities during the life of the mine. During construction and operation, wildlife species and habitat will be displaced or destroyed. Mitigation through habitat restoration cannot be accomplished until the facilities are removed; and usually this cannot occur until some time after restoration. Effects on some species, such as those which are listed as endangered, may be permanent depending upon the type of restoration procedures used.

Hazards to wildlife from roads, railroads, fences or powerlines cannot be completely mitigated. These structures will have a residual impact never fully erased because of unavoidable killing of some animals and the persistance of the barrier to movements of others.

Secondary impacts upon adjacent wildlife populations and habitat may be completely unavoidable. Coal mining activities may force resident populations into these contiguous areas, thus affecting carrying capacities and increasing forced interactions among those species already present.

c. Ecological Interrelationships

Any action that alters the abiotic environment or biotic community can influence ecological relationships to some degree. Mitigating measures cannot be entirely effective. Regardless of all feasible precautions, some activities will disrupt the natural balance of the ecosystem.

Actions that destroy vegetation, disrupt the soil, affect water quality and pollute the air will upset ecological interrelationships. Affects upon nutrient cycling and the hydrologic cycle will remain until the disturbed area is revegetated or the source of disruption is removed. Some areas, where fragile ecosystems are present, will be slow to recover. Mitigating measures cannot immediately or completely restore these areas to their former state.

d. Human Values

(1) Landscape Character

Coal mining operations will have some adverse impacts upon landscape character which cannot be mitigated. Roads and access systems can be built such that they blend in with the topography and are screened by vegetation. However, the uninterrupted character of the area will be disrupted by travel on these routes. This cannot be mitigated entirely.

Actions that disturb the surface to a large extent will create a similar impact. Previously undeveloped areas will be cluttered with a variety of uses that will affect the rural setting and increase the potential for unavoidable impacts.

Restoration may not heal these impacts totally. Alteration of harmonious and accentuating values will result from coal mining activities, and restoration actions can only attempt to heal those values and qualities that we cherish and seek.

(2) Sociocultural Interests

One major risk involved in coal mining activities is the accidential destruction of uninventoried archeological, paleontological, historical and cultural features. Mitigating measures are designed to identify and protect these values. The danger lies in the fact that some of these features are not easily detected and thus risk damage. Operations can be stopped upon detection of these sites, however, at this point protective measures may be too late.

An area of high concern is the influx of people associated with increased activity in the area. This sudden increase of people living and recreating on the land will degrade open space, wildland aesthetics and displace wildlife and reduce habitat. The increased flow of money and added tax base from an increase in population will better the social welfare of the community. However, this creates demands for homesites, utilities, water, roads, recreation facilities which will bring about many changes within undeveloped rural settings. This creates a situation where unavoidable impacts may develop.

B. Relationships Between Short-Term Use and Long-Term Productivity

Under the present coal leasing procedure it is possible for a lease to be issued without having environmental disturbance on the lease. However, in this situation no coal would be mined. Normally, if a coal lease is issued it is anticipated coal removal will occur.

The length of time for coal exploration, development production, and rehabilitation varies with each site and each proposal. Plans for such activities can involve a portion of one lease or a combination of leases.

Environmental impacts which result from prospecting permits are generally short lived lasting only a few days to a few weeks with the exception of situations where vegetation and/or topsoil are removed. In such situations, a longer time span of environmental disturbance occurs. Upon completion of landscaping and seeding, reestablishment of a vegetative cover (generally grasses and forbs) can be expected within a year in this 44 inch rainfall area. Reestablishment of a dense vegetative cover or a tree cover would take considerably longer to regain previous productivity. The prospecting activities generally occur for a few weeks to a few months depending on the size of the area to be examined and the intensity of data needed.

Strip mining activities have much larger impacts and require considerably longer periods of rehabilitation. Total ecosystems are destroyed or altered in this process. By law (The Mining Lands Reclamation Act for Oklahoma) all grading shall be completed within one year after mining and initial seeding and planting at the first appropriate time following completion of grading. The period of time an area is used for strip mining is normally about one year with a year to grade, replace topsoil, seed and a year for plant growth and establishment. This is an average of three years before other economic uses can start to occur on the mined lands.

If the area, prior to strip mining, was in a grass pasture, it can be expected that it could be returned to grazing use within three to five years after the start of mining. Returning an area to dense vegetation or timber stands takes considerably longer and is normally not practiced in this area. Productivity of the destroyed ecosystem would require complete reestablishment.

Due to good precipitation, long growing seasons, and suitable topography, good livestock stocking rates are possible in most of the grazing areas. Because such favorable conditions exist the livestock industry is of major importance in the economy of southeastern Oklahoma. Strip mine areas are now usually returned to a condition suitable for grazing under the State Mining Lands Reclamation Act.

Underground mining has only a small surface affect compared to strip mining. The mine mouth and associated equipment and machinery takes relatively small areas, but the impacts on that area are almost total and eliminates nearly all other uses except mining. The life of an underground mine in this area is unknown since there are no operating mines at present and the recent past two efforts at underground mining have been unsuccessful. Rebuilding productivity of the ecosystem could take many years once an underground mine is closed.

Highwall pits and access such as roads, railroads and rights-of-way that are of a permanent nature have long-term impacts on productivity. Such developments either obstruct normal movement and migration of wildlife and livestock or place serious hazards in their path.

Wildlife dependent upon natural conditions will be affected by loss or reduction of water quality, aquatic habitat, food, cover, solitude, critical habitats, migration routes, and mobility of individual species. In the case of exploration, the above impacts are short-term. However, the impacts of strip mining, deep mining and processing plants are long-term in that the existing habitat is completely destroyed. Restoration of these sites will be beneficial, but reclaimed areas cannot replace conditions existing prior to surface disturbance. However restoration procedures can include planning for other uses in the area such as airstrips, lakes, parks, etc.. This action can subsequently lower the affects of coal mining through increased long-term use of the land.

Sedimentation of aquatic ecosystems may be increased above natural levels despite efforts to mitigate or prevent it. The long-term effects of excessive sedimentation on production such as from accidents are often more serious to aquatic plants and invertebrates in shallow water habitats than the short-term effects from a single pollution kill.

After an underground mine is closed and surface rehabilitation starts, the time frame is similar to that of strip mining for revegetation and establishment of other surface uses. Restoration of these sites will not return them to their former productivity, but it can allow for generation of other uses for the land.

Areas involving coal preparation plants are similar to those of underground mine operations in that there is normally a small area involved and building machinery and equipment are present. The time a specific area or site is occupied by a preparation plant is normally longer. This is due to the fact that such plants can process coal from both strip and underground mines. All that is necessary is that the mined coal be transported to the plant for processing. A coal mine area which was transporting coal to a preparation plant could be mined out, closed and rehabilitated and coal from another mine or a new mine could be sent to the same preparation plant used by the previous mining operations; thus, maintaining the use and life of the preparation plant over a longer period of time.

Rehabilitation of coal preparation plant sites are similar in nature to that of underground mine operations and can be expected to take a similar amount of time.

One area of long-term effects exists in underground mining. This is subsidence. Little is known about it in this area especially as to the degree to which it will occur and from what depth of mining it will occur. If subsidence does occur, it could produce long-term risk and danger to surface actions, activities and resource values.

Some non-coal values would be lost during the mining process such as the aesthetic value of a natural scenic area, livestock forage and the wildlife habitat used by the various wildlife species. Air pollution is expected to increase in the area of operation and expected to be present to some degree until restoration processes are completed.

Effects of mining on ground water are unknown for this area. It is possible to contaminate ground water sources with improper drilling and mining practices. Generally, it is possible to control contamination of surface water sources with proper protection measures. Under normal conditions contamination of surface waters is not expected to occur.

Without proper inventory and planning it is possible that historical, archaeological, endangered wildlife, and other critical habitat values could be lost during the short-term use of coal mining and associated activities.

In summary, when coal activities such as mining or preparation plant construction are started, it can be expected that there will be no other uses other than those involved in the coal mining activities. Following restoration the disturbed area will be returned to other uses which are acceptable to the existing surface owner.

C. Irreversible and Irretrievable Commitment of Resources

Coal when mined is an irreversible and irretrievable commitment of a resource. Once it is removed it cannot be replaced.

Coal which is allowed to remain in place for one reason or another is also considered to be lost for other uses. In strip mining, the coal that is not recovered is about 15%. In underground mining, the coal that is not recovered is about 50% which means this amount of coal stays in the ground.

With the present technology available now and in the foreseeable future it is very unlikely that reentry would occur on either the strip or underground mines after completion of the initial mining operation.

Surface values which are affected especially by strip mining are topography, geologic structure (including subsidence) and vegetation.

Surface values in this area which can have impacts mitigated to a large extent are soil erosion, vegetative removal, surface and subsurface waters, archeological and historical sites, and aesthetic values.

The loss of any endangered species and other critical wildlife habitats constitutes an irreversible and irretrievable commitment. Small, non-mobile species dependent on a limited habitat with only local distributions are vulnerable. Many species may be removed from the affected area for a long period of time. Most endangered species are found living in isolated and/or small habitat areas. These endangered species could be extirpated through loss of water supply, reduced water quality and vegetation removal. In these cases, the habitat could eventually recover, but the species would be lost.

Heavy industrial and domestic use of water may lower water tables and drain marshes and other wetlands. Water pollution in violation of lease stipulations could cause irretrievable changes in aquatic habitat when stream channels, lakes, marshes, or reservoirs become filled with sediments have increased chemical concentrations. The habitats would no longer be capable of producing the quantities and the diversity of wildlife which may be displaced or permanently lost.

Discovery of coal and subsequent mining operations which may result in permanent urban development and construction of roads, railroads are irretrievable commitment of resources. These activities result in a loss of habitat, loss of grazing lands, increased human activity and a loss or displacement of animal life. Roads and railroads particularly at water crossings generally constitute a minor irretrievable loss of vegetation if plants cannot be reestablished.

V. Persons, Groups and Government Agencies Consulted

In order to obtain ideas, information, and opinions of sources outside the Bureau of Land Management two methods were utilized. One method was a personal interview by a member or members of the interdisciplinary team. The interview method was not used a great deal due to the limited time and travel money. The other method used was mailing letters, requesting a response, to persons or groups who may be interested in commenting on coal leasing or mining. Attachment 15 contains a copy of the letter mailed and the mailing list used and the responses received. The following is a summary of the request for information and the responses received as a result of the request.

	Letter Sent to	Written Response Received	Interviewed
State and Local Agencies	22	1/9	2/2
Federal Agencies and Offices	11	2/6	2/4
Coal Lessee	12	1	1
Groups or Individuals	3/366	9	-
Total	411	25	7

1/ One agency was interviewed and also provided a written response This was Kiamichi Economic and Development District of Oklahoma, Wilberton, Oklahoma.

2/ Two agencies were interviewed and also provided written response This was U.S.G.S. McAlester, Oklahoma and U. S. Bureau of Mines, Oklahoma City, Oklahoma.

3/ A total of 377 letters were mailed, however, 11 letters were returned to BLM marked "Returned Not Deliverable".

VI. Intensity of Public Interest

While the volume of response to BLMs efforts to obtain outside imput was not large there was one thought throughout most of the responses. It was that with proper surface protection and restoration requirements, coal mining could be allowed without appreciable harm to the environment.

There were some variations to the above thought and they are as follows:

Oklahoma Archeological Survey - Recommended that an archeological survey be completed of all lands under the control of BLM prior to allowing any leases.

Oklahoma Historical Society - Recommends that a survey of sites potentially suitable and qualified for National Register Status be done prior to the publishing of the Environmental Impact Study and the results included in the impact statement.

Kiamichi Economic Development District of Oklahoma - Suggested an outline procedure to include: (1) gathering and recording resource data which is put into a retrieval system, and (2) conducting a series of public forums to discuss actions and consequences of opening federal coal reserves to the mining industry. This was followed by implicit steps to achieve the above and a recommendation that funds be made available for study purposes at the state and substate level.

Department of the Army - Corps of Engineers - Identified two possible future projects which could be affected by coal mining operations.

Environmental Protection Agency - Expressed concern on air, water and noise pollution and abatement especially in the areas of soil erosion and revegetation.

Bureau of Outdoor Recreation - Provided locations of projects in the area which have received BOR monies and cannot be converted to uses other than outdoor recreation.

One field trip involving the strip mining and reclamation procedures was held on September 18-19, 1974. This trip was hosted by Bureau of Mines, Liaison Officer Robert H. Arndt, Oklahoma City, Oklahoma. A copy of Mr. Arndt's memorandum concerning the field trip and a list of participants is in Attachment 15 under Federal Agencies and Offices.

There were 34 participants listed in attendance which represented a cross section of interest in state and federal governments, private coal industry, and concerned interest groups such as the Sierra Club, Oklahoma Wildlife Federation, and The League of Women Voters.

The field trip was designed to give participants first hand knowledge of conditions present in "Orphan mine" sites (See Part I. G for discussion on Orphan mines) and what can be accomplished in land reclamation. The knowledge gained is to be used in drafting improvements and changes for Oklahoma Mined Lands Reclamation Act. (See for a copy of the Act). Observers found that many of the older strip mined areas which had reestablished some form of vegetative cover were serving as wildlife habitat for a variety of terrestrial and aquatic species and in some cases needed no additional reclamation treatment. They also found that it is possible to do land reclamation successfully in southeastern Oklahoma in a variety of different ways which accomplish restoration of the land to a useful purpose.

VII. Participating Staff

Lloyd Eisenhauer - Area Manager
John B. Rhodes - Mining Engineer
George B. Hollis - Wildlife Biologist
Robert C. Nauert - Natural Resource Specialist - Oklahoma
Robert E. Armstrong - Environmental Coordinator
Leo L. Flynn - Archeologist
Cassandra Richards - Archeologist
Charles R. Frost - Surface Protection Specialist

VIII. Recommendation On Environmental Statement

Coal mining has been a part of the history of southeastern Oklahoma for almost 80 years since the 1890's. This is evidenced by the numerous orphan mine sites found throughout the area. People in the region have mined coal for personal use and for economic gain. Until recently, restoration of the surface was not considered necessary nor a part of the mining process. As concern for conservation of the nations resources grew, opinions were formed in relation to restoration of the surface environment following coal mining activities. Today, coal mining is still a part of southeastern Oklahoma, but concern for the environment also exists. Federal and state laws have been passed to protect the environment and restore the surface after mining activities have ceased. The public input that we have received concerning coal mining activity expresses the following thought; that the mining of Oklahoma's coal resources should continue as long as proper surface restoration procedures are taken after coal mining is concluded.

The abiotic factors-topography, soil and climate - found in this region are quite favorable for surface restoration. The combination of these factors along with proper restoration procedures can allow for sufficient rehabilitation of the surface subsequent to mining activities. Furthermore, with the inclusion of appropriate recommended stipulations, impacts on cultural resources, wildlife, plant life and identified human values can be sufficiently mitigated.

Based upon the preceeding conclusions it is recommend that an Environmental Impact Statement not be prepared.

IX. Signatures

Interdisciplinary Team Members

Robert E Armstrong
Robert E. Armstrong-Environmental Coord. 4/15/75
Date

George B. Hollis
George B. Hollis-Wildlife Biologist 4/15/75
Date

John B Rhodes
John B. Rhodes-Mining Engineer 4/15/75
Date

Robert C. Nauert
Robert C. Nauert-Nat. Resource Spec. 4/15/75
Date

Approved by: ____________________ 4/16/75
Assistant District Manager Date

X. Appendix of Attachments

Attachment 1 - Status Map - Show Outline of Federal Coal Reserves in southeastern Oklahoma.

2 - Oklahoma State Law - "The Mining Lands Reclamation Act"

3 - Secretarial Order #2948, October 6, 1972

4 - Oklahoma Guideline between Bureau of Land Management and U.S. Geological Survey

5 - Soil - Southeastern Oklahoma

6 - Surface Water Records

7 - Aquatic Plant Species Found in Eastern Oklahoma

8 - Distribution of Habitat Types - Biotic Districts

9 - Terrestrial Plant List

10 - List of Mammals Adapted to the Area of Federal Coal Reserves

11 - List of Birds Adapted to the Area of Federal Coal Reserves

12 - List of Fishes Adapted to the Area of Federal Coal Reserves

13 - List of Reptiles and Amphibians Adapted to the Area of Federal Coal Reserves

14 - Lists of Invertebrates species for the Area of Federal Coal Reserves

15 - Public and Agency Response

16 - REA Bulletin 61-10 and Powerlines and Birds of Prey

XI. List of Tables

XII. List of Figures

XIII. REFERENCES

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XIV. ENVIRONMENTAL ANALYSIS WORKSHEETS

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action
Prospecting Permits

2. Stages of implementation
Access | Drilling

4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	3. DISCRETE OPERATIONS / 5. ANTICIPATED IMPACTS: Survey	Clearing	Construction	Drill Site Construction	Drilling-Air&Mud	6. REMARKS
I. NONLIVING COMPONENTS						
A. AIR						
Air movement patterns 1)		L				1)in areas where dense vegetation
Temperature 1)		L				is removed and/or rough terrain
Particulate Matter		-L	-L	-L	-L	
B. LAND						
Soil structure 2)		X	-L3)	-L3)	X	2) on site
Soil nutrient properties					L4)	
Soil Pollutant properties					X	3) medium to high in rough terrain
Soil erosion		-L	-L	-L		and heavy vegetation
Geologic structure					X	4)type of drill mud
Land Use Compatibility		L		-L1)	X5)	
Land Use Suitability		L6)		-L	-L	5)noise and dust
						6) dependent on specific locality
C. WATER						
Hydrologic Cycle		X7)	X7)	X7)		7)negligable on macro climate;
Sediment Load		-L	-L	-L		high on microclimate
Chemicals, Etc.					L4)	
Acid Balance 8)					X	8)on or by live streams or ponds
Temperature		-L		-L	X	(type of drill mud)
II. LIVING COMPONENTS						
A. PLANTS *(Aquatic)* 8)						
		X	X	X	X	

(Continued on reverse)

Form 1790-3 (June 1974)

	DISCRETE OPERATIONS	Access			Drilling		
		Survey	Clearing	Construction	Drill Site Construction	Drilling-Air&Mud	
	COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	ANTICIPATED IMPACTS					REMARKS
II. LIVING COMPONENTS (Cont.)	B. PLANTS (Terrestrial)						
	Grasses		-H		-H		
	Forbs		-H		-H		
	Shrubs		-H		-H		
	Conifers		-H		-H		
	Broadleaf Trees		-H		-H		
	C. ANIMALS (Aquatic)						
	Mammals, Birds, Amp.,& Rept.,		-M	-M	-M	-M	
	Fish, Invert, & Zooplankton		-L	-L	-L	-L	
	D. ANIMALS (Terrestrial)						
	Mammals		-L	-L	-L	-L	
	Birds		X	X	X	X	
	Reptiles & Invertebrates		-L	-L	-L		
	Man		-L	-L	-L	-L	
III. INTERRELATIONSHIPS	A. ECOLOGICAL PROCESSES 4)						
	Succession		-H		-H		
	Food Relationships		-H 1)		-H 1)		
	Community Relationships		-L 9)		-L 9)		9) where veg. is removed
IV. HUMAN VALUES	A. LANDSCAPE CHARACTER						
	Harmonious Element		-L 1)	-L 1)	-L 1)	-L 10)	10) Noise
	Accentuating Element		-L	-L	-L	-L	
	B. SOCIOCULTURAL INTERESTS						11)
	Educational-Scientific 11)		X	X	X	+H 12)	Geologic,paleontogical.
	Cultural		X	X	X		ecological, hydrological, archeolo-
	Social Welfare	+L 13	+L 13	+L 13	+L 13	+L 13	gical, historical
	Attitudes & Expectations	M	M	M	M	M	12) Geology
	Local Regulatory Structures 14)	L	L	L	L	L	13) increase local income
							14) state of Oklahoma

INSTRUCTIONS

1. *Action* – Enter action being taken, analytic step for which worksheet is being used, environmental viewpoint of impact, and any assumptions relating to impact.
   a. Worksheet is normally used to analyze *"Anticipated Impacts"* of action; *however*, it may be used to analyze *"Residual Impacts."* Worksheets may also be used to compare impacts before and after mitigating measures are applied.
   b. State viewpoint that best describes environmental impact. For example, a fence viewed down the fence line has greater impact than the same fence viewed over an entire allotment. Generally, narrow viewpoints better illustrate specific impacts than will broad viewpoints.
   c. Assumptions may be made to establish a base for analysis *(e.g. estimated time periods, season of year, etc.)*.

2. *Stages of Implementation* – Identify different phases of proposed project *(e.g. a road project consists of survey, construction, use, and maintenance stages)*.

3. *Discrete Operations* – Identify separate actions comprising a particular stage of implementation *(e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing)*.

4. *Elements Impacted* – Enter under appropriate heading all environmental elements susceptible to impact from action and alternatives. Relevant elements not contained in the digest should also be entered. See BLM Manual 1791, Appendix 2, Environmental Digest.

5. *Anticipated Impact* – Evaluate anticipated impact on each element and place an entry in the appropriate square indicating degree of impact as low (L), medium (M), high (H), no impact (O), or unknown or negligable (X). Preceed each entry by a plus (+) or minus (-) sign indicating a beneficial or adverse type of impact. If type of impact reflects a matter of opinion or is not known, *do not* preceed with a sign. For exomple, construction of a wind mill on open range has a definite visual impact, *however*, to some people the effect is detrimental while to others it is an improvement. By not entering a plus (+) or minus (-) sign the worksheet is kept factual and unbiased. If both degree and type of impact are unknown, place an (x) in the appropriate square.
   a. The measures of impact *(e.g. low, medium, and high)* are relative and their meaning may vary slightly from action to action. The term *"low"* should not be applied to impacts of a negligible nature. For example, we know that a pickup truck driving down a proposed fence line loying wire hos some impact on air quality. However, the significance of this impact is not normally great enough to warrant even a *"low"* rating. In cases like this, the impact will usually be marked "O" or the element left off the worksheet.
   b. It is recognized that some environmental elements may defy accurate measurement or in-depth analysis within current Bureau capabilities or expertise. The nature of the action as well as type and degree of impact should guide in the decision to seek outside expertise or assistance.

6. *Remarks* – Enter clarifying information.

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action

Prospecting Permits and Intensive Drilling

2. Stages of implementation

Restoration

3. DISCRETE OPERATIONS

4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	5. ANTICIPATED IMPACTS Surface cleanup (Litter&Debris)	Landscaping	Seedbed Preparation	Fertilizer Application (action)	Seeding & result	Post-Site Evaluation	6. REMARKS
I. NONLIVING COMPONENTS							
A. AIR							
Air movement patterns 1)					L		
Temperature 1)			L		L		
Particulate Matter		-L	-L		+L		
B. LAND							
Soil structure 2)		+L	+L		+L		
Soil nutrient properties				+L			
Soil pollutant properties				+L			
Soil erosion		+L	+L		+L		
Geologic structure							
Land Use compatibility	+L	+L			L		
Land Use suitability	+L	+L			+L		
C. WATER							
Hydrologic Cycle		X	X		X 7)		
Sediment Load 2)		+L	+L	X 15	+L		15)Negligable affect until ground cover is established
Acid Balance 8)				X			
Temperature				X	+L		
Chemicals, Etc.				+L			
II. LIVING COMPONENTS							
A. PLANTS *(Aquatic)*							

(Continued on reverse)

Form 1790-3 (June 1974)

Restoration

		Surface cleanup (Litter&Debris)	Landscaping	Seedbed Preparation	Fertilizer Application	Seeding	Post-Site Evaluation	
	DISCRETE OPERATIONS							
	COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	ANTICIPATED IMPACTS						REMARKS
II. LIVING COMPONENTS (Con.)	B. PLANTS (*Terrestrial*)							
	Grasses	+L	+L	+M	+M	+M		
	Forbs	+L	+L	+M	+M	+M		
	Shrubs	+L	+L	+M	+M	+M		
	Conifers	+L	+L	+M	+M	+M		
	Broadleaf Trees	+L	+L	+M	+M	+M		
	C. ANIMALS (*Aquatic*) 8)							
	Mammals, Birds, Amph,&Rept.					+L		
	Fish, Invert, & zooplankton					+L		
	D. ANIMALS (*Terrestrial*)							
	Mammals					+L		
	Birds					+L		
	Reptiles&Invertebrates					+L		
	Man					+L		
III. INTERRELATIONSHIPS	A. ECOLOGICAL PROCESSES							
	Succession					+M		
	Food Relationships				+L	+H		
	Community Relationships					+L		
IV. HUMAN VALUES	A. LANDSCAPE CHARACTER							
	Harmonious Element	+L	+L			+L		
	Accentuating Element	+L	+L			+L		
	B. SOCIOCULTURAL INTERESTS 11) Educational-Scientific					+L 16		16) Ecological info.
	Cultural							
	Social-Welfare	+L 13	+L 13	+L 13	+L 13	+L 13	+L 13	
	Attitude&Expectations	+M	+M	+M	+M	+M		
	Local Regulatory structures 14	+L	+L	+L	+L	+L		

INSTRUCTIONS

1. *Action* – Enter action being taken, analytic step for which worksheet is being used, environmental viewpoint of impact, and any assumptions relating to impact.
   a. Worksheet is normally used to analyze "*Anticipated Impacts*" of action; *however*, it may be used to analyze "*Residual Impacts.*" Worksheets may also be used to compare impacts before and after mitigating measures are applied.
   b. State viewpoint that best describes environmental impact. For example, a fence viewed down the fence line has greater impact than the same fence viewed over an entire allotment. Generally, narrow viewpoints better illustrate specific impacts than will broad viewpoints.
   c. Assumptions may be made to establish a base for analysis *(e.g. estimated time periods, season of year, etc.)*.

2. *Stages of Implementation* – Identify different phases of proposed project *(e.g. a road project consists of survey, construction, use, and maintenance stages)*.

3. *Discrete Operations* – Identify separate actions comprising a particular stage of implementation *(e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing)*.

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6. *Remarks* – Enter clarifying information.

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action

Coal Lease - Strip Mining

2. Stages of implementation

Access | Operation Facilities

3. DISCRETE OPERATIONS

	4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	5. ANTICIPATED IMPACTS Roads	Railroads	Clearing	Site Preparation	Construction	6. REMARKS
I. NONLIVING COMPONENTS	A. AIR						
	Air movement patterns 1)	L	L	L			1) On site
	Temperature 1)	-M2)	-M2)	-M2)			2) Surface air layer
	Particulate Matter	-M3)	-L3)4)	-M3)	-M3)		3) Vicinity of work area
	Carbon Monoxide	X	X	X	X		4) During construction
	Hydrocarbons	X	X	X	X		
	B. LAND						
	Soil Depth 1)	-H	-H	-L	-H		
	Soil Structure 1)	-H	-H	-M	-H		
	Soil Nutrient Properties	-L	-L	-L			
	Soil Pollutant Properties		-L5)			X	5) If Herbicidal weed control used
	Soil Erosion	-M	-L	-M	-M		
	Geologic structure						
	Land Use Compatibility	M	-M	H	-H	-H	
	Land Use Suitability	-L6)	-L6)	-L6)	-M6)	-L6)	6) Short-term time frame
	C. WATER						
	Hydrologic cycle	X7)	X7)	X7)	X7)	X7)	7) Low on macroclimate, high on
	Sediment Load	-L	-L	-M	X		microclimate
	Dissolved Solids	X	X	X	X	X	
	Chemicals, Etc.	-L8)	-L8)	X	X	X	8) if sprayed to control weeds
	Nutrients			X			
	Acid Balance (pH)						
	Temperature	X	X	-L			
II. LIVING COMPONENTS	A. PLANTS *(Aquatic)*						
	All plants considered	-L9)	-L9)	-M	-L		9) high in aquatic zones
	as group - growing in						
	water medium						

(Continued on reverse)

Form 1790-3 (June 1974)

DISCRETE OPERATIONS	Access			Operation Facilities		
	Roads	Railroads	Clearing	Site Preparation	Construction	
COMPONENTS, SUBCOMPONENTS AND ELEMENTS IMPACTED	ANTICIPATED IMPACTS					REMARKS
II. LIVING COMPONENTS (Con.)						
B. PLANTS (Terrestrial) 1)						
Lichens and Mosses	-H	-H	-H			
Grasses	-H	-H	-H			
Forbs	-H	-H	-H			
Shrubs	-H	-H	-H			
Conifers	-H	-H	-H			
Broadleaf Trees	-H	-H	-H			
C. ANIMALS (Aquatic)						10)
Mammals	-L[10]	-L[10]	-H	-L		high in aquatic zones
Birds	-L[10]	-L[10]	-H	-L		
Amphibians and Reptiles	-L[10]	-L[10]	-H	-L		
Fish	-L[10]	-L[10]	-L[10]	-L		
Invertebrates	-L[10]	-L[10]	-L[10]	-L		
Zooplankton	X	X	X	X		
D. ANIMALS (Terrestrial)						
Mammals	-M	-M	-H			
Birds	-M	-M	-H			
Reptiles and Amphibians	-M	-M	-H			
Invertebrates (Insects)	-M	-M	-H			
Man	-L	-L	-L			
III. INTERRELATIONSHIPS						
A. ECOLOGICAL PROCESSES						
Succession	-H	-H	-H			
Food Relationships	-H	-H	-H			
Community Relationships	-H	-H	-H			
IV. HUMAN VALUES						
A. LANDSCAPE CHARACTER						
Harmonious	M	M	M	L	L	
Accentuating	M	M	H	L	L	
B. SOCIOCULTURAL INTERESTS						
Educational-Scientific	X	X	X	X	X	
Cultural Values	X	X	X	X	X	
Social Welfare	+M	+M	+M	+M	+M	
Attitude & Expectations	M	M	M	M	M	
Local Regulatory structure	+M	+M	+M	+M	+M	

INSTRUCTIONS

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   b. State viewpoint that best describes environmental impact. For example, a fence viewed down the fence line has greater impact than the same fence viewed over an entire allotment. Generally, narrow viewpoints better illustrate specific impacts than will broad viewpoints.
   c. Assumptions may be made to establish a base for analysis (*e.g. estimated time periods, season of year, etc.*).

2. *Stages of Implementation* – Identify different phases of proposed project (*e.g. a road project consists of survey, construction, use, and maintenance stages*).

3. *Discrete Operations* – Identify separate actions comprising a particular stage of implementation (*e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing*).

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   b. It is recognized that some environmental elements may defy accurate measurement or in-depth analysis within current Bureau capabilities or expertise. The nature of the action as well as type and degree of impact should guide in the decision to seek outside expertise or assistance.

6. *Remarks* – Enter clarifying information.

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action
Coal lease - Strip Mining

2. Stages of implementation
Mining

	3. DISCRETE OPERATIONS	Vegetative Removal	Topsoil Removal	Overburden Removal	Coal Removal	Water Removal	
	4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	5. ANTICIPATED IMPACTS					6. REMARKS
I. NONLIVING COMPONENTS	A. AIR						
	Air movement patterns 1)	-M11		-M			11) Dependent on type of veg.
	Temperature 1)	-M2)		-M2)			removed (dense)
	Particulate Matter	-M3)	-M3)	-H3)	X		
	Carbon Monoxide	X	X	X	X		
	Hydrocarbons	X	X	X	X		
	B. LAND						
	Soil Depth	-L	-H				
	Soil Structure	-M	-H				
	Soil Nutrient Properties	-L	-L				
	Soil Pollutant Properties				-L	-M	
	Soil Erosion	-M	-M	-M		-L	
	Geologic Structure			-H	-H		
	Land Use Compatibility	H	H	H	H	M	
	Land Use Suitability	-L6)	-H6)	-H6)	+H	-L	
	C. WATER						
	Hydrologic Cycle 1)	X	X	X	X	X	
	Sediment Load	-M	-M	-M12		-L	12) on first cut (stockpile of top-
	Dissolved Solids	-L13	-L13	-L13	-L13	-L13	soil)
	Chemicals, Etc.						13) ferric and ferrous sulfate,
	Nutrients	-L	-L			-L	ferrichy droxide
	Acid Balance (pH)				-L14	-L14	14) H_2SO_4 from low sulfur coal
	Temperature	-H15	-M15	-M15		X15	15) mining occurring across streams
							and near lakes
II. LIVING COMPONENTS	A. PLANTS *(Aquatic)*						
	All plants considered as	-H15				-M	
	a group - growing in a						
	water medium						

(Continued on reverse)

Form 1790-3 (June 1974)

Mining

DISCRETE OPERATIONS

	COMPONENTS, SUBCOMPONENTS AND ELEMENTS IMPACTED	Vegetative Removal	Topsoil Removal	Overburden Removal	Coal Removal	Water Removal	REMARKS
		ANTICIPATED IMPACTS					
II. LIVING COMPONENTS (*Con.*)	B. PLANTS (*Terrestrial*)						
	Lichens and Mosses	-H					
	Grasses	-H					
	Forbs	-H					
	Shrubs	-H					
	Conifers	-H					
	Broadleaf Trees	-H					
	C. ANIMALS (*Aquatic*) 16)						16)
	Mammals	-H	-M	-M		-L	in aquatic zones
	Birds	-H	-L	-M		-L	
	Amphibians & Reptiles	-H	-L	-M		-L	
	Fish	-H	-L	-M		-L	
	Invertebrates	-H	-H	-M		-L	
	Zooplankton	X	X	X		X	
	D. ANIMALS (*Terrestrial*)						
	Mammals	-H	X				
	Birds	-H	X				
	Reptiles-Amphibians	-H	X				
	Invertebrates (Insects)	-H	-H				
	Man	-L 17	X 17	-L	-L 17		17) Noise
III. INTERRELATIONSHIPS	A. ECOLOGICAL PROCESSES						
	Succession	-H	-H			X	
	Food Relationships	-H	-H			X	
	Community Relationships	-H	-H			X	
IV. HUMAN VALUES	A. LANDSCAPE CHARACTER						
	Harmonious	H	H	H		M	
	Accentuating	H	M	H		X	
	B. SOCIOCULTURAL INTERESTS						
	Educational-Scientific	X	X	+L	+L	X	
	Cultural Values	X	X	X		X	
	Social Welfare	+M	+M	+M	+M	+M	
	Attitudes and Expectations	M	M	M	M	M	
	Local Regulatory Structure	+M	+M	+M	+M	+M	

INSTRUCTIONS

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   b. State viewpoint that best describes environmental impact. For example, a fence viewed down the fence line has greater impact than the same fence viewed over an entire allotment. Generally, narrow viewpoints better illustrate specific impacts than will broad viewpoints.
   c. Assumptions may be made to establish a base for analysis (*e.g. estimated time periods, season of year, etc.*).

2. *Stages of Implementation* – Identify different phases of proposed project (*e.g. a road project consists of survey, construction, use, and maintenance stages*).

3. *Discrete Operations* – Identify separate actions comprising a particular stage of implementation (*e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing*).

4. *Elements Impacted* – Enter under appropriate heading all environmental elements susceptible to impact from action and alternatives. Relevant elements not contained in the digest should also be entered. See BLM Manual 1791, Appendix 2, Environmental Digest.

5. *Anticipated Impact* – Evaluate anticipated impact on each element and place an entry in the appropriate square indicating degree of impact as low (L), medium (M), high (H), no impact (O), or unknown or negligahle (X). Preceed each entry by a plus (+) or minus (–) sign indicating a beneficial or adverse type of impact. If type of impact reflects a matter of opinion or is not known, *do not* preceed with a sign. For example, construction of a wind mill on open range has a definite visual impact; *however*, to some people the effect is detrimental while to others it is an improvement. By not entering a plus (+) or minus (–) sign the worksheet is kept factual and unbiased. If both degree and type of impact are unknown, place an (x) in the appropriate square.
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6. *Remarks* – Enter clarifying information.

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action

Coal Lease - Strip Mining

2. Stages of implementation

Restoration

3. DISCRETE OPERATIONS		Surface cleanup (Litter & Debris)	Landscaping	Topsoil Replacement	Fertilizer Application	Seeding	Post Site Evaluation	
	4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	5. ANTICIPATED IMPACTS						6. REMARKS
I. NONLIVING COMPONENTS	A. AIR							
	Air Movement Patterns 1)		+M			X		
	Temperature 1)			+L^{2}		+L^{2}		
	Particulate Matter		-M	-M^{3}	X	+M^{3}		
	Carbon Monoxide	X	X	X	X	X		
	Hydrocarbons	X	X	X	X	X		
	B. LAND							
	Soil Depth			+L				
	Soil Structure			+L		+M		
	Soil Nutrient Properties			+L	+M	+M		
	Soil Pollutant Properties							
	Soil Erosion		+L	+L		+H		
	Geologic structure							
	Land Use Compatibility	+H	+H	+H	+L	+H		
	Land Use Suitability	+L	+H	+H	+L	+H		
	C. WATER							
	Hydrologic Cycle					X		
	Sediment Load		+M	-M^{18}		+M		18) without seeding (or until ground cover is established)
	Dissolved Solids					+L		
	Chemicals Etc.							
	Nutrients				+L			
	Acid Balance (pH)				+L	+L		
	Temperature			-L^{18}		+L		
II. LIVING COMPONENTS	A. PLANTS *(Aquatic)*							
	All plants considered as a group - growing in water medium				+L	+L		

(Continued on reverse)

Form 1790–3 (June 1974)

Restoration

	DISCRETE OPERATIONS	Surface cleanup (Litter & Debris)	Landscaping	Topsoil Replacement	Fertilizer Application	Seeding	Post Site Evaluation	
	COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	ANTICIPATED IMPACTS						REMARKS
II. LIVING COMPONENTS (Cont.)	B. PLANTS (Terrestrial)							
	Lichens and Mosses			X	X	X		
	Grasses			+M	+M	+M		
	Forbs			+M	+M	+M		
	Shrubs			+M	+M	+M		
	Conifers			+M	+M	+M		
	Broadleaf Trees			+M	+M	+M		
	C. ANIMALS (Aquatic)							
	Mammals					+L		
	Birds					+L		
	Amphibians and Reptiles					+L		
	Fish					+L		
	Invertebrates					+L		
	Zooplankton					X		
	D. ANIMALS (Terrestrial)							
	Mammals					+M		
	Birds			+L		+M		
	Reptiles-Amphibians			+L		+M		
	Invertebrates (Insects)			+L	+L	+M		
	Man					+M		
III. INTERRELATIONSHIPS	A. ECOLOGICAL PROCESSES							
	Succession			+L	+L	+M		
	Food Relationships			+L	+L	+M		
	Community Relationships			+L	+L	+M		
IV. HUMAN VALUES	A. LANDSCAPE CHARACTER							
	Harmonious	+H	+H	+L		H		
	Accentuating	+M	M	+L		+H		
	B. SOCIOCULTURAL INTERESTS							19)
	Educational-Scientific		+M[19]	+M[19]	+M[19]	+M[19]		Restoration process
	Cultural Values							
	Social Welfare	+M[20]	+M[20]	+M[20]	+M[20]			20) +H for entire operation
	Attitudes & Expectations	+M[20]	+M[20]	+M[20]	+M[20]			
	Local Regulatory structure	+M	+M	+M	+M			

INSTRUCTIONS

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   c. Assumptions may be made to establish a base for analysis (*e.g. estimated time periods, season of year, etc.*).

2. *Stages of Implementation* – Identify different phases of proposed project (*e.g. a road project consists of survey, construction, use, and maintenance stages*).

3. *Discrete Operations* – Identify separate actions comprising a particular stage of implementation (*e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing*).

4. *Elements Impacted* – Enter under appropriate heading all environmental elements susceptible to impact from action and alternatives. Relevant elements not contained in the digest should also be entered. See BLM Manual 1791, Appendix 2, Environmental Digest.

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6. *Remarks* – Enter clarifying information.

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action

Coal Lease - Underground Mining

2. Stages of implementation

Access | Operation Facilities

3. DISCRETE OPERATIONS	Roads	Railroads	Clearing	Site Preparation	Construction	
4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	5. ANTICIPATED IMPACTS					6. REMARKS
I. NONLIVING COMPONENTS						
A. AIR						
Air movement patterns 1)	L	L	L			1) On site
Temperature 2)	-M	-M	-M			2) Surface air layer
Particulate matter 3)	-M	-L	-M	-M		3) Vicinity of work area
Carbon Monoxide	X	X	X	X		
Hydrocarbons	X	X	X	X		
B. LAND						
Soil Depth 1)	-H	-H	-L	-H		
Soil Structure 1)	-H	-H	-M	-H		
Soil Nutrient Properties	-L	-L	-L			
Soil Pollutant Properties		-L4)			X	4) Spray for weed control; coal spill
Soil Erosion	-M	-L	-M	-M		
Geologic Structure						
Land Use Compatibility	M	-M	H	-H	-H	
Land Use Suitability 5)	-L	-L	-L	-M	-L	5) Short-term time frame
C. WATER						
Hydrologic cycle 6)	X	X	X	X	X	6) High on micro, low on macroclimate
Sediment Load	-L	-L	-M	X		
Dissolved Solids	X	X	X	X	X	
Chemicals Etc.	-L	-L	X	X	X	
Nutrients			X			
Acid Balance (pH)						
Temperature	X	X	-L			
II. LIVING COMPONENTS						
A. PLANTS *(Aquatic)* Considered as a group (only plants that are in water)	-L7)	-L7)	-M	-L		7) -H in aquatic zones

(Continued on reverse)

Form 1790-3 (June 1974)

	DISCRETE OPERATIONS	Access			Operation Facilities		
		Roads	Railroads	Clearing	Site Preparation	Construction	
	COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	ANTICIPATED IMPACTS					REMARKS
II. LIVING COMPONENTS (Con.)	B. PLANTS (Terrestrial)						
	Lichens and Mosses	-H	-H	-H			
	Grasses	-H	-H	-H			
	Forbs	-H	-H	-H			
	Shrubs	-H	-H	-H			
	Conifers	-H	-H	-H			
	Broadleaf trees	-H	-H	-H			
	C. ANIMALS (Aquatic)						
	Mammals	-L[7]	-L[7]	-H[7]	-L[7]		
	Birds	-L[7]	-L[7]	-H	-L		
	Fish	-L[7]	-L[7]	-L[7]	-L		
	Amphibians-Reptiles	-L[7]	-L[7]	-H	-L		
	Invertebrates	-L[7]	-L[7]	-L[7]	-L		
	Zooplankton	X	X	X	X		
	D. ANIMALS (Terrestrial)						
	Mammals	-M	-M	-H[1]			
	Birds	-M	-M	-H[1]			
	Reptiles-Amphibians	-M	-M	-H[1]			
	Invertebrates	-M	-M	-H[1]			
	Man	-L	-L	-L[1]			
III. INTERRELATIONSHIPS	A. ECOLOGICAL PROCESSES						
	Succession 1)	-H	-H	-H			
	Food Relationships 1)	-H	-H	-H			
	Community Relationships 1)	-H	-H	-H			
IV. HUMAN VALUES	A. LANDSCAPE CHARACTER						
	Harmonious	M	M	M	L	L	
	Accentuating	M	M	H	L	L	
	B. SOCIOCULTURAL INTERESTS						
	Educational-Scientific	X	X	X	X	X	
	Cultural Values	X	X	X	X	X	
	Social Welfare	+M	+M	+M	+M	+M	
	Attitudes and Expectations	M	M	M	M	M	
	Local Regulatory Structure[8]	+M	+M	+M	+M	+M	8) State regulations

INSTRUCTIONS

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action
Coal Lease - Underground Mining

2. Stages of implementation
Mining | Restoration

3. DISCRETE OPERATIONS

*may include stockpiling

3. DISCRETE OPERATIONS	*Coal and Waste Remove from Mine	Surface Cleanup Debris & Litter	Seedbed Preparation	Fertilizer Application	Seeding	Post-Site Evaluation	
4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	5. ANTICIPATED IMPACTS						6. REMARKS
I. NONLIVING COMPONENTS							
A. AIR							
Air movement patterns					L[1]		
Temperature	-L[2]				+M[2]		
Particulate Matter	-M[3]		-L[3]		+M		
Carbon Monoxide 4)	X	X	X	X	X		
Hydrocarbons 4)	X	X	X	X	X		
B. LAND							
Soil Depth 1)			+L				
Soil Structure			+L		+M		
Soil Nutrient Properties	-M	+L[9]	+L	+M	+M		9) Removal of coal waste from
Soil Pollutant Properties	-M	+L[9]					soil surface
Soil Erosion	X		+L		+H		
Geologic Structure	-H[10]						10) coal removal and subsidence
Land Use Compatibility	H	+H	+H	+L	+H		
Land Use Suitability	+H	+L	+H	+L	+H		
C. WATER							
Hydrologic cycle					X		
Sediment Load	-L	+L	+L[11]		+M		11) Negligable affect until
Dissolved Solids	-L				+L[12]		ground cover established
Chemicals Etc							12) Vegetal and soil modifications
Nutrients				+L			
Acid Balance (pH)	-L[13]			+L	+L[14]		13) Some H_2SO_4 from low sulfur coal
Temperature			X[11]		+L		14) Stabilizes environment for
							favorable plant growth
II. LIVING COMPONENTS							
A. PLANTS *(Aquatic)*							
Considered as a group	-L			+L	+M		

(Continued on reverse)

Form 1790-3 (June 1974)

DISCRETE OPERATIONS	Mining	Restoration					
	Coal and Waste Removal & Stockpiling	Surface Cleanup Debris & Litter	Seedbed Preparation	Fertilizer Application	Seeding	Post-Site Evaluation	
COMPONENTS, SUBCOMPONENTS AND ELEMENTS IMPACTED	ANTICIPATED IMPACTS						REMARKS
II. LIVING COMPONENTS (Con.)							
B. PLANTS (*Terrestrial*)							
Lichens and Mosses			+M	+M	+M		
Grasses			+M	+M	+M		
Forbs			+M	+M	+M		
Shrubs			+M	+M	+M		
Conifers			+M	+M	+M		
Broadleaf Trees			+M	+M	+M		
C. ANIMALS (*Aquatic*)							
Mammals	-L				+L		
Birds	-L				+L		
Fish	-L				+L		
Amphibians-Reptiles	-L				+L		
Invertebrates	-L				+L		
Zooplankton	X				X		
D. ANIMALS (*Terrestrial*)							
Mammals					+M		
Birds			+L		+M		
Reptiles-Amphibians			+L		+M		
Invertebrates			+L	+L	+M		
Man					+M		
III. INTERRELATIONSHIPS							
A. ECOLOGICAL PROCESSES							
Succession	-L 15		+L	+L	+M		15) Low impact on site from coal
Food Relationships	-L 15		+L	+L	+M		spills in aquatic sites
Community Relationships	-L 15		+L	+L	+M		
IV. HUMAN VALUES							
A. LANDSCAPE CHARACTER							
Harmonious	H	+H	+L		+H		
Accentuating	H	+H	+L		+H		
B. SOCIOCULTURAL INTERESTS 16)							16)
Educational-Scientific	+M	+M	+M	+M	+M		Restoration process in its
Cultural Values	X						entirity is of educational
Social Welfare	+M	+M	+M	+M	+M		value; other scientific finds
Attitudes and Expectations	M	M	M	M	M		
Local Regulatory Structure	+M	+M	+M	+M	+M		

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action (Plant may or may not be on lease)

Coal Lease - Coal Processing Plant

2. Stages of implementation

Access | Operation Facilities

3. DISCRETE OPERATIONS	Road	Railroad	Cleaning	Site Preparation	Construction	
4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	5. ANTICIPATED IMPACTS					6. REMARKS
I. NONLIVING COMPONENTS						
A. AIR						
Air Movement Patterns 1)	L	L	L		L	1) On Site
Temperatures 2)	-M	-M	-M		-L	2) Surface air layer
Carbon Monoxide	X	X	X	X	X	
Hydrocarbons	X	X	X	X	X	
Particulate Matter 3)	-M	-L	-M	-M	-L	3) Vicinity of work area
B. LAND						
Soil Depth	-H	-H	-L	-H		
Soil Structure	-H	-H	-M	-H		
Soil Nutrient Properties	-L	-L	-L			
Soil Pollutant Properties		-L[4]			X	4) Spray to control weeds
Soil Erosion	-M	-L	-M	-M		
Land Use Compatibility	M	-M	H	H	H	
Land Use Suitability	-L	-L	-L	-M	-L	
C. WATER						
Hydrologic cycle 5)	X	X	X	X	X	5) High on micro, low on macro
Sediment Load	-L	-L	-M	X		
Dissolved Solids	X	X	X	X	X	
Chemicals Etc.	-L	-L[4]	X			
Nutrients			X			
Acid Balance (pH)						
Temperature	X	X	-L			
II. LIVING COMPONENTS						
A. PLANTS *(Aquatic)*						
Considered as a group	-L[6]	-L[6]	-M	-L		6) Low overall; -H at all crossings or water

(Continued on reverse)

Form 1790-3 (June 1974)

DISCRETE OPERATIONS	Access		Operation Facilities			
	Road	Railroad	Clearing	Site Preparation	Construction	
COMPONENTS, SUBCOMPONENTS AND ELEMENTS IMPACTED	ANTICIPATED IMPACTS					REMARKS
II. LIVING COMPONENTS (Cont.)						
B. PLANTS (*Terrestrial*)						
Lichens and Mosses 1)	-H	-H	-H			
Grasses 1)	-H	-H	-H			
Forbs 1)	-H	-H	-H			
Shrubs 1)	-H	-H	-H			
Conifers 1)	-H	-H	-H			
Broadleaf trees 1)	-H	-H	-H			
C. ANIMALS (*Aquatic*)						
Mammals, Birds, Amph.&Rept.	-L	-L	-H	-L		
Fish and Invertebrates 7)	-L	-L	-L	-L		7) -H near aquatic areas
Zooplankton	X	X	X	X		
D. ANIMALS (*Terrestrial*)						
Mammals 1)	-M	-M	-H			
Birds 1)	-M	-M	-H			
Reptiles 1)	-M	-M	-H			
Invertebrate 1)	-M	-M	-H			
Man 1)	-L	-L	-L			
III. INTERRELATIONSHIPS						
A. ECOLOGICAL PROCESSES						
Succession 1)	-H	+H	-H			
Food Relationships 1)	-H	-H	-H			
Community Relationships 1)	-H	-H	-H			
IV. HUMAN VALUES						
A. LANDSCAPE CHARACTER						
Harmonious	M	M	M	L	L	
Accentuating	M	M	M	L	L	
B. SOCIOCULTURAL INTERESTS						
Educational-Scientific	X	X	X	X	X	
Cultural Values	X	X	X	X	X	
Social Welfare	+M	+M	+M	+M	+M	
Attitude and Expectations	M	M	M	M	M	
Local Regulatory Structure 8)	+M	+M	+M	+M	+M	8) State regulations

INSTRUCTIONS

1. *Action* – Enter action being taken, analytic step for which worksheet is being used, environmental viewpoint of impact, and any assumptions relating to impact.
   a. Worksheet is normally used to analyze "*Anticipated Impacts*" of action; *however*, it may be used to analyze "*Residual Impacts.*" Worksheets may also be used to compare impacts before and after mitigating measures are applied.
   b. State viewpoint that best describes environmental impact. For example, a fence viewed down the fence lino has greater impact than the same fence viewed over an entire allotment. Generally, narrow viewpoints better illustrate specific impacts than will broad viewpoints.
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2. *Stages of Implementation* – Identify different phases of proposed project (*e.g. a road project consists of survey, construction, use, and maintenance stages*).

3. *Discrete Operations* – Identify separate actions comprising a particular stage of Implementation (*e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing*).

4. *Elements Impacted* – Enter under appropriate heading all environmental elements susceptible to impact from action and alternatives. Relevant elements not contained in the digest should also be entered. See BLM Manual 1791, Appendix 2, Environmental Digest.

5. *Anticipated Impact* – Evaluate anticipated impact on each element and place an entry in the appropriate square indicating degree of impact as low (L), medium (M), high (H), no impact (O), or unknown or negligable (X). Preceed each entry by a plus (+) or minus (-) sign indicating a beneficial or adverse type of impact. If type of impact reflects a matter of opinion or is not known, *do not* preceed with a sign. For example, construction of a wind mill on open range has a definite visual impact, *however*, to some people the effect is detrimental while to others it is an improvement. By not entering a plus (+) or minus (-) sign the worksheet is kept factual and unbiased. If both degree and type of impact are unknown, place an (x) in the appropriate square.
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6. *Remarks* – Enter clarifying information.

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action (Plant may or may not be on lease)

Coal Lease - Coal Processing Plant

2. Stages of implementation: Plant Operation | Restoration

3. DISCRETE OPERATIONS	Processing	Waste-Solids	Waste-Liquids	Plant Salvage	Surface Cleanup Debris & Litter	Seedbed Preparation	Fertilizer Application	Seeding	Post-Site Evaluation	
4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	5. ANTICIPATED IMPACTS									6. REMARKS
I. NONLIVING COMPONENTS										
A. AIR										
Air Movement Patterns				L				L		
Temperature		X	X					+L		
Particulate Matter	-M	-L				-L		+M		
Carbon Monoxide	X	X	X	X	X	X	X	X		
Hydrocarbons	X	X	X	X	X	X	X	X		
B. LAND										
Soil Depth						+L				
Soil Structure						+L		+M		
Soil Nutrient Properties						+L	+M	+M		
Soil Pollutant Properties		-H								
Soil Erosion		-H	-L			+L		+H		
Land Use Compatibility		-M	M	+H	+H	+H	+L	+H		
Land Use Suitability		-M	M		+H	+H	+L	+H		
C. WATER										
Hydrologic cycle		X	X					X		
Sediment Load		-M	-H[9]			+L[10]		+M		9)if earthwork breaks
Dissolved Solids		-L	-M					+L		
Chemicals Etc.		-L	-L							10) Neglible affect until
Nutrients		X	X				+L			ground cover is established
Acid Balance (pH)		X	X							
Temperature		-L	X			X[10]		+L		
II. LIVING COMPONENTS										
A. PLANTS (Aquatic)										
Considered as a group			-L				+L	+M		

(Continued on reverse)

Form 1790–3 (June 1974)

		Plant Operation				Restoration						
	DISCRETE OPERATIONS	Processing	Waste-Solids	Waste-Liquids	Plant Salvage	Surface Cleanup	Debris & Litter	Seedbed Preparation	Fertilizer Application	Seeding	Post-Site Evaluation	
	COMPONENTS, SUBCOMPONENTS AND ELEMENTS IMPACTED		ANTICIPATED IMPACTS									REMARKS
II. LIVING COMPONENTS *(Con.)*	B. PLANTS *(Terrestrial)*											11)
	Lichens and Mosses		-H[11]	-H[9]			X	+M	+M			on disposed area
	Grasses		-H[11]	-H[9]			+M	+M	+M			
	Forbs		-H[11]	-H[9]			+M	+M	+M			
	Shrubs		-H[11]	-H[9]			+M	+M	+M			
	Conifer		-H[11]	-H9			+M	+M	+M			
	Broadleaf trees		-H[11]	-H9			+M	+M	+M			
	C. ANIMALS *(Aquatic)*											
	Mammals, Birds, Amph.&Rept		X	X					+L			
	Fish and Invertebrates		X	X					+L			
	Zooplankton		X	X					X			
	D. ANIMALS *(Terrestrial)*											
	Mammals	X	-H[11]	-H9					+M			
	Birds	X	-H[11]	-H9			+L		+M			
	Reptiles	X	-H[11]	-H9			+L		+M			
	Invertebrates	X	-H[11]	-H9			+L	+L	+M			
	Man	X	-H[11]	-H9					+M			
III. INTERRELATIONSHIPS	A. ECOLOGICAL PROCESSES											
	Succession		-H[14]	-H[15]			+L	+L	+M			
	Food Relationships		-H[14]	-H[15]			+L	+L	+M			
	Community Relationships		-H[14]	-H[15]			+L	+L	+M			
IV. HUMAN VALUES	A. LANDSCAPE CHARACTER											
	Harmonious	-H	-H[14]	L	+M	+M	+L		+M			
	Accentuating	H	-M[14]	L	L	+M	+L		+H			
	B. SOCIOCULTURAL INTERESTS											12)
	Educational-Scientific	L	X	X	X	+M[12]	+M[12]	+M[12]	+M[12]			Restoration process in
	Cultural Values	X	X	X	X							its entirety is educationec
	Social Welfare	+M	+M	+M	+M	+M	+M	+M	+M			and scientific
	Attitudes and Expectations	M	M	M	+M	+M	+M	+M	+M			
	Local Regulatory Structure	+M	+M	+M	+M	+M	+M	+M	+M			

8)

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APPENDIX
OF ATTACHMENT 1 thru 16
FOR SOUTHEASTERN OKLAHOMA COAL REGION
ENVIRONMENTAL ANALYSIS RECORD

ALBUQUERQUE DISTRICT
April 16, 1975

ATTACHMENT 1

Attachment #1

FEDERAL COAL RESERVES
OKLAHOMA


Sallisaw
ROBERT S. KERR
RESERVOIR
ARKANSAS
RIVER
Roland
Muldrow
Gans
Arkoma
Porum
Texanna
EUFAULA
EUFAULA RESERVOIR
CANADIAN
Briartown
Hoyt
Whitefield
Stigler
Garland
Keota
Stony Point
Spiro
Scullyville
Pocola
HASKELL CO
LE FLORE CO
Bokoshe
Milton
McCurtain
Panama
Tahona
Shady Point
Cameron
Enterprise
Quinton
Lewisville
Kinta
Lequire
Featherston
Poteau
OKLAHOMA
ARKANSAS
LE FLORE
SEBASTIAN
Red Oak
Fanshawe
Victor
Wister
Howe
Monroe
Panola
Wilburton
Fourche Maline
WISTER
RESERVOIR
POTEAU
RIVER
Heavener
T11N
T10N
T9N
T8N
T7N
T6N
T5N
R21E
R22E
R23E
R24E
R25E
R26E
R27E
95°00'
94°45'
94°30'
35°00'


Cabaniss
Arpelar
McAlester
Krebs
Alderson
Bache
Dow
Haileyville
Hartshorne
Wilburton
Kiowa
Pittsburg
Cottonwood
Coalgate
Lehigh
Atoka
COAL CO
T2N R11E
T1N R10E
T1N R11E
T1N R12E
T3N R12E
T4N R12E
T1S R9E
T1S R10E
T2S R10E
T2S
OUTLINES OF LANDS
143 Distu
140 Distu
157 Distu
(Numbers show total acre
bank
Paved State, Fe
Paved or unpa
to disturbed la
Highways
Federal Coa
Non-Federal

LEGEND

Outlines of Lands Disturbed During Surface Mining for Coal

143 Disturbed land, unreclaimed; ponds shown in blue

160 Disturbed land, partly reclaimed; ponds shown in blue

157 Disturbed land, reclaimed; ponds shown in blue

(Numbers show total acreage in each outlined tract of disturbed land, including spoil banks, haul roads, ponds, and highwalls)

Highways and Roads

Paved State, Federal, or Interstate highway

Paved or unpaved section-line road or access road; shown only adjacent to disturbed land; source, county road maps of Oklahoma Department of Highways

Federal Coal Reserves

Non-Federal Coal Reserves

ATTACHMENT 2

e/27/73.

THE MINING LANDS RECLAMATION ACT

Gov. Signed - 4/7/72

NOTE: Sub-titles have been provided by Department of Mines for convenience only and are not in printed statutes.

This Act is carried in the statutes as Chapter 8-A, Title 45, Oklahoma Statutes, 1971. Sections 723, 728 and 731 were amended by the second session of the 33rd Legislature; changes have been incorporated in this copy.

BE IT ENACTED BY THE PEOPLE OF THE STATE OF OKLAHOMA:

§721. Short Title. This act may be known and cited as "The Mining Lands Reclamation Act."

§722. Declaration of Policy. It is hereby declared to be the policy of this state to provide for the reclamation and conservation of land subjected to surface disturbance by mining and thereby to preserve natural resources, to encourage the productive use of such lands after mining, to aid in the protection of wildlife and aquatic resources, to encourage the planting of trees, grasses and other vegetation, to establish recreational, home and industrial sites, to protect and perpetuate the taxable value of property, to aid in the prevention of erosion, landslides, floods and the pollution of waters and air, to protect the natural beauty and aesthetic values in the affected areas of this state, and to protect and promote the health, safety and general welfare of the people of this state.

§723. Definitions. Whenever used or referred to in this act, unless a different meaning clearly appears from the context:

(a) "Overburden" means all of the earth and other materials which lie above natural deposits of minerals, and also means such earth and other materials disturbed from their natural state in the process of surface mining.

(b) "Mine" means an underground or surface excavation and development with or without shafts, slopes, drifts or tunnels for the extraction of minerals, with hoisting or haulage equipment and appliances for the extraction thereof, and shall embrace any and all of the land or property of the plant, and the surface and underground, that contribute directly or indirectly to the mining properties, concentration or handling of minerals.

(c) "Mining" means the extraction of minerals from natural deposits by any method or process.

(d) "Minerals" means asphalt, clay, coal, copper, granite, gravel, gypsum, lead, marble, salt, sand, shale, stone, tripoli, volcanic ash and zinc, or any other substance commonly recognized as a mineral, and includes ores or rock containing any such substances, but excludes oil, gas and any other mineral found naturally in a liquid or gaseous state.

(e) "Underground mining" means those mining operations carried out beneath the surface by means of shafts, slopes, tunnels or other openings leading to the mineral being mined and the extraction of the mineral through such shafts, slopes, tunnels or their openings.

(f) "Surface mining" means those mining operations carried out on the surface, including strip mining, auger mining, quarrying, dredging, pumping, or the use of hydraulic methods. Surface mining shall not include excavation or removal of shale, sand, gravel, clay, rock or other materials in remote areas by an owner or holder of a possessory interest in land for the primary purpose of construction or maintenance of access roads to or on such landowner's property. Surface mining shall not include excavations or grading conducted for forming, on-site road construction or other on-site construction, or the extraction of minerals other than anthracite and bituminous coal by a landowner for his own noncommercial use from land owned or leased by him; nor the extraction of such non-coal minerals for commercial purposes in an amount less than five hundred (500) tons per acre of aggregate or mass of mineral matter in any permit year; nor the extraction of sand, gravel, rock, stone, earth or fill from borrow pits for highway construction purposes, so long as such work is performed under a bond, contract and specifications which substantially provide for and require reclamation of the area affected in the manner provided by this act; nor to the handling, processing or storage of slag on the premises of a manufacturer as a part of the manufacturing process.

(g) "Strip mining" means those mining operations carried out by removing the overburden lying above natural deposits of minerals, and mining directly from such natural deposits thereby exposed, but excludes auger mining, quarrying, dredging, pumping or the use of hydraulic methods.

(h) "Reclamation" means conditioning affected land to make it suitable for any uses or purposes consistent with those enumerated in 45 O.S. 1971, §722, and to avoid, minimize or correct adverse environmental effects of mining operations.

(i) "Box cut" means the first open cut in strip mining which results in the placing of overburden on unmined land adjacent to the initial pit and outside the area to be mined.

(j) "Consolidated material" means material of sufficient hardness or ability to resist weathering and to inhibit erosion or sloughing.

(k) "Operator" means any person, partnership, firm or corporation engaged in and controlling a mining operation.

(l) "Pit" means a tract of land from which overburden or minerals have been or are being removed in the process of surface mining.

(m) "Affected land" means the area of land from which overburden shall have been removed, or upon which overburden or refuse has been deposited, or both.

(n) "Refuse" means all waste material directly connected with the production, cleaning or preparation of minerals which have been mined by either underground or surface mining method.

(o) "Ridge" means a lengthened elevation of overburden created in the surface mining process.

(p) "Peak" means a projecting point of overburden created in the surface mining process.

(q) "Department" means the office of the Chief Mine Inspector, herein called the Department of Mines and Mining, or such department, bureau or commission as may lawfully succeed to the powers and duties of such department.

(r) "Director" means the Chief Mine Inspector of the State of Oklahoma or such officer, bureau or commission as may lawfully succeed to the powers and duties of such Chief Mine Inspector.

§724. Permits--Application--Bond.

(a) Necessity for Permit. It shall be unlawful for any operator to engage in any mining operations in this state without first obtaining from the Department a permit to do so for each separate mining operation in such form as is hereinafter provided. The Department shall determine what constitutes a separate mining operation by rules and regulations promulgated under this act.

(b) Application for Permit by Operator of Surface Mine. Any operator desiring to engage in surface mining shall make written application to the Department for a permit. Application for such permit shall be made upon a form furnished by the Department, which form shall contain a description of the tract or tracts of land and the estimated number of acres thereof to be affected by surface mining by the operator until the next succeeding June 30, which description shall include the section, township, range and county in which the land is located and shall otherwise describe the land with sufficient certainty so that it may be located and distinguished from other lands, and a statement that the operator has the right and power by legal estate owned to mine by surface mining the land so described.

(c) Application for Permit by Operator of Underground Mine. Any operator desiring to engage in underground mining shall make written application to the Department for a permit. Application for such permit shall be made upon a form furnished by the Department, which form shall contain a description of the tract or tracts of land to be used as refuse disposal areas until the next succeeding June 30, which description shall include the section, township, range and county in which the land is located and shall otherwise describe the land with sufficient certainty so that it may be located and distinguished from other lands, and a statement that the applicant has the right and power by legal estate owned to use the land so described as a refuse disposal area.

(d) Reclamation Plan. Each application for a permit under subsections (b) and (c) of this section shall be accompanied by a plan of reclamation of the affected land that meets the requirements of this act, and shall set forth the proposed use to be made of the affected land, the grading to be accomplished, the type of revegetation, and shall include the approximate time of grading and initial revegetation effort.

(e) Bond and Fee. Each application for a permit under subsections (b) and (c) of this section shall be accompanied by the bond or security meeting the requirements of §728 of this act, or proof that such bond or security is still in effect, and a fee of Fifty Dollars ($50.00), which shall be deposited in the General Revenue Fund of the State Treasury.

(f) Issuance of Permit. Upon the receipt of such application, bond or security and fee due from the operator, the Department shall issue a permit to the applicant which shall entitle him to engage thereafter in mining on the land therein described until the next succeeding June 30, the period for which such permits are issued being hereafter referred to as the "permit year." Except in the case of permits for new mining operations commenced after the effective date of this act, all applications for permits shall be filed between June 1 and June 30 of each year.

(g) Amendment of Permit. An operator desiring to have his permit amended to cover additional land may file an amended application with the Department. Upon receipt of the amended application, and such additional bond as may be required under the provisions of this act, the Department shall issue an amendment to the original permit covering the additional land described in the amended application, without the payment of any additional fee.

(h) Withdrawal of Land. An operator may withdraw any land covered by a permit, deleting affected land therefrom, by notifying the Department thereof, in which case the penalty of the bond or security filed by such operator pursuant to the provisions of this act shall be reduced proportionately.

(i) Transferability of Permits. Permits issued hereunder to an operator shall not be transferable to another operator.

§725 Procedure for Reclaiming Land.

(a) Affected Land to be Reclaimed. All affected land shall be reclaimed as provided in this act.

(b) Operator to Determine Use of Reclaimed Land. The operator shall determine which parts of the affected land shall be reclaimed for forest, pasture, crop, horticultural, homesite, recreational, industrial or other use including food, shelter and ground cover for wildlife.

(c) Grading Requirements. All ridges and peaks of overburden created by surface mining shall be graded to a rolling topography traversable by machines or equipment customarily used in connection with the use to be made of the land after reclamation, but such slopes need not be reduced to less than the original grade of the area prior to mining, and the slope of the ridge of overburden resulting from a box cut need not be reduced to less than twenty-five (25) degrees from horizontal. Surface mining operations conducted in the flood plains of streams and rivers and subject to periodic flooding shall be exempt from the grading requirements of this section.

(d) Lakes. The operator may construct earth dams to form lakes in pits resulting from surface mining operations, provided that the formation of lakes shall not interfere with other mining operations or damage property of others.

(e) Exposed Faces of Mineral Seams. The operator shall cover the exposed face of a mineral seam, where significant concentrations of acid forming materials are present, to a depth of not less than three (3) feet with earth that will support plant life or with a permanent water impoundment.

(f) Reclamation of Lands Affected by Surface Mining of Sand and Gravel. The operator shall grade down the banks of any pits or depressions created by the removal of sand or gravel by surface mining to a degree of slope determined by the Department, which shall give due consideration to the natural topography of the land affected and adjacent lands, the composition of such banks and the most beneficial use of the pits and depressions comprising the affected land after reclamation.

(g) Revegetation. All affected land except that which is to be covered with water or used for homesites or industrial purposes shall be revegetated by the planting of seeds, plants, trees, shrubs or other plantings appropriate to the use to be made of the land as determined by the operator. No planting of any kind shall be required on any affected land so long as the chemical and physical characteristics of the soil of such affected land are toxic, deficient in plant nutrients or composed of sand, gravel, shale or stone to such an extent as to seriously inhibit plant growth. The Department may prescribe by rules and regulations the required density of such plantings, and may make replanting requirements.

(h) Time Limits. Except where prevented by weather conditions, all grading shall be completed within one (1) year after mining of the affected land has been completed. Initial seeding or planting shall be made at the first appropriate time following completion of grading. If the operator is unable to acquire sufficient planting stock of desired species from state nurseries, or acquire such species elsewhere at comparable prices the Department shall grant the operator an extension of time until planting stock is available to plant such land as originally planned.

§726. Refuse Disposal Areas. All refuse disposal areas shall be reclaimed or treated or the refuse be contained by the operator to avoid adverse environmental effects.

§727. Inspection. The Department, or its accredited representatives, may enter upon the lands of the operator at all reasonable times, for the purpose of inspection, to determine whether the provisions of this act have been complied with.

§728. Bond--Cash Deposit.

(a) Form of Bond. Any bond herein provided to be filed with the Department by the operator shall be in such form as the Director prescribes, payable to the State of Oklahoma, conditioned that the operator shall faithfully perform all requirements of this act and comply with all rules of the Department made in accordance with the provisions of this act. Such bond shall be signed by the operator as principal, and by a good and sufficient corporate surety, licensed to do business in the state, as surety.

(b) Amount of Bond. The penal sum of such bond shall be determined by the Department as not less than Three Hundred Fifty Dollars ($350.00) nor more than Six Hundred Fifty Dollars ($650.00) for each acre, or fraction thereof, of the affected land. For coal and copper mining, the minimum bond shall be Five Thousand Dollars ($5,000.00). For all other mining, the bond shall be the amount per acre as determined by the Department times the number of acres, or fraction of acres involved; however, in no event shall the bond be less than One Thousand Dollars ($1,000.00). Provided no bond will be required for any sand or gravel producer who sells less than One Thousand Dollars ($1,000.00) per year, when a statement of proof for exemption in the form of a certified affidavit shall be provided by the sand or gravel producer each year before July 1 for the previous twelve (12) months from July 1 through June 30.

In determining the amount of the bond within the above limits, the Department shall take into consideration the character and nature of the overburden, the future suitable use of the land involved and the cost of reclamation to be required. In a particular instance where the circumstances are such to warrant an exception, the Department may reduce the amount of the bond for a particular operation to less than the required minimum, or increase the bond for a particular operation to more than the prescribed maximum.

(c) Bond Provisions. A bond shall not be cancellable by the surety except after not less than ninety (90) days' prior written notice to the Department. Bonds may be continued in effect from year to year, and a new bond need not be provided for each permit year. A single bond may cover all of the operator's mining operations in the state. The penalty of the bond or amount of cash and securities, as provided in subsection (e) of this section, shall be increased or reduced from time to time as provided in this act.

(d) Revocation of License of Surety. If the license to do business in the state of any surety upon a bond filed with the Department pursuant to this act shall be suspended or revoked, the operator, within thirty (30) days after receiving notice thereof from the Department, shall substitute for such surety a good and sufficient corporate surety licensed to do business in the state. Upon failure of the operator to make substitution of surety as herein provided, the Department shall have the right to suspend the permit of the operator to conduct operations upon the land described in such permit until such substitution has been made.

(e) Cash in Lieu of Bond. In lieu of such bond, the operator may deposit cash and government securities with the Department in an amount equal to that of the required bond on conditions as above prescribed. In the discretion of the Department surety bond requirements may also be fulfilled by using existing reclaimed areas, in excess of cumulative permit or mined acres, that have been completed under the jurisdiction of this act and approved by the Department.

(f) Release of Bond. Such bond or security shall remain in effect until the mined acres have been reclaimed, approved and released by the Department. If the Department determines that grading has been satisfactorily completed pursuant to this act, the Department may release up to eighty percent (80%) of the penal sum of the bond filed for each acre of land graded.

§729. Violations--Notice--Hearing--Enforcement. The Department shall notify the operator and the surety in writing of any claimed violation of the provisions of this act or the rules and regulations of the Department. If the operator denies the alleged violation, the Department shall hold a hearing on said charges. Said hearing shall be held not less than thirty (30) days from the notice of hearing.

At such hearing the operator shall have the right to present evidence in opposition to the claimed violation.

If upon such hearing the Department shall determine that a violation has occurred, the Department shall make detailed findings of the violation and the necessary corrective measures. The order shall provide a reasonable time, commensurate with the work to be done, for the operator to perform the corrective measures. The surety may perform for the operator.

If the operator fails to perform the corrective work required by the Department or fails to properly perform said work, the Department may contract for the work to be done.

The Attorney General, upon request of the Department, shall institute proceedings to recover any damages and expense which the Department may have sustained by reason of the default of the operator but in no event shall such recovery exceed the face amount of the bond. Such proceedings shall be brought against the operator and surety either in Oklahoma County or the county in which the violation occurred.

§730. Lateral Support. In the case of strip mining operations which remove and do not replace lateral support, unless pursuant to written agreement between the operator and the adjacent property owner, the top of the consolidated material of the open cut adjacent to the property line of other property not owned or leased by the operator shall, at the time mining is completed, not be closer to such other property line than a distance of twenty-five (25) feet plus one and one-half (1½) times the depth of such cut as measured from original ground surface to the top of consolidated material.

§731. Maps--Release. The operator shall submit to the Department, no later than September 1 following the end of each permit year, a map in a form approved by the Department showing the location of the pit or pits by section, township, range and county, with such other description as will identify the land which the operator has affected by mining during such permit year and has completed mining operations thereon, with a legend upon such map showing the number of acres of affected land. Such map shall also show in acres the extent of the reclamation accomplished on the affected land, including grading and revegetation efforts, as of the end of the permit year, and shall show by appropriate designation any deviation from the plan of reclamation filed under subsection (c) of Section 724 of this title and the reasons therefor.

Whenever an operator shall have completed all requirements under the provisions of this act as to any affected land, he shall notify the Department thereof. If the Department determines that the operator has completed reclamation requirements and achieved results appropriate to the use for which the area was reclaimed, the Department shall release the operator from further obligations regarding such affected land and the penalty of the bond shall be reduced proportionately.

§732. Powers and Duties of Department. In addition to the duties and powers conferred on the Department in other provisions of this act, the Department shall have authority and power to:

(a) Adopt and promulgate reasonable rules and regulations respecting the administration of this act and in conformity therewith and the Administrative Procedures Act.

(b) Order, after hearing, the revocation of any permit issued hereunder for violation of this act.

(c) Cause to be instituted, in any court of competent jurisdiction, legal proceedings for injunctive or other appropriate relief to enforce this act.

(d) Make investigations and inspections which are necessary or appropriate to insure compliance with this act.

(e) Collect and disseminate information relating to reclamation of affected lands.

(f) Request the assistance of any federal or state agency for technical advice or any other type of assistance deemed necessary to carry out the purposes of this act.

§733. Legal Assistance. At the request of the Department the Attorney General shall provide such legal assistance as may be needed in interpreting, enforcing and carrying out the provisions of this act including but not limited to institution of and prosecuting legal actions and proceedings for injunctive relief and this improvement shall include the provisions of Section 737 hereof.

§734. Chief Mine Inspector. Any act authorized to be done by the Department may be performed by the Chief Mine Inspector, or an assistant designated by him.

§735. Sand and Gravel--Inspections--Penalties. The Department is designated as the agency to make safety inspections in sand, sand and gravel and in quarrying operations. Any person required by this act to have a permit who engages in mining without a valid permit therefor issued pursuant to this act is guilty of a misdemeanor, and on conviction thereof shall be fined no less than Fifty Dollars ($50.00) nor more than One Thousand Dollars ($1,000.00). Each day of operation without the permit required by this act shall be deemed a separate violation.

§736. Revoked Permits. In no event shall a permit be issued to any operator if a permit issued to such operator has been revoked under Section 732 of this act.

§737. Governmental Agencies to Conform. Any municipal or county governmental agency or body engaged in mining as defined in this act shall conform to all requirements of this act respecting reclamation of affected lands.

§738. Judicial Review. All final decisions and orders of the Department shall be subject to judicial review of the acts of administrative agencies.

THE MINING LANDS RECLAMATION ACT EFFECTIVE JUNE 12, 1971.

AMENDED BY HOUSE BILL NO. 1590, EFFECTIVE APRIL 7, 1972.

Passed the House of Representatives March 15, 1972, the Senate March 30, 1972, and signed into law (emergency clause included) by Governor David Hall April 7, 1972.

ATTACHMENT 3

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

BUR. OF LAND MGMT.
'72 OCT 24 AM 11:20
STATE OFFICE
SANTA FE, NEW MEXICO

October 6, 1972

ORDER NO. 2948

Subject: Division of Responsibility Between the Bureau of Land Management and the Geological Survey for Administration of the Mineral Leasing Laws - Onshore

Sec. 1. Purpose. The purpose of this Order is to set forth the administrative and management procedures for Departmental onshore mineral leasing and operating activities. The spirit and intent of this Order flow from the Department's mineral management objectives of: orderly and timely resources development, protection of the environment, and receipt of fair market value for leased mineral resources.

Sec. 1(a) Orderly and Timely Resource Development includes the Department's responsibilities to:

(1) Foster, promote, and encourage the exploration for and the production of the mineral deposits from the leasable lands; promote competition;

(2) Encourage the active development of the mineral deposits in the leasable lands in a manner compatible with the use of the same lands for other purposes; assure that mineral developers receive the acreage necessary for economic plant investment, development, and production;

(3) Encourage the maximum ultimate recovery of the mineral deposit; prevent waste; promote the conservation of the mineral resources;

(4) Assure adequate minimum production and diligent development requirements for mineral deposits.

(b) Protection of the Environment includes the Department's responsibilities to:

(1) Assure that mineral exploration and production be conducted with the maximum protection of the environment;

(2) Assure the rehabilitation of disturbed lands;

(3) Assure that precautions are taken to protect public health and safety; and

(4) Assure full compliance with the spirit and objectives of the National Environmental Policy Act of 1969, other Federal environmental legislation, and supporting Executive Orders and regulations.

(c) Receipt of Fair Market Value for Leased Mineral Resources includes the Department's responsibilities to assure the public a fair market value return for the use of public lands and the disposition of its mineral resources.

Sec. 2. Agency Responsibilities. The BLM exercises at the Bureau level the Secretary's discretionary authority to determine whether or not leases, permits, and licenses are to be issued. The Bureau of Land Management is responsible for issuing mineral leases, permits, and licenses, and is the office of record in mineral leasing matters. The Geological Survey is responsible for all geologic, engineering, and economic value determinations for the Department's mineral management program. These determinations include: the mineral characteristics of lease and permit areas; parcelling; amounts of bonds; royalties; unit values; rentals; mineral resource evaluations; reserves; investment, diligent development, and minimum production requirements; and all other terms and conditions relating to mineral operations under leases and permits. Geological Survey exercises the Secretary's delegated authority regarding operations conducted within the area of operation by permittees, lessees, and licensees and determines the actions to be taken by them from the standpoint of the development, conservation, and management of mineral resources under the jurisdiction of the Department. GS will refer to BLM any instances of noncompliance with lease terms requiring cancellation action, and BLM will initiate the necessary action.

For the purpose of this Order, the area of operation is defined as that area of the present and planned mine, oil and gas field, or geothermal resource field exploratory, development, and production operations, as presented in an approved exploration or mining plan, drilling permit, oil, gas, or geothermal field development plan, or plan for the abandonment of wells or operations. The area of operation may cover a fraction of a lease or permit area, or it may cover several lease or permit areas. It encompasses the general area needed for storage piles, spoils piles, tailings ponds, on-project mill sites, flow lines, separators, surge tanks, storage tanks, on-project truck or rail-loading stations, drill pads, mud pits, workshops, compressors, generators, on-project power plants, and other such facilities used for on-project mine, oil and gas field, or geothermal resource field exploratory, development, and production operations.

(a) Environmental Protection. The Bureau of Land Management, in cooperation with the Geological Survey, formulates the general requirements to be incorporated in leases, permits, and licenses for the protection of the surface and non-mineral resources and for reclamation. The Geological Survey, before approving exploration and mining plans, drilling permits, oil, gas, or geothermal field development plans, or plans for the abandonment of wells or operations, consults with the Bureau of Land Management on the adequacy of the surface use, environmental protection, and reclamation aspects of the plans and will not grant approval if inconsistent with the BLM's recommendations without further discussions with BLM. If differences remain after these further discussions, the resolution is made by the Assistant Secretary--Mineral Resources and the Assistant Secretary--Public Land Management. If required, the Under Secretary resolves any remaining differences. The BLM is responsible for compliance examinations of environmental protection requirements outside the operating area and for reporting infractions to the GS for discussions with, or orders to, the permittee, lessee, or licensee. GS examines operations to ensure compliance with environmental protection and rehabilitation requirements inside the operating area. With respect to approval of access roads, pipelines, utility routes and other surface uses outside the operating area, the Bureau of Land Management has the primary responsibility but obtains the recommendations of the Geological Survey before taking final action. Orders to operators for any remedial action is the responsibility of the Geological Survey.

(b) Expertise. The Geological Survey is responsible for maintaining engineering, geologic, geophysical, economic, and other technical expertise needed by the Department to assure compliance with applicable laws, operating regulations, and the objectives of the Department's mineral management program. The Bureau of Land Management is responsible for maintaining expertise needed by the Department for action on applications filed with BLM under the mineral leasing laws to assure compliance with applicable laws, leasing regulations, and the objectives of the Department's mineral management program.

(c) Contacts with Applicants.

(1) Prior to the issuance of mineral leases, permits, and licenses, the Bureau of Land Management will represent the Secretary in dealing with applicants.

(2) After issuance and during the exploration, development, and production phases of leases, permits, and licenses, and until a lease, permit, or license has terminated (at which time management is the sole responsibility of BLM) the Geological Survey is the sole representative of the Secretary in all matters relating to the supervision of operations.

Sec. 3. Issuance of Mineral Leases, Permits, and Licenses.

(a) Applications. Prior to the issuance of mineral prospecting permits, leases, or licenses, the Bureau of Land Management refers all applications for such permits, leases, or licenses to the Geological Survey for a report as outlined in (b) below.

(1) The Geological Survey is responsible for determining, under the mineral leasing laws and regulations, if sufficient information is known about a mineral deposit to warrant offering the deposit for lease by competitive sale and to notify the Bureau of Land Management of its determination. If the Geological Survey finds that sufficient information is not available to warrant competitive leasing, it notifies the Bureau of Land Management of its conclusions so that the Bureau of Land Management may issue a prospecting permit or noncompetitive lease, as appropriate. The Geological Survey establishes prospecting requirements for prospecting permits. When lands are to be leased, the Geological Survey determines and reports, as appropriate, on: the mineral characteristics of lease and permit areas; parcelling; amounts of bonds; royalties; unit values; rentals; mineral resource evaluations; reserves; investments; diligent development and minimum production requirements; and all other terms and conditions pertaining to lease operations, including environmental and surface rehabilitation stipulations relating to mineral exploration and extraction. With respect to applications for licenses, the Geological Survey determines and reports as to whether the license may be issued.

(2) The Geological Survey is responsible for determining whether a prospecting permittee has demonstrated that the lands contain a mineral deposit having the characteristics required by law and regulations to qualify for a preference right lease and to notify the Bureau of Land Management.

(3) The Bureau of Land Management refers to the Geological Survey all other type applications received which, if approved, may affect operations on existing permits, leases, or licenses.

(4) The Bureau of Land Management notifies the Geological Survey of known oil, gas, and geothermal resource geophysical exploration activity, including the area involved, the type of survey employed, and the name of the operator.

(5) All applications for noncompetitive oil and gas, mineral, and geothermal resource leases filed with the Bureau of Land Management will, prior to issuance of a lease, be referred to the Geological Survey for a determination as to whether the lands are within a known geologic structure (KGS), a known geothermal resource area (KGRA), or a known leasing area (KLA).

(b) Mineral Resource Evaluation Report. GS is responsible for submitting a report of its findings, mineral resource evaluations, and resultant recommendations to the BLM, together with a summary explanation of how the resource evaluations were developed from geophysical, geologic, economic, and engineering data available at the time of the evaluation. The BLM reviews these findings and recommendations in light of multiple-use management requirements and will not issue leases or permits inconsistent with the findings and recommendations without further discussion with GS. If differences remain after further discussion, the resolution is made by the Assistant Secretary--Mineral Resources and the Assistant Secretary--Public Land Management. If required, the Under Secretary resolves any remaining differences.

(c) Competitive Lease Sales. The Bureau of Land Management advertises and conducts competitive lease sales. The Geological Survey's resource evaluations will be used and the Geological Survey will have representatives at the sale and renders a post-sale recommendation to BLM regarding acceptance or rejection of the bids, which must be confirmed in writing.

(d) Files and Records. BLM maintains the official application, permit, and lease case files and forwards to the Geological Survey a copy of each permit, lease, and license, together with copies of relevant correspondence thereafter conducted by the Bureau. The GS forwards to the BLM copies of mining and exploration plan applications, drilling permit applications, and relevant items submitted by the applicants directly to the GS, except confidential proprietary information cited under paragraph (e) below.

(e) Security of Information. The Geological Survey is responsible for receiving and protecting for the confidential use of the Federal Government all proprietary geological, geophysical, engineering, economic, statistical, or other information, mineral resource data, and well logs required to be submitted under Title 30 CFR, Parts 200, 211, 216, 221, 231, 270, and related regulations. The Survey Office receiving such information is designated the Office of Control for those data. Authorized officials of BLM or other surface-managing agencies having a need to see such information will normally make appropriate arrangements to visit the Office of Control for access to such data and for technical advice based on it pertinent to their management responsibilities.

Sec. 4. Mineral Reports. The Geological Survey is responsible for preparing and submitting to the Bureau of Land Management mineral classification and evaluation reports with respect to the leasable mineral value of lands within proposed exchanges, withdrawals, sales, land entries, or other disposals and all other land transactions. The Geological Survey, upon request, also prepares and furnishes mineral reports and other information to the Bureau of Land Management needed for its use in long-range multiple-use planning or inventory of the public lands.

Sec. 5. General Relationships. Such additional references, reports, interchange of information, and advice shall be made by or between the Bureau of Land Management and Geological Survey as may be necessary to perpetuate or improve current practice and provide effective administration of the mineral leasing laws.

The Bureau of Land Management and the Geological Survey must submit to each other for review and recommendations any proposed changes in standard lease terms, regulations, instructions, or other changes that would affect each agency's management responsibilities.

Sec. 6. Implementation of Order. It is intended that there will be no duplication by the BLM or GS of the functions assigned by this Order. BLM and GS will promptly bring their manuals and instructions into agreement with the terms and the spirit and intent of this Order.

Sec. 7. Revocation. The Secretary's instruction (procedures relating to the administration of the mineral leasing laws - General Land Office and Geological Survey) dated September 22, 1925 (51 L. D. 219) is revoked.

OCT - 6 1972

Secretary of the Interior

Attachment 4

Oklahoma Guidelines
Between
Bureau of Land Management
And
Geological Survey - Minerals Division
For
Carrying Out Secretarial Order 2948
For
Coal

The area of operation is defined as that area of the present and planned mine, as presented in an approved exploration or mining plan. The area of operation may cover a fraction of a lease or permit area, or it may cover several lease or permit areas. It encompasses the general area needed for storage piles, spoils piles, tailings ponds, on-project mill sites, flow lines, separators, surge tanks, storage tanks, on-project truck or rail-loading stations, workshops, compressors, generators, on-project power plants, and other such facilities used for on-project mine.

Within the "area of operations," Survey personnel are responsible for making final decisions, subject to BLM and GS agreement, regarding proposed operations, for contacting the operator, and for seeing that the required work is done. Survey personnel will work closely with

BLM, will enforce stipulations necessary for the protection of the surface, and will not grant approval of any prospecting or mining operation without the prior consent of BLM. Operations outside of the "area of operations" are under the direct control of BLM personnel. Any unresolvable disagreement with lease or permit conditions or mining plan proposals will be settled under procedures established by Sec. 2(a) of Secretarial Order No. 2948.

Permit and Lease Actions

BLM will:

1. Provide U.S.G.S. with a copy of the application.
2. Contact U.S.G.S. regarding a technical report and the need of a joint field examination.
3. Prepare technical report which includes U.S.G.S. input.
4. Process the application if approved and attach any stipulations.

U.S.G.S. will:

1. Participate in joint field examination.
2. Provide necessary imput for technical report and environmental analysis record which will include comments on geologic, engineering, and economic value determinations.

Prospecting and Mining Plan Submittions

U.S.G.S. will:

1. Submit a copy of the Plan to the BLM District Office.
2. Contact BLM regarding the need for a joint field examination.
3. Process the submitted plan and if approved which will include BLM recommendations on the adequacy of the surface use, environmental protection, and reclamation aspects of the plan.

BLM will:

1. Participate in any joint field examination.
2. Submit recommendations to U.S.G.S. on the submitted plan.

COMPLIANCE

USGS will:

1. Make periodic inspections to insure that applicant complying with approved application and plan.
2. Seek BLM assistance and expertise in circumstances involving changes in the approved stipulations and the operator's ability to meet them.
3. Request the BLM to make compliance check if appropriate.

BLM will:

1. At the request of GS or in the course of its own duties, note operator compliance with permit, lease or plan stipulations and notify GS immediately of any non-compliance.
2. Contact the operator directly in cases involving an emergency any other condition endangering health, safety, or significant resources. GS will be notified of any actions of this nature immediately. At this time, agreement will be made with GS concerning resolution of the emergency and BLM's continued involvement.

Cancellation, Termination and Abandonment

USGS will:

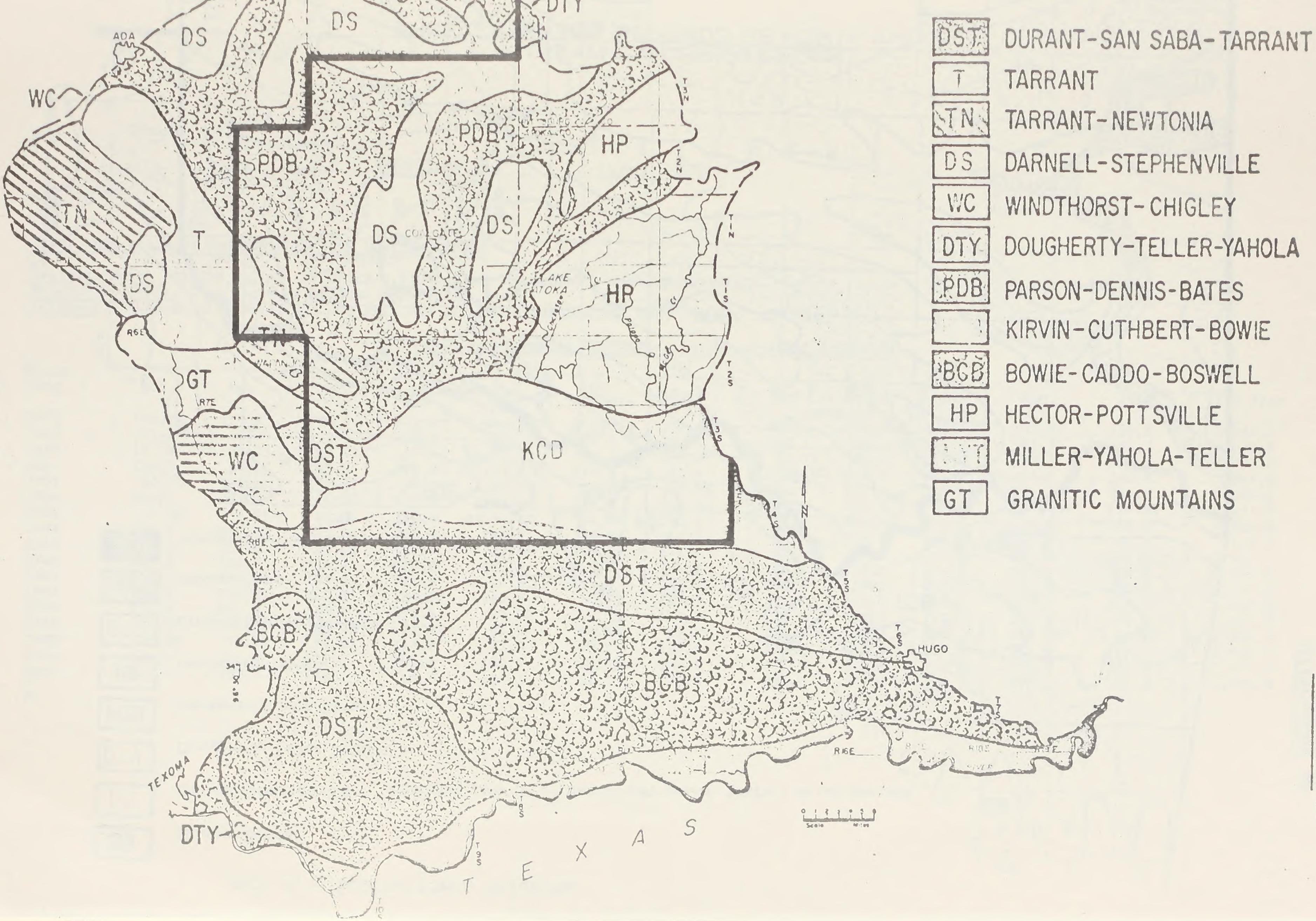
1. Notify BLM of any plans for cancellation, termination or abandonment and coordinate any needed joint field meeting.

BLM will:

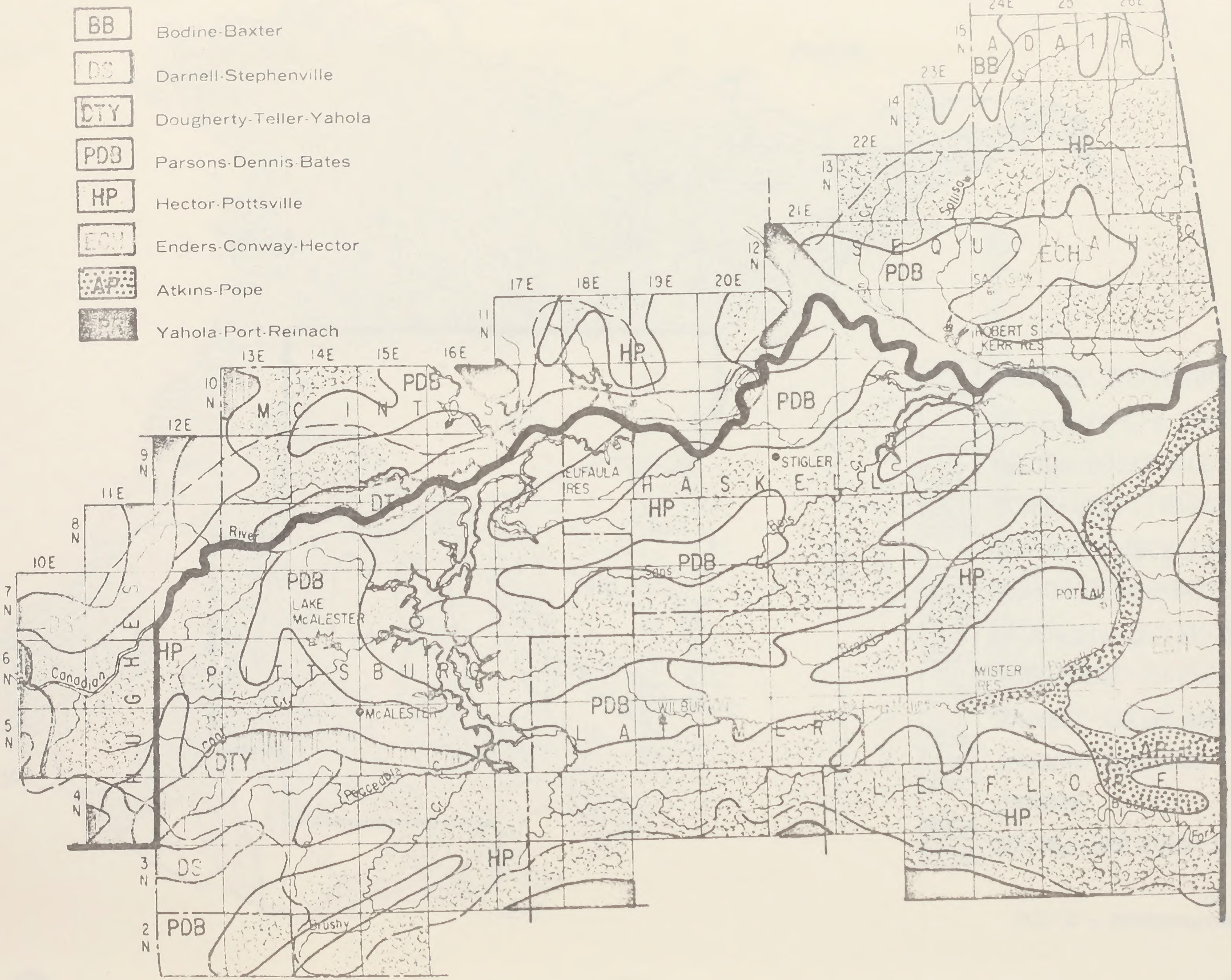
1. Participate in any needed joint field meeting and provide U.S.G.S. with recommendation involving surface actions.

Attachment #5

SOILS - Southeastern Oklahoma



SOILS - Southeastern Oklahoma



Attachment #6

SURFACE WATER RECORDS REGION V AND VI 3/
STREAM GAGING STATIONS

3316. RED RIVER AT DENISON DAM, NEAR DENISON, TEXAS

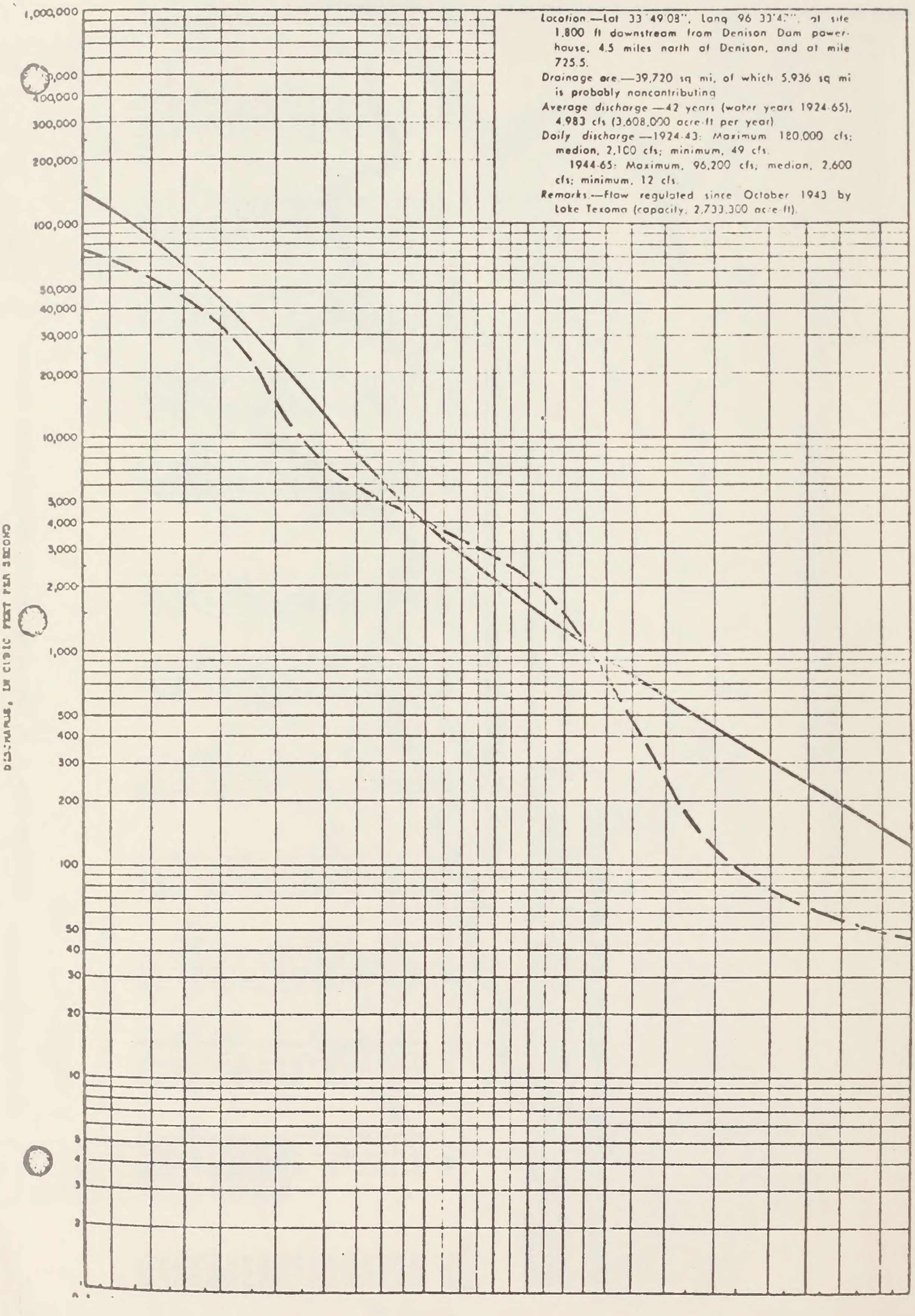
Drainage area - 39,720 sq. mi. of which 5,936 sq. mi. is probably noncontributing.
Average discharge - 44 years, 3,529,000 acre-ft per year.
Extremes - Maximum discharge, 201,000 cfs, May 21, 1935; Minimum, 12 cfs, January 10, 1944.

Monthly and Yearly Discharge, in Thousands of Acre-Feet

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The Year
1951	493.7	174.4	184.4	177.7	183.5	143.5	124.4	853.9	1,545.0	837.4	191.8	152.5	5,062.0
1952	113.2	98.77	111.6	163.2	105.7	116.5	180.3	151.3	169.2	166.5	193.1	100.7	1,670.0
1953	147.2	90.23	83.33	92.44	70.41	43.70	104.0	90.79	125.4	154.8	180.3	159.1	1,342.0
1954	135.0	70.56	136.6	123.6	121.9	153.3	161.6	762.4	568.5	283.4	196.0	146.5	2,859.0
1955	68.21	117.2	127.8	20.0	56.40	50.51	69.88	196.9	692.4	219.4	221.3	160.0	2,000.0
1956	907.5	284.0	249.2	223.0	231.0	138.3	64.81	126.5	86.2	97.17	84.89	84.69	2,577.0
1957	4.10	4.74	41.61	130.0	84.02	91.08	190.5	2,134.0	3,984.0	775.3	150.8	289.9	7,880.0
1958	351.7	550.0	323.4	102.0	244.2	98.99	184.2	708.5	139.5	175.6	152.8	96.02	3,128.0
1959	112.1	113.8	91.21	139.4	42.89	149.5	134.7	43.78	126.0	243.0	284.2	182.9	1,663.0
1960	983.2	154.7	414.3	486.0	429.5	255.1	191.3	166.2	212.7	232.7	136.3	114.9	3,777.0
1961	740.1	193.1	307.3	304.9	117.9	165.8	361.6	149.6	179.5	210.0	168.8	213.8	3,112.0
1962	296.0	270.02	263.0	184.7	102.0	76.71	118.9	75.32	1,121.0	278.1	266.7	224.5	3,277.0
1963	276.4	242.8	364.7	270.6	63.09	89.08	170.3	159.6	151.1	177.6	138.4	89.3	2,193.0
1964	66.35	47.77	68.08	75.42	81.54	66.54	95.11	101.6	118.7	154.3	150.36	70.05	1,096.0
1965	59.67	48.49	55.87	112.8	113.0	100.1	110.1	119.2	165.3	193.9	166.4	161.5	1,406.0
1966	126.4	146.8	121.5	195.5	107.5	80.52	178.1	323.9	210.6	211.1	129.9	204.8	2,037.0
1967	241.2	152.4	156.0	99.9	107.3	52.3	73.4	136.0	177.1	159.7	174.6	163.3	1,693.0

Compiled from U. S. Geological Survey Surface Water Records

DURATION CURVE OF DAILY DISCHARGE, RED RIVER AT DENISON DAM



Location.—Lat 33°49'08", long 96°33'4?", at site 1,800 ft downstream from Denison Dam powerhouse, 4.5 miles north of Denison, and at mile 725.5.

Drainage area.—39,720 sq mi, of which 5,936 sq mi is probably noncontributing

Average discharge.—42 years (water years 1924-65), 4,983 cfs (3,608,000 acre-ft per year)

Daily discharge.—1924-43: Maximum 180,000 cfs; median, 2,100 cfs; minimum, 49 cfs.

1944-65: Maximum, 96,200 cfs; median, 2,600 cfs; minimum, 12 cfs.

Remarks.—Flow regulated since October 1943 by Lake Texoma (capacity, 2,733,300 acre-ft).

SURFACE WATER RECORDS REGION V AND VI
STREAM GAGING STATIONS

3325. BLUE RIVER NEAR BLUE, OKLAHOMA

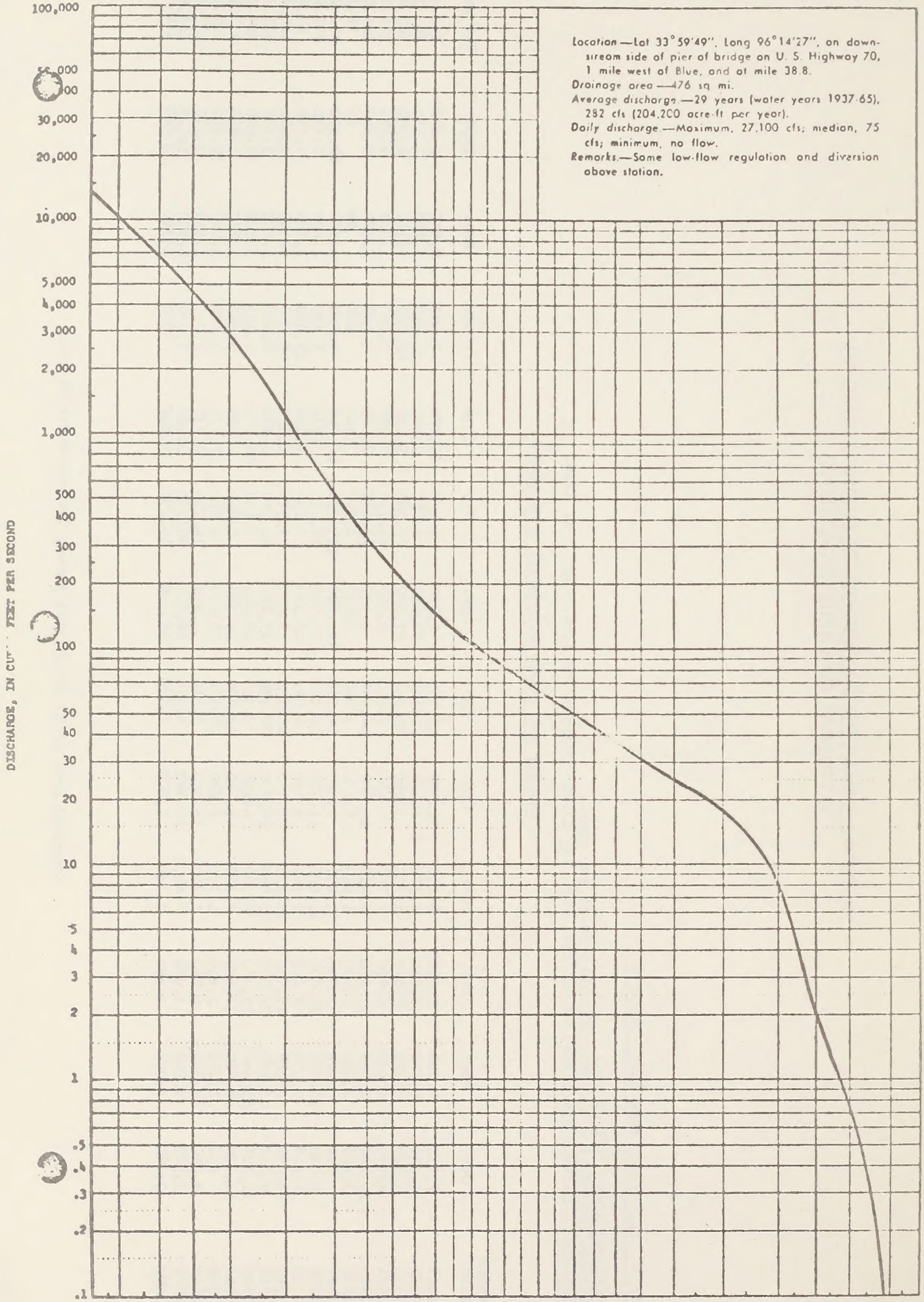
Drainage area - 476 sq. mi.
Average discharge - 31 year, 200,500 acre-ft per year.
Extremes - Maximum discharge, 34,400 cfs, Feb. 17, 1938: Minimum, no flow, Aug. 3-4, 1936.

Monthly and Yearly Discharge, in Acre-Feet

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The Year
1951	7,510	6,760	6,510	6,210	16,970	11,710	6,770	5,670	60,470	7,320	2,570	2,620	141,100
1952	4,360	6,720	3,630	3,370	3,410	10,110	53,400	8,930	2,880	1,910	1,270	1,150	101,100
1953	1,180	2,600	2,040	1,730	1,860	11,040	31,010	21,080	5,680	46,600	8,100	6,000	140,900
1954	4,000	4,880	6,990	7,760	3,370	2,660	9,010	73,110	9,520	2,260	1,510	1,590	126,700
1955	14,130	2,020	10,150	8,210	12,040	14,340	8,720	17,910	2,690	9,100	1,320	8,360	109,000
1956	1,800	1,500	1,620	1,610	4,020	1,980	3,070	3,990	2,360	322	58	25	22,360
1957	284	946	2,290	1,680	6,320	14,650	141,200	135,300	86,220	8,610	4,360	89,340	491,200
1958	8,080	70,570	16,090	31,820	11,910	36,160	22,530	79,030	7,210	4,390	2,680	2,280	292,800
1959	1,860	2,130	2,200	2,140	1,960	6,040	13,160	7,250	5,280	10,830	2,290	5,310	60,450
1960	29,460	4,480	19,410	25,930	21,370	23,190	7,470	26,580	6,360	8,170	4,330	3,620	180,400
1961	9,950	3,490	22,800	10,940	16,220	20,880	13,160	12,240	5,620	4,440	1,770	3,750	125,300
1962	11,120	30,440	19,540	8,900	6,910	9,930	16,280	4,800	57,570	5,110	3,000	10,660	184,300
1963	31,110	39,980	17,890	7,880	5,070	13,100	13,120	5,030	2,530	1,860	1,210	1,060	139,800
1964	832	1,210	1,800	1,700	1,970	10,070	13,630	8,970	18,720	1,600	3,220	19,060	82,780
1965	3,200	28,240	8,040	7,780	19,080	7,510	6,830	16,210	4,210	2,030	1,550	3,110	107,800
1966	1,520	3,560	1,870	2,460	36,960	5,310	46,930	20,180	2,580	1,640	6,120	5,520	134,600
1967	1,960	2,000	1,900	1,610	1,500	1,720	58,750	16,290	36,310	7,280	2,860	28,460	160,600

Compiled from U. S. Geological Survey Surface Water Records

DURATION CURVE OF DAILY DISCHARGE, BLUE RIVER AT BLUE, OKLAHOMA



Location.—Lat 33°59'49", Long 96°14'27", on downstream side of pier of bridge on U. S. Highway 70, 1 mile west of Blue, and at mile 38.8.

Drainage area.—476 sq mi.

Average discharge.—29 years (water years 1937-65), 282 cfs (204,200 acre-ft per year).

Daily discharge.—Maximum, 27,100 cfs; median, 75 cfs; minimum, no flow.

Remarks.—Some low-flow regulation and diversion above station.

SURFACE WATER RECORDS REGION V AND VI
STREAM GAGING STATIONS

3340. MUDDY BOGGY CREEK NEAR FARRIS, OKLAHOMA

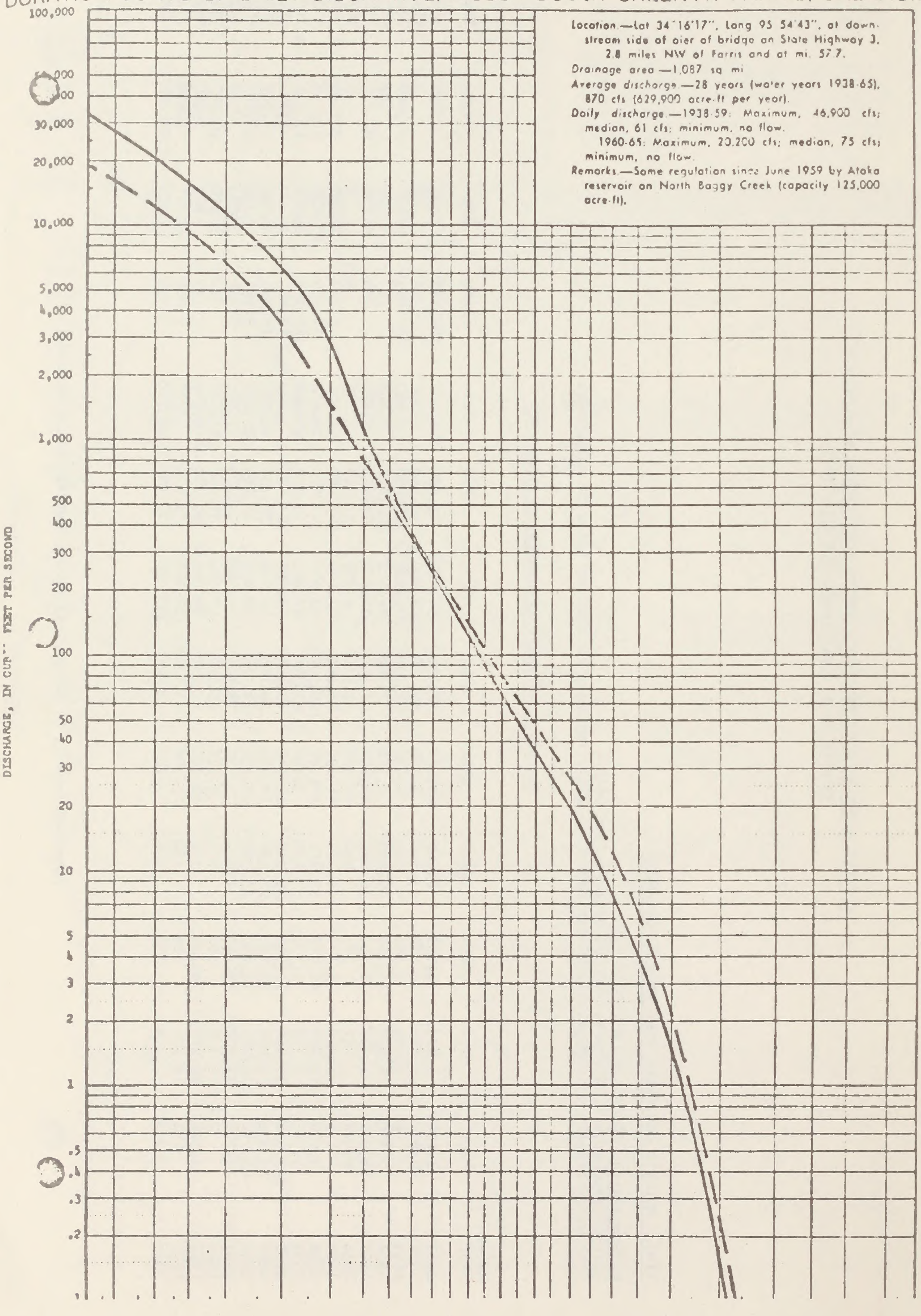
Drainage area - 1,087 sq. mi.
Average discharge - 30 years, 613,900 acre-ft. per year.
Extremes - Maximum discharge, 61,900 cfs, June 17, 1945; Minimum, no flow at times in many years.

Monthly and Yearly Discharge, in Acre-Feet

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The Year
1951	3,020	1,820	1,530	2,080	69,530	37,930	35,620	8,970	279,100	26,580	195	2,660	469,000
1952	12,610	28,490	4,240	1,540	9,950	45,150	165,300	17,060	9,550	14	82	7.7	294,000
1953	0	2,350	3,390	461	4,470	86,750	224,300	165,900	2,750	207,500	5,630	10,960	714,500
1954	7,330	5,860	17,030	40,980	8,140	1,700	46,600	310,200	4,560	163	25	186	442,800
1955	23,930	1,010	31,450	16,990	54,200	104,800	21,830	31,270	5,880	186	3,890	82,330	377,800
1956	9,640	47	107	170	24,490	1,460	6,520	37,760	22,710	8.9	0	0	102,900
1957	533	1,990	5,270	6,310	64,190	83,800	497,500	407,000	214,800	4,700	4,100	223,800	1,514,000
1958	3,900	151,400	49,040	59,870	14,160	126,500	61,630	147,800	28,600	19,100	63,610	12,450	738,100
1959	1,580	6,760	1,330	938	1,140	81,360	57,940	79,500	15,890	105,700	3,540	13,510	369,200
1960	146,800	19,540	79,990	82,540	40,640	45,120	9,500	307,900	5,640	49,300	7,700	1,990	796,700
1961	19,930	2,970	63,450	23,410	36,820	58,890	46,940	38,310	11,690	29,060	7,790	17,660	356,900
1962	45,660	116,200	74,450	23,380	22,150	54,230	92,840	10,290	43,110	2,400	230	13,080	498,000
1963	78,270	75,100	49,260	7,070	1,910	19,070	85,360	18,470	1,540	2,730	1,100	266	340,100
1964	2.6	0	505	105	2,310	35,160	52,380	35,490	41,590	232	3,030	60,840	231,600
1965	1,920	59,270	6,900	12,150	52,560	21,120	26,660	91,070	8,600	359	226	3,170	284,000
1966	251	3,230	396	3,310	103,100	15,970	137,100	44,070	224	1,080	9,810	3,650	322,200
1967	909	104	611	606	635	2,350	197,100	72,040	30,370	2,480	1,220	133,500	441,900

Compiled from U. S. Geological Survey Surface Water Records

DURATION CURVE OF DAILY DISCHARGE, MUDDY BOGGY CREEK AT FARRIS, OKLAHOMA



Location.—lat 34°16'17", long 95°54'43", at downstream side of pier of bridge on State Highway 3, 2.8 miles NW of Farris and at mi. 57.7.

Drainage area.—1,087 sq mi

Average discharge.—28 years (water years 1938-65), 870 cfs (629,900 acre-ft per year).

Daily discharge.—1938-59: Maximum, 46,900 cfs; median, 61 cfs; minimum, no flow.
1960-65: Maximum, 20,200 cfs; median, 75 cfs; minimum, no flow.

Remarks.—Some regulation since June 1959 by Atoka reservoir on North Boggy Creek (capacity 125,000 acre-ft).

SURFACE WATER RECORDS REGION V AND VI
STREAM GAGING STATIONS

3365. KIAMICHI RIVER NEAR BELZONI, OKLAHOMA

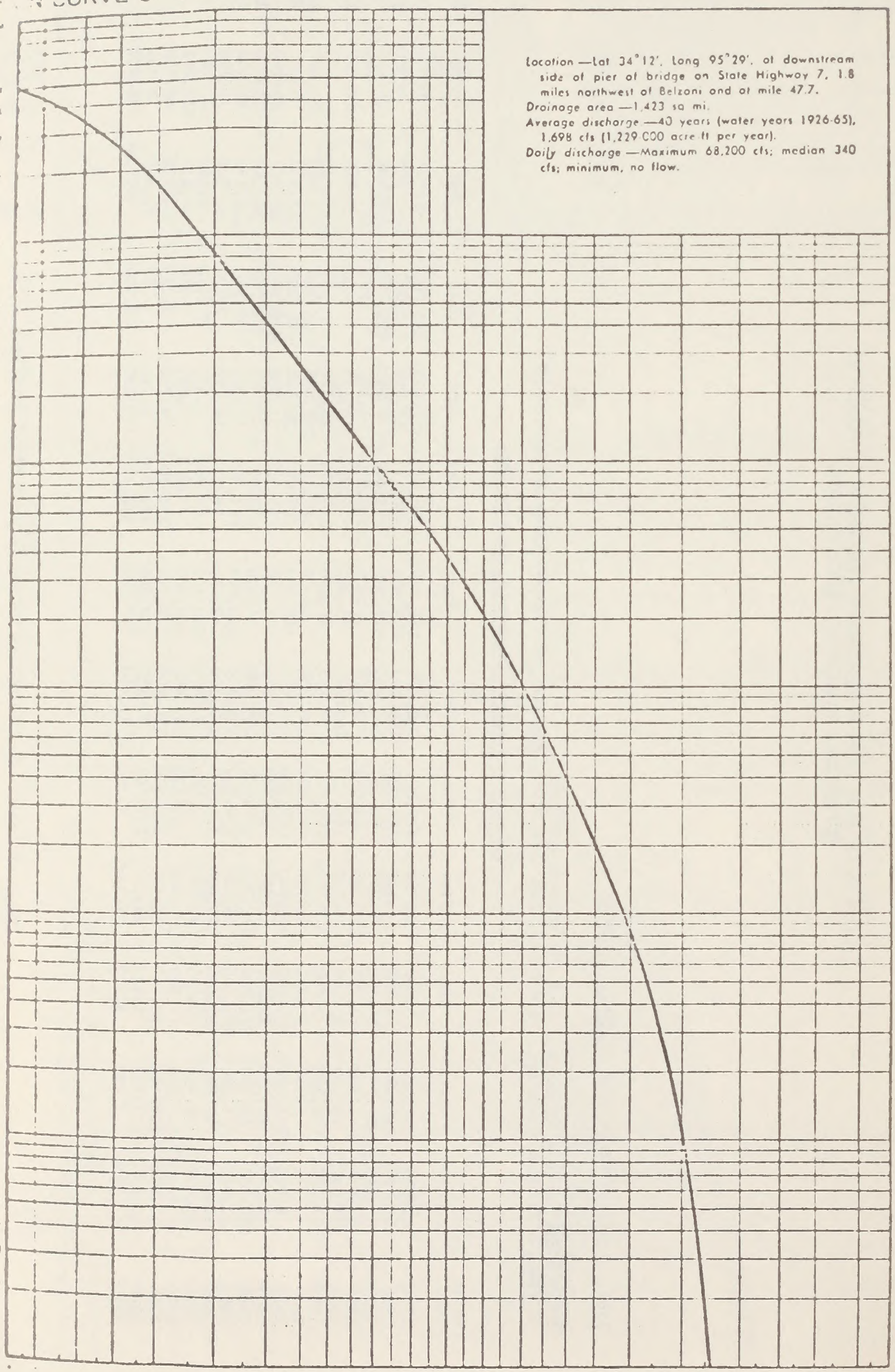
Drainage area - 1,423 sq. mi.
Average discharge - 42 years, 1,208,000 acre-ft per year.
Extremes - Maximum discharge, 71,400 cfs, Feb. 18, 1938: Minimum, no flow at times in many years.

Monthly and Yearly Discharge, in Acre-Feet

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The Year
1951	11,590	4,840	3,800	36,700	373,000	108,700	125,700	58,350	397,400	140,000	5,950	8,740	1,275,000
1952	31,090	150,600	51,720	34,510	44,980	169,100	459,500	44,150	15,850	1,090	179	1,400	1,004,000
1953	336	23,170	34,590	21,770	71,160	229,900	511,000	283,500	4,240	239,700	9,940	2,110	1,431,000
1954	655	1,950	20,290	213,000	39,030	10,810	76,900	230,800	7,380	221	3.4	143	601,200
1955	103,000	15,720	93,060	75,330	180,400	262,900	73,600	75,230	8,120	464	8,930	179,900	1,077,000
1956	17,160	1,200	1,490	2,000	154,500	33,530	36,430	111,000	15,190	821	6.0	0	373,300
1957	0	7,010	26,430	81,290	192,100	198,900	769,100	558,400	290,300	4,340	1,800	273,900	2,404,000
1958	8,960	302,000	103,600	109,200	65,920	264,400	140,800	385,000	30,660	40,250	27,910	8,040	1,487,000
1959	2,190	26,150	12,310	17,100	25,940	119,900	105,100	95,160	21,230	182,600	19,260	25,090	652,000
1960	150,600	32,160	217,900	179,200	116,400	104,500	25,670	537,000	19,710	125,200	28,140	10,010	1,546,000
1961	21,010	7,590	222,300	66,120	130,500	142,300	110,500	243,900	33,860	75,290	14,150	45,110	1,113,000
1962	51,350	252,800	180,300	129,600	111,100	147,100	239,300	29,210	56,080	2,170	728	11,770	1,212,000
1963	161,900	92,450	72,110	47,490	8,560	97,670	103,400	29,990	2,530	10,190	2,150	249	628,700
1964	0.2	38	540	420	11,500	131,400	163,300	49,800	3,300	503	35,630	138,700	535,100
1965	17,840	132,400	40,210	55,530	166,800	128,500	70,910	118,300	34,220	4,280	1,810	46,190	817,000
1966	10,370	13,560	5,110	24,220	237,300	27,910	267,200	121,500	2,780	1,270	12,910	4,950	729,100
1967	975	729	3,270	4,080	4,300	17,480	307,600	219,300	85,060	23,010	2,130	175,600	843,500

Compiled from U. S. Geological Survey Surface Water Records.

N CURVE OF DAILY DISCHARGE, KIAMICHI RIVER NEAR BELZONI, OKLAHOMA



Location —Lat 34°12', Long 95°29', at downstream side of pier of bridge on State Highway 7, 1.8 miles northwest of Belzoni and at mile 47.7.

Drainage area —1,423 sq mi.

Average discharge —40 years (water years 1926-65), 1,698 cfs (1,229 000 acre ft per year).

Daily discharge —Maximum 68,200 cfs; median 340 cfs; minimum, no flow.

SURFACE WATER RECORDS REGION V AND VI
STREAM GAGING STATIONS

3385. LITTLE RIVER BELOW LUKFATA CREEK, NEAR IDABEL, OKLAHOMA.

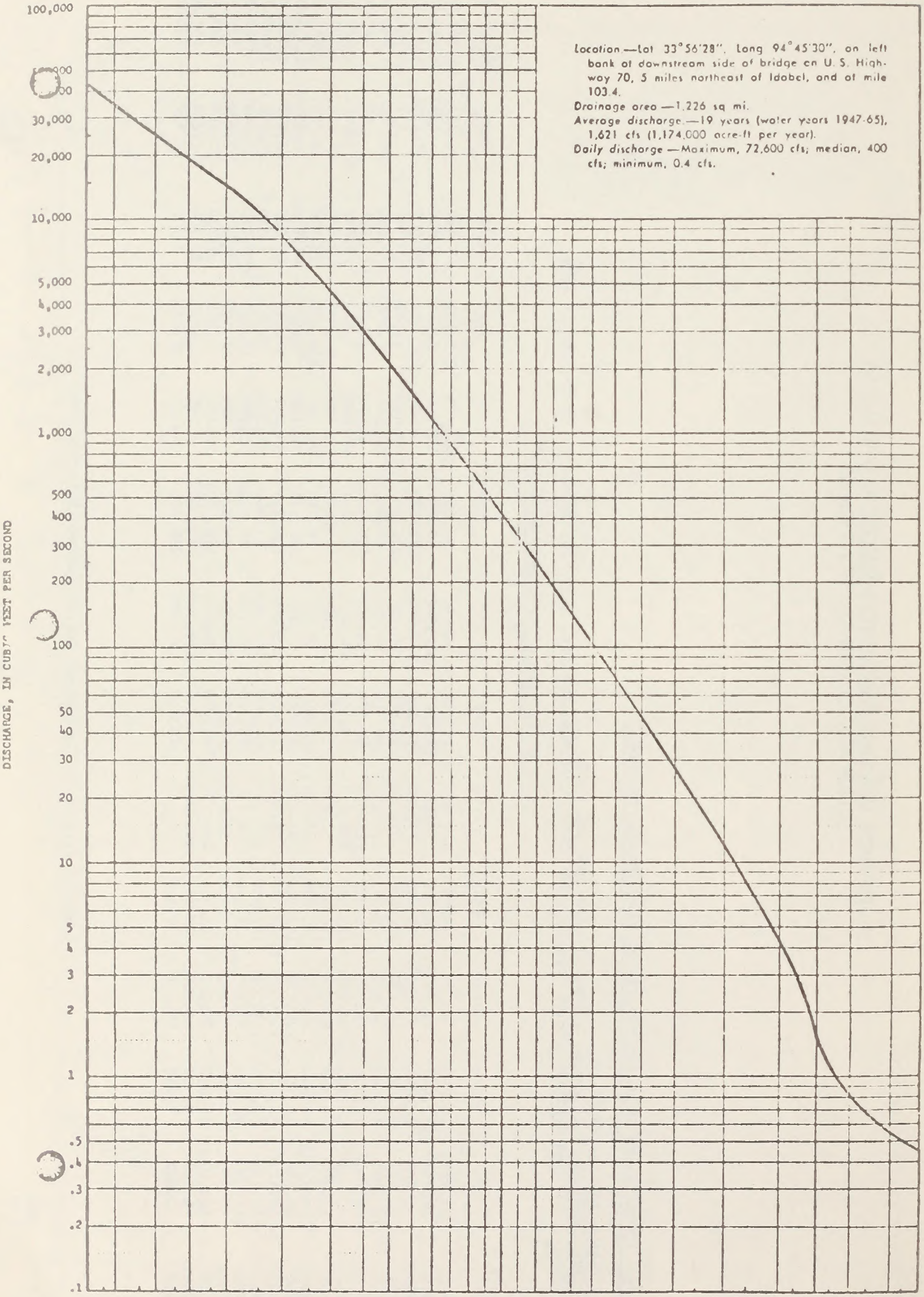
Drainage area - 1,226 sq. mi.
Average discharge - 21 years, 1,124,000 acre-feet per year.
Extremes - Maximum discharge, 76,000 cfs, Jan. 26, 1949: Minimum, 0.4 cfs, Sept. 15, 16, Sept. 21 to Oct. 1, 1956.

Monthly and Yearly Discharge, in Acre-Feet

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The Year
1951	22,390	12,650	8,080	53,230	318,900	76,380	91,650	66,450	340,000	237,000	5,430	6,230	1,238,000
1952	14,810	132,600	82,350	76,990	66,380	166,500	517,900	62,940	17,500	2,820	1,410	815	1,143,000
1953	474	32,840	50,160	53,420	72,270	231,100	372,500	399.500	6,590	213,500	10,900	3,190	1,446,000
1954	990	1,650	26,870	172,300	65,760	13,860	77,230	232,300	40,400	1,180	376	432	633,300
1955	267,700	41,640	64,420	86,240	119,900	189,600	98,700	67,340	12,530	2,650	3,690	86,060	1,040,000
1956	48,730	3,020	5,370	6,920	225,600	54,130	22,670	106,400	9,730	1,010	126	34	483,700
1957	50	15,380	34,890	111,600	175,200	227,500	594,000	544,200	184,900	5,670	5,630	131,400	2,030,000
1958	15,240	255,300	85,030	158,300	56,890	251,200	174,200	313,000	11,530	24,300	9,620	40,130	1,395,000
1959	26,820	83,850	30,070	35,350	61,030	111,600	74,450	48,050	21,750	136,500	19,300	9,750	658,500
1960	60,750	49,160	228,600	182,900	93,640	95,640	37,390	346,300	31,130	75,160	46,810	5,950	1,253,000
1961	10,140	8,770	223,200	79,170	106,700	122,600	135,200	284,200	18,050	94,330	49,920	27,120	1,159,000
1962	34,150	151,400	179,200	177,800	114,100	104,600	219,300	41,660	25,810	2,980	1,860	30,190	1,083,000
1963	111,100	71,880	57,600	65,680	14,770	128,200	57,440	48,580	3,890	13,870	9,910	2,000	584,900
1964	336	523	1,680	1,140	16,200	154,800	262,700	59,820	7,590	1,380	29,830	63,400	599,400
1965	22,810	86,290	55,350	85,410	265,200	87,830	85,640	144,500	33,120	5,840	3,730	53,680	929,400
1966	6,540	8,920	8,910	29,330	146,000	36,730	194,000	185,500	4,260	1,450	31,760	11,230	664,600
1967	1,820	838	6,110	9,420	10,580	44,350	194,700	216,400	92,330	18,870	1,190	58,410	655,000

Compiled from U. S. Geological Survey Surface Water Records

DURATION CURVE OF DAILY DISCHARGE, LITTLE RIVER NEAR IDABEL, OKLAHOMA



Location.—Lat 33°56'28", long 94°45'30", on left bank of downstream side of bridge on U.S. Highway 70, 5 miles northeast of Idabel, and at mile 103.4.

Drainage area.—1,226 sq mi.

Average discharge.—19 years (water years 1947-65), 1,621 cfs (1,174,000 acre-ft per year).

Daily discharge.—Maximum, 72,600 cfs; median, 400 cfs; minimum, 0.4 cfs.

3390. MOUNTAIN FORK RIVER NEAR EAGLETOWN, OKLAHOMA.

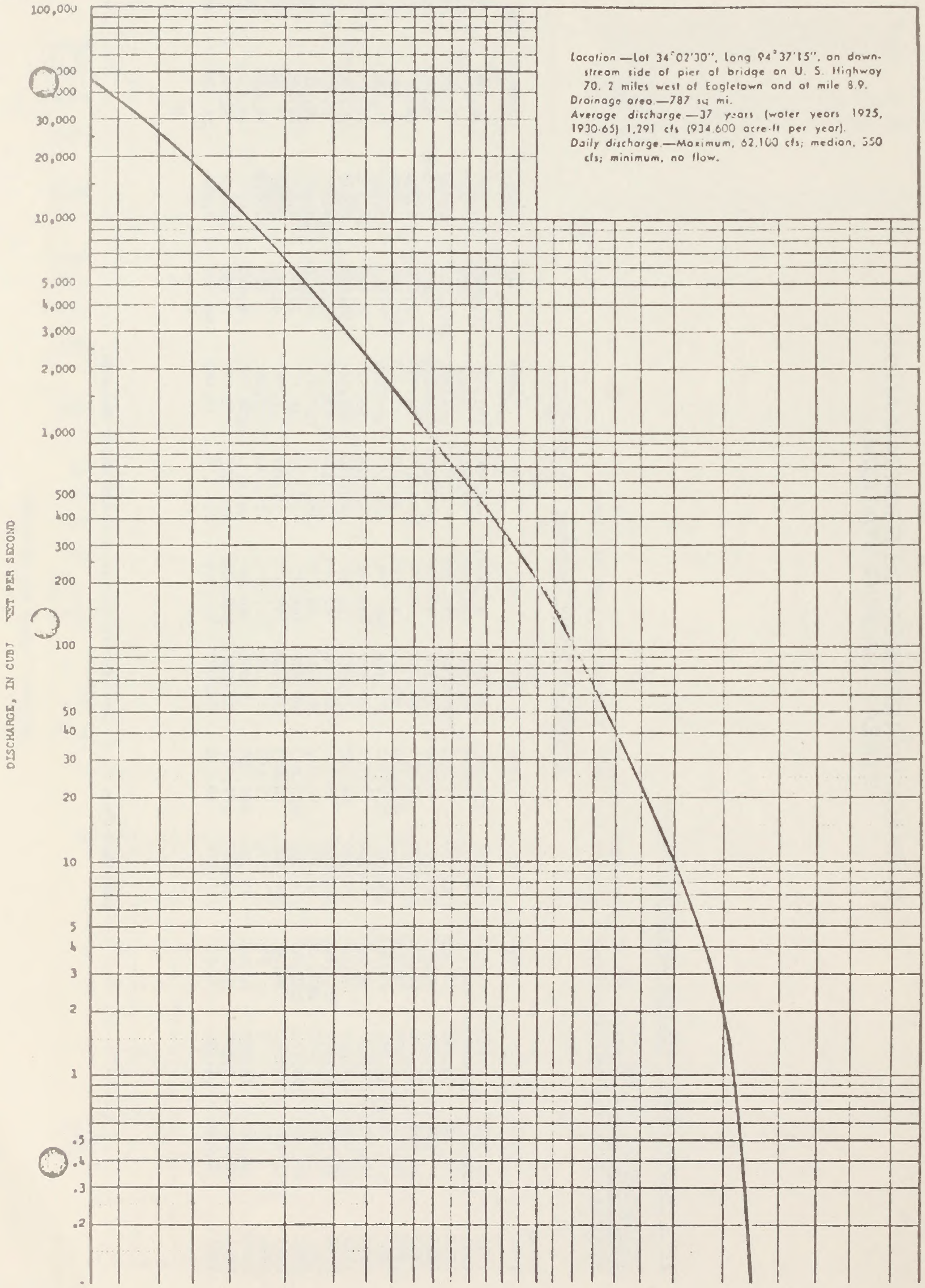
Drainage area - 787 sq. mi.
Average discharge - 39 years, 915,800 acre-feet per year.
Extremes - Maximum discharge, 101,000 cfs, May 20, 1960: Minimum, no flow at times.

Monthly and Yearly Discharge, in Acre-Feet

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The Year
1951	17,220	9,610	5,260	36,050	235,500	78,600	67,900	42,890	131,400	151,400	5,930	10,460	792,200
1952	21,850	128,700	94,120	102,700	71,340	122,200	435,600	47,960	6,850	808	137	1.0	1,032,000
1953	0	69,420	79,300	83,460	99,250	209,000	319,500	256,300	4,600	151,000	8,310	1,090	1,281,000
1954	101	1,070	20,960	149,000	92,350	19,100	72,800	146,600	4,650	313	1.6	6,980	513,900
1955	171,600	27,720	57,510	61,690	117,000	153,000	109,400	66,830	11,920	5,170	5,690	16,590	804,100
1956	28,560	2,370	5,210	17,070	212,300	50,760	29,490	68,000	3,240	540	192	257	418,000
1957	4.8	16,150	43,880	124,000	114,700	177,100	487,700	302,400	138,500	5,350	2,660	34,520	1,447,000
1958	10,440	117,200	58,060	97,800	33,710	214,900	152,300	223,800	55,320	14,160	14,350	16,100	1,008,000
1959	21,650	157,100	26,880	31,150	64,150	131,400	80,490	42,700	17,610	54,410	9,910	10,220	647,700
1960	87,530	29,820	210,900	146,800	93,320	83,960	42,210	311,600	42,670	93,000	38,040	5,050	1,185,000
1961	5,970	11,050	240,500	63,140	94,930	184,600	91,490	161,900	17,810	54,420	24,290	18,960	969,100
1962	27,170	133,200	152,400	172,500	103,000	106,400	106,200	25,110	14,350	1,370	2,940	11,360	856,000
1963	111,600	43,530	30,060	40,780	10,640	135,900	56,870	25,540	2,240	4,190	2,750	1,160	465,300
1964	22	0	921	976	19,660	157,100	177,800	29,430	2,840	127	32,210	49,630	470,700
1965	20,400	76,390	38,010	77,320	208,300	77,860	48,240	165,500	110,700	8,980	841	24,510	857,100
1966	12,140	6,300	12,560	32,410	157,200	32,190	120,400	130,300	2,570	456	36,630	8,960	552,100
1967	1,050	1,090	6,920	11,270	13,110	58,540	157,200	194,500	78,460	48,060	1,640	14,410	586,200

Compiled from U. S. Geological Survey Surface Water Records

DURATION CURVE OF DAILY DISCHARGE, MOUNTAIN FORK AT EAGLETOWN, OKLAHOMA



Location.—Lat 34°02'30", long 94°37'15", on downstream side of pier of bridge on U. S. Highway 70, 2 miles west of Eagletown and at mile 8.9.

Drainage area.—787 sq mi.

Average discharge.—37 years (water years 1925, 1930-65) 1,291 cfs (934,600 acre-ft per year).

Daily discharge.—Maximum, 62,100 cfs; median, 350 cfs; minimum, no flow.

SURFACE WATER RECORDS, REGION VII

STREAM GAGING STATION 7-2315

CANADIAN RIVER AT CALVIN

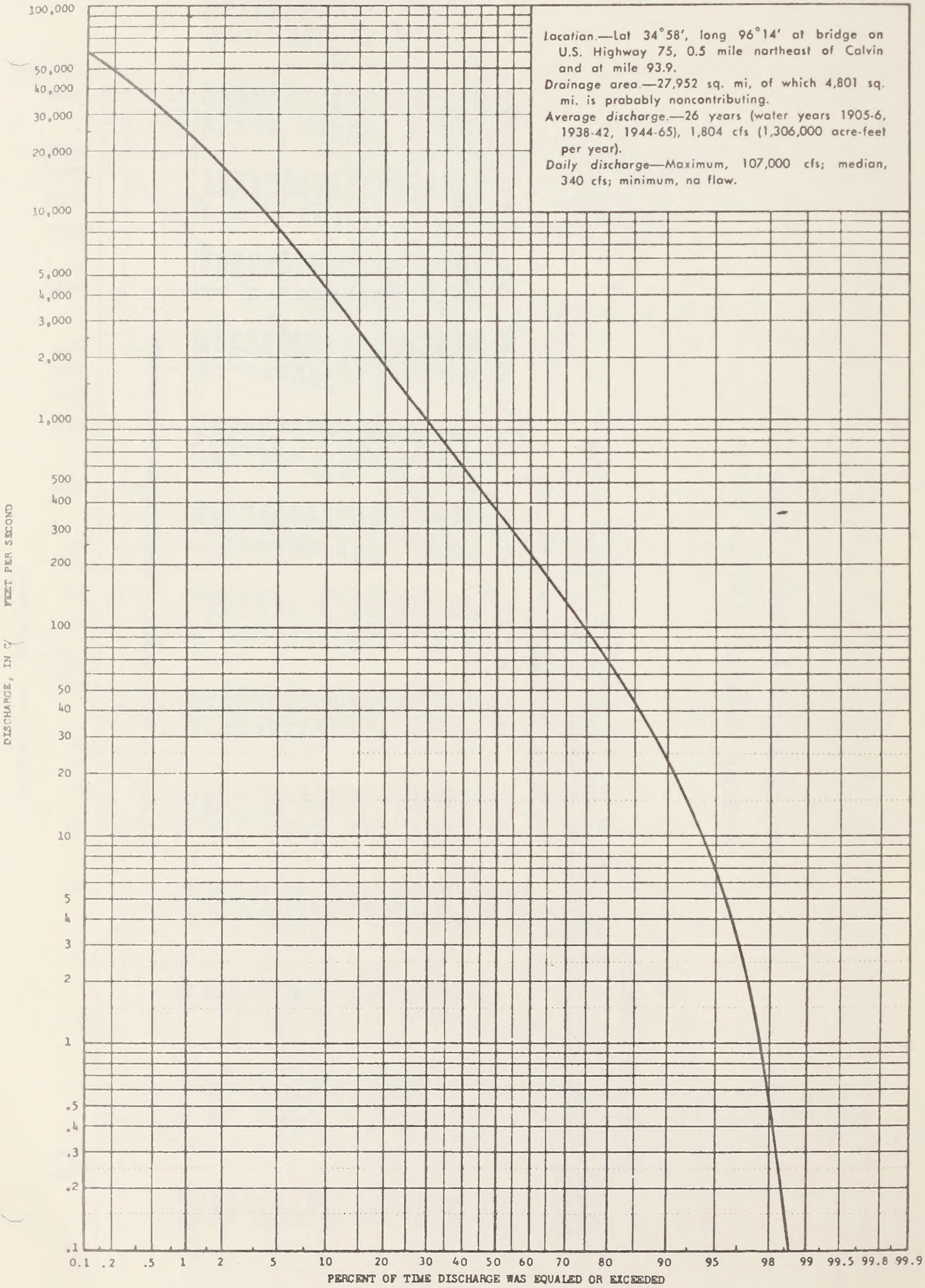
Drainage Area - 27,952 sq. mi. of which 4,801 sq. mi. is probably noncontributing
Average Discharge - 29 Years (1905-6, 1938-42, 1944-68), 1,680 cfs (1,216,000 acre-ft per year).
Extremes - Maximum discharge 174,000 cfs May 11, 1950; Minimum, no flow at times.

Monthly and Yearly Discharge, in Acre-Feet

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The Year
1951	48,730	8,040	8,740	21,770	47,420	59,670	17,950	538,200	251,900	28,370	4,630	7,360	1,043,000
1952	3,770	6,950	5,640	9,780	9,750	37,860	80,250	127,900	16,910	19,360	1,070	517	319,800
1953	73	3,490	2,830	2,290	2,420	29,350	100,200	33,300	3,850	210,300	51,170	17,980	457,300
1954	148,300	70,650	41,840	10,040	9,450	9,490	33,170	417,000	29,140	2,040	1,070	6	772,200
1955	5,910	601	3,990	6,670	6,380	17,180	7,630	457,100	81,750	33,650	34,510	53,240	708,600
1956	179,100	2,580	3,300	4,530	13,900	3,620	2,720	44,300	29,430	1,120	984	0	285,600
1957	6	3,790	9,960	5,890	9,750	33,670	400,900	993,500	640,900	34,560	60,690	164,200	2,358,000
1958	19,780	71,560	23,260	50,150	33,060	135,500	105,400	140,000	294,300	165,900	270,200	66,680	1,376,000
1959	7,230	4,520	6,910	9,220	13,420	13,570	28,390	204,700	80,090	146,300	41,370	218,300	774,000
1960	421,300	79,100	163,800	171,200	155,700	76,100	93,730	485,700	148,100	280,200	137,200	23,990	2,236,000
1961	209,600	29,660	99,640	45,200	54,200	140,500	89,910	117,400	102,700	121,200	36,240	91,320	1,138,000
1962	67,530	131,700	73,300	32,980	30,090	51,790	82,970	32,710	224,000	11,370	79,570	51,370	869,400
1963	68,420	30,650	51,860	18,300	20,000	44,840	127,600	23,110	29,180	4,100	1,750	525	420,300
1964	49	840	2,200	1,620	19,520	11,010	22,480	149,200	27,600	997	5,540	21,730	253,800
1965	3,060	130,400	18,960	19,820	16,760	16,640	30,060	53,590	49,310	22,410	5,480	73,350	439,800
1966	16,940	4,840	8,780	10,730	17,750	14,870	29,820	11,990	2,010	666	14,580	23,890	156,900
1967	983	227	477	1,060	1,300	1,290	157,700	29,090	49,160	7,920	506	17,620	267,300
1968	12,300	7,830	5,410	42,530	29,940	102,700	55,190	322,400	169,800	72,600	22,500	33,870	877,000

Compiled from U. S. Geological Survey Surface Water Records

DURATION CURVE OF DAILY DISCHARGE, CANADIAN RIVER NEAR CALVIN


Location.—Lat 34°58′, long 96°14′ at bridge on U.S. Highway 75, 0.5 mile northeast of Calvin and at mile 93.9.

Drainage area.—27,952 sq. mi, of which 4,801 sq. mi. is probably noncontributing.

Average discharge.—26 years (water years 1905-6, 1938-42, 1944-65), 1,804 cfs (1,306,000 acre-feet per year).

Daily discharge—Maximum, 107,000 cfs; median, 340 cfs; minimum, no flow.

SURFACE WATER RECORDS, REGION VII

STREAM GAGING STATION 7-2450

CANADIAN RIVER NEAR WHITEFIELD

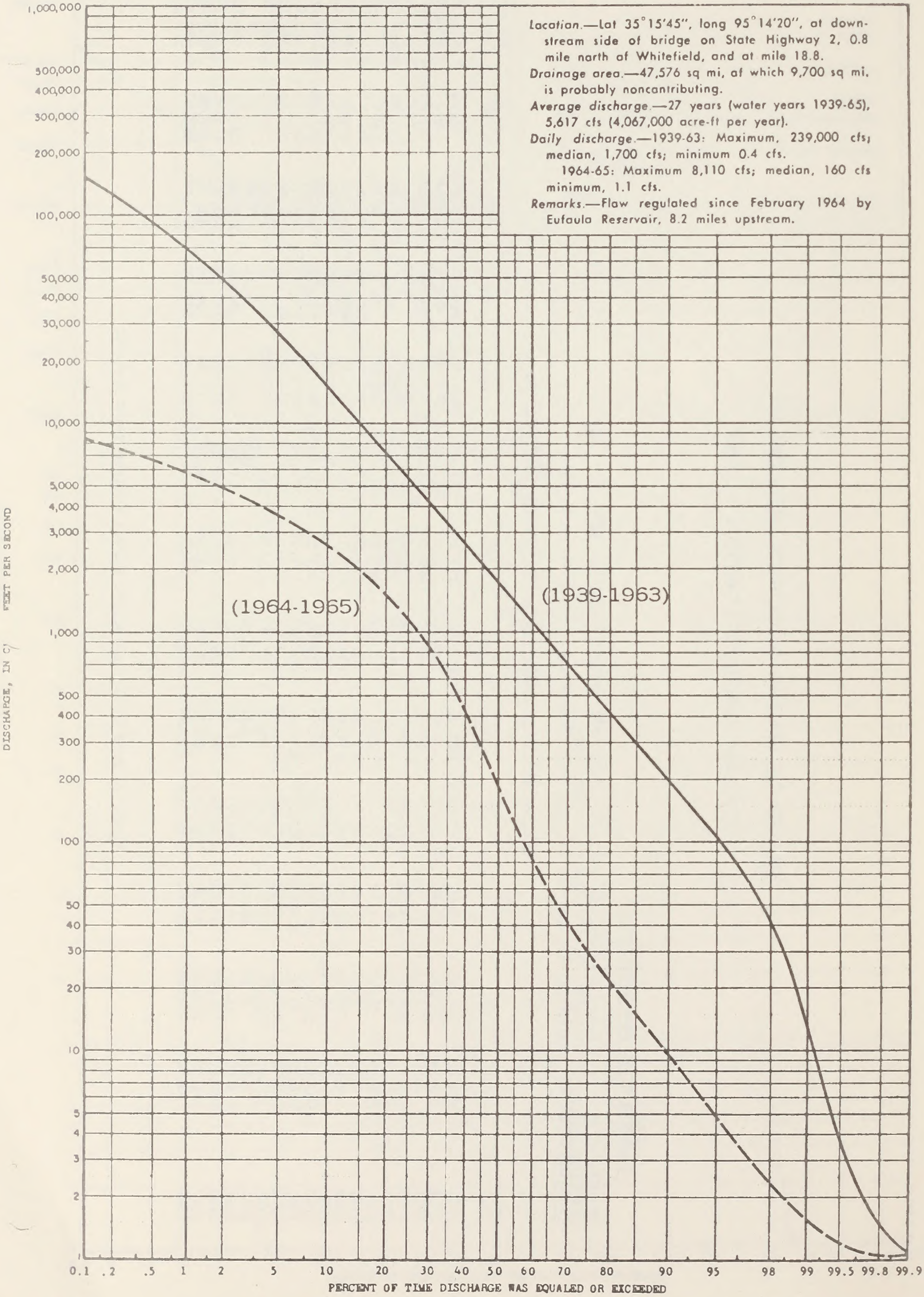
Drainage area - 47,576 sq. mi. Records available July 1938 through September 1968.
Average discharge - 30 years, 3,886,000 acre-ft per year.
Extremes - Maximum discharge, 281,000 cfs May 10, 1943; Minimum, 0.4 cfs October 8, 1956.

Monthly and Yearly Discharge, in Thousands of Acre-Feet

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The Year
1951	176.60	44.66	37.07	73.62	407.00	354.80	157.40	651.80	962.50	285.30	78.26	97.56	3,327.00
1952	45.04	107.70	37.66	58.79	86.51	365.20	689.10	293.70	143.40	49.06	16.78	9.17	1,902.00
1953	2.40	16.51	18.45	11.19	14.81	380.10	699.00	484.30	18.69	504.40	129.50	83.98	2,363.00
1954	215.90	160.10	122.20	98.00	47.37	38.40	49.83	1,301.00	104.80	9.29	3.53	0.89	2,151.00
1955	11.74	3.33	26.72	42.19	95.78	258.70	126.30	862.20	208.50	81.00	55.39	111.40	1,883.00
1956	299.70	14.64	11.21	12.23	70.60	15.11	13.49	163.30	98.67	9.34	2.79	0.16	711.20
1957	0.14	9.69	17.07	28.90	109.00	194.70	1,775.00	2,875.00	2,504.00	272.40	167.00	416.70	8,370.00
1958	52.50	274.50	118.20	181.10	129.60	631.80	477.30	585.10	771.50	490.30	597.00	169.80	4,479.00
1959	40.89	35.44	29.15	28.46	32.93	303.40	179.00	750.00	279.80	753.90	202.30	389.10	3,024.00
1960	1,665.00	363.00	598.40	568.90	456.10	332.00	337.20	2,020.00	341.40	581.40	222.50	41.80	7,528.00
1961	218.70	93.13	205.00	121.50	135.80	367.60	333.10	527.60	250.70	504.70	107.10	297.70	3,163.00
1962	206.70	460.50	359.50	176.80	131.10	337.20	542.20	115.10	551.50	211.40	94.60	209.50	3,396.00
1963	155.40	151.90	216.30	64.95	39.06	93.07	335.80	159.70	55.62	93.70	49.03	6.36	1,421.00
1964	2.05	3.15	10.18	8.36	8.82	1.26	1.84	5.09	0.23	9.19	5.70	15.00	70
1965	3.99	16.54	54.59	83.17	57.05	42.50	40.58	44.40	69.91	157.80	298.40	181.00	1,050.00
1966	100.70	119.90	53.21	30.01	44.13	29.57	43.77	66.09	171.80	173.60	243.00	175.00	1,251.00
1967	135.30	173.10	74.86	28.31	28.53	24.40	21.14	68.26	51.24	34.68	88.20	137.80	865.80
1968	85.92	181.00	161.00	171.10	238.90	675.10	637.00	1.24	551.40	349.90	206.40	192.60	4,688.00

Compiled from U. S. Geological Survey Surface Water Records

DURATION CURVE OF DAILY DISCHARGE, CANADIAN RIVER NEAR WHITEFIELD



Location.—Lat 35°15′45″, long 95°14′20″, at downstream side of bridge on State Highway 2, 0.8 mile north of Whitefield, and at mile 18.8.

Drainage area.—47,576 sq mi, of which 9,700 sq mi. is probably noncontributing.

Average discharge.—27 years (water years 1939-65), 5,617 cfs (4,067,000 acre-ft per year).

Daily discharge.—1939-63: Maximum, 239,000 cfs; median, 1,700 cfs; minimum 0.4 cfs.
1964-65: Maximum 8,110 cfs; median, 160 cfs minimum, 1.1 cfs.

Remarks.—Flow regulated since February 1964 by Eufaula Reservoir, 8.2 miles upstream.

SURFACE WATER RECORDS, REGION VII

STREAM GAGING STATION 7-2465

ARKANSAS RIVER NEAR SALLISAW

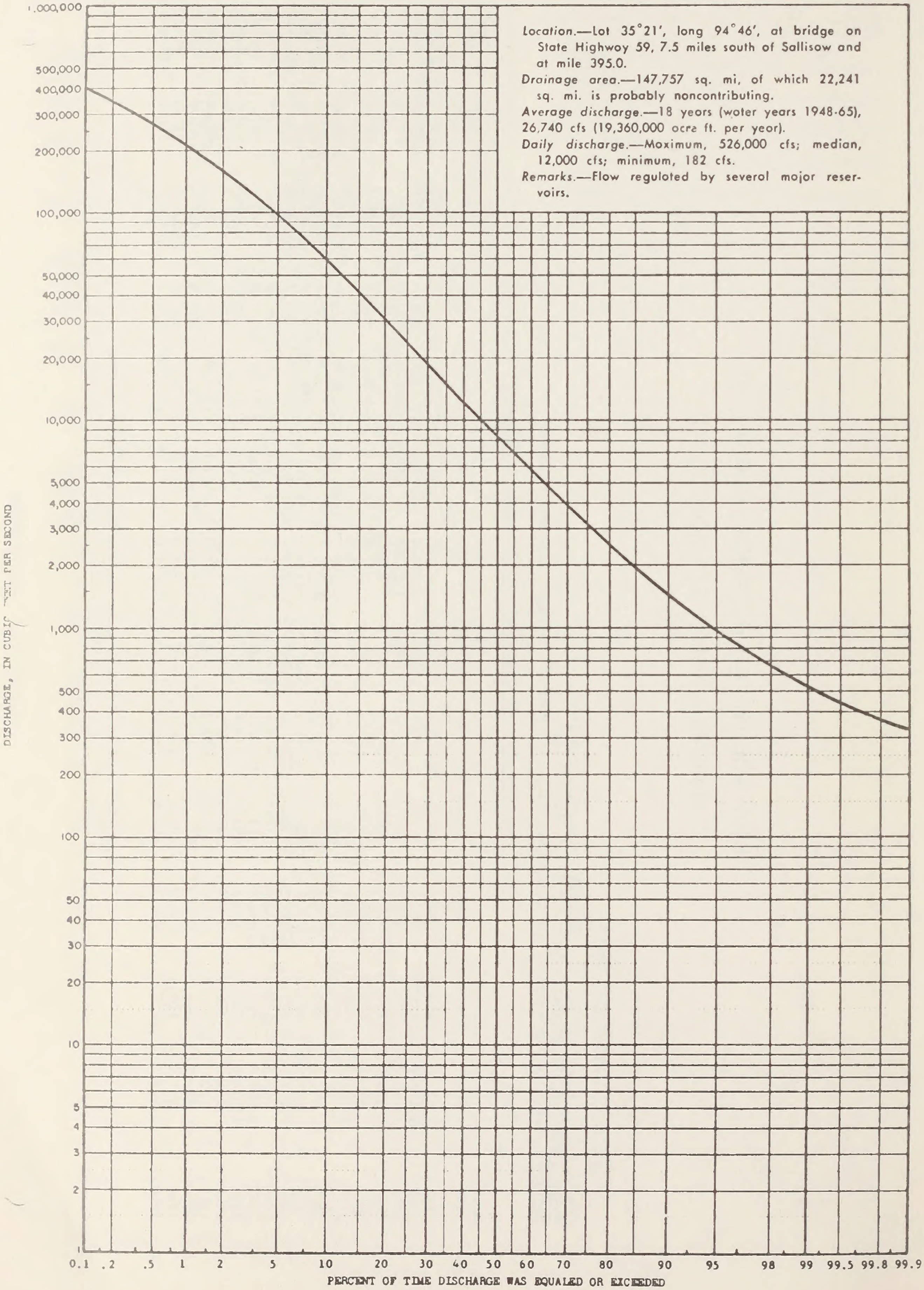
Drainage area - 147,757 sq. mi. Records available 1948-1968.
Average discharge - 21 years, 18,330,000 acre-ft per year.
Extremes - Maximum discharge, 544,000 cfs May 27, 1957; Minimum, 161 cfs, October 12, 1956.

Monthly and Yearly Discharge, in Thousands of Acre-Feet

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The Year
1951	1,072.0	438.7	394.5	444.5	1,976.0	1,799.0	1,094.0	455.5	4,566.0	10,720.0	1,494.0	3,035.0	31,590
1952	1,323.0	2,426.0	1,263.0	957.8	1,190.0	3,000.0	3,090.0	1,567.0	1,003.0	326.6	252.0	194.0	16,590
1953	96.18	109.1	146.7	147.3	143.3	873.2	1,911.0	1,713.0	302.9	944.5	379.7	221.6	6,988
1954	294.0	302.4	306.0	302.1	230.7	195.6	208.9	2,788.0	615.7	243.7	136.6	49.37	5,673
1955	161.9	132.8	190.2	396.4	410.8	817.5	562.8	2,250.0	1,608.0	857.4	333.1	352.2	8,073
1956	1,505.0	234.2	252.6	186.7	235.6	164.0	151.7	493.2	381.3	205.9	145.1	37.38	3,993
1957	24.33	74.14	105.7	111.8	371.5	531.9	5,320.0	11,800.0	12,290.0	4,673.0	688.1	1,122.0	37,110
1958	447.0	880.7	546.0	615.1	658.1	3,887.0	3,258.0	2,434.0	2,071.0	4,726.0	2,042.0	1,134.0	22,700
1959	494.8	426.1	353.6	334.1	509.0	1,345.0	1,053.0	2,436.0	1,068.0	3,812.0	1,264.0	1,192.0	14,290
1960	9,692.0	2,017.0	1,806.0	1,919.0	2,041.0	2,438.0	2,384.0	5,585.0	2,225.0	2,170.0	1,381.0	852.0	34,510
1961	747.2	1,063.0	1,076.0	514.4	676.6	1,609.0	2,509.0	9,708.0	2,912.0	3,341.0	1,881.0	4,479.0	30,520
1962	2,854.0	4,508.0	2,664.0	1,377.0	1,760.0	1,586.0	1,779.0	589.1	2,471.0	1,124.0	741.1	1,866.0	23,320
1963	1,838.0	869.6	838.8	691.2	378.4	912.8	697.4	458.6	467.7	729.4	396.9	528.8	8,808
1964	182.1	126.7	104.6	97.55	129.5	142.8	624.6	654.1	1,302.0	419.0	373.7	612.8	4,769
1965	152.7	1,579.0	972.3	675.6	360.9	740.3	3,191.0	1,067.0	2,904.0	1,585.0	631.3	1,899.0	15,760
1966	880.5	344.5	358.1	479.2	843.3	634.1	815.5	1,138.0	755.5	487.5	685.4	600.6	8,022
1967	377.6	305.1	256.2	171.3	124.3	148.4	525.6	478.6	1,150.0	2,693.0	1,012.0	839.8	8,081
1968	1,149.0	1,271.0	935.7	963.5	1,926.0	2,883.0	3,041.0	2,797.0	2,359.0	1,132.0	1,305.0	670.8	20,430

Compiled from U. S. Geological Survey Surface Water Records

DURATION CURVE OF DAILY DISCHARGE, ARKANSAS RIVER NEAR SALLISAW



Location.—Lat 35°21′, long 94°46′, at bridge on State Highway 59, 7.5 miles south of Sallisaw and at mile 395.0.

Drainage area.—147,757 sq. mi, of which 22,241 sq. mi. is probably noncontributing.

Average discharge.—18 years (water years 1948-65), 26,740 cfs (19,360,000 acre ft. per year).

Daily discharge.—Maximum, 526,000 cfs; median, 12,000 cfs; minimum, 182 cfs.

Remarks.—Flow regulated by several major reservoirs.

SURFACE WATER RECORDS, REGION VII

STREAM GAGING STATION 7-2475

FOURCHE MALINE NEAR RED OAK

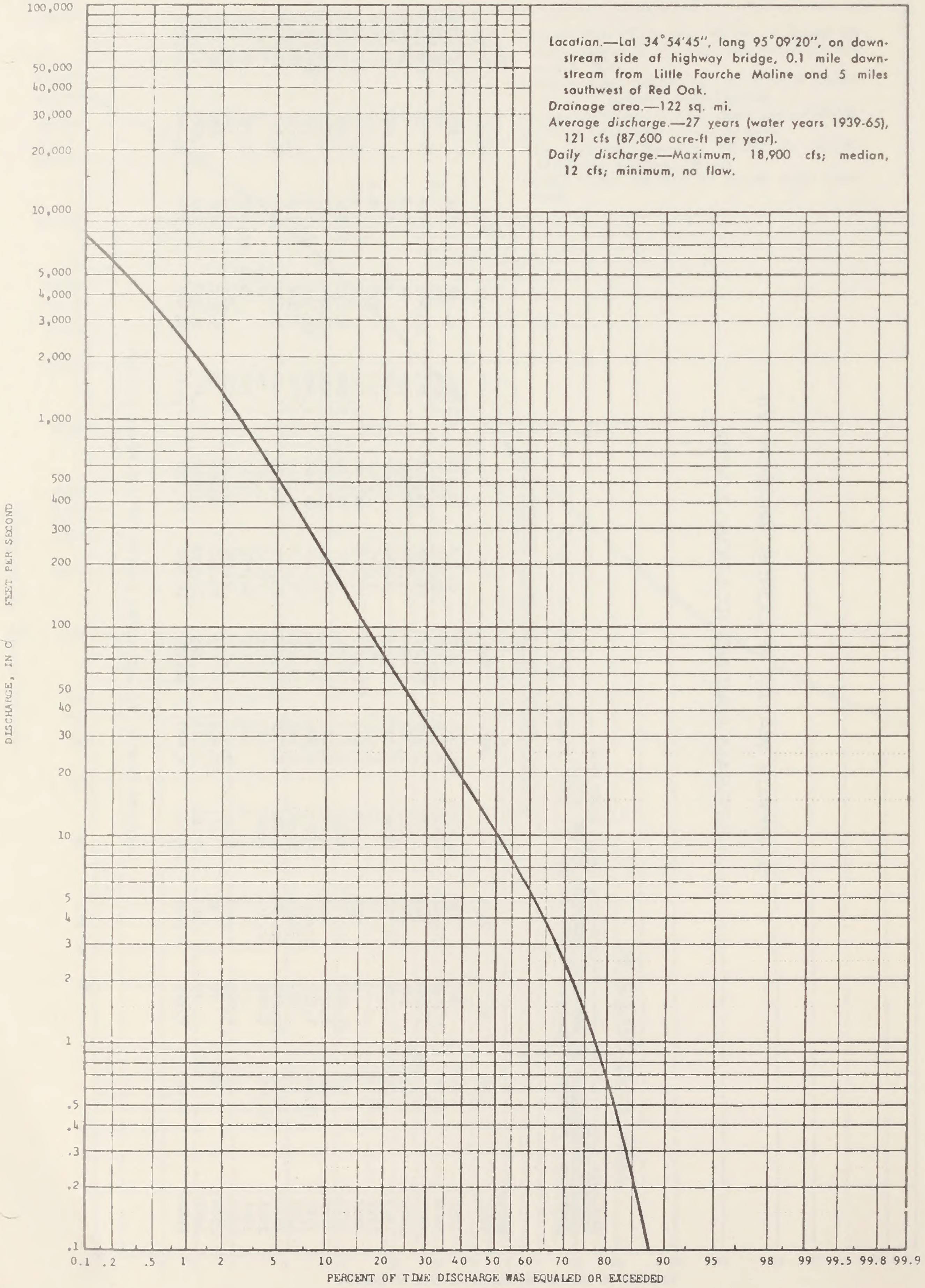
Drainage area - 122 sq. mi. Records available 1939-1968.
Average discharge - 30 years, 86,880 acre-ft per year.
Extremes - Maximum discharge, 41,500 cfs May 19, 1960; Minimum, no flow at times.

Monthly and Yearly Discharge, in Acre-Feet

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The Year
1951	498	105	181	1,760	30,090	6,690	6,750	8,510	23,000	3,110	733	811	82,240
1952	1,430	9,040	2,600	1,510	2,250	13,420	28,590	2,720	1,870	59	5.2	96	63,590
1953	5.6	1,310	916	746	2,780	37,250	46,940	18,730	141	11,900	478	50	121,200
1954	173	143	821	5,010	1,730	605	2,110	7,810	190	34	0	0	18,630
1955	163	36	3,780	3,140	9,500	20,160	9,670	3,030	323	2.6	345	852	51,000
1956	1,310	15	25	32	6,460	618	1,540	2,760	167	379	8.5	0	13,310
1957	0	0	105	3,150	7,410	17,070	72,840	36,250	22,550	211	1.6	5,700	165,300
1958	431	11,660	4,700	5,590	2,640	19,700	7,090	22,710	8,590	5,030	8,820	2,020	98,980
1959	208	3,360	866	1,130	1,360	21,060	8,500	22,800	496	9,060	689	1,290	70,820
1960	13,260	3,120	11,580	15,850	8,600	8,560	2,200	84,640	1,870	28,550	6,770	263	185,300
1961	371	257	9,220	3,980	5,570	18,650	5,180	6,710	1,270	7,170	215	1,780	60,370
1962	2,230	19,530	13,370	8,800	8,540	7,890	21,690	2,020	1,080	5,950	122	1,100	92,320
1963	10,690	8,920	4,750	3,040	421	1,520	7,950	1,500	54	4.0	0	0	38,850
1964	0	0	0	0	106	4,750	14,000	6,730	102	5.6	11,620	2,790	40,100
1965	403	4,220	673	1,700	9,650	6,800	2,280	20,210	2,530	227	252	749	49,690
1966	54	78	82	371	19,660	809	30,190	8,890	59	5,050	830	389	66,460
1967	2.9	30	103	85	97	149	16,610	13,160	3,840	4,500	330	2,820	41,730
1968	4,660	2,120	15,310	14,060	4,640	38,220	14,010	27,150	7,390	2,140	377	3,160	133,200

Compiled from U. S. Geological Survey Surface Water Records

DURATION CURVE OF DAILY DISCHARGE, FOURCHE MALINE NEAR RED OAK



Location.—Lat 34°54′45″, long 95°09′20″, on downstream side of highway bridge, 0.1 mile downstream from Little Fourche Maline and 5 miles southwest of Red Oak.

Drainage area.—122 sq. mi.

Average discharge.—27 years (water years 1939-65), 121 cfs (87,600 acre-ft per year).

Daily discharge.—Maximum, 18,900 cfs; median, 12 cfs; minimum, no flow.

SURFACE WATER RECORDS, REGION VII

STREAM GAGING STATION 7-2485

POTEAU RIVER NEAR WISTER

Drainage area - 993 sq. mi. Records available May 1938 through September 1968.
Average discharge - 30 years, 802,900 acre-ft per year.
Extremes - Maximum discharge, 78,600 cfs May 16, 1945; Minimum discharge, zero flow at times.

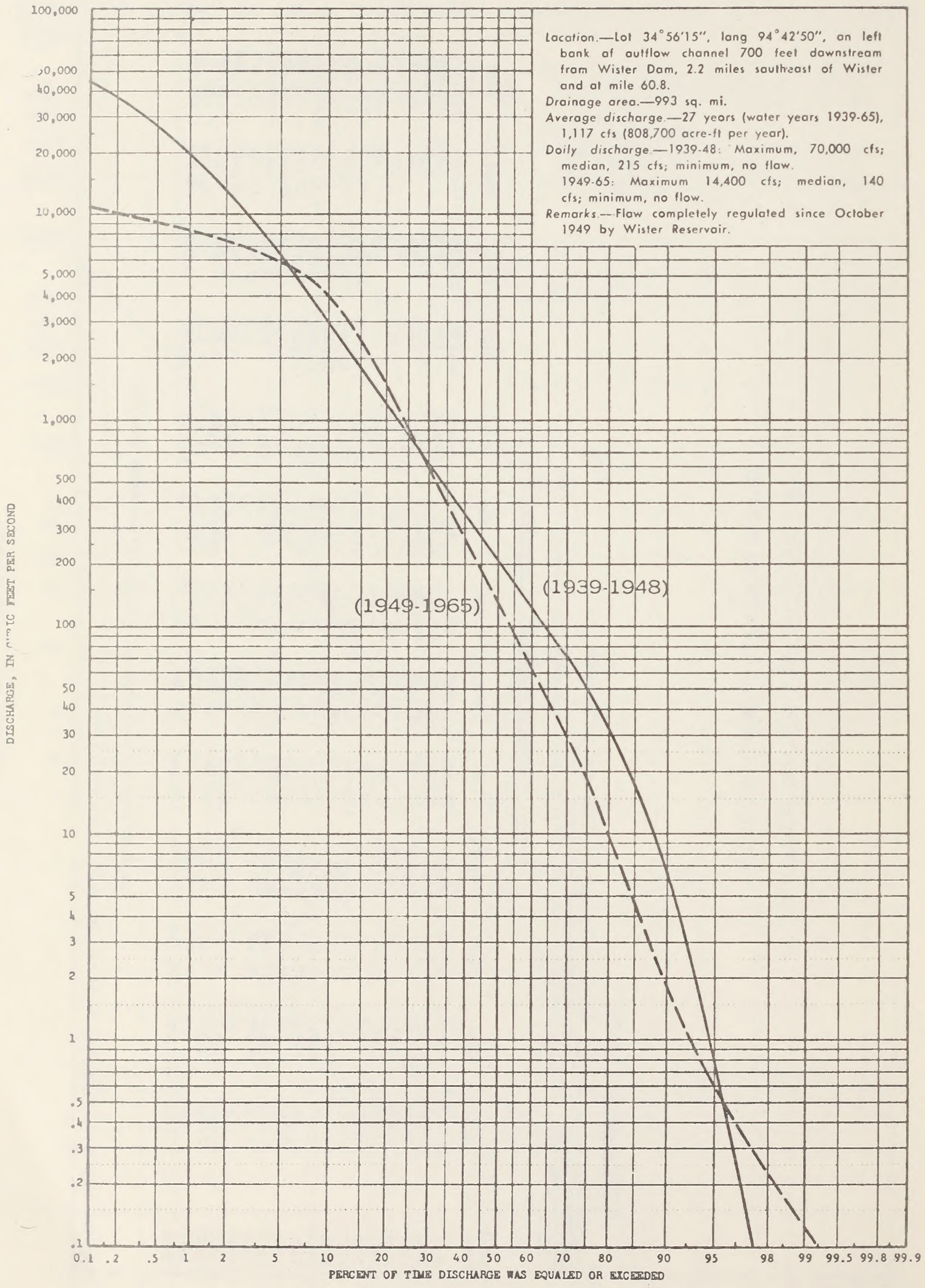
Monthly and Yearly Discharge, in Acre-Feet 1/

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The Year
1951	67,890	395	2,290	19,600	77,350	213,700	52,050	33,510	94,450	32,280	16,530	13,460	623,500
1952	18,610	140,100	67,300	48,670	33,230	142,400	216,400	117,000	14,060	694	544	425	799,400
1953	299	31,580	54,110	41,530	47,050	215,600	241,200	365,200	679	59,610	7,310	587	1,065,000
1954	208	931	11	100,600	30,170	5,730	41,250	127,400	1,680	82	558	254	308,900
1955	1,990	3,280	31,620	63,500	80,640	140,600	146,600	22,640	3,820	201	153	2,070	497,100
1956	2,610	109	59	519	95,380	16,880	8,010	18,500	2,660	51	400	24	145,200
1957	259	31	21,770	59,840	134,400	126,500	169,100	250,300	174,300	350,700	121,800	78,870	1,488,000
1958	26,010	125,500	45,190	73,710	37,470	180,900	132,500	263,800	62,400	59,440	27,350	7,100	1,041,000
1959	2,600	34,010	11,870	20,750	20,340	118,600	81,900	56,050	3,470	32,180	6,630	1,670	390,100
1960	61,150	25,990	119,700	121,000	74,140	88,550	13,590	202,900	328,700	60,500	72,350	1,240	1,170,000
1961	2,380	1,700	108,700	47,930	77,810	74,320	122,200	61,900	91,760	71,340	12,510	13,330	685,900
1962	43,830	67,170	193,900	95,580	55,410	102,100	100,700	32,180	6,070	9,950	1,270	46,660	754,800
1963	38,490	38,070	28,050	16,660	3,720	59,710	14,360	39,580	1,180	685	1,440	654	242,600
1964	336	66.6	31.1	8.7	1,090	66,990	70,570	47,320	1,270	402	11,870	37,650	237,600
1965	42,130	88,670	36,440	53,890	126,200	95,820	97,120	79,800	57,280	2,500	416	32,490	712,800
1966	2,800	1,100	2,870	14,130	128,100	18,230	30,170	203,700	1,510	2,480	7,660	4,330	417,100
1967	280	250	406	1,850	555	3,270	64,540	216,500	73,650	27,570	772	36,530	426,200
1968	7,560	120,200	122,200	85,440	133,600	107,700	258,400	236,000	311,900	21,080	1,030	5,570	1,411,000

Compiled from U. S. Geological Survey Surface Water Records

1/Flow completely regulated by Wister Reservoir since Oct. 1949.

DURATION CURVE OF DAILY DISCHARGE, POTEAU RIVER NEAR WISTER



Location.—Lat 34°56'15", long 94°42'50", on left bank of outflow channel 700 feet downstream from Wister Dam, 2.2 miles southeast of Wister and at mile 60.8.

Drainage area.—993 sq. mi.

Average discharge.—27 years (water years 1939-65), 1,117 cfs (808,700 acre-ft per year).

Daily discharge.—1939-48: Maximum, 70,000 cfs; median, 215 cfs; minimum, no flow.
1949-65: Maximum 14,400 cfs; median, 140 cfs; minimum, no flow.

Remarks.—Flow completely regulated since October 1949 by Wister Reservoir.

SURFACE WATER RECORDS, REGION VII

STREAM GAGING STATION 7-2505

ARKANSAS RIVER AT VAN BUREN, ARKANSAS.

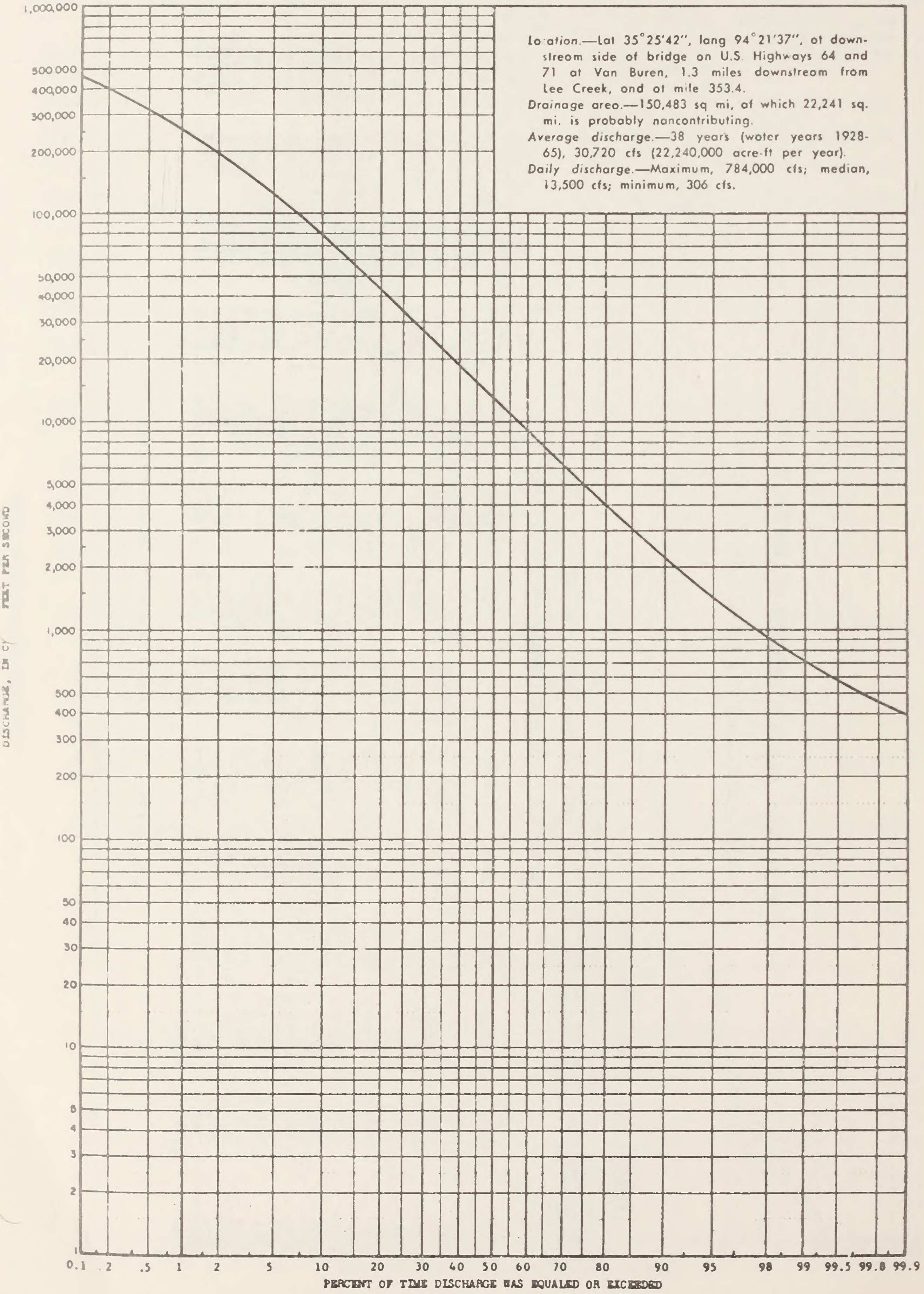
Drainage area - 150,483 sq. mi. Records available 1928-1968.
Average discharge - 41 years, 21,650,000 acre-ft per year.
Extremes - Maximum discharge, 850,000 cfs May 12, 1943; Minimum, 300 cfs October 12, 1956.

Monthly and Yearly Discharge, in Thousands of Acre-Feet

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The Year
1951	1,182.0	463.2	400.1	471.3	2,430.0	2,216.0	1,182	4,529.0	4,937.0	10,820.0	1,591.0	3,050.0	33,270
1952	1,458.0	2,915.0	1,538.0	1,107.0	1,303.0	3,529.0	3,782	1,885.0	1,101.0	337.9	263.0	201.3	19,420
1953	105.7	147.5	240.0	218.6	243.7	1,460.0	2,597	2,399.0	318.5	1,013.0	399.1	223.1	9,365
1954	272.3	302.7	321.9	462.3	297.8	217.3	288.4	2,917.0	616.7	251.0	135.9	51.69	6,135
1955	165.1	155.8	273.3	547.1	633.9	1,279.0	808.7	2,155.0	1,702.0	893.9	334.1	350.0	9,298
1956	1,507.0	244.0	245.2	187.2	381.5	198.2	189.5	548.2	423.8	215.7	145.4	44.17	4,330
1957	30.24	75.09	130.8	192.9	652.9	756.2	5,811	12,010.0	13,020.0	5,067.0	891.2	1,273.0	39,910
1958	482.7	1,161.0	617.1	739.7	742.0	4,173.0	3,648	3,198.0	2,255.0	5,137.0	2,342.0	1,172.0	25,670
1959	508.3	568.1	384.4	356.5	551.0	1,856.0	1,323	2,726.0	1,148.0	3,879.0	1,318.0	1,125.0	15,740
1960	10,100.0	2,236.0	2,117.0	2,359.0	2,278.0	2,642.0	2,412	6,191.0	2,747.0	2,361.0	1,449.0	903.0	37,800
1961	699.8	1,108.0	1,256.0	590.1	754.9	1,813.0	2,833	9,819.0	3,101.0	3,469.0	1,883.0	4,248.0	31,570
1962	2,876.0	4,471.0	3,063.0	1,682.0	1,946.0	1,795.0	2,014	665.6	2,483.0	1,133.0	710.5	1,831.0	24,670
1963	1,977.0	976.6	940.1	684.3	373.4	1,006.0	694.9	601.5	464.5	715.6	426.6	549.0	9,410
1964	200.7	137.0	109.4	111.6	142.9	315.4	942.2	854.0	1,292.0	448.9	362.3	700.1	5,616
1965	221.0	1,636.0	1,102.0	810.3	584.9	898.5	3,479	1,302.0	2,901.0	1,693.0	634.1	1,934.0	17,200
1966	974.1	334.8	327.0	535.3	1,195.0	724.1	1,100	1,569.0	782.7	495.6	690.5	618.0	9,347
1967	387.9	303.9	255.8	177.9	134.3	154.4	793.4	910.0	1,235.0	2,839.0	995.0	872.0	9,058
1968	1,191.0	1,458.0	1,274.0	1,410.0	2,398.0	3,437.0	3,645.0	3,613.0	2,928.0	1,234.0	1,398.0	709.8	24,430

Compiled from U. S. Geological Survey Surface Water Records

ATION CURVE OF DAILY DISCHARGE, ARKANSAS RIVER NEAR VAN BUREN, ARKANSAS



Location.—Lat 35°25'42", long 94°21'37", at downstream side of bridge on U.S. Highways 64 and 71 at Van Buren, 1.3 miles downstream from Lee Creek, and at mile 353.4.

Drainage area.—150,483 sq mi, of which 22,241 sq. mi. is probably noncontributing.

Average discharge.—38 years (water years 1928-65), 30,720 cfs (22,240,000 acre-ft per year).

Daily discharge.—Maximum, 784,000 cfs; median, 13,500 cfs; minimum, 306 cfs.

Attachment #7

Aquatic Plant Species Found In Eastern Oklahoma [5&8/]

Scientific Name	Common Name
Alisma plantago-aquatica	American water plantain
Azolla caroliniana	Water velvet
Bacopa rotundifolia	Disc water hyssop
Brasenia schreberi	Watershield
Cabomba caroliniana	Fanwort
Callitriche heterophylla	Water star-worts
Carex straminea	Straw-sedge
Ceratophyllum demersum	Coontail
Chara contraria	Muskgrass
Chara harteusis	
Echinodorus cordifolius	Erect burhead
Eleocharis quadrangulata	Squarestem spikerush
Eleocharis macrostactaya	Common spikerush
Heteranthera dubia	water star-grass
Heteranthera limosa	smaller mud-plantain
Juncus effusus var. solvtus	soft rush
Juncus nodatus	common rush
Jussiaca repens	smooth water primrose
Justicia americana	waterwillow
Lerrsia oryzoidis	rice cut-grass
Lemna minor	little duckweed
Limnobium spongia	American Frogbit
Myriophyllum brasiliense	Parrotfeather
Myriophyllum pinnatum	water milfoil
Najas quadalupensis	najad
Neulumbo lutea	water chinquapin
Nymphaceae odorata	American waterlily
Nuphar advena	Spatterdock
Polygonum coccineum	Bigioat smartweed
Polygonum hydropiperoides	swamp smartweed
Polygonum lepathifoliun	Curltop smartweed
Potamogeton diversifolius	Waterthread pondweed
Potamogeton nodosus	Common pondweed
Potamogeton pectinatus	Fennalleaf pondweed
Sagittaria latifolia	Broad-bared arrow-head
Scirpus validus	Softstem bulrush
Saururus cernuus	
Spirodela polyrhiza	Big duckweed
Typha domingensis	Southern cattail
Typha latifolia	Common cat-tail
Ultricularia gibba	Bladderwort
Zizaniopsis miliacea	Water millet

Attachment #8

Distribution of Habitat Types Biotic Districts

The distribution of habitat types in the biotic districts in Oklahoma. The estimated extent of each habitat type in each district in relation to the extent of the other habitat types in the district is indicated by the number of check marks. The maximum of 5 checks indicates that the habitat type is of major extent in the district, and the estimated extent of the habitat type decreases with the number of checks.

				BIOTIC DISTRICTS									
			HABITAT TYPES	Mesa de Maya	Short-grass Plains	Mesquite Plains	Mixed-grass Plains	Wichita Mountain	Osage Savanna	Cherokee Prairie	Ozark	Ouachita	Mississippi
FOREST ASSOCIATIONS	Closed Mesic	Heavy Soils	Mississippi flood-plain forest										xxx
			Ouachita flood plain forest									xx	
			Oak—elm flood-plain forest						x	x	x		
			Mesic ravine forest					xxx	x	x	x	xx	
	Open Forest	Heavy Soils	Open flood-plain forest					x	x	x	x	x	x
			Pine—sweetgum alluvial forest									x	xxx
		Thin Soils	Oak—yellow pine forest								x	xxxxx	x
			Oak—hickory forest				x	xxxxx		x	xxxxx	xx	
		Sandy Soils	Blackjack forest					x	xxxxx				
			Cottonwood—willow association	x	xx	xxx	xxx	x	x	x	x	x	x
	Xeric Rock		Oak—juniper saxophile forest		x		x						
			Pinyon—juniper saxophile forest	xxx							xx	x	
SCRUB AND THICKET ASSOCIATIONS	Mesic or Wet		Flood-plain thickets					x	x	xx	xx	xx	xx
			Forest margin thickets	x	x		x	xx	xx	xx	xx	xx	xx
	Xeric		Dry thickets on heavy soil			x	x	x	x	xx	x	x	
			Shin-oak thickets on sand		x		xxx						
			Dry thickets on sand	x	x	x	xx	x					
			Dry thickets on shallow soils	x	x	x	x	x	x	x	x	x	
			Thorn scrub	x		xxxx							
			Canyon and rock-slope thickets	xxx	x		x	x	x				

								✓			✓	
GRASSLAND AND HERBAGE ASSOCIATIONS	Wet	Emergent vegetation	x	x	x	x	x	x	x	x	x	x
		Sedge, bulrush, cat-tail marshes	x	x	x	x	x	xx	xx	x	x	xx
		Wet meadows and seepage slopes	x	x		x	x	xx	x	xx	xx	xx
	Heavy Deep Soil	Rank herbage and weed thickets	x	x	x	x	x	x	x	x	x	x
		Tall-grass association		x		xx	x	xx	xxxxx	xx	x	
	Sand	Bunch-grass on sand	x	xx	xx	xxx	x				x	
	Shallow or immature Soils	Mixed-grass association				xxxxx	xxxxx	xxxx	x			
		Grass—mesquite association			xxx	x	x					
		Dry weed fields on thin soil	xx	xx	xx	xx	x	x	x	x	x	x
		Sagebrush flats	x	xx	xx	xx						
		Short-grass association	xxxxx	xxxxx	x	x	x	x	x			
BARE OR SPARSELY VEGETATED SOIL	Wet	Sand bars, muddy stream banks	x	x	x	x	x	x	x	x	x	x
		Pond margin mud flats	x	x	x	x	x	x	x	x	x	x
		Deep alluvial and mature residual soils			x		x	x	xx	x	x	xx
	Sand	Salt flats				xx						
		Dry sandy soil	xx	xx	x	xx	x	x	x	x	x	x
	Thin	Shallow, stony, immature or eroded soils	xxxx	xx	x	xx	xx	x	x	x	x	
		Rock ledges and cliffs	xxx	x	x	x	xx	x	x	xx	xx	
HYPOGEIC HABITATS		Deep alluvial and mature residual soils			x		x	x	xx	x	x	xx
		Sandy soils	xx	xx	xx	xxx	x	xx	x	x	x	x
		Shallow, stony, immature, or eroded soils	xxx	xx	xx	xxx	xx	xx	x	xx	xx	
		Caves in limestone, gypsum, lava	x	x	x	x	x	x	x	xx		
Climate		Rainfall (inches)	18	22-25	20	27-32	31.5	38	37-43	42.4	42.52	45.4
		Temperature	54.8°	54-58°	63°	58-63°	62°	59-64°	60°	60.1°	63°	61.6°
		Growing season (days)	179	180-206	224	203-224	219	200-235	200-218	209	216	240

ATTACHMENT 9

Terrestrial Plant List 5/

TABLE

KEY TO FLORA ASSOCIATIONS*

DESCRIPTION	ASSOCIATION
Lobbolly Pine Forest	1
Cypress Bottomlands Forest	2
*Bottomland-floodplain	3
*Oak-Pine Forest	4
*Oak-Hickory Woodland	5
*Post Oak-Blackjack Oak	6
*Tall-grass Prairie	7
Mixed Grass Eroded Plains	8
Disturbed	9

ABUNDANCE	RATING
Rare	1
Uncommon	2
Common	3
Present	X

*SPECIES PRESENT IN SUBJECT AREA OCCUR IN ASSOCIATIONS 3, 4, 5, 6, & 7 ONLY

			Associations										
Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
Abutilon theophrasti	Indian mallow	Malvaceae			x						x	17,34	
Acacia angustissima	Prairie acacia	Leguminosae					x		x		3	16,23	
Acalypha gracilens	Copperleaf	Euphorbiaceae			x				x			17,34	
Acalypha ostryaefolia	Hophornbeam copperleaf	Euphorbiaceae							3			17	
Acalypha rhomboidea	Copperleaf	Euphorbiaceae							2			27	
Acalypha virginica	Virginia copperleaf	Euphorbiaceae							2			17	
Acer leucoderme	Chalk maple	Aceraceae				x		x				19 14,15	
Acer negundo	Box elder	Aceraceae			x	x	x	x	x			27,34	
Acer roubrum, var. Ric. Tridens	Red maple	Aceraceae		x		x	x	x				19,25	
Acer saccharinum	Silver maple	Aceraceae			x	x	x	x	x			25,34	
Acer saccharum	Sugar maple	Aceraceae			x	x	x	x	x			25 3,15	Disjunct occurring in Devils Canyon
Achillea lanulosa	Yarrow	Compositae			x				3		x	18 11,27	
Acorus calamus	Drug sweetflag	Araceae			x							16,34	
Aesculus arguta	Shrubby buckeye	Hippocastanaceae					x		x			25	
Aesculus glabra	Ohio buckeye	Hippocastanaceae				x						14,17	
Aesculus pavia	Scarlet buckeye	Hippocastanaceae				x						25,14	Southeast Oklahoma
Agalinis aspera	Rough Purple Agalinis	Scrophulariaceae										16,17	Northwest Oklahoma
Agalinis heterophylla	Prairie Agalinis	Scrophulariaceae										16,17	
Agalinis purpurea	Large Purple Agalinis	Scrapholariaceae										16	
Agastache nepetoides	Catnip gianthyssop	Labiatae					x					17	Dominant in Northeast Oklahoma
Agave (Polianthes) virginica	Aloe	Amaryllidaceae										17,31	
Agoseris (Nothcalais) cruspidata	Prairie False Dandelion	Compositae							1			16	
Agrimonia mollis	Softleaf groovebur	Rosaceae										17	
Agrimonia parviflora	Manyflower groovebur	Rosaceae			x							27	
Agrimonia pubescens	Groovebur	Rosaceae										21	
Agropyron biflorum	Purplish Wheat-Grass	Graminae										16	Alphine form of A. Trachycavlum. Only Reported. No specimens known.
Agropyron repens	Couch-Grass	Graminae										16	
Agrostis alba	Redtop bentgrass	Gramineae										17,16	
Agrostis elliottiana	Elliot's bentgrass	Gramineae										16	

Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
			Associations										
Agrostis hyemalis	Spring bentgrass, Rough hairgrass	Gramineae							x			16,17	
Agrostis perennans	Autumn upland bentgrass	Gramineae										16	
Aira elegans	Hairgrass	Gramineae			x							7,34	
Alisma plantago-aquatica	American water-plantain	Alismaceae										16	Aquatic
Allium canadense var. canadense	Southern onion	Liliaceae										17	
Allium canadense var. mobilense	Canada garlic	Liliaceae										17,21	
Allium drummondii	Wild drummond onion	Liliaceae										21,23	
Alnus maritima	Seaside alder	Betulaceae					x		x			21,25	
Alnus rugosa	Hazel alder	Betulaceae		3	3	x						19,25	
Alopecurus geniculatus var. aristulatus	Water foxtail	Gramineae										17	Reported only. No specimen at O.U.
Amaranthus albus		Amaranthaceae			x							34	
Amaranthus graecizans	Tumble-weed	Amaranthaceae										16,17	
Amaranthus hybridus	Slim amaranth	Amaranthaceae										17	
Amaranthus palmeri	Plamer's Amaranth	Amaranthaceae									3	16,55	
Amaranthus retroflexus	Redroot pigweed	Amaranthaceae			x							17,34	
Amaranthus spinosus	Spiny pigweed	Amaranthaceae									3	27,55	Weedy
Amaranthus tamariscinus	Common waterhamp	Amaranthaceae			x							17,27	
Amaranthus torreyile	Torrey's Amaranth	Amaranthaceae										16	
Ambrosia artemisiifolia, var. elatior	Short common ragweed	Compositae			3							17,34	
Ambrosia bidentata	Lance-leaved Ragweed	Compositae										16,17	
Ambrosia psilostachya	Western ragweed	Compositae			x				3			34 11,23	
Ambrosia psilostachya, var. coronopiifolia	Ragweed	Compositae										27	
Ambrosia trifida, var. tiexana	Giant ragweed	Compositae			x							27,34	
Amelanchier arborea	Downy serviceberry	Rosaceae		x		x	x					25,31	
Ammannia auriculata	Wright's ammannia	Lythraceae			x							16,34	
Ammannia coccinea	Purple ammannia	Lythraceae			x							17,34	
Ammoselinum butleri	Butler sandparsley	Umbelliferae										17	Southeast Oklahoma
Amorpha angustifolia	False indigo	Leguminosae										16	
Amorpha canescens	Lead plant	Leguminosae					x		3			23 12,21	
Amorpha fruticosa	Indigobush amorpha	Leguminosae			3	x	x		x			21,51	

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Amorpha globra		Leguminosae			3	x						19,25	Southeast Oklahoma
Ampelopsis arborea	Peppervine	Vitaceae		x			x		x		x	19,25	
Ampelopsis cordata	Simple-leaved Ampelopsis	Vitaceae		x	x	x	x		x			14,27	
Amphicarpaea bracteata		Leguminosae										17	
Amphicarpaea bracteatae, var. comosa	Pitcher's hogpeanut	Leguminosae										17	
Amsonia ciliata, var. filifolia	Fringe Slimpod	Apocynaceae										21,42	McCurtain
Amsonia tabernaemontana	Willow slimpod	Apocynaceae										17	
Anaphalis margaritacea	Pearly Everlasting	Compositae										16 ·	
Andrachne phyllanthoides	Maidenbush, Buckbrush	Euphorbiaceae					x					19,50	
Andropogon gerardi, var. chrysocomus	Yellow-Haired beardgrass	Gramineae										16	
Andropogon gerardi	Big Bluestem	Gramineae				x	x		3			3,21 11,18	
Andropogon glomeratus	Bushy Beardgrass	Gramineae										16	
Andropogon hallii	Sand bluestem	Gramineae										14,23	
Andropogon (Bothriochloa) saccharoides	Silver bluestem	Gramineae			x				3			11,16 21,3	
Andropogon (Schizachyrium) scoparius	Little bluestem	Gramineae							3	x		11,23	
Andropogon ternarius	Silvery beardgrass	Gramineae										16,21	
Andropogon virginicus	Virginia beardgrass	Gramineae			x				3			1,34	
Androsace occidentalis	Western rockjasmine	Primulaceae							x		3	21,23	
Androstephium coeruleum	Blue funnellily	Liliaceae										16,21	
Anemone caroliniana	Caralina anemone	Ranunculaceae							2		3	21 11,17	
Anemone decapetala	Tenpetal anemone	Ranunculaceae										17	
Anemone virginiana	Virginia anemone	Ranunculaceae										17	
Anethum graveolens	Dill	Umbelliferae										16	Colt
Antennaria neglecta	Wood pussytoes	Compositae										17	
Antennaria plantaginifolia (fallax)	Plantainleaf pussytoes	Compositae					x					21,36	
Anthemis cotula	Mayweed camomile	Compositae										17	Weedy
Anthriscus scandiciana	Chevil	Umbelliferae									1	28	Devils Canyon
Aphanostephus skirrobasis	Arkansas dozedaisy	Compositae			x							17,34	Western limit in Muskogee
Apios americana	Potatobean	Leguminosae										27	
Apios tuberosa		Leguminosae											

			Associations										
Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
Apocynum cannabinum	Hemp dogbane	Apocynaceae			x				3			17 1,12	
Apocynum cannabinum, var. hypericifolium	Prairie dogbane	Apocynaceae										27	
Arbis canadensis	Sicklepod	Cruciferae										17	
Arbis virginica	Virginia rockcress	Cruciferae							2		3	17,23	
Arlia spinosa	American spikenard	Araliaceae		3								19,25	
Arctium minus	Smaller burdock	Compositae										17	
Arenaria drummondii	Starwort	Caryophyllaceae										17	
Arenaria patula	Pitcher's Sandwort	Caryophyllaceae									1	12,21	
Arenaria serpyllifolia	Thymeleaf sandwort	Caryophyllaceae										17	
Arenaria stricta, var. Texana	Rock Sandwort	Caryophyllaceae										21	
Argemone polyanthemos	Leafy White Prickly Poppy	Papoveraceae			x							16	
Arisaema dracontium	Dragonroot Jack-in-the-pulpit	Araceae										14,22	
Arisaema triphyllum	Indian Jack-in-the-pulpit	Araceae										17	
Aristida adscensionis	Sixweeks threeawn	Gramineae										21	
Aristida dichotoma, var. curtissii	Curtiss's Triple-awned Grass	Gramineae										16	
Aristida intermedia	Kearney threeawn	Gramineae										17	
Aristida lanosa							1					38	
Aristida longespica	Slimspike threeawn	Gramineae										17	
Aristida oligantha	Few-flowered Aristida	Gramineae							3		3	11,21	
Aristida purpurascens	Arrowfeather threeawn	Gramineae							2			1,12	
Aristida wrightii	Wright's Triple-awned grass	Gramineae										16	
Aristolachia reticulata	Texas Dutchman's Pipe	Aristolochiaceae			1							28	
Aristolachia tomentosa	Dutchman's pipe	Aristolochiaceae					x					17,19	
Artemisia carruthii	Sagewort	Compositae							3			14	
Artemisia ludoviciana, var. ludoviciana	Sage	Compositae							2			12,24	
Artemisia ludociciana, var. mexicana	Mexican sagewort	Compositae										17	
Artemisia vulgaris		Compositae										17	European, probably misidentified
Arundinaria gigantea	Giant cane	Gramineae		x		x	x					19,25	
Arundinaria gigantea	Switch cane	Gramineae										17	
Asclepias amplexicaulis	Bluntleaf milkweed	Asclepiadaceae							3			1,17	

Scientific Name	Common Name	Family	Associations									Ref.	Comments
			1	2	3	4	5	6	7	8	9		
Asclepias arenaria	Sand milkweed	Asclepiadaceae										16	
Asclepias asperula, var. decumbens	Milkweed	Asclepiadaceae										21	
Asclepias engelmanniana		Asclepiadaceae										27	
Asclepias incarnata	Swamp milkweed	Asclepiadaceae			x							16,34	
Asclepias lanceolata	Few-flowered Milkweed	Asclepiadaceae										16	
Asclepias pumila	Low milkweed	Asclepiadaceae										16	
Asclepias quadrifolia	Fourleaf milkweed	Asclepiadaceae										17	Western limit in Muskogee
Asclepias speciosa	Showy milkweed	Asclepiadaceae										16,27	
Asclepias stenophylla	Slimleaf milkweed	Asclepiadaceae										12,27	
Asclepias subverticillata												27	
Asclepias sullivantii	Sullivant's milkweed	Asclepiadaceae										16	
Asclepias tuberosa	Butterfly weed	Asclepiadaceae										17,21	
Asclepias verticillata	Whorled milkweed	Asclepiadaceae										17	
Asclepias viridis	Green milkweed	Asclepiadaceae										21	
Asimina triloba	Paw Paw	Anonaceae			3	x	x					19,15	
Aster adscendens	Western aster	Compositae										16	
Aster azureus	Azure aster	Compositae										17	
Aster drummondi	Drummond aster	Compositae										14,17	
Aster dumosus	Buchy aster	Compositae										16,30	
Aster ericoides	Many-flowered aster	Compositae			x				3		3	34,27 21,24	
Aster lateriflorus	Calico aster	Compositae										17	
Aster oblongifolius	Aromatic aster	Compositae							1			23,28	
Aster paludosus	Southern swamp aster	Compositae										16	
Aster parviceps	Small-header aster	Compositae										16	
Aster patens	Skydrop aster	Compositae							3			17	
Aster praealtus	Willow aster	Compositae										21,27	
Aster purpuratus	Southern smooth aster	Compositae										16	Maybe misidentified. Western limit is Arkansas
Aster sagittifolius	Arrow-leaved aster	Compositae										21	
Aster subulatus, var. ligulatus	Slim aster	Compositae										16	
Aster sericeus	Silky aster	Compositae										17	

Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
Aster trigonicus	Thickleaf aster	Compositae										16	Naauthentic record for this plant.
Aster turbinellus	Prairie aster	Compositae										16	
Aster umbellatus, var. latifolia												30	New
Aster umbellatus, var. subulaefolius	Flattop aster	Compositae										30	
Astragalus crassicarpus, var. crassicarpus	Milkvetch, ground plum	Leguminosae							3		1	11,23	
Astragalus canadensis	Canada milkvetch	Leguminosae										17,21	
Astragalus distortus	Bent milkvetch	Leguminosae										16	
Astragalus nuttallianus	Nuttall milkvetch	Leguminosae										27	
Astragalus plattensis	Platte milkvetch	Leguminosae										16,27	
Astragalus chortianus	Milkvetch	Leguminosae										16	Not known from Okla.; Probably misidentified
Astranthium integrifolium	Western daisey	Compositae			x	x						21,34	
Atriplex argentea	Saltbush	Chenopodiaceae										27	Saline areas
Aureolaria grandiflora		Scrophulariaceae										17	
Avena sativa	Common oat	Gramineae										17	Cult
Baccharis halimifolia		Compositae										29	
Baccharis neglecta	Linear-leaved baccharis	Compositae										16	
Baccharis salicina	Willow baccharis	Compositae			x				x			25,34	Western limit in Muskogee
Bacopa acuminata	Sawtooth waterhyssop	Scraphulariaceae										17	
Bacopa rotundifolia	Disc waterhyssop	Scrophulariaceae										34	Aquatic
Baptisia australis, var. minor	Blue wild indigo	Leguminosae							3		1	1,2 17,21	
Baptisia leucantha	Atlantic wild indigo	Leguminosae							3			17	
Baptisia leucophoea	Plains wild indigo	Leguminosae							x			21 1,23	Western limit in Muskogee
Baptisia australis, var. minor	Blue wild indigo	Leguminosae							3		1	1 12,11	
Barbarea vulgaris	Yellow Rocket	Cruciferae										16	
Berchemia scandens	Rattan vine, Alabama supple jack	Rhamnaceae		x	x	x						21,19 34,17	Western limit in Muskogee
Bergia texana	Texas bergia	Elatinaceae			x							34,27	
Berlandiera texana	Texan Berlandiera	Compositae										16	
Berteroa incana	Hoary false alyssum	Cruciferae										38	Rare weed
Betula nigra	River birch	Betulaceae			3	x	x					19 25,35	
Bidens bipinnata	Spanish needles	Compositae										21 17,14	

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Bidens cernua	Nodding beggarticks	Compositae										27	
Bidens comosa	Leafy-bracted tickseed	Compositae										16	
Bidens discoidea		Compositae			x							34	
Bidens frondosa	Beggar ticks	Compositae			x							34,16	
Bidens polylepis		Compositae										17	
Bidens tripartita	Purple-stemmed swamp beggar ticks	Compositae										16	
Bidens vulgata	Tall beggar ticks	Compositae										17	
Bifora americana	Prairie Bishop	Umbelliferae										21	
Boehmeria cylindrica	Smallspike false nettle	Urtieaceae			3							34 14,17	Western limit
Boltonia diffusa	Smallhead boltonia	Compositae											
Boltonia asteroides, var. letisquamea	Violet boltonia	Compositae										17	
Bouteloua curtipendula	Side oats grama	Gramineae							3	x		11,21 3,12	
Bouteloua gracilis	Bluegrama	Gramineae							x	x			
Bouteloua hirsuta	Hairygrama	Gramineae											
Brasenia schreberi	Water shield, purple wen-dock	Nymphaceae										34	Aquatic
Brassica juncea	Indian mustard	Cruciferae										16	
Brassica nigra	Black Mustard	Criciferae										16	
Brassica rapa	Turnip	Cruciferae										16	
Brickellia grandiflora	Large flowered thoroughwort	Compositae										16	
Bromus arvensis	Field grass	Gramineae										16	
Bromus catharticus	Rescuegrass	Gramineae										11,12	
Bromus ciliatus	Fringed brome	Gramineae										17	
Bromus commutatus	Hairy brome	Gramineae									2	11,12 17,53	
Bromus mollis	Soft chess	Gramineae										29	
Bromus purgans	Hairy wood gyess	Gramineae										14 16,17	
Bromus racemosus	Upright chess	Gramineae										16	
Bromus secalinus	Cheat	Gramineae										16,17	
Bromus tectorum		Gramineae			x							34	
Bromus unioloides	Southern chess	Gramineae										21,16	
Brunnichia ovata	Eardrop vine	Polygonanceae		3								25,19	Southeast Oklahoma

Scientific Name	Common Name	Family	Associations									Ref.	Comments
			1	2	3	4	5	6	7	8	9		
Buchloe dactyloides	Buffalo grass	Gramineae			3				x	x	2	3,11 13,34	Invader plant
Buchnera americana	American bluehearts	Scrophylariaceae							3			1,17	Western limit in Muskogee
Bulbostylis capillaris		Cyperaceae										17	
Bumelia lanuginosa	Wooly buckthorn, Chittamwood	Sapotaceae		x	x	x	3	x	x			14 36,37	
Cabomba caroliniana		Nymphaceae										34	Aquatic; Southeast Oklahoma
Cacalia plantaginea	Indian plantain	Compositae										21,17	
Callicarpa americana	French mulberry	Verbenaceae		x		x	x					19,25	
Callirhoe alcaeoides	Plains poppymallow	Malvaceae										17,21	
Callirhoe involucrata	Purple poppymallow	Malvaceae			x				2			12,16 23,34	
Callirhoe digitata	Finger poppymallow	Malvaceae										17	
Callitriche heterophylla		Callitrichaceae										39	Aquatic; McCurtain
Calycocarpum lyonii	Cupseed	Menispermaceae				3						25,19	
Camassia scilloides	Wild hyacinth	Liliaceae										17,16	
Camelina microcarpa	Littlepod false flax	Cruciferae										17	
Campanula americana	American bellflower	Campanulaceae										17	
Campsis radicans	Trumpet flower	Cruciferae		x		x	x		x				
Capsella bursa-pastoris	Common Shepherdpurse	Cruciferae										17,21	
Cardamine parviflora, var. arenicola	Bitter cress	Cruciferae					3					36,27	
Cardmine pennsylvanica	Pennsylvania bittercress	Cruciferae										17	Dominant in Northeast Oklahoma
Cardiospermum halicacabum	Balloon vine	Sapindaceae			x							34,16	
Carduus nutans	Muskthistle	Compositae									1	28	Recorded in Northeast Oklahoma
Carex alata	Broad-winged sedge	Cyperaceae										16	
Carex amphibola var. variegata	Greysedge	Cyperaceae										17	
Carex annectens					x							34	
Carex austrina	Southern sedge	Cyperaceae			x							16	
Carex bicknellii	Bicknell's sedge	Cyperaceae										16	
Carex blanda	Woodland sedge	Cyperaceae										7,21	
Carex brevior		Cyperaceae										39	
Carex cherokeensis	Cherokee sedge	Cyperaceae										39,16	
Carex cristata	Crested sedge	Cyperaceae										16	

Scientific	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Carex frankii	Frank's sedge	Cyperaceae			x							21 39,17	
Carex granularis	Meadas sedge	Cyperaceae										17	
Carex leacenworthii	Leavenworth's sedge	Cyperaceae										16	
Carex lupulina	Hop sedge	Cyperaceae			x							34,17	
Carex lurida		Cyperaceae										39	
Carex meadii		Cyperaceae										17	
Carex muhlenbergii	Muhlenberg sedge	Cyperaceae									2	12,17	
Carex oligocarpa	Few-fruited	Cyperaceae										16	
Carex polygama		Cyperaceae										17	
Carex retroflexa	Reflexed sedge	Cyperaceae										17	
Carex riparia		Cyperaceae										17	
Carex siccata	Dry-spiked sedge	Cyperaceae										16	
Carex straminea	Straw-sedge	Cyperaceae										7,16	Recorded around Lake Austin, Leflore Co.
Carex triceps, var. hirsuta		Cyperaceae										17	
Carex varia		Cyperaceae										17	
Carex vulpinoidea	Fox sedge	Cyperaceae		x								34,17	
Carpinus caroliniana	American hornbeam	Betulaceae		x	3	x						15,19	
Carya aquatica	Water hickory	Juglandaceae			x							25 15,19	
Carya cordiformis	Bitternut hickory	Juglandaceae										17,25 36,37	
Carya glabra	Pignut hickory	Juglandaceae					x					3	
Carya illinoensis	Pecan	Juglandaceae			3		3			3		17	
Carya laciniosa	Big Shagbark hickory	Juglandaceae				3		x				3 16,35	
Carya myristicaeformis	Nutmeg hickory											19	Southeast Oklahoma
Carya ovata	Shagbark hickory	Juglandaceae		x		x	3		x			19,35	
Carya pecan	Pecan	Juglandaceae			3							37 16,27	
Carya texana	Black hickory	Juglandaceae						3				17,21 24,36	
Carya tomentosa	White Mockernvt hickory	Junglandaceae	3			3	3		x			21 35,33	
Cassia chamaecristoides (texana)	Texas senna	Leguminosae										17	

			Associations										
Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
Cassia fasciculata	Wild senna, partridge pea	Leguminosae			x				2		2	34,11 12,27	
Cassia medsgeri		Leguminosae										17	
Cassia nictitans	Wild senna, sensitive pea	Leguminosae										17,16	
Cassia tora	Sickle senna	Leguminosae										17	
Castanea ozarkensis	Ozarkchinquapin	Fagaceae			x	x	x					15,25	
Castanea pumila var. ashei	Allegany chestnut	Fagaceae			1	x						19,46	Tom, Mt.
Castilleja coccinea	Indian paint brush	Scrophulariaceae									1	17	prairie
Castilleja indivias	Texas paint brush	Scrophulariaceae									x	21	prairie
Castilleja purpurea	Prairie paint brush	Scrophulariaceae									x	17	prairie
Catalpa bignoniodes	Catalpa	Bignoniaceae										14,19	
Catalpa speciosa	Northern catalpa	Bignoniaceae										27	
Cayaponia grandifolia		Curcurbitaceae	x								x	25	Recorded from Mc-Curtain Co.
Ceanothus americanus	Jerseytea	Rhamnaceae				3	x		x			19,21	
Ceanothus herbaceus	Smaller Red-root	Rhmnaceae					x		x			25 16,19	
Celastrus scandens	American bittersweet	Celastraceae					x		x			17,25	
Celtis laevigata	Southern hackberry	Ulmaceae		x	x	x	x		x			24,27	
Celtis laevigata, var. texana	Texas hackberry							x				24,25	
Crltis accidentais, var. crassifolia	Hackberry	Ulmacrae							x			14,25	
Celtis occidentalis	hackberry	Ulmaceae				x	x		x			25 16,17	
Celtis tenuifolia, var. georgiana	Dwarf hackberry	Ulmaceae				x						19,25	
Celtis reticulata	Neatleaf hackberry	Ulmaceae			x		x	x			2	34,27 12,14	
Cenchrus carolinianus	Small Bur-grass	Gramineae										16	
Cenchrus pauciflorus (incertus)	Mat sandbur, grassbur	Gramineae			x				x			17 34,23	
Centaurea americana	Basket flower	Compositae			x							17 34,21	
Centaurea cyanus	Blue-bottle	Compositae										16	
Centaurai calycosum	Buckley's Centaury	Gentianaceae										16	
Centunculus minimus	Chaffweed	Primulaceae										17	
Cephalanthus occidentalis, var. pubescens	Common buttonbush	Rubiaceae		3	x	x	x		x			10,25 27,19	

Scientific Name*	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Cerastium brachypodum	Shortstolk chickweed	Carypohyllaceae										17	
Cerastium longipedunculatum	Nodding chickweed	Alismaceae										16	
Cerastium nutans	Powderhorn chickweed	Caryophyllaceae										17	
Cerastium glomeratum	Sticky chickweed	Caryophyllaceae										5	
Cratophyllum demersum	Coon-tail hornwort	Ceratophylloceae	x									34	Aquatic
Cerastium vulgatum	Big chickweed	Caryophyllaceae										17,40	
Cercis canadensis	Red bud	Leguminosae										17,36 37,14	
Chaerophyllum procumbens	Spreading chervil	Umbelliferae				x						36 16,21	
Chaerophyllum tainturieri	Florida chervil	Umbelliferae										27	
Chaerophyllum texanum	Texas chervil	Umbelliferae			2							34 12,17	
Chaetopappa asteroides	Least daisy	Compositae							x			23 17,21	
Chara contraria		Characeae	x									34	Aquatic
Chara haitensis		Characeae	x									34	Aquatic
Chasmanthium latifolium	Broadleaf spanglegrass	Gramineae			x							34 14,17	
Chenopodium album	Lambs quarters	Chenopodiaceae		x								17,34	
Chenopodium ambrosioides	Wormseed goosefoot	Chenopodiaceae											
Chenopodium hybridum, var. gigantospermum	Bigseed goosefoot	Chenopodiaceae											
Chenopodium hybridum	Goosefoot	Chenopodiaceae									3	17	
Chenopodium leptophyllum	Slimleaf goosefoot	Chenopodiaceae			x							17,34	
Chenopodium roscianum	Bosc's Goosefoot	Chenopodiaceae										16	
Chenopodium standleyanum	Standley goosefoot	Chenopodiaceae										27	
Chionanthus virginia	White fringetree	Oleaceae											
Chloris verricillata	Windmill grass	Gramineae											
Chorispora tenella	Blue mustard	Cruciferae											
Chrysopsis heterotheca pilosa	Golden aster	Compositae									2	21 12,17	
Chrysopsis villosa var. canescens	Grey goldaster	Compositae										27	
Chrysopsis villosa var. stenophylla	Hairy goldaster	Compositae							3			14,17	
Cicuta maculata	Water hemlock	Umbelliferae			x							34,11 17,21	
Cinna grundinacea	Stout woodreed	Gramineae			2							17	

			Associations										
Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
Cirsium altissimum	Tall thistle	Compositae										17,21	
Cirsium lanceolatum	Common thistle	Compositae										16	
Cirsium undulatum	Wavy-leaved thistle	Compositae			x				x		2	16 34,12	
Cirsium virginianum	Virginia thistle	Compositae										27	
Cissus incusa	Marine vine	Vitaceae			3	x	x		x			51 17,25	
Citrullus vulgaris	Watermelon	Cucurbitaceae										17	Cult
Cladrastis lutea	American yellowwood	Leguminosae					x					17,25	rare; limit is in Muskogee Co.
Claytonia virginica	Spring Beauty	Portulacaceae					3		x			4,27 36,23	
Clematis crispa	Blue jasmine	Ranunculaceae			x							16	
Clematis pitcheri	Clematis	Ranunculaceae				x						17,25	
Cleomella angustifolia	Northern cleomella	Capparidaceae										16	prevalent in Saline Sites
Clitoria marjana	Butterfly-pea	Leguminosae										17,21	
Cnidoscolus stimulosus	Spurge nettle	Euphorbiaceae										16	
Cnidoscolus texanus	Bull nettle	Euphorbiaceae										21	
Cocculus carolinus	Redberried moonseed	Menispermaceae				x	x					17,14 19,21	
Collinsia violacea	Violet-eyed Mary	Scroplulariaceae					3					21 17,36	
Commondra pallida	Western comandra	Santalaceae										17	
Commelina communis	Common dayflower	Commelinaceae										27	
Commelina diffusa		Commelinaceae										27	
Commelina erecta var. angustifolia	Curlyleaf dayflower	Commelinaceae										17	
Commelina erecta	Slender Day-flower	Commelinaceae			x							21 16,34	
Commelina hirtella (virginica)		Commelinaceae										17	
Commelina nudiflora		Commelinaceae										17	
Commelina virginica	Virginia Day-Flower	Commelinaceae										16	
Conringia orientalis	Hare's ear	Cruciferae										16	
Conrolvulus ambigens		Convolvulaceae										27	
Convolvulus arvensis	Field bindweed	Convolvulaceae										17	
Convalvulus sepium (caly stegia)	Hedge bindweed	Convolvulaceae										16	

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Conyza canadensis	Horse weed	Compositae			1				2		2	53,34 16,12	
Corallorrhiza odontarhiza	Late coral root	Orchidaceae										20,41	only in LeFlore Co. Blue Mountains
Corallorrhiza Wisteriana	Coral root	Orchidaceae										4,17	
Coreopsis cardaminefolia	Cardamine coreupsis	Compositae										27	
Coreopsis grandiflora	Big flower coreopsis	Compositae										17,21	
Coreopsis tinctoria	Plains coreopsis	Compositae			x					3		34 17,18	
Coreopsis verticillata	Wharled tickseed	Compositae										16	
Cornus amomum	Silky dogwood	Cornaceae				x	x		x			19,25	
Cornus drummondii	Roughleal dogwood	Cornaceae		x	x	x	x	x	x			37,17	
Cornus florida	Flowering dagwood	Cornaceae		x		x	x		x			21,25 17,19	
Cornus obliqua	English dogwood	Cornaceae										15	found in McCurtoin Co.
Corydalis aurea	Golden carydalis	Fumariaceae							x			17,23	
Corydalis crystallina	Mealy corydolis	Fumariaceae										17	
Corydalis flavula	Pale corydalis	Fumariaceae										17	
Carydalis micrantha	Small-Flower carydalis	Fumariaceae										17,21	
Cotinus abbratus	Wild Smoke-tree	Anacardiaceae				1						25,16	rare; possibly on Rich Mt.
Crataegus bellica		Rosaceae			2							21,19	
Crataegus marshallii	Parsley hawthorn	Rosaceae			x	x						21,19	
Crataegus bushii	Bushes hawthorn	Rosaceae				x					x	21,19	
Crataegus brazaria		Rosaceae				2						17	
Crataegus crus-galli	Cock-spur thorn	Rosaceae				x		x	x			16	
Crataegus engelmannii	Dallas hawthorne	Rosaceae										17	
Crataegus mollis	Downy hawthorne	Rosaceae										21 35,17	
Crataegus spathulata	Little hip hawthorne	Rosaceae				x						19	
Crataegus trianthaphora		Rosaceae				2						17,19	SE Protective unit
Crataegus viridis	Green hawthorne	Rosaceae										17	
Crepis pulchra	Hawk's beard	Compositae			1	1						29	recorded Wilburtan, Latimer Co.
Crataloria sagittalis	Rattlebox	Leguminosae										17,21	

Scientific Name	Common Name	Family	Associations									Ref.	Comments
			1	2	3	4	5	6	7	8	9		
Croton capitatus	Wooly craton	Euphorbiaceae			x							17,34	
Croton glandulosus	Tropic craton	Euphorbiaceae			x						2	34 12,17	
Croton lindheimerianus		Euphobiaceae									x	17,23	
Croton monanthogynus	One seed craton	Euphobiaceae			x						1	34 17,12	
Croton texensis	Texas croton	Euphobiaceae			x							16,34	
Crotonopsis linearis	Rushfoil	Euphorbiaceae						x	x			17	
Cryptotaenia canadensis	Wild chervil	Umbelliferae				x		x	x			17,14	western limit in Muskogee Co.
Cucumis melo	Musk melon	Cucurbitaceae									x	16	
Cucurbita foetidissima	Stinking gourd	Cucurbitaceae			x						1	34,17	
Cuphea petiolata (viscosissima)	Blue waxweed, clammy cuphea	Lythraceae										17	
Cuscuta campestris	field dodder	Conovolvulaceae										17	
Cuscuta cuspidate	Cusp dodder	Conovolvulaceae										17,16	
Cuscuta gronovii	Gronovius dodder	Conovolculaceae										17	
Cycloloma atriplicifolium	Winged pigweed	Chenopodiaceae										16,17	
Cynanchum leave	Blue vine, sandvine	Asclepiodaceae										27,55	Weedy
Cynodon dactylon	Bermuda grass	Gramineae			x							16,17 34,14	
Cynoglossum amabile	hound's tongue, beggars lice	Boraginaceae			x							45	Broken Bow Mt.
Cyperus acuminatus	Taper leaf flat sedge	Cyperaceae										17	
Cyperus erythrorhizos	Redroot flat sedge	Cyperaceae			x							34,17	
Cyperus aristatus		Cyperaceae			x							34,17	
Cyperus esculentus	Chufa	Cyperaceae			3							17,35	
Cyperus filiculmis	Slender flat sedge	Cyperaceae			x				3		1	12,39 34,17	
Cyperus globulosus	Baldwin's cyperus	Cyperaceae										16	
Cyperus hallii	Hall's cyperus	Cyperaceae			x							34,16	
Cyperus odoratus	Coarse flat sedge	Cyperaceae										17	
Cyperus ovularis	Globe flat sedge	Cyperaceae			x				3			39,21 34,17	
Cyperus pseudovegetus virens	Marsh flat sedge	Cyperaceae										17	
Cyperus schweinitlii	Schweinite's cyperus	Cyperaceae										16	

			Associations										
Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
Cyperus strigosus	False nutgrass	Cyperaceae			x							17,34	
Cyperus uniflorus	One-flowered flat sedge	Cyperaceae										17,21	
Cypripedium calceolus	Yellow lady's slipper	Orchidaceae										20	Muskogee only
Cypripedium pubescens		Orchidaceae										2	Cookson Hills and Rich Mt.
Dactylis glomerata	Orchard-Grass	Gramineae										16	
Dalea aurea	Silktop dalea	Leguminoseae										21,16	
Dalea enneandra		Leguminosae										16	
lanata		Leguminosae										17	
Danthonia spicata	Poverty danthonia	Gramineae										17	
Datura stramonium	Jimsonweed	Solanaceae										17	
Datura wrightii	Entire-leaved Thorn-Apple	Solanaceae										16,40	OK Cle
Daucus pusillus	Wild carrot	Umbelliferae									2	12 17,21	
Delphinium ajacis	Rocket larkspur	Ranunculaceae										17,16	
Delphinium carolinianum	Carolina Larkspur	Ranunculaceae										16	
Delphinium virescens	Prairie larkspur	Ranunculaceae					3		3			36,23 17,16	
Descurainia incisa	Western tansy-mustard	Cruciferae										16	
	Tansy-mustard	Cruciferae										16	
Descurainia pinnata, var. pinnata	Pinnate tansy-mustard	Cruciferae			x							34 27,21	
Desmanthus illinoensis	Mimosa, Illinois bundleflower	Leguminosae			x				3			34 17,16	
Desmanthus leptolobus	Prairie bundleflower	Leguminosae										21	
Desmodium cuspidatum	Bracted tickclover	Leguminosae										17	
Desmodium canescens	Hoary tickclover	Leguminosae										17	
Desmodium ciliare	Littleleaf tickclover	Leguminosae										27	
Desmodium glabellum	Dillen tickclover	Leguminosae										21,27	
Desmodium glutinosum	Sessil tickclover	Leguminosae										21	
Desmodium grandiflorum		Leguminosae										17	
Desmodium illinoense	Illinois tickclover	Leguminosae										16,27	
Desmodium laevigatum	Smooth tickclover	Leguminosae										17	
Desmodium obtusum		Leguminosae										17	
Desmodium paniculatum	Panickled tickclover	Leguminosae										16,17	
Desmodium sessilifolium	Sessil tickclover	Leguminosae							3			11,12 17,23	

			Associations										
Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
Desmodium viridiflorum	Velvetleaf tickclover	Leguminosae										17	
Dicliptera brachiata	Dicliptera	Acathaceae										17	
Digitaria adscendens	Fringed crabgrass	Gramineae										16	
Digitaria filiformis	Slender fingergrass	Gramineae										17	
Digitaria humifusa	Small crabgrass	Gramineae										16	
Digitaria Ischaemum	Smooth crabgrass	Gramineae										17	
Digitaria sanguinalis	Hairy crabgrass	Gramineae			3							17 34,35	
Diodia teres	Poorja	Rubioceae			x							17 21,34	
Diospyros virginiana, var. pubescens	Persimmon	Ebenaceae		x	3	x	x	x	x			27 34,36	Clearings and fence rows
Dirca palustris	Leatherwood	Thymelaeaceae				1						17 19,25	Recorded from Southeastern Oklahoma
Dioscorea villosa	Atlantic yam	Dioscoreaceae										17	
Distichlis spicata	Marsh spike grass	Gramineae										16	
Distichlis stricta	Spike grass	Gramineae										53	Saline Flats: Western Oklahoma
Dodecatheon meadia	Common shootingstar	Primulaceae										17,21	
Draba brachycarpa	Shortpod draba	Cruciferae										17,21	
Draba cuneifolia	Wedge leaved whitlow grass	Cruciferae					3		x			17 23, 36	
Draba reptans, var. reptans	Draba	Cruciferae					x					16 21,36	
Draba reptans	Carolina draba	Cruciferae										21,27	
Drosera annua	Annual sundew	Droseraceae						1	1			2	tallgrass, postoak, blackjack Panama LF Lat. Mt.
Echiniacea angustifolia	Narrow-leaved purple cone-flower	Compositae							x			23 16,21	
Echiniacea atrorubens	Yellow echiniacea	Compositae										21	
Echiniacea pallida	Pale purple cone-flower	Compositae										16,17	
Echinochloa colonum					x							34	
Echinochloa crusgalli	Barnyardgrass	Gramineae			x							34,17	
Echinochloa longearistata	Echinochloa	Gramineae										16	
Echinochloa crusgalli		Gramineae										21	
Echinodorus cordifolius	Erect burhead	Alismaceae										34,27	Aquatic
Eclipta alba	Yerba de tayo	Compositae			x							34,17	

Scientific Name	Common Name	Family	Associations									Ref.	Comments
			1	2	3	4	5	6	7	8	9		
Eleocharis acicularis					x							34	
Eleocharis albida	White spike-rush	Cyperaceae										16	
Eleocharis compressa	Flatstem spikesedge	Cyperaceae										17	
Eleocharis macrostachya					x							34	
Eleocharis obtusa	Blunt spikesedge	Cyperaceae			x							34,17	
Eleocharis palustris	Common spikesedge	Cyperaceae										17	
Eleocharis tenuis	Slender spike-rush	Cyperaceae										16	
Eleocharis torreyana	Torrey's spike-rush	Cyperaceae										16	
Elephantopus carolinianus	Leafy elephantfoot	Compositae										21 17,14	
Elephantopus nudatus	Smoothish elephantfoot	Compositae										16	
Eleusine indica	Goosegrass	Gramineae			x							34,17	
Ellisia nyctelea	Aunt-Lucy Ellisia	Hydrophyllaceae										17	
Elymus canadensis	Nodding wild rye	Gramineae			x				3		2	12,23 34,16	
Elymus striatus	Slender wild rye	Gramineae										16	
Elymus villosus	Hairy wild rye	Gramineae										17	
Elymus virginicus, var. glabriflorus	Smooth southern wild rye	Gramineae			3							17,31	
Elymus virginicus, var. jejunus	Western wild rye	Gramineae										16	
Eragrostis capillaris	Lacegrass	Gramineae			x						2	34 12,17	
Eragrostis curtipedicellata	Short-stalked love-grass	Gramineae			x				x		2	53,12 34,16	Invader
Eragrostis cilianensis	Stinkgrass	Gramineae			x							23 34,17	
Eragrostis diffusa					x							34	
Eragrostis frankii	Frank's love-grass	Gramineae			x							34,16	
Eragrostis hirsuta	Stout love-grass	Gramineae										16	
Eragrostis intermedia	Love-grass	Gramineae							3			1 16,53	Invader
Eragrostis orcuttiana						x						39	Okmulgee
Eragrostis oxylepis	Love-grass	Gramineae			x							21,34	
Eragrostis pectinacea	Carolina love-grass	Gramineae										17,34	
Eragrostis pilosa	India love-grass	Gramineae									2	12,21	

			Associations										
Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
Eragrostis reptans	Creeping love-grass	Gramineae			x							34,17	
Eragrostis secundiflora		Gramineae									1	12,17	
Eragrostis sessilispica	Tumble love-grass	Gramineae									3	12,11	
Eragrostis spectabilis	Purple love-grass	Gramineae							2 3			1,12	Increased abundance where land is cultivate
Eragrostis trichodes	Sand love-grass	Gramineae										17	
Eragrostis weigeltiana	Hoary creeping love-grass	Gramineae										16	
Erigeron annuus	Annual fleabane	Compositae										17,21	
Erigeron bellidiastrum	Western daisy fleabane	Compositae										10	
Erigeron divaricatus	Low fleabane	Compositae										17	
Erigeron divergens	Spreading fleabane	Compositae										16	
Erigeron philadelphicus	Philadelphia fleabane	Compositae										17,21	
Erigeron ramosus	Daisy fleabane	Compositae					x		3			36 17,18	
Erigeron strigosus	Prairie fleabane	Compositae			x				x		2	34 12,11	
Erigeron tenuis	Slender Rough fleabane	Compositae										16,21	
Eriocaulon articulatum		Eriocaulaceae	x									17	
Eriocaulon kornickianum												31	Rare; Southeast Oklahoma.
Eriogonum alatum	Winged Eriogonum	Polygonaceae										16	
Eriogonum annuum	Annual fleabane	Polygonaceae			x							34 16,14	
Eriogonum longifolium, var. *plantagineum*	Longleaf wild-buckwheat	Polygonaceae						1	2		2	17,40 12,27	
Eryngium levenworthii	Levenworth Eryngo	Umbelliferae			x							34,21	
Eryngium yuccifolium	Buttonshakerroot eryngo	Umbelliferae							3			17,1	
Erysimum repandum	Spreading erysimum	Cruciferae										27,16	
Erythronium albidum	White fawnlily	Liliaceae										17,21	
Erythronium mesochoreum	Midland Adder's Tongue	Liliaceae					3					16 36,17	
Eupatorium altissimum	Tall Eupatorium	Compositae										17	
Eupatorium coelestinum	Mist flower	Compositae										17,21	
Eupatorium compositifolium		Compositae										29	Broken Bow, McCurtain County
Eupatorium hyssopifolium	Hyssop-leaved throughwort	Compositae										16	

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Eupatorium incarnatum												38	
Eupatorium perfoliatum	Boneset	Compositae										17	
Eupatorium rotundifolium						x	x	x				38	Broken Bow, McCurtain County
Eupatorium serotinum	Late eupatorium	Compositae			x							34 17,21	
Eupatorium urticaefolium		Compositae										17	
Euphorbia arkansana		Euphorbiaceae					x					27,36	
Euphorbia corollata	Flowering spurge	Euphorbiaceae							3			1 17,21	
Euphorbia corollata, var. mollis		Euphorbiaceae							3			27,18	
Euphorbia dentata	Toothed euphorbia	Euphorbiaceae										17,21	
Euphorbia fendleri	Fendler's spurge											16	
Euphorbia geyeri	Geyer euphorbia	Euphorbiaceae										27,16	
Euphorbia glyptosperma	Ridgeseed euphorbia	Euphorbiaceae			x							34,17	
Euphorbia heterophylla	Painted euphorbia	Euphorbiaceae										14 17,27	
Euphoriba hexagona	Sixangle euphorbia	Euphorbiaceae										27	
Euphorbia humistrata	Hairy Spreading euphorbia	Euphorbiaceae			x							34,27	
Euphorbia maloca	Blackland euphorbia	Euphorbiaceae										17	
Euphorbia marginata	Snow-on-the-mountain	Euphorbiaceae			x				x			34,21 17,27	
Euphrobia missurica	Missouri spurge	Euphorbiaceae										27	
Euphorbia missurica, var. intermedia		Euphorbiaceae			x							34,27	
Euphorbia nutans	Milk purslove, Spotted suphorbia	Euphorbiaceae			x							34 17,27	
Euphorbia obtustata	Roughpod cubhorbia	Euphorbiaceae										27	
Euphorbia petaloidea	White flower euphorbia	Euphorbiaceae										17	
Euphorbia preslii	Red euphorbia	Euphorbiaceae										17	
Euphorbia prostrata	Prostrate euphorbia	Euphorbiaceae									1	12,11	
Euphorbia spathulata	Warty euphorbia	Euphrobiaceae			x							34,17	
Euphorbia serpens	Mat euphorbia	Euphorbiaceae			x							34,17	
Euphorbia serphyllifolia	Thyme leaved spurge											16	
Euphorbia strictospora	Slimseed euphorbia	Euphorbiaceae			x							27,34	

Scientific Name	Common Name	Family	Associations									Ref.	Comments
			1	2	3	4	5	6	7	8	9		
Euphorbia zygophylloides	Prairie surge	Euphorbiaceae							3			16	
Euphorbia supina	Euphorbia	Euphorbiaceae			x				x			27,53 1,34	
Eurytaenia texana	Texas Eurytaenia	Umbelliferae										16	
Eurytaenia russellianum												17	Western limit in Muskogee
Eustoma exaltatum	Eustoma	Gentianaceae										16	
Evax multicaulis	Manystem evax	Compositae										27	
Evax prolifera	Bighead evax	Compositae									1	12,17	
Evalvulus nuttallianus	Nuttall evalvulus	Convalvulaceae										27	
Evalvulus pilosus	Silver evalvulus	Convalvulaceae									2	12,16	
Evonymus americana	Brook euonymus	Celastraceae					2	2				19	Predominantly South-eastern Oklahoma
Evonymus atropurpureus	Eastern wahoo	Celastraceae			3							37,51 19,14	
Fagus grandifolia, var. caroliniana	Beech	Fagaceae				1						54 25,19	
Festuca myuros (vulpia)	Fescue										1	40	
Festuca octoflora (vulpia)	Six weeks fescue	Gramineae					x		x		1	12,36 17,23	
Festuca pratensis	Tall Fescue	Gramineae										16	
Facelis retusa		Compositae				3						30,46	
Festuca sciurea	Southern Fescue	Gramineae										16	
Festuca shortii		Gramineae										17	
Fimbristylis autumnalis	Slender fimbry	Cyperaceae			x							34,17	Moist place
Fimbristylis caroliniana	Fimbry	Cyperaceae			x						2	34 12,11	
Fimbristylis puberula	Hairy fimbristylis	Cyperaceae							3		3	16	
Flaveria campestris	Plains flaveria	Compositae										16	
Foeniculum vulgare	Common fennel	Umbelliferae										16	
Forestiera acuminata	Swamp privet	Oleaceae			3		3					34 25,17	
Forestiera pubescens	Swamp privet	Oleaceae							x			14,25	
Fragaria americana	American Wood Strawberry	Rosaceae										16	
Fragaria virginiana, var. Illinoensis	Wild Strawberry	Rosaceae										17	
Fragaria virginiana, var. virginiana	Wild Strawberry	Rosaceae										21	

Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
Fraxinus americana	White ash	Oleaceae		x	x	x	3					19,25 37,10 17,36	
Fraxinus pennsylvanica	Green ash	Oleaceae			x 3		x		x			15 34,37 24,17	
Froelichia floridana	Prairie Froelichia	Amaranthaceae										16	
Froelichia gracilis	Slender snakecotton	Amaranthaceae										17	
Fuirena simplex	Umbrellagrass	Cyperaceae			x							34,17	Western limit in Muskogee
Gaertneria acanthicarpa	Hooker's Gaertneria	Ambrosiaceae										16	
Gaertneria discolor	White-leaved Gaertneria	Ambrosiaceae										16	
Gaertneria tomentosa	Wally Gaertneria	Ambrosiaceae										16	
Gaillardia aristata	Great-flowered Gaillardia	Compositae										16	
Gaillardia lanceolata	Blanket flower	Compositae							3			17,14	
Gaillardia pulchella	Snowy Gaillardia	Compositae										16,21	
Gaillardia sauvis	Sweet Gaillardia	Compositae							3			16 27,23	
Gaillardia serotinum	Yellow Gaillardia	Compositae										16	
Galactia volubilis	Downy milkpea	Leguminosae			x							34 17,21	
Galium Aparine	Catchweed bedstraw	Rubiaceae										21 17,14	
Galium circaezans	Woods bedstraw	Rubiaceae										17	
Galium obtusum	Blunt leaf bedstraw	Rubiaceae										27	
Galium pilosum	Hairy bedstraw	Rubiaceae										17	
Galium triflorum	Fragrant bedstraw	Rubiaceae										17	
Galium virgatum	Southwest bedstraw	Rubiaceae									1	12,17	
Gaura biennis	Biennial gaura	Onagraceae										17	
Gaura filiformis	Tall gaura	Onagraceae										27	
Gaura lindheimeri	gaura	Onagraceae										7	New
Gaura parviflora	Small flower gaura	Onagraceae			x							17,34	
Gaura sinuata	Wavy-leaved gaura	Onagraceae										16	
Gaura tripetala	Three petal gaura	Onagraceae										27	
Gelsemium sempervirens	Caralina jessamine	Loganiaceae				x						25	

			Associations										
Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
Geranium carolinianum	Carolina Crane's-bill	Geraniaceae			x		3				2	34,36 11,12	
Geum canadense, var. camperum	White Avens	Rosaceae										17,21	
Geum strictum	Yellow Avens	Rosaceae										16	
Geum virginianum	Routh Avens	Rosaceae										16	
Gilia rubra	Standing cypress	Palemoniaceae			x							21,34	
Gillenia stipulata	Indian physic	Rosaceae										17	
Gleditsia triacanthos	Honey locust	Leguminosar		x	x	x	x					37 19,25	
Gleditsia tricanthos; f. inermis	Common honey locust	Leguminosae			x							27,34	
Glycyrrhiza lepidota	Wild licorice	Leguminosae			x							16,34	
Gnaphalium polycephalum		Compositae										17	
Gnaphalium purpureum	Purple cudweed	Compositae										17	
Gratiola brevifolia		Scrophulariaceae			1							43	
Gratiola virginica	Virginia-hedge hyssop	Scrophulariaceae			x							17,34	
Grindelia lanceolata	Spinytooth gumweed	Compositae							x			17,23	
Grindelia squarrosa	Curlycup gumweed	Compositae										17	
Gutierrezia (Xanthocephalum) dracunculoides	Common broomweed	Compositae			x				x			11,53	
Gymnocladus dioica	Kentucky coffeetree	Leguminosae					x		x			36 14,25	
Halesia carolina	Mountain silverbell	Styracaceae				1						19,25	very rare
Hamamelis vernalis		Hamamelidaceae				x						25	
Hamamelis virginiana	Ozark witchhazel	Hammamelidaceae				3						19,25	
Haplopappus ciliatus	Wax goldenweed	Compositae										17,21	
Haplopappus divaricatus	Slender goldenweed	Compositae										17	
Hedeoma drummondii	False pennyroyal	Labiatae											
Hedeoma hispidum	Rough false pennyroyal	Labiatae											
Hedyotis angustifolia	Prairie bluet	Rubiaceae										17	
Hedyotis crassifolia	Bluet	Rubiaceae										21	
Hedyotis caerulea	Bluets	Rubiaceae										16	
Hedyotis nigricans		Rubiaceae			x							27,34	

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Hedyotis uniflora		Rubiaceae			1								
Helenium amarum, var. amarum	Bitter Sneezeweed	Compositae			x				3			1 21,34	
Helianthus annuus	Common sunflower	Compositae			x							17,34	
Helianthus divaricatus	Rough sunflower	Compositae										16	
Helianthus grosse-serratus	Sawtooth sunflower	Compositae										17	
Helianthus hirsutus	Hairy sunflower	Compositae										17,21	
Helianthus laetiflorus	Stiff sunflower	Compositae										16,17	
Helianthus maximiliani	Maximilian's sunflower	Compositae			x							16,34	
Helianthus mollis	Ashy sunflower	Compositae							3			1,17	
Helianthus petiolaris	Prairie sunflower	Compositae			x							17,34	
Helianthus salicifolius	Linear-leaved sunflower	Compositae										16	
Helianthus strumosus	Pale-leaved wood sunflower	Compositae										16	
Helianthus tuberosus	Jerusalem-artichoke	Compositae										17	
Heliopsis helianthoidos, var. scabra	Sunflower	Compositae										21	
Heliopsis scabra	Rough heliopsis	Compositae										17	
Heliotropium convolvulaceum	Bindweed heliotrope	Boraginaceae										17	W limit in Muskogee
Heliotrapium indicum	India heliotrope	Boraginaceae			x							34,17	
Heliatropium tenellum	Pasture helliotrope	Boraginaceae			x							21 34,17	
Hemicarpha micrantha	Common hemicarpha	Cyperaceae										17	
Heteranthera dubia	Water star-grass	Pontederiaceae										34,16	Aquatic
Heteranthera limosa	Smaller mud-plantain	Pontederiaceae										34,16	Aquatic
Heterotheca latifolia	Champharweed	Compositae										21	
Heteratheca subaxillaris	Camphorweed	Compositae										17	
Hibiscus lasiocarpos	Woolly rose-mallow	Malvaceae										17	W limit in Muskogee
Hibiscus militaris	Rose-mallow	Malvaceae										17	
Hibiscus trionum	Bladder ketmia	Malvaceae			x							34	
Hieracium gronovii	Granovius hawkweed	Compositae										27	
Hierocium (Gronovii) longipilum	Long-bearded hawkweed	Compositae										16,17	

			Associations										
Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
Holosteum umbellatum	Jagged chickweed	Caryophyllaceae									1	7	Cle. Payne
Hordeum pusillum	Little barley	Gramineae			x				x		1	34 12,17	Invader
Hordeum stebbinsii		Gramineae									1	6,11	Norman
Hosackia americana		Leguminosae										17	
Humulus lupulus	Common hop	Cannabinaceae										16	Adventive
Hydrangea arborescens	Smooth hydrangea	Saxifragaceae				x	x		x			19,25	
Hydrocotyle umbellata	Umbrella pennywort	Umbelliferae										7	Schooler Lake, Chocto
verticillata	Whorled pennywort	Umbelliferae			x							34,17	
Hymenopappus coraliniensis	Whitebract woollywhite	Compositae										17	
Hymenopappus fillifolius	Low tufted hymenoppus	Compositae										16	
Hymenopappus scabiosioeus	Wolly white	Compositae										21	
Hymenopappus tenuifolius	Wolly white hymenoppus	Compositae							x			23,16	
Hymenoxys linearifolia	Hymenoxys	Compositae							2		3	21,27	
Hypericum densiflorum	St. Johnswort	Hypericaceae				1						15	
Hypericum drummondii		Hypericaceae										17	
Hypericum hyperoides (Ascyrum)	St. Andrew's cross	Hypericaceae				x	x					17,25	
mutilum	Dwarf St. John's wort	Hypericaceae			x							17,34	
Hypericum prolificum		Hypericaceae		x		x	x					19,25	
Hypericum punctatum	Spotted St. John's wort	Hypericeae										17	
Hypericum sphaerocarpum	St. John's wort	Hypericaceae										21	
Hypoxis hirsuta	Yellow stargrass	Amaryllidaceae					x					17,36	
Hystrix patula	Bottle brushgrass	Gramineae										17	
Iodanthus pinnatifidus	Purple rocket	Cruciferae										17,39	
Ilex ambigua	Carolina holly	Aquifoliaceae										15	
Ilex decidua	Deciduous holly	Aquifoliaceae		x	3	x	x		x			19 34,25	
Ilex opaca	American holly	Aquifoliaceae		x	3	x						50 19,25	Northern limit in Page, Oklahoma
Ilex vomitoria	Youpon	Aquifoliaceae		x	3							19,25	
Imperata hookeri	Hooker's imperata	Gramineae										16	
Indigofera, var. miniata leptosepala	Coast indigo	Leguminosae										17	Western limit in Muskogee
Ipomoea coccinea	Small red morning-glory	Convolvulaceae										16	

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Ipomoea hederacea	Ivyleaf morning-glory	Conovolvulaceae										17	
Ipomoea lacunosa	White morning-glory	Conovolvulaceae										17	
Ipomoea leptophylla	Bush morning-glory	Convolvulaceae										16	
Ipomoea pandurata	Wild potatovine	Conovolvulaceae										17,16	
Ipomoea purpurea	Morning-glory	Convolvulaceae										16	
Ipomoea shumardiana	Morning-glory	Convolvulaceae										16	
Iresine rhizomatosa	Rootstock bloodleaf	Amaranthaceae										14,27	
Isopyrum biternatum	Atlantic isopyrum	Ranunculaceae										17	
Itea virginica	Virginia sweetspire	Saxifragaceae		x		x						25	
Iva angustifolia	Narrowleaf sumpweed	Compositae										17	
Iva annua	Rough marsh elder	Compositae			x							16,34	
Jacquemontia tamnifolia	Hairy clustervine	Convolvulaceae										30	Irregular weed Stillwater
Jatropha texana		Euphorbiaceae										27	
Juglans nigra	Black walnut	Juglandaceae			3	x	x		x			19,21 35,14 17,37	
Juncus brachycarpus	Whiteroot rush	Juncaceae										17	
Juncus crassifolius	Flatleaf rush	Juncaceae			x							34,17	
Juncus dichotomus	Forked rush	Juncaceae										16	
Juncus diffusissimus	Slimpod rush	Juncaceae			x							34,17	
Juncus dudleyi	Dudley rush	Juncaceae										17,21	
Juncus effusus, var. solvtus	Common rush	Juncaceae										34,17	Aquatic
Juncus interior	Inland rush	Juncaceae			x						1	12,11 34,17	
Juncus marginatus	Grassleaf rush	Juncaceae			x							34,17	
Juncus robustus		Juncaceae										17	
Juncus scirpoides		Juncaceae										39	
Juncus tenuis	Poverty rush	Juncaceae			x							17,34	
Juncus torreyi	Torrey rush	Juncaceae			x							34 17,21	
Juniperus virginianum	Red cedar	Pinaceae		x	x	x	x		x			14,19 35,17	
Jussiaea decurrens	Water primrose	Onagraceae			x							34,17	

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Jussiaea diffusa	Floating water primrose	Onagraceae										17	
Jussiaea repens var. glabrescens	Smooth water primrose	Onagraceae										34	Aquatic
Justicia americana	Water willow	Acanthaceae										34,17	
Justicia ovata var. lancealata		Acanthaceae			x							34	Se Ok
Kallstraemia (Parviflora) intermedia	Intermediate caltrop	Zygophyllaceae										27	
Koeleria macrantha	Prairie junegrass	Gramineae							3			17,18	
Krameria secundiflora	Linear-leaved Kramerla	Leguminosae										16	
Krigia dandelian	Potato tuber dwarf dandelion	Compositae										17,16	
Krigia occidentalis	Western dwarf dandelion	Compositae										27	
Krigia oppositifolia		Compositae					x					16,36	
Krigia virginica	Virginia dwarf dandelion	Compositae										17	
Kuhnia eupatorioides, var. ozarkana	Plains kuhnia	Compositae			1							17,29	Albun. Push Talihina LF
Kuhnia glutinosa	Prairie false boneset	Compositae										16	
Lactuca, var. ludaviciana campestris		Compositae										27	
Lactuca canadensis	Canada lettuce	Compositae										17,16	
Lactuca canadensis, var. canadensis	Arrow-leaved lettuce	Compositae										16,17	
Lactuca canadensis, var. latifolia	Canada lettuce	Compositae										27	
Lactuca floridana	Florida lettuce	Compositae										16,17	
Lactuca hirsuta	Hairy wood-lettuce	Compositae										16,17	
Lactuca ludoviciana	Western lettuce	Compositae										16	
Lactuca oblongifolia	Large-flowered blue lettuce	Compositae										16	
Lactuca scariola, var. integrata	Lettuce	Compositae			x							34,17	
Lamium amplexicaule	Henbit deadnettle	Labiatae										17,21	
Laportea canadensis	Canada woodnettle	Urticaceae										17,14	
Lappula texana	Hairy stickweed	Boraginaceae										16	
Lappula virginiana	Virginia stickweed	Boraginaceae										17	
Lathyrus pusillus	Low peavine	Leguminosae										17	
Lechea tenuifolia	Narrowleaf pinweed	Cistaceae										17	

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Leersia oryzoides	Rice cut-grass	Gramineae										34,16	Aquatic
Leersia virginica	Whitegrass	Gramineae			x							34 14,17	
Lepidium densiflorum	Wild pepper-grass	Cruciferae			x						1	34 12,16	
Lepidium oblongum	Veiny pepper-grass	Cruciferae										27,23	pasture
Lepidium sativum	Garden pepper-grass	Cruciferae										16	
Lepidium virginicnum	Virginia peppergrass	Cruciferae										17	Common
Leptochloa fascicularis	Bearded sprangletop	Gramineae			x							34,17	
Leptochloa filiformis	Red spangletop	Gramineae										17	
Leptoloma cognatum	Diffuse crab-grass fall witchgrass	Gramineae			x				3		3	34 12, 1 16,11	increase grazing
Lespedeza capitata	Roundhead lespedeza	Leguminosae							3			17,1	
Lespedeza frutescens	Wand lespedeza	Leguminosae							3			17,14	
Lespedeza hirta	Hairy lespedeza	Leguminosae										17	
Lespedeza intermedia	Lespedeza	Leguminosae							3			27,23	
Lespedeza procumbens	Trailing lespedeza	Leguminosae										17	
Lespedeza repens	Creeping lespedeza	Leguminosae										17	
Lespedeza simulata	Mound lespedeza	Leguminosae										17	
Lespedeza stipulacea	Korean lespedeza	Leguminosae			x						3	34,12 4,21	
Lespedeza striata	Common lespedeza	Leguminosae										17	
Lespedeza stuevei	Stuev's lespedeza	Leguminosae							3		2	21,12 11, 1 17	
Lespedeza stuvei, var. neglecta		Leguminosae							3			17,18	
Lespedeza violacea	Violet lespedeza	Leguminosae										17	
Lespedeza virginica	Slender bush-clover	Leguminosae										16	
Lesquerella globosa	Shortls bladder-pod	Cruciferae										16	
Lesquerella gordonii	Mustard	Cruciferae										8	
Lesquerella gracilis	Slender bladder-pod	Cruciferae										16, 8	
Lesquerella ovalifolia	Mustard	Cruciferae										21	
Leucospora multifada		Scrophulariaceae			x							27,16	
Liatris acidota	Slender button-shakeroot	Compositae										16,27	

Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
			Associations										
Liatris aspera	Rough Gay Feather	Compositae										21	
Liatris punctata	Dotted Gay Feather	Compositae							3 x			1 17,23	
Liatris pycnostachya	Kansas Gay Feather	Compositae										17	
Liatris scariosa	Tall Gay Feather	Compositae										17	
Liatris squarrosa	Scaly Gay Feather	Compositae							x			17,23	
Limnobium spongia		Hydrocharitaceae										13	Tom, Mt. Aquatic
Limnosciadium pinnatum	Arkansas dogshade	Umbelliferae			x							17,16	
Linaria canadensis var. texana	Oldfield toadflax	Scrophulariaceae			x		3					17,36 34,21	
Lindera benzoin	Spice bush	Lauraceae			x	x	x					25, 3 17,19	
Lindernia anagallidea	False pimpernel	Scrophulariaceae										17	
Lindernia attenuata	Shortstaked false pimpernel	Scrophulariaceae										16	
Linum berlandieri var. rigidum	Berlandier's Yellow Flax	Linaceae										16	
Linum lewissi, var. pratense	Lewis flax	Linaceae										27,21	
Linum medium	Texas flax	Linaceae										17	
Linum rigidum	Large-flowered yellow flax	Linaceae									2	12 16,11	
Linum sulcatum	Grooved-yellow flax	Linaceae							3			1 17,16	
Liquidambar styraciflua	Sweetgum	Hamamelidaceae		x	x	x						34,15 3,19 25	
Lithospermum angustifolium		Boraginaceae					x				2	12,11 17,36	
Lithospermum arvense	Corn Gromwell	Boraginaceae										16	
Lithospermum carolinense	Hairy Puccoon	Boraginaceae										16	
Lithospermum incisum	Narrowleaf gromwell	Boraginaceae							x			27,23	
Lithospermum linearifolium	Narrow-leaved Puccoon	Boraginaceae										16	
Lobelia cardinalis	Cardinal Flower	Lobeliaceae										17,27 14,21	
Lobelia inflata	Indian tobacco	Lobeliaceae											
Lobelia leptostachys		Lobeliaceae										17	
Lobelia puberula	Downy lobelia	Lobeliaceae										17	
Lobelia spicata	Palespike lobelia	Lobeliaceae										17	
Lolium perenne	Ray-Grass	Gramineae			x							34,16	

			Associations										
Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
Lomatium daucifolium	Carrot leaved parsley	Umbelliferae										16	
Lomatium foeniculaceum		Umbelliferae										27,21	
Lonicera prolifera	Honeysuckle	Caprifoliaceae				x						19,25	
Ludwigia alternifolia	Seedbox	Onagraceae			x							34,17	
Ludwigia glandulosa	False loosestrife	Onagraceae			x							34,17	
Ludwigia palustris	False loosestrife	Onagraceae			x							34,17	
Lycopersicon esculentum	Tomato	Solaceae										16	prob. cult.
Lycopus americanus	Bugleweed	Labiatae			x							34,17	
Lycopus asper	Western Water Hoarhound	Labiatae										16	
Lyonia ligustrina	Maleberry	Ericaceae				x						19,25	
Lyonia mariana	Stagger bush	Ericaceae			1							46	Tom Mt.
Lythrum lanceolatum var. alatum	Winged lytrum	Lythraceae			x							34,17	
Maclura pomifera	Osageorange, Bois d'arc	Ulmaceae				x	x					17,25 27,19	
Magnolia acuminata	Cucumber magnolia	Magnoliaceae				x						19 25,50	Talinina, Leflore Co. Rich Mt. Northern limit
Magnolia tripetala	Umbrella magnolia	Magnoliaceae				x						25,19	Cucumber Spring, Leflore Co.
Malva rotundifolia	Common mallow	Malvaceae							1			40	Edmund, OK.
Malvastrum angustum		Malvaceae										17	
Malvastrum coccineum	Red false, mallow	Malvaceae										16	
Mamillaria missourienis	Missouri nipplecactus	Cactaceae										21	
Mamillaria similis	Nipplecactus	Cactaceae										27	
Manisurus cylindrica	Carolina jointtail	Gramineae							1 3		2	18,12 17,11	
Marrubium vulgare	Horehound	Labiatae										17	
Marshallia caespitosa	Barbara's buttons	Compositae										21	Southeast Oklahoma
Matelea baldwinianum	Baldwin milkvine	Asclepiadaceae										19	
Matelea gonocarpa		Asclepiadaceae										27	
Matelea hirsutum		Asclepiadaceae										16	
Matelea suberosum		Asclepiadaceae										16	
Matricaria matricarioides	Mayweed	Compositae										27	

Scientific Name	Common Name	Family	Associations									Ref.	Comments
			1	2	3	4	5	6	7	8	9		
Medicago arabico	Spotted medic	Leguminosae										16	
Medicago lupulina	Black medic	Leguminosae										16	
Medicago minimia	Little Burclover	Leguminosae										27	
Medicago sativa	Alfalfa, lucerne	Leguminosae										17	
Melia azedorach	Chinaberry, chinatree	Meliacea										19,44	Escope Mt.
Melilatus alba	White sweet clover	Leguminosae			3							34,17	
Melilotus officinalis	Yellow sweet clover	Leguminosae										17,21	
Melathria pendulo	Drooping melonette	Cucurbitaceae										14 17,16	
Menispermum canadense	Comman moonseed	Menispermaceae			3	x	x					19 21,17 14,51	
Mentha spicata	Spearmint	Labiatae										21	
Mentzelia aligosperma	Stickleaf	Loasaceae										17,21	E limit in Muskogee
Mikania scandens	Climing hempweed	Compositae			x							34 28,17	Se OK
Mimulus alatus	Monkey flower	Scrophulariaceae			x							34,17	
Mimulus geyeri	Geyer's yellow monkey-flower	Scrophulariaceae										16	
Mimulus glabratus, var. oklahomensis	Roundleaf mankey-flower	Scrophulariaceae										27	
Mimulus ringens	Square-stemmed monkey-flower	Scophularioceae										27	
Mirabilis olbida	Pale umbrella-wort	Nyctaginaceae										16	Western
Mirabilis floribundus	Flowering umbrella-wort	Nyctaginaceae										27	
Mirabilis hirsutus	Hairy umbrella-wort	Nyctaginaceae										27	
Mirabilis linearis	Narrow leaved umbrella-wort	Nyctaginaceae										16	
Mirabilis nyctaginea	Wild four a' clock	Nyctaginaceae									3	16,55	
Mollugo verticillata	Carpet weed	Aizoaceae			x							34,17	
Monarda citriodora	Lemon beebalm	Labiatae			x							34,21	
Monarda clinopodioides	Basil beebalm	Labiateae			x							34 27,16	
Monarda dispersa		Labiatae										17	
Monarda fistuloso	Wild Bergamot	Labiatae										16	
Monarda pectinata	Plains, lemon monarda	Labiatae										16	
Monarda punctata	Spotted beebalm	Labiatae										17	

Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
			Associations										
Monarda russelliana	Russel beebalm	Labiatae										17	
Monolepis nuttalliana	Monolepsis	Chenopodiaceae			x							16,34	
Monotropa uniflora	Indianpipe	Pyrolaceae										15	Rare, McCurtain
Morus alba	White mulberry	Moraceae										14,27	
Morus rubra	Red mulberry	Moraceae		x	3	x	x	x				19,17	
Muhlenbergia mexicana	Satin-grass	Gramineae										16	
Muhlenbergia schreberi	Nimble will	Gramineae										16,14	W. limit Canadian Co.
Muhlenbergia sobolifera	Rock muhly	Gramineae										17	
Myosotis virginica	Spring forget-me-not	Boraginaceae										36,19	
Myosurus minimus	Mousetail	Ranunculaceae										17	
Myrica cerifera	Southern waxmyrtle	Myricaceae										25,19	SE OK
Myriophyllum brasiliense												38	Aquatic
Myriophyllum pinnatum	Water milfoil	Haloragaceae										34	Aquatic
Najas guadalupensis	Najad	Najadaceae										22,34	Aquatic
Nama ovatum		Hydrophyllaceae										17	
Nelumbo lutea	Water chinquapin	Nymphaceae										34	Aquatic
Nelumbo pentapetala		Nymphaceae										27	
Nemastylis coelestina		Iridaceae							x			17	
Nemastylis geminiflora	Prairie irid	Iradaceae										21	
Nemophila phacelioides	Largeflower nemophilla	Hydrophyllaceae										27	
Nepeta cataria	Catnip	Labiatae										17	Northeastern Oklahoma
Neptunia lutea	Yellow neptunia	Leguminosae										16,17	
Nothocalais cuspidata	Prairie false dandelion	Compositae							1			16,55	
Nothoscordum bivalve	False garlic	Liliaceae					x		x		1	21,36 11,12	
Nuphar advena	Spatterdock	Nymphaceae										34	Aquatic
-Nyctelea nyctelea	Nyctelea	Hydrophyllaceae											
Nymphacaea odorata	American waterlily	Nymphaceae										21,34	Aquatic
Nyssa sylvatica	Blackgum, sourgum	Nyssaceae		x	x	x	x					19,3	Western limit in Muskogee

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Oenothera biennis	Common evening primrose	Onagraceae										17	
Oenothera grandis	Large cutleaved evening primrose	Onagraceae										16	
Oenothera laciniata	Cutleaf evening primrose	Onagraceae			x		x		x			21 34,23	
Oenothera linifolia	Threadleaf sundrops	Onagraceae					3					36,17	
Oenothera macrocarpa, var. oklahomensis	Ozark sundrops	Onagraceae										27,21	
Oenothera rhombipetala	Four point evening primrose	Onagraceae			x							34,17	
Oenothera serrulata	Evening primrose	Onagraceae			3				2			11,21 24,34	
Oenothera speciosa	Showy sundrops	Onagraceae										17,16	
Oenothera triloba	Stemless evening primrose	Onagraceae										17	
Onosmodium var. occidentale	Marbleseed	Boraginaceae										17	
Onosmodium molle, var. subsetosum		Boraginaceae										42	
Oplismenus setarius	Oplismenus	Gramineae										7	New
Opuntia compressa		Cactaceae				x						19,14 21,25	
Opuntia engelmannii	Prickley Pear Cactus	Cactaceae										14	
Orobanche ludociciana	Louisiana broomrape	Orobanchaceae										17	
Ostrya virginiana	Ironwood	Betulaceae			x	x	x		x			19,37	
Oxalis corniculata	Yellow Procumbent Wood-Sorrel	Oxalidaceae										16	
Oxalis filipes	Slender Yellow Wood-Sorrel	Oxalidaceae										16	
Oxalis interior	Inland oxalis	Oxalidaceae										17	
Oxalis stricta	Upright Yellow Wood-Sorrel	Oxalidaceae			x		x		3		2	23,36 18,12	
Oxalis stricta, f. viridiflora		Oxalidaceae										43	
Oxalis violacea	Violet Wood-Sorrel	Oxalidaceae					3		x			12,23	
Oxalis violacea, f. albida		Oxalidaceae				1						29,11	
Oxytropis lamberti	Stemless Loco-Weed	Leguminosae										16	
Palafoxia callosa	Small papafoxia	Compositae										21,16	
Palafoxia Texana		Compositae										27	
Panicum anceps	Beaked panicum	Gramineae			x							34,21	
Panicum angustifolium	Narrow-Leaved Panic Grass	Gramineae										16	
Panicum Boscii	Bosc panicum	Gramineae										17	

Scientific Name	Common Name	Family	Associations									Ref.	Comments
			1	2	3	4	5	6	7	8	9		
Panicum capillare	Common Switch Grass	Gramineae			x				3			1 34,17	
Panicum clandestinum	Panicum	Gramineae										17	
Panicum dichotomiflorum	Fall panicum	Gramineae			x							34,17	
Panicum flexile	Panicum	Gramineae										17	
Panicum hians	Gaping panicum	Gramineae			x							17,34	
Panicum hillmani	Hillman panicum	Gramineae										23,17	
Panicum lanuginosum	Wooly panicum	Gramineae										17,21	
Panicum lanuginosum, var. fasciculatum	Panicum	Gramineae										17,21	
Panicum lanuginosum, var. lindheimeri		Gramineae			x							17,34	
Panicum linearifolium	Slimleaf panicum	Gramineae										17,31	
Panicum malacophyllum	Softleaf panicum	Gramineae										17	
Panicum mutabile	Tall Fringed Panic-grass	Gramineae										16	
Panicum obtusum	Blunt Panic-grass	Gramineae			x							21 16,34	
Panicum oligosanthes	Panicum	Gramineae										53	
Panicum philadelphicum	Philadelphia switchgrass	Gramineae										17	
Panicum polyanthes	Leafy panicum	Gramineae										17	
Panicum praecocius	Early panicum	Gramineae										17	
Panicum ravenelii	Panic grass	Gramineae										17	
Panicum rigidulum	Redtop panicum	Gramineae			x							17,34	
Panicum scribnerianum	Scribner panicum	Gramineae					x		3		3	36 1,12	
Panicum sphaerocarpon	Roundseed panicum	Gramineae			x							34 17,21	
Panicum tennesseense	Tennessee panicum	Gramineae										17,31	
Panicum virgatum	Switch grass	Gramineae			3				3			24,34 11,23	
Papaver dubium	Poppy	Papaveraceae									2	40	
Pappophorum opertum	Pappophorum	Gramineae										16	
Parapholis cylindrica	Pitted joint grass	Gramineae										16	
Parietaria pennsylvanica	Pellitory	Urticaceae										14,21	
Paronychia jamesii	James nailwart	Illacebraceae										27	

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Parthenium hysterophorus	Ragweed parthenium	Compositae			x							17,34	
Parthenocissus quinquefolia	Virginia creeper	Vitaceae		x	x	x	x	x	x			24,25 14,19	
Paspalum distichum	Joint-grass	Gramineae			x							21,34	
Paspalum floridanum	Florida paspalum	Gramineae			x				3			1,34	
Paspalum laeviglume	Smooth-scaled paspalum	Gramineae										16	
Paspalum longipendunculatum	Long-stalked paspalum	Gramineae										16	
Paspalum pubiflorum	Hairyseed paspalum	Gramineae										17	
Paspalum setaceum	Slender Paspalum	Gramineae										16	
Paspalum setaceum, var. muehlenbergii	Hurrahgrass	Gramineae			x				3		3	11,12	
Passiflora incarnata	Maypop passion flower	Passifloraceae										17	
Passiflora lutea	Yellow passion flower	Passifloraceae										17	
Pastinaca sativa	Wild parsnip	Umbelliferae										17,27	
Pedicularis canadensis	Early lousewort	Scrophulariaceae										17	
Penstemon cobaea	Cobaea beard-tongue	Scrophulariaceae							3			21,23	
Penstemon grandiflorus (Bradburii)	Large-flowered beard-tongue	Scrophulariaceae										16	
Penstemon hirsutus	Hairy beard-tongue	Scrophulariaceae										16	
Penstemon laevigatus, var. digitalis		Scrophulariaceae										17	
Penstemon laxiflorus	beard-tongue	Scrophulariaceae										27	
Penstemon oklahomensis	Oklahoma beard-tongue	Scrophulariaceae										21,27	
Penstemon pallidus	Pale beard-tongue	Scrophulariaceae										16	
Penstemon tubiflorus	Tube penstemon	Scrophulariaceae										17	
Penthorum sedoides	Ditch stonecrop	Saxifragaceae			x							16,34	
Peplis diandra												43	Rare
Perilla frutescens	beefsteak plant	Labiatae										17	
Petalostemum candidum, var. candidum	White prairie clover	Leguminosae							3			1 18,23	
Petalostemum candidum, var. oligophyllum	Western prairie clover	Leguminosae										27	
Petalostemum multiflorum	Roundhead prairie clover	Leguminosae										17,21	
Petalostemum purpureum	Purple prairie clover	Leguminosae			x				3		1	18,34 12,23	

Scientific Name	Common Name	Family	Associations									Ref.	Comments
			1	2	3	4	5	6	7	8	9		
Petalostemum tenuifolium	Silky prairie-clover	Leguminosae										16	
Petalostemum villosum	Hairy prairie-clover	Leguminosae										16	
Phacelia dubia	Smallflower phacelia	Hydrophyllaceae										17,36	
Phacelia hirsuta	Hairy phacelia	Hydrophyllaceae										17,21	
Phalaris caroliniana	Canary grass	Gramineae			x							17,34	
Philadelphus pubescens	Mock orange	Saxifragaceae		x		3	x					3,25	
Phleum pratense	Timothy	Gramineae										16	
Phlox divaricata	Sweet william phlox	Polemoniaceae										17	
Phlox pilosa	Downy phlox	Polemoniaceae										17	
Phoradendron serotinum	Christmas mistletoe	Loranthaceae		x		x	x					19,21	
Phragmites australis (communis)	Common Reed-grass	Gramineae										16	
Phryma leptostachya	Lopseed	Phrymaceae										21 17,14	
Phyla cuneifolia	Wedge leaf frogfruit	Verbenaceae										27	
Phyla lanceolata	Frogfruit	Verbenaceae										34,17	
Phyla nodiflora	Common frogfruit, capeweed	Verbenaceae			x							21,34	
Phyllanthus caroliniensis	Carolina leaflower	Euphorbiaceae										17	
Physalis angulata	Cutleaf ground cherry	Solanaceae										17	
Physalis angulate, var. pendula	purplevein ground cherry	Solanaceae										27,21	
Physalis heterophylla	Clammy ground cherry	Solanaceae										17,21	
Physalis lobata	Purple ground cherry	Solanaceae										27	
Physalis mollis	Field ground cherry	Solanaceae										17	
Physalis philadelphica	Tomatillo ground cherry	Solanaceae										27	
Physalis pubescens	Downy ground cherry	Solanaceae										17	
Physalis pubescens, var. missouriensis	Missouri ground cherry	Solanaceae										17	
Physalis pumila	Low ground cherry	Solanaceae										21,27	
Physalis rotuniata	Round-leaved ground cherry	Solanaceae										16	
Physalis subglabrata	Toperleaf ground cherry	Solanaceae										17	
Physalis virginiana	Virginia ground cherry	Solanaceae										17	

Scientific Name	Common Name	Family	Associations									Ref.	Comments
			1	2	3	4	5	6	7	8	9		
Physalis virginiana, var. sonorae	Long-leaved ground cherry	Solanaceae										16,21	
Physalis virginiana, var. subglobrata	Bladder ground cherry	Solanaceae										27	
Physalis viscosa	Stellata ground cherry	Solanaceae										16,31	
Physostegia virginiana		Labiatae										17	
Phytolacca americana	Poke weed	Phytolaccaceae			3							34 14,51	
Pilea pumila	Canada clear weed	Urticaceae										17	
Pinus echinata	Short leaf pine	Pinaceae		x		3	3					19 3,25	
Pinus taeda	Loblolly pine	Pinaceae	3	x		x						3,19	SE McCurtain only
Planera aquatica	Water elm	Ulmaceae		x	x	x						19,25	McCurtain Co.
Plantago aristata	Bottle brush plantain	Plantaginaceae										17	
Plantago elongata	Plantain	Plantaginaceae							3			17,18	
Plantago hybrida	Slender plantain	Plantaginaceae										16	
Plantago lanceolata	Ribwort	Plantaginaceae										16	
Plantago purshii (patagonica)	Wooly plantain	Plantaginaceae			x						1	34 11,21	
Plantago rhodosperma	Redseed plantain	Plantaginaceae										17,21	
Plantago rugelii	Blackseed plantain	Plantaginaceae										17	
Plantago virginica	Paleseed plantain	Plantaginaceae			x				x		1	34 12,23	
Platanus occidentalis	Sycamore	Platanaceae			3	x	x					24 19,25	
Pluchea camphorata	Spicy fleabane	Compositae										16	
Pluchea foetida	Viscid marsh fleabane	Compositae										16	
Pluchea marilandica		Compositae										27	
Pluchea petiolata	Stalkleaf pluchea	Compositae										17	
Pluchea purpurascens	Purple pluchea	Compositae			x							27,34	
Poa annua	Annual bluegrass	Gramineae										17	
Poa arachnifera	Texas bluegrass	Gramineae							x			16,23	Invader
Poa arida	Prairie spear-grass	Gramineae										16	
Poa autumnalis	Bluegrass	Gramineae										9	New
Poa chapmaniana	Chapman's spear-grass	Gramineae										16	

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Poa pratensis	Kentucky bluegrass	Gramineae										17	
Podophyllum peltatum	May apple mandrake	Berberidaceae					3					3,21	
Polanisia trachysperma	Roughseed clammyweed	Capparidaceae										17	
Polygala alba	White Milkwort	Polygalaceae									1	12,16	
Polygala incarnata	Pink Milkwort	Polygalaceae									1	11,12	
Polygala sanguinea	Blood milkwort	Polygaloceae										17	
Polygala verticillata	Whorled Milkwort	Polygaloceae			x				3			18,34	
Polygonatum biflorum	Great salomon seal	Convallariaceae										14,21	
Polygonum acre		Polygonaceae										17	
Polygonum paviculare, var. littorale	Prostrate knotweed	Polygonaceae			x							17,34	
Polygonum (Persicaria) bicornis	Pink smartweed	Polygonaceae										17	
Polygonum buxiforme	Shore knotweed	Polygonaceae											
Polygonum (Persicaria) coccinum	Bigroot smartweed	Polygonaceae										34,27	Aquatic
Polygonum convolvulos	Dullseed cornbind	Polygonaceae										16,27	
Polygonum douglasii	Douglas' Knotweed	Polygonaceae										27	
Polygonum dumetorum	Hedge Knotweed	Polygonaceae										27,31	
Polygonum (Persicaria) hydropiper	Marshpepper smartweed	Polygonaceae										27	
Polygonum (Persicaria) hydropiperoides	Swamp smartweed	Polygonaceae										34 14,21	Aquatic
Polygonum (Persicaria) lapathifolium	Curltop smartweed	Polygonaceae										31,34	Aquatic
Polygonum (Persicaria) opelousanum		Polygonaceae										16,27	
Polygonum pensylvanicum	Pennsylvania smartweed	Polygonaceae			x							7,34	
Polygonum pensylvanicum var. laevigatum		Polygonaceae										21,24	
Polygonum (Persicaria) punctatum	Dotted smartweed	Polygonaceae			x							27,34	
Polygonum ramossissimum	Bushy knotweed	Polygonaceae			x							17,34	
Polygonum scandens	Hedge cornbind	Polygonaceae										27	
Polygonum tenue	Pleatleaf knotweed	Polygonaceae										17,27	
Polygonum virginianum	Virginia jumpseed	Polygonaceae										17	
Polygonum vulgaris	Ladys thumb	Polyagonaceae										16	

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Polymnia uvedalia	Yellow leafcup	Compositae										17	
Polypogon monspelienis	Annual Beard-grass	Gramineae			x							16,34	
Polypremum procumbens	Juniperleaf	Loganiaceae			x							17,34	
Polytaenia nuttallii	Prairie parsley	Umbelliferae										17,21	
Populus deltoides	Cotton wood	Salicaceae			3		x		x			37 10,33	
Portulaca mundula	Shaggy purslane	Portulacaceae										17	
Portulaca oleracea	Common purslane	Portulacaceae										17	
Portulaca parvula	Sinkerleaf purslane	Portulacaceae										27	
Potamogeton diversifolius	Waterthread pondweed	Najadaceae										22,34	Aquatic
Potamogeton nodosus	Common pondweed	Najadaceae										22,34	Aquatic
Potamogeton pectinatus	Fennelleaf pondweed	Najadaceae										34,39	Aquatic
Potentilla simplex	Oldfield cinquefoil	Rosaceae										17	
Prenanthes altissima		Compositae			1							29	
Prenanthes aspera	Rough rattlesnake root	Compositae										17	
Prosopis juliflora, var. glandolosa	Mesquite	Leguminosae										14	
Prunella vulgaris, var. lanceolata	Self-heal	Labiatae			x							27,34	
Prunus americana	American plum	Rosaceae				x	x		x			17,25	
Prunus angustifolia	Chickasaw plum	Rosaceae			3							35 19,34	
Prunus gracilis	Oklahoma plum	Rosaceae					x		x			14,27	
Prunus hortulana	Hortulan plum	Rosaceae					x		x			17,25	
Prunus mexicana	Mexican plum	Rosaceae					x		x			14,27	
Prunus serotina	Black cherry	Rosaceae		x	3	x	x		x			25,35	
Psoralea cuspidata	Large-bracted psoralea	Leguminosae										16	
Psoralea digitata	Digitate Psoralea	Leguminosae							x			16,23	
Psoralea esculenta		Leguminosae										47	
Psoralea pedunculata	Scurfpea	Leguminosae										17	
Psoralea subulata		Leguminosae										47	
Psoralea tenuiflora	Wild alfalfa	Leguminosae			x				3			18,21	

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Ptelea trifoliata	Common hoptree	Rutaceae				x	x		x		2	17,19	
Ptilimnium capillaceum	Threadleaf mockbishop	Umbelliferae										27	
Ptilimnium costatum		Umbelliferae										39	
Ptilimnium nuttallii		Umbelliferae							3			18	
Pycnanthemum tenuifolium	Slender mountain mint	Labiatae			x							17,34	
Pyrrhopappus carolinianus	Carolina false dandelion	Compositae			x				x			23,34	
Pyrrhopappus geiseri		Compositae										21	
Pyrrhopappus grandiflorus	False dandelion	Compositae			x						2	11,12	
Pyrrhopappus scaposus	False dandelion	Compositae										27	
Quercus alba	White oak	Fagaceae		x	x	3	3		x			19,35 3,15	
Quercus bicolor	Swamp white oak	Fagaceae										27	
Quercus borealis, *maxima*	Northern red oak	Fagaceae		x	3	x	x					15,37	
Quercus falcata	Southern red oak	Fagaceae	3			x	x					15,33	
Quercus macrocarpa	Bur oak	Fagaceae										14,21	
Quercus marilandica	Blackjack oak	Fagaceae		x		3	3	x	x			24,33 3,21	
Quercus michauxii	Cow oak	Fagaceae										16	
Quercus muhlenbergii	Chinquapin oak	Fagaceae		x		x	3		x			21,36 14,19	
Quercus nigra	Water oak	Fagaceae	3	x		x						15,33	
Quercus palustris	Pin oak	Fagaceae					x		x			3,17	
Quercus phellos	Willow oak	Fagaceae		x	x	3						3,19	
Quercus prinoides	Scrub Oak	Fagaceae					x		2			11,16	
Quercus prinus	Swamp chesnut oak	Fagaceae					x		x			15,25	
Quercus rubra	Red oak	Fagaceae				3	x					3,19	
Quercus shumardii	Texas oak, spotted oak	Fagaceae				3	x					21 14,3	
Quercus shumardii; var. *schneckii*	Schneck's oak	Fagaceae			3	3						17,33	
Quercus stellata	Post oak	Fagaceae	x	x		3	3	x	x			21,33 3,35	
Quercus velutina	Black oak	Fagaceae		x		x	3	x				24 3,19	
Ricinus communis	Castor-bean	Euphorbiaceae										16	

Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
							Associations						
Ranunculus abortivus	Littleleaf buttercup	Ranunculaceae					x					17,36	
Ranunculus cymbalaria	Crowfoot	Ranunculaceae										16	
Ranunculus fascicularis	Tufted buttercup	Ranunculaceae										17	
Ranunculus macranthus	Buttercup	Ranunculaceae										17	
Ranunculus pusillus	Weak buttercup	Ranunculaceae										27	
Ranunculus sceleratus	Blister buttercup	Ranunculaceae			x							27,34	
Ratibida columnaris	Upright prairie coneflower	Compositae										16,27	
Ratibida tagetes	Short-rayed Cone-flower	Compositae										16	
Rhamnus caroliniana	Caralina buckthorn	Rhamnaceae										19,25	
Rhododendron arborescens		Ericaceae				3						25	
Rhododendrun canescesn	Pink azelia	Ericaceae										3	
Rhododendrun oblongifolium	Texas azalia	Ericaceae										19	
Rhus aromatica, var. flabelliformis	Skunk brush	Anacardiaceae					x		x			3,25	
Rhus aromatica, var. serotina	Fargrant sumac											21	
Rhus canadensis		Anacardiaceae										19,36	
Rhus copallina	Winged sumac	Anacardiaceae										24,36 18,15	
Rhus glabra	Smooth sumac	Anacardiaceae		x	x	x	3	x	x			37 18,36	
Rhus radicans	Poison Ivy	Anacardiaceae			3			x				24,51	
Rhus toxicodendron	Poison oak	Anacardiaceae										14,19	
Rhynchosia latifolia	Broadleaf snoutbeam	Leguminosae										17,16	
Rhynchosia tomentosa	Twining rhynchosia	Leguminosae										16	
Rhynchospora globularis	Grasslike beakrush	Cyperaceae										17	
Rhynchospora macrostachya	Tall beakrush	Cyperaceae										17	
Ribes aureum		Saxlfragaceae					x		x			14,25	
Ribes cynosbati	Pasture gooseberry	Saxifragaceae		x								19,25	
Ribes odoratum	Golden Currant	Saxlfragaceae			3		x		x			27,51	
Rivina humilis	Bloodberry rougeplant	Phytolaccoceae										17	
Robinia pseudo-acacia	Black locust	Leguminosae			3	x	x		x			3,37	

Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
			Associations										
Robinia viscosa		Leguminosae										19	
Rorippa islandica	Bogmarshcress	Cruciferae										27	
Rorippa nastortium-aquaticum	True water cress	Cruciferae										17	
Rorippa sessiliflora	Stalkless yellow cress				x							34	
Rorippa sinuata	Yellow cress	Cruciferae										17	
Rosa carolina	Caralina rose	Rosaceae				x	x					19,25	
Rosa foliolosa	Leafy rose white priairie rose	Rosaceae					x		x			17,25	
Rosa prutincola		Rosaceae							x			17,25	
Rosa setigera	Prairie rose	Rosaceae		x		x	x		x			19,25	
Rosa woodsii	Woods' rose	Rosaceae								x		16,25	
Rotala ramosior	Toothcup	Lythraceae			x							17,34	
Rubus argutus		Rosaceae		x		x						19,25	
Rubus flagellaris	Blackberry northern dewberry	Rosaceae										14	
Rubus flagellaris, var. invisus	Blackberry	Rosaceae										19	
Rubus procumbens	Dewberry	Rosaceae										16	
Rubus trivialis	Southern dewberry	Rosaceae				x						21,25	
Rubus villosus		Rosaceae					x		x			17,25	
Rudbeckia (Dracopsis) amplexicaulis	Clasping coneflower	Compositae			2							21,34	
Rudbeckia bicolor	Pinewoods coneflower	Compositae							x			21,23	
Rudbeckia grandiflora	Rough coneflower	Compositae										17	
Rudbeckia hirta	Black-eyed susan	Compositae					x		3		2	11,18	
Rudbeckia triloba	Brown eyed susan	Compositae										17	
Ruellia humilis	Wild petunia	Acanthaceae							3			1 12,11	
Ruellia pendunculata	Stalked ruellia	Acanthaceae										17	
Ruellia strepens	Limestone ruellia	Acanthaceae										21,17	
Rumex altissimus	Pale dock	Polygonaceae			x							21,34	
Rumex britonnica	Great water-dock	Polygonaceae										16	
Rumex conglomeratus	Clustered green dock	Polygonaceae										16	

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Rumex crispus	Curly dock	Polygonaceae			x							21,34	
Rumex hastatulus	Heartwing sorrel	Polygonaceae										17	
Rumex obtusifolius	Bitter dock	Polygonaceae										17	
Rumex verticillatus	Swamp dock	Polygonaceae			x							16,34	
Sabal minor	Bush palmetto	Palmae		3								25	
Sabatia angularis	Squarestem rose gention	Gentianaceae			x				x			23,34	
Sabatia campestris					2							17,34	
Sagina decumbens	Trailing pearlwort	Caryophyllaceae										17	
Sagittaria ambigua	Kansas sagittaria	Alismaceae			2							16,34	
Sagittaria lancifolia		Alismaceae										22,29	
Sagittaria latifolia	Broad-leaved arrow-head	Alismaceae										16,34	Aquatic
Salix caroliniana	Willow	Salicaceae		x	3		x		x			19	
Salix humilis	Willow	Salicaceae			2	x	x					19,25	
Salix interior	Sandbar willow	Salicaceae			3							35 27,34	
Salix interior var. Wheeleri	Sandbar willow	Salicaceae										27	
Salix longifolia		Salicaceae				x	x		x			14,17	
Salix nigra	Black willow	Salicaceae		x	3		x		x			27,37 24,34	
Salsola kali var. tenuifolia	Russian thistle	Chenopodiaceae			x							27,34	
Salsola pestifer	Russian thistle	Chenopodiaceae										16	
Salvia azurea var. grandiflora	Azure sage	Labiatae							3			1 14,21	
Salvia lyrata	Lyreleaf sage	Labiatae										21	
Sambucus canadensis	American elder	Caprifoliaceae		x	3	x	x		x			37 14,19	
Samolus parviflorus	Water pimpornel, brookweed	Primulaceae										17	
Sanguinaria canadensis	Bloodroot	Papaveraceae					3					3,31	
Sanguisorba annua	Prairie burnet	Rosaceae										27	
Sanicula canadensis	Short-styled snake-root	Umbelliferae										14,21	
Sapindus saponaria, var. drummondii	Western soapberry	Sapindaceae		x		x	x		x			17,25	
Saponapia officinalis	Bouncing bet	Caryophyllaceae										17	

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Sassafras albidum		Lauraceae				x	x					19,25	
Satureja arkansana		Labiatae										17	
Saururus cernuus	Common lizardtail	Saururaceae										17,31	
Saxifraga texana		Saxifragaceae										17	
Schedonnardus paniculatus	Schedonnardus	Gramineae			x						2	12,34	
Schrankia microphylla	Narrow leaf sensitive briar	Leguminosae										16	
Schrankia uncinata	Catclaw sensitive briar	Leguminosae					3		x			18,23	
Scirpus americanus	American bulrush	Cyperaceae			x							17,34	
Scirpus carinatus		Cyperaceae										17	
Scirpus hallii	Hall's Club-Rush	Cyperaceae										16	
Scirpus lineatus	Rusty bulrush	Cyperaceae			x							17,34	
Scirpus maritimus, var. macrostachyus	Salt Marsh Bulrush	Cyperaceae										16	
Scirpus maritimus, var. paludosus	Prairie Bulrush	Cyperaceae										16	
Scirpus occidentalis	Viscid Great Bulrush	Cyperaceae										16	
Scirpus torreyi	Torrey's Bulrush	Cyperaceae										16	
Scirpus validus	Softstem bulrush	Cyperaceae			x							34,39	
Scleria ciliata	Fringed bulrush	Cyperaceae							3			17,18	
Scleria triglomerata	Whip nutrush	Cyperaceae										17	
Scrophyularia marylandiaca		Scraphulariaccae										17	
Scutellaria galericulata	Hooded Willow-herb	Labiatae										16	
Scutellaria laterifiora	Side flowering skullcap	Labiatae										17	
Scutellaria avatc, var. bracteata	Mad dog skullcap	Labiatae										17	
Scutellaria parvula	Small skullcap	Labiatae							3			18,21	
Sedum nuttallianum	Yellow stonecrop	Crassuiaceae										17	
Sedum pulchellum	Texas stonecrop	Crassulaceae										17,21	
Selenia aurea		Cruciferae					3					17,36	
Senecia aureus	Golden Ragwort	Compositae										16	
Seneccia glabellus		Compositae										27	

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Senecio imparipinnatus	Groundsel	Compositae										17	
Senecio obovatus	Roundleaf groundsel	Compositae					x					21,36	
Senecio plattensis	Prairie Ragwort	Compositae										16	
Senecio riddellii	Riddell's Senecio	Compositae										16	
Sesbania macrocarpa		Leguminosae										17	
Setaria geniculata	Knotroot bristlegrass	Gramineae							3			1 21,53	
Setaria glauca	Bristlegrass, Yellow foxtail	Gramineae										16,21	
Setaria imberbis	Perennial foxtail grass	Gramineae										16	
Setaria viridis	Green bristlegrass	Gramineae			x							17,34	
Seymeria (Dasistoma) serrata	False foxglove	Scrophulariaceae										16	
Sicyos angulatus		Cucurbitaceae										16,17	
Sida spinosa	Prickly sida	Malvaceae										17,31	
Silene antirrhina	Sleepy catchfly	Caryophyllaceae					3					36,45	
Silene stellata	Starry campion	Caryophyllaceae										17,21	
Silphium asperrimum	Roughstem rosinweed	Compositae										27	
Silphium catesii	Rosin-weed	Compositae							3			23,16	
Silphium integrifolium	Whole leaf rosinweed	Compositae										17	
Silphium laciniatum	Compass plant	Compositae							3			1,17	
Silphium perfoliatum	Cup rosinweed	Compositae										17	
Siphium terebinthinaceum	Prairie Dock	Compositae										16	
Sisymbrium altissimum	Tumblemustard	Cruciferae										16,27	
Sisymbrium officinale	Hedge mustard	Cruciferae										27	
Sisyrinchium angustifolium	Common blue-eye grass	Iridaceae										14,21	
Sisyrinchium bushii	Blue-eye grass	Iridaceae							x		1	27 12,23	
Sisyrinchium campestre	Prairie blue-eye grass	Iridaceae										17,27	
Smilax bona-nox	Bristly Greenbriar	Liliaceae			3	x		x			x	24 34,14 19,21	
Smilax glauca	Glaucous-leaved Greenbriar	Liliaceae				x			x		x	16,19	
Smilax herbaceae	Carrion-flower	Liliaceae										16,17	

Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
Smilax hispida	Hispid Greenbriar	Liliaceae				x	x		x			27 14,19	
Smilax rotundifolia	Greenbriar	Smilaceae		x		x	x		x			16,19	
Solanum americanum	Black nightshade	Solanaceae										21	
Solanum carolinense	Carolina Horsenettle	Solanaceae			x							21,34	
Solanum dimidiatum	Western Horsenettle	Solanaceae							3			1,17	
Solanum elaeagnifolium	Silverleaf nightshade	Solanaceae			x							17,34	
Solanum nigrum	Black nightshade	Solanaceae			x							17,34	
Solanum rostratum	Buffalobur	Solanaceae			x							17,34	
Solidago altissima		Compositae										17,21	
Solidago bootii		Compositae										17	
Solidago delicatula		Compositae										27	
Solidago gymnospermoides	Sticky goldenrod	Compositae										16,17	
Solidago (Euthamia) leptocephala		Compositae										27	
Solidago missouriensis, var. fasciculata	Missouri goldenrod	Compositae							3			1 18,23	
Solidago mollis	Variety Golden-Rod	Compositae							3			1	
Solidago nemoralis	Gray Golden-Rod	Compositae										16,21	
Solidago petiolaris	Narrowleaf downy ragged Golden-Rod	Compositae										16,17	
Solidago radula		Compositae										17	
Solidago rigida	Stiff Golden-Rod	Compositae							2		2	21 11,12	
Solidago serotina		Compositae										17	
Solidago speciosa, var. rigidiuscula	Slender Showy Golden-Rod	Compositae										16	
Solidago tortifolia	Twisted-leaf Golden-Rod	Compositae										16	
Solidago ulmifolia		Compositae										17,21	
Sonchus asper	Spiny Sow-Thistle	Cichoriaceae									1	11,21	
Sonchus oleraceus	Annual Sow-Thistle	Cichoriaceae									1	4,28	
Sorghastrum elliotii	Slender Indiangrass	Gramineae										41	
Sorghastrum nutans (avenaceum)	Indiangrass	Gramineae							3			11,24	
Sorghum bicolor	Sorghum	Gramineae										17	

Scientific Name	Common Name	Family	Associations									Ref.	Comments
			1	2	3	4	5	6	7	8	9		
Sorghum halepense	Johnsongrass	Gramineae			3							21,51	
Sorghum sudanese	Sudan Grass	Gramineae										16	
Spartina cynosuroides	Salt Reed-Grass	Gramineae											
Spartina michaxiana	Tall Marsh-Grass	Gramineae											
Spartina pectinatan		Gramineae											
Spergularia lobra	Sand spurry	Caryophyllaceae										16	
Spermacoce glabra	Smooth buttonplant	Rubiaceae											
Spermolepis divaricata	Forked scaleseed	Umbelliferae											
Spermolepis echinata	Bristly-fruited spermolepis	Ammiaceae											
Spermolepis inermis	Scaleweed	Umbelliferae											
Sphaeralcea coccinea	Scarlet globe mallow	Malaraceae											
Sohenopholis intermedia	Slender wedgescale	Gramineae											
Sphenopholis obtusata	Prairie wedgescale	Gramineae											
Sphenopholis pallens	Tall Eaton's Grass	Gramineae											
Spiranthes cernua	Nodding lady's tresses	Orchidaceae											
Spiranthes gracilis	Slender lady's tresses											16,17	
Spiranthes grayi	Little lady's tresses	Orchidaceae											
Spiranthes lacera	Lady's tresses	Orchidaceae											
Spiranthes vernalis	Upland lady's tresses	Orchidaceae										17,20	
Sporobolus giroides	Hair-Grass Dropseed	Gramineae			x							16,34	
Sporobolus argutus		Gramineae										17	
Sporobolus asper	Tall dropseed, Long-Leaved Rush-Grass	Gramineae			x				3		1	1 11,34	
Sporobolus cryptandrus	Sand dropseed	Gramineae			x						2	11,34	
Sporobolus drummondii	Drummond's Rush-Grass	Gramineae										16	
Sporobolus vaginiflorus	Sheathed Rush-Grass	Gramineae										16	
Sporobolus virginicus	Sea-Shore Rush-Grass	Gramineae										16	
Stachys palustris, var. pilosa		Labiatae										8,28	
Stachys tenuifolia	Slenderleaf betony	Labiatae										17	

Scientific Name	Common Name	Family	Associations									Ref.	Comments
			1	2	3	4	5	6	7	8	9		
Staphylea trifolia	Bladdernut	Staphyleaceae				x	3		x			3,19	
Stellaria media	Chickweed starwort	Caryophyllaceae									1	11,12	
Stenosiphon linifolius		Onagraceae										27	
Stillingia salicifolia	Willow-Leaved Stillingia	Euphorbiaceae										16	
Stillingia sylvatica	Queen's Delight	Euphorbiaceae			x							27 14,34	
Streptanthus hyacinthoides		Cruciferae			x							27,34	
Streptanthus platycarpus	Mottled Mustard	Cruciferae										16	
Strophostyles helvola	Trailing wildbean	Leguminosae			x							21,34	
Strophostyles pauciflora		Leguminosae							3			17,18	
Stylosanthes biflora	Sidebeak pencilflower	Leguminosae									1	11,12	
Styrax americana		Styracaceae		3								19,25	
Suaeda linearis		Chenopodiaceae										27	
Symphoricarpos orbiculatus	Coral-berry, buckbrush	Caprifoliaceae		x	3	x	3	x	x			24,36 3,12	
Symphoricarpos symphoricarpos	Coral-berry	Caprifoliaceae										16	
Symplocos tinctoria	Horse sugar, sweetleaf	Symplocaceae		x								15,19	
Taenidia integerrima	Yellow pimpernel	Umbelliferae										17	Western limit in Muskogee
Talinum calycinum	Large Flowered Talinum	Portulacaceae										16	
Talinum parviflorum	Prairie fameflower	Portulacaceae										17	
Talinum teretifolium	Quill fameflower	Portulacaceae										17	
Tamarix gallica	Salt cedar	Tamaricaceae			3		x		x			34,35	Western limit in Muskogee
Taraxacum officinale	Redseed dandelion	Compositae										16,27	
Taxodium distichum	Bald cypress	Pinaceae		3	x							3,34	Largest tree in Oklahoma, near Mt. Fork River, Broken Bow.
Tephrosia onobrychoides	Multibloom tephrosia	Leguminosae										17	Western limit in Muskogee
Tephrosia virginiana	Wild sweetpea	Leguminosae							3			11 14,21	
Teucrium canadense	Virginia germander	Labiatae			x							17,34	
Thalictrum dasycarpum	Purplish Meadow-rue	Ranunculaceae										14,16	
Thelesperma fillifolium	Greenthread	Compositae										21	
Thelesperma trifidum	Fine-leaved Tetraneuris	Compositae			x				x			23,27	

						Associations							
Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
Thlaspi arvanse	Field Penny-cress	Cruiferae										16	
Tilia americana	Basswood	Tiliaceae				3						3	
Tilia floridana	Florida basswood	Tiliaceae				3						19,15	
Tomanthera auriculata	Earleaf	Scrophulariaceae										17	Very rare
Tomanthera densiflora	Fineleaf											27	
Torilis anthriscus	Upright hedgeparsley	Umbelliferae										17	
Torilis japonica	Hedge parsley	Umbelliferae			x							21,34	
Trachelospermum difforme	American starjasmine	Apocynaceae										19	
Tradescantia ernestiana		Commelinaceae										17	
Tradescantia occidentalis	Western Spiderwort	Commelinaceae							x			16,23	
Tradescantia ohiaensis	Reflexed Spiderwort	Commelinaceae										16	
Tradescantia virginiana	Spiderwort	Commelinaceae										16	
Tragia nepetoefolia	Catnip noseburn	Euphorbiaceae										11,17	
Tragia ramosa	Branching Tragia	Euphorbiaceae										16,17	
Tragia urticifolia	Nettleleaf noseburn	Euphorbiaceae							3			1, 21	
Tragopogon dubius	Goat's beard	Compositae										27	
Tragopogon porrifolius	Oyster Plant	Compositae										16	
Trepocarpus aethusae		Umbelliferae			x							17	
Tribulus terrestris	Puncture vine	Zygophyllaceae			x							21,34	
Trichostema brachiatum	Fluxweed	Labiatae										17	
Trichastema dichotomum	Forked blue curls	Labiatae									1	43	
Tridens flavus	Tall Red-top	Gramineae							3			1,11	
Tridens strictus	Narrow-Three-Toothed Grass	Gramineae							3			1,16	
Trifalium dubium	Least Hop-clover	Leguminosae										16	
Trifolium pratense	Red clover	Leguminosae										17	
Trifalium procumbens	Bighop clover	Leguminosae										17	
Trifalium repens	White clover	Leguminosae										17	
Triodanis biflora	Small Venus looking glass	Campanulaceae			x							12,34	

Scientific Name	Common Name	Family	1	2	3	4	5	6	7	8	9	Ref.	Comments
Triodanis leptocarpa	Slimpod Venus looking glass	Campanulaceae			x		3					34,36	
Triodanis perfoliata	Clasping Venus looking glass	Campanulaceae									1	11,12	
Triodia elanyata		Gramineae										17	
Triodia flava		Gramineae									2	12,17	
Triodia stricta		Gramineae										17	
Triosteum perfoliatum	Feverwort, horse gentian	Caprifoliaceae										17	
Tripsacum dactyloides	Eastern gamagrass	Gramineae							3			23,31	
Triticum aestivum	Wheat	Gramineae										17	
Typha angustifolia	Narrow-leaved Cat-tail	Typhaceae										16,17	
Typha domingensis	Tule	Typhaceae										22,34	
Typha latifolia	Common Cat-tail	Typhaceae										22,34	Aquatic
Ulmus alata	Winged elm	Ulmaceae			x	x	3					36,37 3,35	
Ulmus americana	American elm	Ulmaceae		x	3	x	3					36,37 34,35	
Ulmus crassifolia	Cedar elm	Ulmaceae		x			x					17,25	
Ulmus rubra	Red elm, slippery elm	Ulmaceae			x	x	x					14,19	
Ulmus serotina	September elm	Ulmaceae					x					15,25	
Urtica chamaedryoides	Heartleaf nettle	Urticaceae										17,21	
Urtica dioica	Stinging nettle	Urticaceae										16	
Utricularia gibba	Bladderwort	Lentibulariaceae										34	Aquatic
Uvularia sessilifolia	Little merrybells	Liliaceae										6	
Vaccinium arboreum	Farkleberry, huckleberry	Ericaceae				x	x					19 24,40	
Vaccinium melanocarpum	Farkleberry, blueberry, huckleberry	Ericaceae				x			x			19,25	
Vaccinium neglectum	Southern deerberry	Ericaceae		x								19,25	
Vaccinium stamineum	Huckleberry	Ericaceae					x					19,25	
Vaccinium vacillans	Blueberry, huckleberry	Ericaceae				x	x					3,15	
Vaccinium virgatum	Rabbiteye blueberry	Ericaceae				x						19	
Valerianella amarella	Hairyseed cornsalad	Valerianaceae										21,27	
Valerianella longiflora	Tubeflower cornsalad	Valerianaceae										17	

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Valerianella nuttallii	Nuttall cornsalad	Valerianaceae										17	
Valerianella radiata	Beaked cornsalad	Valerianaceae										17,21	
Valerianella stenocarpa	Narrowcell cornsalad	Valerianaceae					3					17,36	
Valerianella stenocarpa, var. *parviflora*	Narrowcell cornsalad	Valerianaceae										27	
Verbascum blattaria	Moth mullein	Scrophulariaceae										17	
Verbascum thapsus	Flannel mullein	Scrophulariaceae										17	
Verbena angustifolia	Ragweed verbena	Verbenaceae										17	
Verbena bipinnatifida	Small-flowered verbena	Verbenaceae			x				x			16,34 21,23	
Verbena bracteata	Bigbract verbena	Verbenaceae			x							27,34	
Verbena canadensis	Rose verbena	Verbenaceae										17,21	
Verbena hastata	Blue verbena	Verbenaceae										17	
Verbena pumila	Pink verbena	Verbenaceae										17	
Verbena simplex	Rose verbena, verbena	Verbinaceae										21	
Verbena stricta	Hoary verrain	Verbenaceae										16,17	
Verbena urticifolia	White verbena	Verbenaceae										17	
Verbesina alba	Jerba de taja	Compositae										16	
Verbesina alternifolia	Yellow wingstem	Compositae										27,55	
Verbesion encelioidea	Cowpen daisy	Compositae									3	27,55	
Verbesina helianthoides		Compositae			3							51	
Verbesina occidentalis	Small yellow crownbeard	Compositae										16	
Verbesina virginica	White crownbeard	Compositae										17,27	
Vernonia altissima	Tall ironweed	Compositae										17	
Vernonia baldwini	Baldwin ironweed	Compositae			x				x		2	11,23	
Vernonia crinita	Bur ironweed	Compositae							3			1,17	
Vernonia fasiculata	Western ironweed	Compositae										16	
Vernonia missurica	Missouri ironweed	Compositae										17	
Vernonia noveboracensis		Compositae										17	
Veronica arvensis		Scrophulariaceae										17	

Scientific Name	Common Name	Family	Associations									Ref.	Comments
			1	2	3	4	5	6	7	8	9		
Veronica peregrina	Purselane speedwell	Scrophulariaceae			x							21,34	
Viburnum dentatum	Arrowood	Caprifoliaceae										15	
Viburnum prunifolium	Blackhaw	Caprifoliaceae										35,37	
Viburnum rufidulum	Rusty blackhaw	Caprifoliaceae		x	x	x	3	x	x			24,36	
Vicia caroliniana	Carolina vetch	Leguminosae										17	
Vicia hirsuta	Tine vetch	Leguminosae										21	
Vicia ludoviciana	Lousiana vetch	Leguminosae										27	
Vicia micrantha		Leguminosae										17	
Vicia minutiflora	Smallflower vetch	Leguminosae										21	
Vicia sparsifolia	Narrow-leaved American vetch	Leguminosae										16	
Vicia villosa	Hairy vetch	Leguminosae										27	
Viola emarginata	Triangleleaf violet	Violaceae										17	
Viola eriocarpa	Smoothish yellow violet	Violaceae										16,17	
Viola kitaibeliana, var. rafinesquii	Lberian violet	Violaceae										21	
Viola lanceolata, var. uittata	Lanceleaf violet	Violaceae			1							28	
Viola lovelliana	Lovell violet	Violaceae										17	
Viola missouriensis	Missouri violot	Violaceae										14,21	
Viola pedatifida	Birdsfoot violet	Violaceae										17	
Viola primulifolia	Primrose violet	Violaceae										27	
Viola rafinesquii	Field pansy	Violaceae					3				1	36 11,12	
Viola sagittata	Arrowleaf violet	Violaceae										40	
Viola sorora	Sister violet	Violaceae										17	
Viola triloba, var. dilatata	Three-lobed violet	Violaceae										16,21	
Vitis aestivalis	Grape	Vitaceae					3					3,17	
Vitis cinerea	Sweet grape	Vitaceae				x			x			17,25	
Vitis cordifolia	Frost grape	Vitaceae					x		x			14,19	
Vitis lincecumii	Pinewoods grape	Vitaceae				x	x					14,21	
Vitis palmata	Missouri grape	Vitaceae										16	

Scientific Name	Common Name	Family	Associations 1	2	3	4	5	6	7	8	9	Ref.	Comments
Vitis riparia	Grape	Vitaceae										27	
Vitis rotundifolia	Wild grape	Vitaceae				x						19,25	
Vitis rupestris	Sand grape	Vitaceae					x		x			16,25	
Vitis vulpina	Riverbank grape	Vitaceae								x		17,21	
Xanthium americanum	American Cocklebur	Compositae										16	
Xanthium commune	Cocklebur	Compositae			3							35	
Xanthium spinosum	Spiny cocklebur	Ambrosiaceae										16	
Xanthium strumorium	Abrojo	Compositae										17,42	
Xanthisma texanum	Texas sleepydaisy	Compositae										17	
Xanthocephalum dracunculoides		Compositae										12,55	
Xyris torta		Xyridaceae										27	
Yucca arkansana	Shrubby Yucca Small soapweed	Liliaceae			x	x						15,25	
Yucca glauca	Bear-grass	Liliaceae				x	x		3			23 14,21	
Yucca louisianensis	Louisiana yucca	Liliaceae					2					17,25	
Zanthoxylum americanum	Common pricklyash	Rutaceae		x	3		x					17,51	
Zanthoxylum clava-herculis	Pepperbark, toothache tree	Rutaceae		x			x					19,25	
Zea Mays	Indian corn	Arumineae										17	
Zephranthes brazosensis (cooperia drummondii)	Cebolleta	Amaryllidaceae										17	
Zigadenus nuttallii	Nuttall deathcamas	Liliaceae										17	
Zizaniopsis miliacea	Water millet, giant cutgrass	Gramineae										17,34	Aquatic
Zizia aurea	Golden alexanders	Umbelliferae										17,21	

Attachment #10

List of Mammals Adapted to the Area of Federal Coal Reserves

Occurrence

C = Common or abundant
O = Scattered individuals or local populations
R = Widely dispersed, few individuals, or possibly none (not known)

Habitat

C = Cave inhabiting
E = Edificarian--uses buildings for nesting, resting, etc.
M = Marshes, wetlands
P = Prairie, grasslands, meadows
R = Riparian, wooded areas, or other thick vegetation associated with rivers or streams
S = Saxicolous, living in and around rocky areas
W = Woodlands, forested areas
U = Ubiquitous, several different habitats

Common Name	Scientific Name	Occurrence	Habitat	Remarks	Biotic Districts (Blair, 1939)
Order marsupialia (marsupials)					
* Opossum	Didelphis marsupialis	C	U	Entire area, especially wooded places	2,5
Order insectivora (shrews and moles)					
** Eastern mole	Scalopus aquatious	C	P,R,W	Anywhere, except in rocky soils; especially in humid forests in soils with detritis	2,5 -,5
** Short-tailed shrew	Blarina brevicauda	C	R,W	Entire study area, especially in floodplain forest habitat	?,(5) -,5
* Desert shrew	Notiosorex crawfordi	R	S	Known from on location only living in and around rocky areas	
* Least shrew	Cryptotis parva	C	P	Entire area, especially in grassland habitats with dense ground cover	?,5
Order chiropquera (Bats)					
* Little brown myotis	Myotis lucifugus	R	E	Known only from capture in buildings. Extreme eastern Oklahoma	
* Mississippi myotis	Myotis austroriparius	R	S	Forages over woodland streams. Extended habitat.	
* Gray myotis	Myotis grisescens	O	C	Northeast part of study area; migrates out of state in winter	
* Keen myotis	Myotis keeni	R	C	Records from caves in eastern part of study area.	
* Indiana myotis	Myotis sodalis	R	C	Extreme eastern part of study area; forages over woodlands	
* Silver-haired bat	Lasionycteris noctivagans	R	W	Records of migrante, only	
* Eastern pipistrelle	Pipistrellus subflavus	C	C,W	Prefers cave habitats near water	2,5
** Big brown bat	Eptesicus fuscus	C	C,E	Entire area; in buildings, as well as caves; may forage over plains, too	2,?
* Red bat	Lasiurus borealis	C	W	In study area where there are trees	2,5
* Hoary bat	Lasiurus cinereus	R	W	Throughout area	? ?

Table 6-1 (Continued)

Common Name	Scientific Name	Occurrence	Habitat	Remarks	Biotic Districts (Blair, 1939)
* Evening bat	*Nycticeius humeralis*	C	W,E	Forested araas in eastern parts of study area; may use buildings for nurseries	2,(5)
* Southern long-eared bat	*Plecotus rafinesquii*	R	E	Edemic to Ouachita Mountains	
* Guano bat; Brazilian free-tailed bat	*Tadarida barsiliensis*	O	E	Accidental in eastern Oklahoma	
Order edentata (Edentates)					
* Nine-banded armadillo	*Dasypus novencinctus*	O,C	P,R,W	Bottomland habitats, especially	-,5
Order Lagomorpha (Rabbits)					
* Black-tailed jackrabbit	*Lepus californicus*	O,C	P	Grassland and prairie habitats, rare in east part of study area	-,5
* Eastern cottontail	*Sylvilagus floridanus*	C	P,R, W	Mixed grass and woods in study area	
* Swamp rabbit	*Sylvilagus aquaticus*	C	R,M	Throughout eastern Oklahoma, along streams in bottomland forests	2,5
Order Rodentia (Rodents)					
* Nutria	*Myocastor coypus*	O	R	Emergent vegetation in rivers and swampy areas	2,5
* Beaver	*Castor canadensis*	O,C	R	In all streams in eastern part study area	??,5
* Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*	C	P	Throughout study area, in grassy areas	-.5
* Eastern gray squirrel	*Sciurus carolinensis*	C	R,W	Eastern Oklahoma flood plain forests	?,5
* Eastern fox squirrel	*Sciurus niger*	C	R,W	Throughout study areas; upland forests and along wooded streams	2,5
* Southern flying squirrel	*Glaucomys volans*	C	R,W	Through area; wooded habitats especially	?,?
Prairie dog	*Cynomys ludovicianus*	O	P	West part of study area, still being poisoned on occasion.	
* Eastern chipmunk	*Tamias striatus*	O,C	W,S	Eastern part of state; distribution uneven	2,(5)
** Plains pocket gopher	*Geomys bursarius*	O,C	P	Grassland areas in deep soils	-,5
Ord's kangaroo rat	*Dipodomys ordii*	C	P	Sandy areas along rivers in western part of study area. There is a local geographic race endemic in Canadian River in Cleveland County	-,(5)
Hispid pocket mouse	*Perognathus hispidus*	O	P	Common in sparse grassland, not in southeastern part of study area	
* Muskrat	*Ondatra zibethicus*	O,C	R	Marsh and stream banks and farm ponds	-,5
* Prairie vole	*Microtus ochrogaster*	R	R	May reach southern part of U.S. range in northern part of study area	-,?
* Pine vole	*Microtus pinetorum*	O,C	W	Forested areas through area	

Table 6-1 (Continued)

Common Name	Scientific Name	Occurrence	Habitat	Remarks	Biotic Districts (Blair, 1939)
Meadow jumping mouse	*Zapus hudsonius*	R	P,W	May reach southern part of U.S. range in northern part of study area	
*Eastern harvest mouse	*Reithrodontomys humilis*	C	P,W	Northeastern part of study area in old fields, marshes, wet meadows	
*Fulvous harvest mouse	*Reithrodontomys fulvescens*	C	P	Dense grassland in study area	2,5
*Plains harvest mouse	*Reithrodontomys montanus*	O,C	P	Absent from southeast part of study area; upland habitat with sparse grassy vegetation	-,5
*Brush mouse	*Peromyscus boylii*	C	S	Rocky areas throughout study area	2,5
*Deer mouse	*Peromyscus maniculatus*	C	P,W	Dry land habitats and meadows; not in extreme southeast of study area	2,5
**White-footed mouse	*Peromyscus leucopus*	C	W,P	Woody, or brushy areas mainly	-,5 2,5
*Cotton mouse	*Peromyscus gossypinus*	O,C	W,R	Wooded areas along streams; also swampy areas in southeast part of study area	2,-
Golden mouse	*Peromyscus nuttalli*		W,R	Forests, edges of cavebrakes, moist thickets.	2,5
*Hispid cotton rat	*Sigmodon hispidus*	C	P,W	Prefers tall grass, sedges; dense ground cover	2,5
*Eastern woodrat	*Neotoma floridana*	O,C	W,S,R	Rocky areas and forests, generally	2,5
*Black rat (roof rat)	*Rattus rattus*	O	E	Near man-made structures where food is stored	
*Norway rat	*Rattus norvegicus*	C	E	Common urban pest	
*House mouse	*Mus musculus*	C	E	Common urban pest	
Order Carnivora (carnivores)					
*Coyote	*Canis latrans*	C	U	Plains and prairie habitats	
*Red wolf	*Canis niger*	R	W	Probably extirpated, but might be found in forested areas (Recent literature - indicates present range exclude Oklahoma)	-,5
*Red fox	*Vulpes fulva*	O,C	P,W	Oak-hickory forests and open areas with scattered timber	?,5
*Gray fox	*Urocyon cinereoargenteus*	C	W	Oak-hickory forests	
*Black bear	*Ursus americanus*	R	W	Occasional in eastern Oklahoma, may represent those released in Arkansas	?,5
*Ringtail cat	*Bassariscus astutus*	R	W,S	Rocky cliffs; known records may be "escapes"	

Table 6-1 (Continued)

Common Name	Scientific Name	Occurrence	Habitat	Remarks	Biotic Districts (Blair, 1939)
Raccoon	Procyon lotor	C	U	Common in area, mostly along streams in forests	2,5
Long-tailed weasel	Mustela frenata	R	W,P,R	Occurring in various habitats, declining in numbers	5
Mink	Mustela vison	C	R	Along streams in area	5
Spotted skunk	Spilogale putorius	O	P,S,W	Adapted to various habitats	2,5
Striped skunk	Mephitis mephitis	C	U	Varied habitats, including dwellings	2,5
Mountain lion	Felis concolor	R	W,S	Forested areas; can adapt to man if given sufficient roon	2,5
Bobcat		O,C	U	Uncommon; in a variety of habitats	2,5
Order Artiodactyla (even-toes ungulants)					
Whitetail deer	Odocoileus virginianus		R,M,W	Forests, swamps and open brushy areas	-,??

* Single species occurs in subject area
** Two species occur in subject area
(5) Occurs only in edge of the district
? Probably occurs in the district
?? Probably occurred in the past but is now extirpated

List of Birds Adapted to the Area of Federal Coal Reserves

Common Name	Scientific Name	County
Order Gaviiformes		
Family Gaviidae		
Common Loon	(Gavia Inmer)	Atoka
Order Pelecaniformes		
Family Phalacrocoracidae		
Double-crested Cormorant	(Phalacrocorax auritus)	LeFlore
Family Anhingidae		
Anhinga	(Anhinga anhinga)	LeFlore
Order Ciconiiformes		
Family Ardeidae		
Great Blue Heron	(Ardea herodias)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Little Blue Heron	(Florida caerulea)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Common Egret	(Casmerodius albus)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Snowy Egret	(Leucophoyx thula)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Yellow-crowned Night Heron	(Nyctanassa Violacea)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Least Bittern	(Ixobrychus exilis)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Family Ciconiidae		
Wood Ibis	(Mycteria americana)	LeFlore
Order Anseriformes		
Family Anatidae		
Whistling Swan	(Olor columbianus)	Pittsburg
White-fronted Goose	(Anser albiforns)	Atoka, Coal, Haskell, Latimer, LeFlore
Snow Goose	(Chen hyperborea)	LeFlore, Pittsburg
Blue Goose	(Chen caerulescens)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Wood Duck	(Aix sponsa)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Redhead	(Aythya americana)	LeFlore
Greater Scaup	(Aythya marila)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Common Goldeneye	(Bucephala clangula)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Ruddy Duck	(Oxyura jamaicensis)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Hooded Merganser	(Lophodytes cucullatus)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Common Merganser	(Mergus merganser)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Red-breasted Merganser	(Mergus serrator)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Order Falconiformes		
Family Accipitridae		
Harlan's Hawik	(Buteo harlani)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Red-shouldered Hawk	(Buteo lineatus)	Atoka
Broad-winged Hawk	(Buteo platypterus)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Ferruginous Hawk	(Buteo regalis)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Golden Eagle	(Aquila chrysaetos)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Marsh Hawk	(Circus hudsonius)	
Family Pandioidae		
Osprey	(Pandion haliaetus)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Family Falconidae		
Peregrine Falcon	(Falco peregrinus)	Latimer, LeFlore
American Kestrel or Sparrow Hawk	(Falco sparverius)	Atoka, Coal, Haskell Latimer, LeFlore, Pittsburg
Order Galliformes		
Family Tetraonidae		
Greater Prairie Chicken	(Tympanuchus cipudo)	Pittsburg
Family Phasianidae		
Bobwhite	(Colinus virginianus)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Family Meleagrididae		
Turkey	(Meleagris gallopavo)	Pittsburg

Common Name	Scientific Name	County
Order Gruiformes		
Family Gruidae		
Whooping Crane	(*Grus americana*)	Atoka, Coal, Pittsburg
Order Ralliformes		
Family Rallidae		
King Rail	(*Rallus elegans*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Virginia Rail	(*Rallus limicola*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Sora Rail	(*Porzana carolina*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Black Rail	(*Laterallus jamaicensis*)	Pittsburg
Purple Gallinule	(*Porphyrula martinica*)	Atoka, Haskell, Latimer
American Coot	(*Fulica americana*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Order Charadriiformes		
Family Charadriidae		
Semipalmated Plover	(*Charadrius semipalmatus*)	Coal, Haskell, Latimer, LeFlore, Pittsburg
Piping Plover	(*Charadrius melodus*)	LeFlore
Killdeer	(*Charadrius vociferus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
American Golden Plover	(*Pluvialis dominica*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Black-bellied Plover	(*Squatarola squatarola*)	LeFlore
Family Scolopacidae		
American Woodcock	(*Philohela minor*)	Atoka, Coal, LeFlore
Common Snipe	(*Capella gallinago*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Whimbrel	(*Numenius phaeopus*)	LeFlore
Upland Plover	(*Bartramia Longicauda*)	Pittsburg
Spotted Sandpiper	(*Actitis macularia*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Solitary Sandpiper	(*Tringa solitaris*)	Atoka, Coal, Haskell, Latimer, LeFlore
Willet	(*Catoptrophorus semipalmatus*)	LeFlore
Greater Yellow legs	(*Totanus melanoleucus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Lesser Yellow legs	(*Totanus flavipes*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Pectoral Sandpiper	(*Erolia melanotos*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Baird's Sandpiper	(*Erolia bairdii*)	Atoka, Haskell, Latimer, LeFlore, Pittsburg
Western Sandpiper	(*Ereunetes mauri*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Hudsonian Godwit	(*Limosa haemastica*)	LeFlore
Family Recurvirostridae		
American Avocet	(*Recurvirostra americana*)	Atoka
Family Phalaropodidae		
Wilson's Phalarope	(*Steganopus tricolor*)	LeFlore
Family Laridae		
Forster's Tern	(*Sterna forsteri*)	Latimer
Least Tern	(*Sterna albifrons*)	Latimer
Caspian Tern	(*Hydroproane caspia*)	Latimer
Family Columbidae		
Mourning Dove	(*Zenaidura macroura*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Order Cucliformes		
Family Cuclidae		
Yellow-billed Cuckoo	(Coccyzus americanus)	LeFlore, Pittsburg
Roadrunner	(*Geococcyx californianus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Order Strigiformes		
Family Stridigae		
Screech Owl	(*Otus asio*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Great Horned Owl	(*Bubo virginianus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Snowy Owl	(*Nyctea scandiaca*)	Pittsburg
Order Caprimulgiformes		
Family Caprimulgidae		
Chuck-will's-widow	(*Caprimulgus carolinensis*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Common Nighthawk	(*Chordeiles minor*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Order Apodiformes		
Family Apodidae		
Chimney Swift	(*Chaetura pelagica*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg

Common Name	Scientific Name	County
Order Coraciiformes		
Family Alcedinidae		
Belted Kingfisher	(*Megaceryle alcyon*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Order Piciformes		
Family Picidae		
Yellow-shafted Flicker	(*Colaptes auratus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Red-shafted Flicker	(*Colaptes cafer*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Pileated Woodpecker	(*Dryocopus pileatus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Red-bellied Woodpecker	(*Centurus carolinus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Red-headed Woodpecker	(*Melanerpes erythrocephalus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Yellow-bellied Sapsucker	(*Sphyrapicus varius*)	Latimer, LeFlore
Hairy Woodpecker	(*Dendrocopos villosus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Downy Woodpecker	(*Dendrocopos pubescens*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Red-cockaded Woodpecker	(*Dendrocopos borealis*)	Latimer, LeFlore, Pittsburg
Order Passeriformes		
Family Tyrannidae		
Eastern Kingbird	(*Tryannus tryannus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Western Kingbird	(*Tryannus verticalis*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Scissor-tailed Flycatcher	(*Muscivora forficata*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Great Crested Flycatcher	(*Myiarchus crinitus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Eastern Phoebe	(*Sayornis phoebe*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Acadian Flycatcher	(*Empidonax virescens*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Traills' Flycatcher	(*Empidonax traillii*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Least Flycatcher	(*Empidonax minimus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Eastern Wood Pewee	(*Contropus virens*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Family Alaudidae		
Horned Lark	(*Eremophila alpestris*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Family Hirundinidae		
Tree Swallow	(*Tachycineta bicolor*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Bank Swallow	(*Riparia riparia*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Rough-winged Swallow	(*Stelgidopteryx ruficollis*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Barn Swallow	(*Hirundo rustica*)	Atoka, Coal, Haskell, Latimer. LeFlore, Pittsburg
Cliff Swallow	(*Petrochelidon pyrrhonota*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Purple Martin	(*Progne subis*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Family Corvidae		
Blue Jay	(*Cyanocitta cristata*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Common Crow	(*Corvus brachyrhyrchos*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Carolina Chickadee	(*Parus carolinensis*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Tufted Titmouse	(*Parus bicolor*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Family Sittadae		
White-breasted Nuthatch	(*Sitta carolinesis*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Red-breasted Nuthatch	(*Sitta canadensis*)	Latimer, LeFlore
Family Certhiidae		
Brown Creeper	(*Certhia familaris*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Family Troglodytidae		
House Wren	(*Troglodytes aedon*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg

Common Name	Scientific Name	County
Winter Wren	(*Troglodytes troglodytes*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Bewick's Wren	(*Thryomanes bewickii*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Carolina Wren	(*Thryothorus ludovicianus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Long-billed Marsh Wren	(*Telmatodytes palustris*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Short-billed Marsh Wren	(*Cistothrous platensis*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Family Mimidae		
Mockingbird	(*Mimus polyglottis*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Catbird	(*Dumetella carolinensis*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Brown Thrasher	(*Toxostoma rufum*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Family Turdidae		
Robin	(*Turdus migratoruis*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Wood Thrush	(*Hylocichla mustelina*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Hermit Thrush	(*Catharus guttatus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Swainson's Thrush	(*Catharus ustulatus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Gray-cheeked Thrush	(*Catharus minimus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Veery	(*Catharus fuscescens*)	Latimer, Pittsburg
Eastern Bluebird	(*Sialia sialis*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Family Sylviidae		
Blue-gray Gnatcatcher	(*Polioptila caerulea*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Golden-crowned Kinglet	(*Regulus satrapa*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Ruby-crowned Kinglet	(*Regulus calendula*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Family Motacillidae		
Water Pipit	(*Anthus spinoletta*)	Atoka, Coal, Haskell, Latimer. LeFlore, Pittsburg
Sprague's Pipit	(*Anthus spragueii*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Family Bombycillidae		
Bohemian Waxwing	(*Bombycilla garrulus*)	Pittsburg
Cedar Waxwing	(*Bombycilla cedroroum*)	Atoka, Coal, Haskell, LeFlore, Pittsburg
Family Laniidae		
Loggerhead Shrike	(*Lanius ludovicianus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Family Sturnidae		
Starling	(*Sturnus vulgaris*)	LeFlore
Family Vireonidae		
White-eyed Vireo	(*Vireo griseus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Yellow-throated Vireo	(*Vireo flavifrons*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Solitary Vireo	(*Vireo solitarius*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Red-eyed Vireo	(*Vireo olivaceus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Philadeophia Vireo	(*Vireo philadelphicus*)	LeFlore
Warbling Vireo	(*Vireo gilvus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Family Parulidae		
Black-and-White Warbler	(*Mniotilta varia*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Prothonotary Warbler	(*Protonotaria citrea*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Tennessee Warbler	(*Vermivora peregrina*)	Atoka, Coal, Pittsburg
Orange-crowned Warbler	(*Vermivora celata*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Parula Warbler	(*Parula americana*)	LeFlore
Yellow Warbler	(*Dendroica petechia*)	Atoka
Magnolia Warbler	(*Dendroica magnolia*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Myrtle Warbler	(*Dendroica coronata*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg

Common Name	Scientific Name	County
Black-throated Green Warbler	(Dendroica virens)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Cerulean Warbler	(Dendroica cerulea)	Atoka, Haskell, Latimer, LeFlore, Pittsburg
Blackburnian Warbler	(Dendroica fusca)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Yellow-throated Warbler	(Dendroica dominica)	Latimer, LeFlore
Chestnut-sided Warbler	(Dendorica pensylvanica)	Latimer
Blackpoll Warbler	(Dendroica striata)	Haskell
Pine Warbler	(Dendroica pinus)	Latimer, LeFlore, Pittsburg
Prairie Warbler	(Dendroica discolor)	Atoka, Coal, Haskell, LeFlore, Pittsburg
Oven bird	(Seiurus aurocapillus)	LeFlore
Northern Waterthrush	(Seiurus noveboracensis)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Louisiana Waterthrush	(Seiurus motacilla)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Kentucky Warbler	(Oporornis formosus)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Mourning Warbler	(Oporornis philadelphia)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Yellow-breasted Chat	(Icteria virens)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Hooded Warbler	(Wilsonia citrina)	Atoka, Latimer
Wilson's Warbler	(Wilsonia pusilla)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
American Redstart	(Setophaga ruticilla)	LeFlore
Family Ploceidae		
English Sparrow	(Passer domesticus)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Family Icteridae		
Bobolink	(Dolichonyx oryzivorus)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Eastern Meadow lark	(Sturnella magna)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Western Meadowlark	(Sturnella neglecta)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Red-winged Blackbird	(Agelaius phoeniceus)	LeFlore
Orchard Oriole	(Icterus spurius)	Latimer
Baltimore Oriole	(Icterus galbula)	Latimer
Boat-tailed Grackle	(Cassidix mexicanus)	LeFlore
Brown-headed Cowbird	(Molathrusater)	LeFlore, Pittsburg
Family Thraupidae		
Scarlet Tanager	(Piranga olivacea)	Coal, LeFlore
Summer Tanager	(Piranga rubra)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Family Fringillidae		
Cardinal	(Pyrrhuloxia cardinalis)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Rose-breasted Grosbeak	(Pheucticus ludovicianus)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Blue Grosbeak	(Guiraca caerulea)	Coal
Indigo Bunting	(Passerina cyanea)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Lazuli Bunting	(Passerina amoena)	Coal, Pittsburg
Dickcissel	(Spiza americana)	Coal
Purple Finch	(Carpodacus purpureus)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
American Goldfinch	(Spinus tristis)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Red Crossbill	(Loxia curvirostra)	Latimer
Eastern Towhee	(Pipilo erythrophthalmus)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Spotted Towhee	(Pipilo maculatus)	Latimer
LeConte's Sparrow	(Passerherbulus caudacutus)	Atoka, Coal, Latimer
Sharp-tailed Sparrow	(Ammospiza caudacuta)	LeFlore, Pittsburg
Vesper Sparrow	(Pooecetes gramineus)	Atoka, Coal, LeFlore, Pittsburg,
Lark Sparrow	(Chondestes grammacus)	Atoka, LeFlore
Rufous-crowned Sparrow	(Aimophila ruficeps)	Atoka, Latimer
Slate-colored Junco	(Junco hyemalis)	Atoka, Coal, LeFlore, Pittsburg
Chipping Sparrow	(Spizella passerina)	Atoka, Coal, Latimer, LeFlore, Pittsburg
Clay-colored Sparrow	(Spizella pallida)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg

Common Name	Scientific Name	County
Field Sparrow	(*Spizella breweri*)	Atoka, Coal, Latimer, LeFlore
White-throated Sparrow	(*Zonotrichia albicollis*)	Atoka, Latimer, LeFlore, Pittsburg
Fox Sparrow	(*Passerella iliaca*)	Atoka, Coal, Latimer, LeFlore, Pittsburg
Lincoln's Sparrow	(*Melospiza lincolnii*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Swamp Sparrow	(*Melospiza georgiana*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
McCown's Lngspur	(*Rhynchophanes mccownii*)	Atoka, Coal, Pittsburg
Lapland Longspur	(*Calcarius lapponicus*)	Atoka, Pittsburg
Smith's Longspur	(*Calcarius pictus*)	Atoka, Coal, Haskell, Latimer, LeFlore, Pittsburg
Chestnut-collared Longspur	(*Calcarius ornatus*)	Coal, Pittsburg

Attachment #12

A List of Fishes Adapted to the Area of Federal Coal Reserves
(Adapted from M.E.C.A., 1972, and Miller and Robison, 1973)

Occurrence
C = Common: Abundant throughout the area, occurring at many localities
O = Occassional: Not widespread throughout the area, occurring in selective localities in small numbers
R = Rare: Highly localized, restricted to specific habitats
E = Endangered: Threatened by extinction
X = Literature on distribution indicates existence in report area

Habitat
M = Mainstream
L = Lake or impoundment
T = Tributary

			Biotic Province		
Common Name	Scientific Name	Habitat	Ouachita	Osage	Remarks
Lampreys					
Chestnut lamprey	Ichthyomyzon castaneus	M	R		Poteau R.; Eastern 1/3 Okla.
Southern brook lamprey	Ichthyomyzon gagei	M	R	R	Clear streams; Eastern Okla.
Sturgeon					
Shovelnose sturgeon	Scaphirhynchus paltorynchus	M,L		X	Arkansas & Red River Tribs.
Paddlefish	Polyodon Spatula	M,L			Arkansas & Red River Trib.
Gars					
Spotted gar	Lepisosteus oculatus	M,L		O	Eastern Oklahoma
Longnose gar	Lepisosteus osseus	M,L	O	C	Scattered localities
Shortnose gar	Lepisosteus platostomus	M,L			Eastern ½ Oklahoma
Alligator gar	Leoisosteus spatula	M,L	R		Poteau River
Bowfin	Amia calva	M,L			Southeastern Oklahoma
Eel					
American eel	Anguilla rostrata	M,T	R	R	Eastern ½ Oklahoma
Shad					
Gizzard shad	Dorosoma cepidianum	M,L	C	C	Throughout Oklahoma
Alabama shad	Alosa alabamae	M,L		(R) X	Poteau R. (records few)
Skipjack herring	Alosa chrysochloris	M,L	R	X	Clear streams and rivers in Eastern Oklahoma
Mooneyes					
Goldeye	Hiodon alosoides	M,L	R	X	Arkansas R. & Red R. trib.
Pickerels					
Grass pickerel	Esox americanus	M,L		R	Poteau River Sys.
Pikes					
Northern pike	Esox lucius	reserviors			Introduced
Minnows					
Stoneroller	Campostoma anomalum	T	C	O	Statewide
Goldfish	Carrassius auratus	L		R	Limited locations
Carp	Cyprinus carpio	M,L,T	O	C	Statewide
Plains minnow	Hybognathus placitus	M,T	R	O	Statewide
Silvery minnow	Hybognathus nuchalis	M,T		X	Red River and Tributaries

			Biotic Province		
Common Name	Scientific Name	Habitat	Ouachita	Osage	Remarks
Speckled chub	*Hybopis aestivalis*	M,T,		X	Statewide
Silver chub	*Hybopsis storeriana*	M		0	Eastern 3/4 Oklahoma
Hornyhead chub	*Nocomis biguttatus*	T	0		
Golden shiner	*Notemigonus crysoleucas*	L,T	0	0	Eastern 2/3
Pallid shiner	*Notropis anmis*	T,M	X	0	Poteau R. & Red River Sys. west to clear Boggy River
Emerald shiner	*Notropis atherinoides*	M	0	0	Statewide (one or both forms)
Red River shiner	*Notropis bairdi*	M,T		X	Red River & tributaries
River shiner	*Notropis blennius*	M	0	0	Arkansas & Red River Basins
Bigeye shiner	*Notropis boops*	T	C	R	Eastern ½ Okla. - Arkansas And Red River sys.
Ghost shiner	*Notropis buchanani*	M	0	X	Eastern ½ or 2/3 Oklahoma
Striped shiner	*Notropis chrysocephalus*	T	C		
Common shiner	*Notropis cornutus*	T		X	Red River and tributaries
Pugnose minnow	*Notropis emiliae*	T	0		Southeastern Oklahoma
Ribbon shiner	*Notropis fumeus*	T	0	X	Poteau River, Red River tributaries
Red shiner	*Notropis lutrensis*	M,T,L	R	C	Statewide
Kiamichi shiner	*Notropis ortenburgeri*	T	C	X	Arkansas and Poteau River
Chub shiner	*Notropis potteri*	M,T		X	Red River and tributaries
Rosyface shiner	*Notropis rubellus*	T	C	X	Eastern - Arkansas & Red R.
Silverband shiner	*Notropis shumardi*	M	0	0	Arkansas, Poteau & Red Rivers
Sand shiner	*Notropis stramineus*	T		X	Plains tributaries - Arkansas and Red Rivers
Redfin shiner	*Notropis umbratilis*	T	0	0	Eastern 1/3 Oklahoma
Mimic shiner	*Notropis volucellus*	M,T	0	R	Arkansas - Eastern 1/3 Okla.
Steelcolor shiner	*Notropis whipplei*	T	0	R	Southeastern 1/5 Oklahoma
Suckermouth minnow	*Phenocobius mirabilis*	T	0	0	Statewide
Blacktail shiner	*Notropis venustus*				Red River basin
Bluntnose minnow	*Pimephales notatus*	T,M	0	C	Eastern ½ Oklahoma
Bullhead minnow	*Pimephales vigilax*	M,T	0	0	Statewide
Suckers					
River carpsucker	*Carpiodes carpio*	M,L,T	0	C	Statewide
Highfin carpsucker	*Carpiodes velifer*	M,L		R	Clear tributaries
Creek chubsucker	*Erimyzon oblongus*	T,L	0	R	Arkansas River sys.
Spotted sucker	*Minytrema melanops*	T,L	0	0	Eastern ½ Oklahoma
River Redhorse	*Moxostoma carinatum*	T	0	X	Eastern Okla. - Poteau River
Black Redhorse	*Moxostoma duquesnei*	T	C	R	Clear tributaries - Arkansas and Red Rivers
Golden Redhorse	*Moxostoma erythrurum*	T	C	X	Eastern & Southern Oklahoma
Smallmouth buffalo	*Ictiobus bubalus*	M,L	0	C	Eastern ½ Oklahoma
Bigmouth buffalo	*Ictiobus cyprenellus*	M,L	0	C	Eastern ½ Oklahoma
Black buffalo	*Ictiobus niger*	M,L		0	Eastern and Central Okla.
Catfishes					
Blue catfish	*Ictalurus furcatus*	M,L	0	0	Red River and Arkansas River (lower trib.)
Black bullhead	*Ictalurus melas*	M,L,T	0	C	Statewide
Yellow bullhead	*Ictalurus natalis*	T,L	0	0	Statewide
Channel catfish	*Ictalurus punctatus*	M,L	0	C	Statewide
Tadpole Madtom	*Noturus gyrinus*	T	R	X	Lakes & Poteau & Red R. Sys.
Freckled madtom	*Noturus nocturnus*	T	0	R	Arkansas & Red River Sys.
Flathead catfish	*Pylodictus olivaris*	M,L	C	C	Larger streams and lakes
Topminnows					
Blackstripe topminnow	*Fundulus notatus*	T	0	0	Eastern ½ Oklahoma
Starhead topminnow	*Fundulus notti*	T	R	X	Poteau River
Black spotted topminnow	*Fundulus olivaceus*	T,L	0	0	Eastern 1/3 Oklahoma
Livebearers					
Mosquitofish	*Gambusia affinis*	T,M,L	C	C	Scattered - Introduced
Silversides					
Brook silverside	*Labidesthes sicculus*	M,T,L	0	R	Eastern Oklahoma common

			Biotic Province		
Common Name	Scientific Name	Habitat	Ouachita	Osage	Remarks
Sunfishes					
Green sunfish	Lepomis cyanellus	T,L	C	C	Statwide
Warmouth	Lepomis gulosus	T,L	0	0	Eastern Oklahoma
Orangespotted sunfish	Lepomis humilis	T,L	0	0	Statewide
Bluegill sunfish	Lepomis macrochirus	T,L	0	C	Statewide - ponds, lakes
Longear sunfish	Lepomis magalotis	T,L	C	C	Statewide
Redear sunfish	Lepomis microlophus		X	X	Irregular distribution
Banded pigmy sunfish	Elassoma zonatum	T		X	Red River tributaries
Smallmouth bass	Micropterus dolomieui	T	C	X	Eastern uplands
Spotted bass	Micropterus punctulatus	T,L	C	0	Eastern ½ Oklahoma
White bass	Morone chrysops	M,L		X	Rivers, lakes - Eastern ½ Okla
Largemouth bass	Micropterus salmoides	M,L,T	C	C	Statewide - ponds and lakes
White crappie	Pomoxis annularis	T,L,M	0	0	Statewide
Black crappie	Pomoxis nigromaculatus	T,L	0	0	Eastern Okla - clear waters
Perches					
Scaly sand darter	Ammocrypta vivax	T,M	X	X	Poteau River Sys.
Greenside darter	Etheostoma blennoides	T	0	X	Poteau River Sys.
Bluntnose darter	Etheostoma chlorosomum	T,L	0	0	Arkansas R. Eastern 1/3 Okla.
Slough darter	Etheostoma gracile	T,L	X	0	Eastern 1/3 Oklahoma
Harlequin darter	Etheostoma histrio	T	R	X	Poteau River Sys.
Cypress darter	Etheostoma proelaire	T,L	X	X	Poteau, Red River
Orangethroat darter	Etheostoma spectabile	T	C	0	Hilly regions - Arkansas and Red Rivers.
Redfin darter	Etheostoma whipplei	T	0	0	Arkansas River sys.
Banded darter	Etheostoma zonale	T	0	X	Eastern Okla - Arkansas River
Yellow perch	Perca flavescens	L,M		R	Introduced into lakes
Log perch	Percina caprodes	T,L	C	0	Eastern ½ Oklahoma
Channel darter	Percina copelandi	T	0	X	Eastern ½ Okla - Arkansas R.
Blackside darter	Percina maculata	T	R	X	Poteau R. & Red R. tributaries
Western sand darter	Ammocrypta clara	M,T		X	Red River sys.
Orangebelly darter	Ertheostoma radiosum	T		X	Red River tributaries
Longnose darter	Percina nasuta	T	R	X	Arkansas & Poteau River sys.
Leopard darter	Percina pantherina	T	E		Not known in report area
Slenderhead darter	Percina phoxocephala	T			Arkansas & Red River sys.
Least darter	Etheostoma microperca	M,L	X	X	Arkansas & Red River sys.
Johnny darter	Etheostoma nigrum	T	X	X	Widespread
Dusky darter	Percina sciera	T	0	X	Southeastern 1/3 Oklahoma
Sauger	Stizostedon canadese	M	X	X	Poteau River sys.
Drum					
Freshwater drum	Aplodinotus grunniens	M,L	0	C	Throughout most of Oklahoma
Mullets					
Striped mullet	Mugil cephalus	M		X	Red River below dam

Attachment #13

List of Reptiles and Amphibians Adapted to the
Area of Federal Coal Reserves
(Adapted from M.E.C.A., 1972)

Scientific Name	Common Name	Habitat	Comment
ORDER TESTUDINES-TURTLES			
Chelydra serpentina	Common Snapping Turtle	*A	Statewide; large rivers, impoundments small pasture, ponds, narrow head water streams; any kind of relatively, clear or turbid, aquatic habitat.
Deirochelys reticularia miaria	Western Chicken Turtle	A	Southeastern Oklahoma; N.W. extent in Oak-woodland type① found in small shallow wood stream and ponds.
Graptemys kohni	Mississippi Map Turtle	A	Eastern Oklahoma; Arkansas River② drainage, confined to interior highlands.
Graptemys pseudogeographica ouachitensis	Ouachita Map Turtle	A	Eastern Oklahoma; Tributaries of Arkansas Rivers, rivers, streams, impoundments; extends west into oak woodland.
Kinosternon flavescens flavescens	Yellow Mud Turtle	**T	Western Oklahoma; (may exist in western portion of report area). Inhabit the oak-woodland; abundant in grassland in temporary waters.
Kinosternon subrubrum hippocrepis	Mississippi Mud Turtle	A	Eastern Oklahoma; Found in Interior highlands, oak-woodland, large impoundments, ponds, small creek and streams.
Macroclemys temmincki	Alligator Snapping Turtle	A	Eastern Oklahoma; Found mostly in permanent waters, impoundments, creeks, lakes, rivers.
Pseudemys floridana hoyi	Missouri Slider	A	Eastern Oklahoma; rivers and lakes, shallow-water mud flats.
Pseudemys scripta elegans	Red-eared Turtle	A	Throughout state permanent-lakes, ponds, rivers, streams, temporary water - small shallow ponds.
Sternotherus odoratus	Stinkpot	A	Eastern half Oklahoma west to Osage and Murray Co., rivers, streams, ponds in Interior highlands, Oak-woodland.
Terrapene carolina triunguis	Three Toed Box Turtle	T	Eastern Oklahoma; west to Alfalfa, Canadian, and Carter Co., Interior highlands, oak woodlands, partial to wooded hillsides where forest cover has been removed.
Terrapene ornata ornata	Ornate Box Turtle	T	Throughout state except extreme east. Abundant in grasslands and open woodlands. Also found in shallow water, prairie ponds. Removal of forest cover favors this species.
Trionyx muticus muticus	Midland Smooth Softshell Turtle	A	Throughout state perm.-rivers, streams, impoundments.
Trionyx spiniferus hartwegi	Spiny Softshell Western Turtle	A	Distribution is over the northern 2/3 of the state. In the Arkansas River drainage. Permanent lakes, rivers - either clear or turbed waters. Soft substrates of mud and sand preferred. Also found in gravel bottoms.
ORDER SQUAMATA Sub-Order Sauria-Lizards			
Anolis carolinensis carolinensis	Carolina Anole	T	Distribed in eastern McCurtain Co., southern Choctaw Co., and Leflore, Pushmataha Co. Flood plain habitats, along rivers, streams, found in wooded ravines

Scientific Name	Common Name	Habitat	Comment
*Cnemidophorus gularis gularis	Spotted Whiptail Lizard	T	Eastern extent limited by interior highlands. Flat and hilly areas of the grassland and oak-woodland; hard packed soils with small rocks and low sparse cover.
Cnemidophorus sexlineatus viridis	Prairie Lined Racerunner	T	Throughout state many different kinds of habitat - from shrubby hillsides in east to short grass in west. Floodplains of rivers and creeks, and among sedges, willows, weeds, grass clumps and brush.
Crotaphytus collaris collaris	Eastern Collared Lizard	T	Throughout state mostly in rocky habitats, bouldered slopes, rock out crops near creeks and streams.
*Eumeces anthracinus pluvialis	Southern Coal Skink	T	Eastern Oklahoma; found in interior highlands and sparingly in Oak-woodland. Under debris, rocks, and along rivers and streams.
Eumeces fasciatus	Five-lined Skink	T	Eastern half of state; mostly, woodland hillsides and in lowlands among debris, rocks.
*Eumeces laticeps	Broad-headed Skink	T	Extreme eastern part of Oklahoma; arboreal in forested and savanna regions.
Eumeces obsoletus	Great Plains Skink	T	May occur eastward to western most part of the report area. Wooded grassy hillsides - under flat rocks, among limestone outcroppings.
Eumeces septentrionalis obtusirostris	Southern Prairie Skink	T	From oak-woodland under logs, sandy places, in open, under litter.
Lygosoma laterale	Ground Skink	T	Eastern Oklahoma; abundant in Oak-Woodland and interior highlands; under debris, rocks, where veg. in close to ground.
Ophisaurus attenuatus attenuatus	Western Slender Glass Lizard	T	Eastern Oklahoma. Burrows in loose soil in grassy, brushy areas found under debris.
*Phrynosoma cornutum	Texas Horned Lizard	T	LeFlore, Latimer, less abundant in east. Oklahoma commonly found in open, sandy or loose soil areas where they can burrow.
Sceloporus undulatus hyacinthinus	Northern Frence Lizard	T	Eastern Oklahoma; confined mostly to the interior highlands, and intergrading with S.U. gasmani in oak-woodland arboreal.
Sceloparus undulatus garmani	Northern Prairie Lizard	T	Terrestrial - grassy rocky knolls, sandy sparsely vegetative places.
ORDER SQUAMATA Sub-Order Serpentes-Snakes			
Agkistrodon contortrix two subspp. laticinctus mokasen	Copperheads	T	Eastern Oklahoma; most common in rocky, wooded country, mostly gran-herb areas having scattering of logs.
Agkistrodon piscivorous leucostoma	Western Cottonmouth	T	Eastern Oklahoma; mostly interior highlands, range extends west into oak-woodland in lowlands of river floodplains having rocky bluffs.

Scientific Name	Common Name	Habitat	Comment
*Carphophis amoenus vermis	Western Worm Snake	T	Eastern Oklahoma; occur in oak-woodland; most common in interior highlands, burrowing - found under rocks or logs.
Cemophora coccinea copei	Scarlet Snake	T	Eastern Oklahoma; little known; secretive and fossorial; found in interior highlands and in part of Oak-woodland; specimens taken Pittsburg Company near McAlester, and Haywood.
Colubur constrictor flaviventris	Eastern Yellow Bellied Racer	T	Throughout the state many different habitats - often found in trees and near water.
*Crotalus atrox	Western Diamond back	T	Irregular distribution, prefer dissected topography - rocky or mountainous habitats.
Crotalus horridus horridus	Timber Rattlesnake	T	Eastern Oklahoma, very common in north wooded rocky habitats and along rivers and streams.
Diadophis punctatus arnyi	Prairie Ingneck Snake		Throughout the state. Secretive, burrowing - in spring under small limestone rocks-on grassy or wooded hillsides. Less abundant in East.
Elaphe guttata emoryi	Great Plains Rat Snake	T	Throughout the state, but few records available. Little known.
Elaphe obsoleta obsoleta	Black Rat Snake	T	Eastern Oklahoma; wooded or shrubby areas of interior highlands, oak woodland.
Heterodon nasicus nasicus	Plains Hognose Snake	T	Western part of report area. Intergradation of two species in oak-woodland.
Heterodon nasicus gloydi	Dusty Hognose Snake	T	Eastern Oklahoma. Zone intergradation of the two subspecies in Okmulgee Co. Intergradation of two species in oak-woodland.
Heterodon platyrhinos	Eastern Hognose Snake	T	Throughout the state. Vegetated places along floodplains of rivers and streams.
*Hypsiglena ochrorhyncha texana	Texas Night Snake		May be found in western portion of report area.
Lampropeltis calligaster calligaster	Prairie Kingsnake	T	Throughout the state. Most records are in grassland and oak woodland.
Lampropeltis getulus holbrooki	Speckled Kingsnake	T	Throughout the state. Steep rocky hillsides, under rocks, flats in grassy places, logs, flood plain pools. Various habitat.
Lampropeltis triangulum syspila	Red Milk Shake	T	Eastern Oklahoma; this subspecies is uncommon. Mostly interior highlands; under rocks, debris on wooded hillsides.
Masticophis flagellum flagellum	Eastern Coach Whip	T	Eastern Oklahoma.
Natrix erythrogaster transversa	Blotched Water Snake	A	Throughout the state near slough, impoundments and along rivers and streams.

Scientific Name	Common Name	Habitat	Comment
*Natrix fasciata confluens	Broad-banded Water Snake	A	Southeastern Oklahoma; from Atoka, prefer quiet water environments; brush, drift piles of back water sloughs and cut-off pools near rivers.
Natrix rhombifer rhombifera	Diamond-backed Water Snake	A	Throughout the state near permanent bodies of water; grassy banks and debris.
*Natrix spiedon plueralis	Midland Water Snake	A	Found in eastern Oklahoma; uncommon. Near rivers, creeks, ponds, sloughs. Mostly in interior highlands and less abundant in oak-woodlands.
Opheodrys aestivus majalis	Western Rough Green Snake	T	Eastern Oklahoma; extends into grasslands; open, grassy areas and often along streams or river.
Pituophis melanoleucus sayi	Bullsnake	T	Interior highlands serve as a barrier to this snake eastward.
Regina grahami	Graham's Water Snake	A	Throughout report area prefer ponds, sloughs, creeks, headwater streams.
*Regina rigida sinicola	Western Glossy Water Snake	A	Southeastern Oklahoma; only from Latimer, Pittsburg, Rare. Occur in Ouachita hits; in lowland habitats along streams.
*Sistrurus miliarius streckeri	Western Pigmy Rattlesnake	T	Eastern Oklahoma; preference for oak-woodland.
Sonora episcopa episcopa	Great Plains Ground Snake	T	Throughout the state; burrowing; under small rocks on grassy or partly wooded hillsides; most frequently in oak-wooded less so in interior highlands.
Storeria dekayi	Brown Snakes	T	Eastern Oklahoma; wooded and shrubby areas under rocks, and debris.
*Storeria occipitomaculata occipitomaculata	Northern Red-bellied Snake	T	Eastern Oklahoma; Ouachita Highlands. Data very sparse.
Tantila gracilis	Flat-headed Snake	T	Eastern Oklahoma; best adapted to loose soils of interior highlands and oak woodlands; burrowing.
Thamnophis proximus proximus	Western Ribbon Snake	A	Throughout the state; most abundant in east; sloughs, streams, also away from water in grassy areas.
Thamnophis sirtalis parietalis	Red-sided Garter Snake	A	Eastern Oklahoma; expected in most riparian habitats; also found in wooded and shrubby areas away fr. water.
Tropidoclonion lineatum annectens	Central Lined Snake	A	Mostly in oak-woodland in western part of report area. In mesic habitats along rivers and streams.
Virginia striatula	Rough Earth Snake	T	Eastern Oklahoma; interior highlands oak-woodlands burrowing - under logs, rocks.
Virginia valeriae elegans	Western Earth Snake	T	Eastern Oklahoma; habits same as v. striatula. Uncommon.

*Note: Species marked with * are of special significance and are enumerated in a separate list and mapped on the following page.

Scientific Name	Common Name	Habitat	Comment
ORDER ANURA-TOADS AND FROGS			
Scaphiopus hurteri	Hurter's Spadefoot	T	Eastern Oklahoma; found in woodland and savannah only.
Scaphiopus bombifrons	Plains Spadefoot	T	Found only in grasslands scattered records.
Bufo americanus charlesmithi	Dwarf American Toad	T	Essentially a toad of the eastern half of Oklahoma, and characteristic of the higher, rougher, and wooded areas. It may also live in valleys.
Bufo woodhousei woodhousei	Rocky Mountain Toad	A	Common along the Arkansas River. This is the principal toad of gardens and lawns within its Oklahoma range. Fowler's toad replaces this species in southeast.
Bufo woodhousei fowleri	Fowler's Toad	T	Wooded areas particularly in valleys and low areas. True B.w. fowleri intergrades with B.w. velatus are common in most southeastern Oklahoma counties.
Bufo terrestris americanus (Holbrook)	American toad	T	Eastern half of Oklahoma. Mostly in woodland and savannah; wooded hillsides; farther west valleys also.
Bufo punctatus (Baird and Girard)	Canyon Toad	T	Distribution is questionable. One record near southernmost part of report area in McCurtain County.
Gastrophryne carolinensis	Eastern narrow-mouth toad	T	Eastern Oklahoma; only known in 1950 in Central Latimer. Leflore counties found in grassy valleys and in woodland edges along streams.
Gastrophryne olivacea olivacea	Great Plains narrow-mouth toad	T	Distribution statewide except where replaced by M.c. carolinensis. Intergrades with latter in Latimer County. Abundant dry rocky uplands.
Bufo woodhousei velatus	East Texas Toad	T	Intergrades of B.w. velatus and B.w. fowleri are common in many counties of southeastern Oklahoma.
Bufo cognatus	Great Plains Toad	T	Occurs most abundantly in areas of high prairie above the valleys of streams and rivers. Western part of report area.
Acris crepitans blanchardi	Blanchard's Cricket Frog	A	Statewide in Oklahoma. Frequents shores of streams and ponds. Prefers a gradually sloping muddy bank with scanty vegetation.
Hyla crucifer crucifer	Spring Peeper	T	Abundant in eastern Oklahoma. Occurs in trees along streams.
Hyla versicolor versicolor	Eastern Gray Treefrog	T	Common in the savannahs and wooded areas of southeastern Oklahoma. Most Gray Treefrogs in eastern Oklahoma are probably intergrades of H.v. versicolor and H.v. chrysoscelis.
Hyla versicolor chrysoscelis	Southern Gray Treefrog	T	Occurs in wooded areas of southeastern Oklahoma. Most Gray Treefrogs in eastern Oklahoma are probably intergrades of H.v. versicolor and H.v. chrysoscelis.
Pseudacris triseriata feriarum	Upland Chorus Frog	T	Occupies the southeastern fourth of Oklahoma. Essentially a species of wooded or partly wooded areas. Can be very abundant.

Scientific Name	Common Name	Habitat	Comment
Pseudacris clarki	Spotted Chorus Frog	T	A prairie species most abundant in the mixed grass and short grass prairies. Probably in western portions of report area.
Pseudacris streckeri streckeri	Strecker's Chorus Frog	T	Broadly unrestricted ecologically within Oklahoma. Western and northwestern portion of report area.
Rana catesbeiana	Bullfrog	A	Found throughout Oklahoma near any permanent water.
Rana clamitans clamitans	Bronze Frog	A	Occurs in southeastern Oklahoma, westward to Coal County.
Rana clamitans melanota	Green Frog	A	Northern part of report. Muddy marshy banks of streams and ponds. Rare except in extreme eastern Oklahoma.
Rana pipiens berlandieri	Rio Grande Leopard Frog	A	This is a common frog throughout the state near any water.
Rana palustris palustris	Pickerel Frog	A	This frog is known in valleys with streams from southeastern Oklahoma.
Rana areolata areolata	Southern Crawfish Frog	A	Found in an about crayfish holes and in mountain valleys. South of the Arkansas River and to western edge of report area.
ORDER CAUDATA-SALAMANDERS			
Necturus maculosus louisianensis	Red River Waterdog	A	Found primarily in spring fed streams in spring fed streams in eastern Oklahoma.
Amphiuma means tridactylum	Three-toed Amphiuma	A	Completely aquatic habitat.
Ambystoma texanum	Small-mouthed Salamander	T	Found only in very moist areas under objects, in the eastern half of Oklahoma.
Ambystoma talpoideum	Mole Salamander	T	The colony in southeastern Oklahoma is disjunct and members of this species are rare. These are burrowing salamanders but occasionally found under objects.
Ambystoma opacum	Marbled Salamander	T	Found in a variety of habitats in southeastern Oklahoma. Especially common in low, heavily wooded areas near streams.
Ambystoma maculatum	Spotted Salamander	T	Found under objects in moist areas of eastern Oklahoma.
Ambystoma tigrinum tigrinum	Eastern Tiger Salamander	?	Members of this species are supposed to occur throughout eastern Oklahoma, only a few specimens have been collected south of report area.
Diemictylus viridescens louisianensis	Central Newt	A	Common in ponds, ditches and river bottoms in wooded areas.
Desmognathus fuscus brimleyorus	Central Dusky Salamander	T	Usually found under objects along rocky streams in hilly country of eastern Oklahoma.
Plethodon cinereus serratus	Ouachita Red-backed Salamander	T	Frequently common in the forested mountains of eastern Oklahoma.

Scientific Name	Common Name	Habitat	Comment
Plethodon glutinosus glutinosus	Slimy Salamander	T	Frequently found under objects in moist ravines and quite common in the twilight zones of limestone caves in eastern Oklahoma.
Plethodon ouachitae	Rich Mountain Salamander	T	This salamander has a very restricted distribution on the wooded slopes of Rich Mountain and in the vicinity of the Ouachita Mountains of eastern Oklahoma. Endangered species.
Eurycea longicauda melanopleura	Dark-sided Salamander	T	Common salamander of eastern Oklahoma caves in the twilight zone. Also occasionally found out of caves in moist areas under objects or about springs.
Eurycea multiplicata multiplicata	Many-ribbed Salamander	A	Members of this species can be very abundant along tiny streams running over limestone.
Manculus quadridigitatus	Dwarf Salamander	T	A very rare salamander in eastern Oklahoma and probably found only along the eastern borders of LeFlore County. Endangered Species.
ORDER TRACHYSTOMATA-SIREN			
Siren intermedia nettingi	Western Lesser Siren	A	Found in the bottoms of ditches, ponds, and other bodies of shallow water.

* A - Aquatic

** T - Terrestrial

① Oak-woodland physiographic regions described by Webb (1970) in his book the Reptiles of Oklahoma
② Interior highlands

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LIST OF INVERTEBRATE SPECIES FOR THE AREA OF FEDERAL COAL RESERVES

A List of *Invertebrate* *Species* Adapted to Counties
of the Federal Coal Reserves
(Adapted from M.E.C.A., 1972)

PHYLUM: CLASS

PROTOZOA (FREE-LIVING): MASTIGOPHORA

ORDER OR FAMILY

Anisonema *acinus*
Anthophysa *vegetans*
Astasia *trichophora*
Ceratium *hirundinella*
Chiilomonas *paramecium*
Chlamydomonas *pulvisculus*
Entosiphon *sulcatus*
Euglena *acus*
Euglena *spirogyra*
Euglena *viridis*
Gonium *pectorale*
Monas *fluida*
Mallomonas sp.
Peranema sp.
Phacus *longicaudus*
Phacus *pleuronectus*
Phacus *pyrum*
Pleodorina *illinoisensis*
Volvox sp.

PROTOZOA: SARCODINA (AQUATIC)

Actinophrys *sol*
Actinosphaerium sp.
Amoeba *dubia*
Amoeba *guttula*
Amoeba *limax*
Amoeba *proteus*
Amoeba *radiosa*
Amoeba *spatula*
Amoeba *verrucosa*
Amoeba *villosa*
Arcella *vulgaris*
Arcella sp.
Cochiliopodium *bilimbosum*
Difflugia *lobostoma*
Difflugia *pyriformis*
Hyalodiscus *limax*
Lithocolla sp.

PROTOZOA: SARCODINA (AQUATIC) Continued

Nuclearia simplex
Pelomyxa carolinensis
Raphidiophrys elegans

PROTOZOA: SARCODINA: MYCETOZOA

Arcyria sp.
Ceratiomyxa sp.
Didymium sp.
Fuligo sp.
Lycogala sp.
Physarum sp.
Stemonitis sp.
Trichia sp.

PROTOZOA: CILIOPHORA

Acineta sp.
Amphileptus claparedei
Amphileptus sp.
Aspidisca costata
Bursaria truncatella
Carchesium epistylidis
Carchesium polypinum
Chilodon caudatus
Chilodon cucullulus
Chilodon fluviatilis
Chilodon sp.
Cinetochilym sp.
Coleps bicuspis
Coleps hirtus
Coleps octospinus
Colpidium colpoda
Colpidium striatum
Colpoda cucullus
Colpods helia
Colpoda inflata
Colpoda saprophila
Colpoda sp.
Cothurnia curva
Cyclidium glaucoma
Didinium nasutum
Dileptus gigas
Epistylis sp.

PROTOZOA: CILIOPHORA (Continued)

Euplotes charon
Euplotes patella
Eutreptia sp.
Frontonia leucas
Glaucoma scintillans
Halteria grandinella
Holophrya sp.
Lacrymaria olor
Lionotus fasciola
Lionotus pleurosigma
Lionotus varsaviences
Loxophyllum sp.
Onychodroums grandis
Ophrydium sp.
Ophryoglena atra
Ophryoglena oblonga
Oxytricha pellionella
Paramecium aurelia
Paramecium bursaria
Paramecium caudatum
Paramecium multimicronucleatum
Parameciu trichium
Pleuronema sp.
Reptomonas caudata
Scyphidia sp.
Sphaerophrya magna
Spirostomum ambiguum
Spirostomum teres
Stentor coeruleus
Stentor polymorphus
Stentor roeseli
Stichotricha secunda
Strombidium claparedei
Strombidium globosum
Strombidium sp.
Stylonychia notophora
Stylonychia pustulata
Telotrochidium crateriforme
Tetrahymena pyriformis
Tillina magna
Tokophrya sp.
Trichophrya sp.
Urocentrum turbo
Vorticella alba
Vorticella elongata
Vorticella microstoma
Vorticella monilata
Vorticella picta
Vorticella striata
Vorticella telescopia
Zoothamnium sp.

PORIFERA (Sponges)

	COUNTIES
Trochospongilla leidyi	Pittsburg

COELENTERATA

Chlorohydra viridissima	Cleveland, Pottawatomie
Hydra americana	Cleveland
Hydra oligactis	Cleveland

(In addition to the species above, the following species, which have been taken in adjacent counties, almost certainly occur within this region:)

Cordylophora lacustris	in impoundments
Craspedacusta sowerbyi	in impoundments
Hydra littoralis	in clear, fast flowing streams.

PLATYHELMINTHES: TURBELLARIA

Dugesia tigrina
Cura foremani

NEMERTINEA

Prostoma rubra

GASTROTRICHA

Chaetonotus sp.	Cleveland
Lepidodermella sp.	Cleveland

ROTATORIA

Brachionus militaris	LeFlore
Philodina aculeata	Cosmopolitan in locality and habitat
Philodina roseola	Cosmopolitan in locality and habitat

BRYOZOA (Ectoprocta)

Fredericella sultana	
Pectinatella magnifica	LeFlore
Plumatella sp.	

TARDIGRADA

Macrobiotus areolatus	Creek, LeFlore, McCurtain, McIntosh, Muskogee
Macrobiotus echinogenitus	Hughes, LeFlore
Macrobiotus harmsworthi	Latimer, LeFlore
Macrobiotus intermedius	LeFlore
Milnesium tardigradum	Hughes, LeFlore

* Only known localities in the United States

ANNELIDA: OLIGOCHAETA

Allolobophora sp.
Tubifex sp.

MOLLUSCA: GASTROPODA. AQUATIC SNAILS.

Campeloma decisum	Haskell, LeFlore
Cincinnatia integra	LeFlore
G. parvus	Haskell, LeFlore
Helisoma anceps	Probably every county in state
H. trivolvis	Probably every county in region
Lymnaea (Stagnicola) bulimoides	Probably every county in state
L. (Pseudosuccinea) columella	Latimer, LeFlore, Pittsburg
L. (Fossaria) humilis	Haskell, LeFlore, Pittsburg
Menetus dilatatus	LeFlore,
M. sampsoni	Haskell, LeFlore,
Mudalia plebia	LeFlore
Physa anatina	Probably every county in state
Physa gyrina	Every county in state
Physa halei	Probably every county in state

MOLLUSCA: GASTROPODA. SLUGS.

Eumelas wetherbyi ragsdalei	Latimer
Limax flavus	
Philomycus carolinianus	Latimer

MOLLUSCA: GASTROPODA: TERRESTRIAL SNAILS

BULIMULIDAE	
Bulimulus dealbatus	Counties south and east of Payne
CARYCHIIDAE	
Carychium exiguum (=*exile*)	East of Pontotoc and Pottawatomie
ENDODONTIDAE	
Anguispira alternata	From Payne south and east
Helicodiscus nummus	Scattered throughout region
H. parallelus	Throughout region
H. singleyanus	Scattered throughout region
Punctum vitreum	Scattered throughout region
OLIGYRIDAE	
Oligyra orbiculata	From Muskogee and Pontotoc east

	COUNTIES
POLYGYRIDAE	
Mesodon clausus	LeFlore
M. indianorum	Atoka, Latimer, LeFlore, Pittsburg
M. kiowaensis	Atoka, Pittsburg
M. thyroidus	From Payne east and south
M. zaletus	Haskell, LeFlore
Stenotrema fraternum imperforatum	LeFlore
S. labrosum	LeFlore
S. leai	Throughout the region
S. pilsbryi	LeFlore
Polygyra deltoidea	Atoka, Pittsburg
P. dorfeuilliana	From Payne south and east
P. jacksoni	Atoka, LeFlore
P. leporina	Atoka, Haskell, LeFlore
P. texasiana	Throughout the region
Triodopsis albolabris	LeFlore,
T. divesta	Atoka, Latimer, LeFlore
T. vultuosa cragini	Coal, Latimer, LeFlore, Pittsburg
PUPILLIDAE	
Gastrocopta armifera	Throughout the region
G. contracta	Throughout the region
G. cristata	Scattered throughout the region
G. holzingeri	LeFlore
G. pellucida	Scattered throughout the region
G. pentodon	Throughout the region
G. procera	Throughout the region
G. tappaniana	Throughout the region
Pupoides albilabris	Throughout the region
Vertigo milium	Haskell, LeFlore,
V. ovata	Scattered throughout the region
V. rugulosa	Atoka, Haskell, LeFlore, Pittsburg
V. tridentata	LeFlore
STROBILOPSIDAE	
Strobilops labyrinthica (-*aenia*, *texasiana*)	Throughout the region
SUCCINEIDAE	
C. vermeta (=*Quickella wandae*)	Throughout the region
Sussinea concordialis (=*grosvernori*)	Throughout the region
VALONIIDAE	
Vallonia gracilicosta	Haskell,
V. parvula	Scattered throughout the region
ZONITIDAE	
Econulus chersinus trochulus	Haskell, LeFlore,
Euconulus fulvus	Haskell,
Hawaiia minuscula	Scattered throughout region
M. friabilis	LeFlore,
M. vulgatus	LeFlore
P. simpsoni	Atoka, Haskell, LeFlore,

ZONITIDAE (Continued)	
Pilsbryna tridens	Haskell, LeFlore
Retinella cryptomphala	Latimer, LeFlore
R. identata	Haskell, LeFlore, Pittsburg
Striatura meridionalis	Haskell, LeFlore
Ventridens brittsi	LeFlore
V. demissus lamellata	LeFlore
V. ligera	LeFlore
Zonitoides arboreus	Haskell, LeFlore

MOLLUSCA: PELECYPODA (CLAMS OR MUSSELS)
(Clams or Mussels)

	COUNTIES OR LOCALITIES
SPHAERIIDAE	
Pisidium spp.	Widely distributed in eastern and central counties
Sphaerium spp.	Widely distributed in eastern and central counties
UNIONIDAE	
*Actinonaia (Lampsilis) ligamentina carinata	Poteau River
*Amblema costata (=Quadrula undulata)	Widespread in small streams
*Amblema peruviana (=Quadrula plicata)	Widespread in small streams
Amblema (Quadrula) perplicata	Poteau River
Anodonta grandis	Widespread, common in eastern counties
Elliptio dilatatus (=Unio gibbosus)	Kiamichi and Poteau Rivers, deeply imbedded
Fusconaia flava (=Quadrula rubiginosa)	Widespread and common
F. (=Quadrula) undata	Kiamichi and Poteau Rivers
Lampsilis anodontoides	Widespread
L. fallaciosa	Widespread
L. siliquoidea (=hydiana)	Widespread in southern counties
*Lasmigona (=Symphynota) complanata	Widespread
*L. ventricosa	Kiamichi and Poteau Rivers
Leptodea fragilis (=Lampsilis gracilis)	Common, widespread (in mud bottoms)
Ligumia (=Lampsilis) recta	Poteau River
Megalonaia gigantea (=Quadrula heros)	Widespread in southern streams
Obliquaria reflexa	Commn in Kiamichi and Poteau Rivers
Plagiola lineolata (=securis)	In fast eastern streams
Plethobasus cyphyus	In swift eastern rivers
*Pleurobema (=Quadrual) cordatum	Poteau and Kiamichi Rivers
*P. (=Lampsilis) purpurata	Widespread; harvested for pearls
Q. pustulosa	Widely distributed, abundant in Poteau River

UNIONIDAE (Continued)

*_Q. quadrula_ (=_lachrymosa_)	Widely distributed
Q. fragosa	Southern streams, rare
*_Tritogonia verrucosa_	Kiamichi and Poteau Rivers, common
Truncilla donaciformis (=_Plagiola_)	Common in all large, sandy streams
Uniomerus tetralasmus (=_Unio_)	Widespread in sloughs, temporary ponds

ARTHROPODA: CRUSTACEA EUBRANCHIOPODA (Phyllopoda)

ANOSTRACA

Eubranchipus oregonus	Atoka, Coal

CLADOCERA

Alona costata	Haskell
Alona quadrangularis	Latimer, LeFlore, Pittsburg
Bosmina coregoni	Atoka, Coal, Haskell, Latimer, LeFlore
Bosimna longirostris	Atoka, Latimer
Camptocercus oklahomensis	Coal
Camptocercus rectirostris	Coal
Ceriodaphnia cornuta	Atoka
Ceriodaphnia lacustris	Atoka, Latimer, LeFlore
Ceriodaphnia pulchella	Atoka
Ceriodaphnia quadrangula	Latimer
Ceriodaphnia rigaudi	Atoka
Chydorus sphaericus	Atoka, Coal, Haskell, Latimer, LeFlore
Daphnia ambiqua	Atoka
Daphnia longispina	Atoka
Daphnia pulex	Atoka, Latimer, LeFlore, Pittsburg
Diaphanosoma brachyurum	Atoka, Coal, Latimer, LeFlore, Pittsburg
D. leuchtenbergianum	Atoka, Coal, Latimer, LeFlore, Pittsburg
Ilyocryptus sordidus	Atoka, Coal
Kurzia latissima	Coal
Macrothrix laticornis	Atoka
Moina affinis	Atoka, Coal
Moina macrocopa	Atoka
Pleuroxus denticulatus	Atoka, Coal, Latimer
Pleuroxus hamulatus	Atoka
Simocephalus serrulatus	Atoka, Pittsburg
Simocephalus vetulus	Atoka, Pittsburg
Scapholeberis mucronata	Atoka, Pittsburg

CRUSTACEA: COPEPODA

CALANOIDA

Diaptomus clavipes	Coal, Pittsburg
Diaptomus pallidus	All counties concerned except Pittsburg
Diaptomus reighardi	Latimer
Diaptomus sciloides	Atoka, Coal

CYCLOPOIDA

Cyclops vernalis	Atoka, Latimer
Eucyclops agilis	Atoka, Coal
Mesocyclops edax	Latimer, Pittsburg

CRUSTACEA: MALACOSTRACA

ISOPODA	
AQUATIC SPECIES	
Asellus montanus	Latimer, LeFlore (mountain streams)
Asellus (=Caecidotea) oculatus	Latimer, LeFlore (mountain streams)
Lirceus (=Asellus, Mancasellus) hoppinae	Latimer, LeFlore, (springs and streams)
TERRESTRIAL SPECIES	(No precise distributional data available)
Armadillidium vulgare	Probably every county in region
Oniscus asellus	At least eastern counties
Porcellio laevis	Probably every county in region
Porcellio scaber	At least eastern counties
Porcellionides pruinosus	Perhaps every county in region
AMPHIPODA	
C. (=Eucrangonyx) shoemakeri	Temporary streams of eastern half of state
Hyalella azteca	
Stygonectes alabemensis	Latimer, (caves and seeps)
(=Synpleonia americana, S. clantoni?)	
DECAPODA	
SHRIMP	
Palamonetes kadiakensis	LeFlore, Pittsburg
CRAWFISHES	
Cambarus diogenes	
Eaxonella (Cambarus) clypeata	LeFlore
Orconectes causeyi	Latimer
Orconectes (=Cambarus) difficilis	Coal, Pittsburg
Orconectes (Cambarus) menae	LeFlore
Orconectes palmeri longimanus	Coal, Latimer, LeFlore
(=Cambarus longimanus)	Pittsburg
Procambarus a. acutus	Latimer, LeFlore
(=Cambarus blandingi acutus)	Pittsburg
Procambarus (=Cambarus) gracilis	Pittsburg
Procambarus (=Cambarus) s. simulans	Coal, Latimer, LeFlore, Pittsburg
Procambarus tenuis	LeFlore, Pittsburg
ARANEAE (Spiders): Many Families	
AGELENIDAE	
Agelena naevia	Latimer
Cicurina varians	LeFlore
ARGIOPIDAE	
Acrosoma gracilis	LeFlore

Epeira domiciliorum	Latimer
Epeira prompta	Latimer
Mangora gibberosa	LeFlore
Mangora placida	LeFlore
GNAPHOSIDAE (=DRASSIDAE)	
Gnaphosa sericata	LeFlore
LINYPHIIDAE	
Diplocephalus crenatum	
LOXOSCELIDAE	
Loxosceles reclusa	
OXYOPIDAE	
Oxyopes salticus	Latimer, LeFlore
PISAURIDAE	
Dolomedes scriptus	Latimer
Dolomedes triton sexpuncatatus	Latimer
Dolomedes urinator	Latimer
SALTICIDAE (ATTIDAE)	
Marpissa formosa	LeFlore
Marpissa undata	Latimer
Phidippus howardi	Latimer
TETRAGNATHIDAE	
Leucauge hortorum	LeFlore
Tetragnatha grallator	Latimer
THERAPHOSIDAE	
Dugesiella (=*Eurypelma*) *hantzi*	Latimer
Pachylomerus carabivorus	Latimer, LeFlore
THERIDIIDAE	
Achaearenea (*Theridion*) *tepidariorum*	Latimer
Achaearenea porteri	Latimer (in caves)
Latrodectus mactans	
THOMISIDAE	
Philodromoides iatrariae	Latimer
Xysticus triguttatus	LeFlore

	COUNTIES
PHALANGIDA (OPILIONES)	
Cynorta sayi	Latimer
Hadrobunus grande	Latimer
Leiobunum dorsatum	Latimer, LeFlore
Phalangium opilio	Latimer

ACARINA (mites and ticks)

Hydrachnellae--various genera and species of water mites. Widespread.
Trombiculidae--*Eutrombicula* spp. (Chiggers or redbugs) Widespread pests.
Tetranychidae--red spider mites. Widespread plant pests on plants.
Trombidiidae--velvet mites. Common parasites upon insects.

Oribatid mites--common beetle mites of soil and leaf litter; serve as intermediate hosts of tapeworm parasites of grazing animals.
Mesostigmatid mites--common pests of domestic birds and mammals, in feathers or fur.
Sarcoptid mites--itch and mange mites which burrow in skin.
Ticks--nuisance in southeastern counties (wood ticks--Demacentor spp., lone star tick--*Amblyomma americanum*, rabbit ticks-- Haemaphysalis *leporispalustris*), potential vectors of such diseases as tularemia and spotted fever.

DIPLOPODA (MILLIPEDES) FROM CAVES

Abacion texense	LeFlore
Brachycybe lecontei	LeFlore
Eurymerodesmus sp.	LeFlore
Narceus annularis	LeFlore

INSECTA

THYSANURA	
Lepisma saacharina	probably every county
Thermobia domestica	probably every county
ISOPTERA	
Reticulitermes flavipes	probably every county
ZORAPTERA	
Zorotypus hubbardi	Atoka, Latimer, LeFlore
EPHEMEROPTERA (MAYFLIES)	
Ameletus	Latimer
Hexagenia	
Stenonema	
MEGALOPTERA	
Corydalus cornutus	Latimer, LeFlore

NEUROPTERA: (AQUATIC) SISYRIDAE (Spongillaflies)

Climacia areolaris	Latimer, LeFlore

ODONATA: Many Families

DRAGONFLIES

AESHNIDAE

Anax junius	Latimer, LeFlore, Pittsburg
Basiaeschna janata	LeFlore
Epiaeschna heros	LeFlore
Nasiaeschna pentacantha	Latimer

CORDULEGASTERIDAE

Cordulegaster obliquus	Latimer, LeFlore

GOMPHIDAE

Dromogomphys spinosus	Haskell, Latimer, LeFlore
D. spoliatus	Latimer
G. graslinellus	Haskell, Latimer, LeFlore
G. Lentulus (=*subapicalis*)	Latimer
G. militaris	Latimer
G. oklahomensis	Latimer
G. plagiatus	LeFlore
G. submedianus	LeFlore
Hagenius brevistylus	Latimer, LeFlore
Progomphus obscurus	Latimer

LIBELLULIDAE

Celithemis elisa	Latimer
C. eponina	Pittsburg
C. fasciata	Latimer, Pittsburg
C. verna	Pittsburg
Didymops transversa	Latimer, LeFlore, Pittsburg
Epicordulia princeps	Latimer, LeFlore
Erythrodiplax umbrata	Latimer
L. cyanea	LeFlore
L. flavida	Latimer
L. incesta	Atoka, Latimer, LeFlore, Haskell, Pittsburg
L. luctuosa	Atoka, Latimer, LeFlore
Libellula pulchella	Latimer, LeFlore
L. vibrans	LeFlore
Macromia georgina (=*australensis*)	Haskell, Latimer, LeFlore
M. pacifica	Atoka, Latimer
N. xanthosoma	Latimer, LeFlore
Orthemis ferruginea	Haskell, Latimer, Pittsburg
Pachydiplax longipennis	Haskell, Latimer, LeFlore, Pittsburg
Pantala hymenea	Latimer, Pittsburg
Perithemis tenera (=*domitia*)	Haskell, LeFlore, Pittsburg
Plathemis lydia	virtually every county in region

Somatochlora linearis	Latimer, LeFlore
S. ozarkensis	Latimer, LeFlore
S. tenebrosa	Latimer, LeFlore
Sympetrum ambiguum	LeFlore, Pittsburg
S. vicinum	Latimer, LeFlore
Tarnetrum corruptum	LeFlore
Tetragoneuria cynosura	Latimer, LeFlore, Pittsburg
T. spinosa	Latimer
T. williamsoni	LeFlore
T. lacerata	Latimer, LeFlore, Pittsburg
T. onusta	Haskell, Latimer, LeFlore, Pittsburg

DAMSELFLIES

AGRIONIDAE

Agrion maculatum	Pittsburg
Hetaerina americana	LeFlore
Hetaerina titia (=tricolor)	LeFlore

COENAGRIONIDAE

Anomalagrion hastatum	Latimer, LeFlore, Pittsburg
Argia apicalis	Atoka, Haskell, Latimer, LeFlore, Pittsburg
A. bipunctulata	Latimer
A. immunda	Latimer
A. moesta (=intruda, putrida)	LeFlore, Latimer
A. sedula	Atoka
A. tibialis	Atoka, Latimer, LeFlore, Pittsburg, Haskell
A. translata	Latimer
A. violacea	Latimer, LeFlore
A. vivida plana	Latimer
Enallagma aspersum	Latimer
E. basidens	Latimer, LeFlore
E. civile	Latimer, LeFlore, Pittsburg
E. divagans	Latimer, LeFlore
E. dubium	
E. exsulans	Haskell, Latimer, LeFlore
E. geminatum	LeFlore
E. signatum	Latimer, LeFlore
E. traviatum	Latimer, LeFlore
E. vesperum	LeFlore
Ischnura kellicotti	LeFlore
I. posita	Latimer, LeFlore

LESTIDAE

Archilestes grandis	Latimer
L. disjunctus australis (forcipatus)	Latimer, Pittsburg
L. inaequalis	LeFlore

INSECTA

ORTHOPTERA: ACRIDIDAE

Agenotettix deorum
Acrolophitis hirtipes
Amphitornus coloradus
Arphia conspersa
A. simplex
A. xanthoptera
Boopedon gracile
Brachystola magna
Chortophaga viridifasciata
Dichromorpha viridis
Dissosteira carolina
D. longipennis (a major pest in western counties)
Eritettix simplex
Hadrotettix trifasciatus
Hesperotettix speciosus
H. viridis
Hippiscus rugosus
Leprus wheeleri
Leptysma marginicollis
Melanoplus angustipennis
M. bilituratus
M. bispinosus
M. bivittatus (a major pest occasionally)
M. confusus
M. differentialis (probably the most serious local grasshopper pest)
M. femur-rubrum
M. foedus fluviatilis
M. keeleri
M. mexicanus (probably the second most serious local grasshopper pest)
M. packardi
M. ponderosus
M. regalis
Mermiria maculipennis
Opeia obscura
O. pelidna
Orphulella speciosa
Paratettix cucullatus
Pardalophora saussurei
Philibostroma quadrimaculatum
Pseudopomala brachyptera
Psoloessa texana
Schistocerca americana
S. damnifica
S. lineata
S. obscura
Spharagemon collare

BLATTIDAE	
Blatta orientalis	Probably in every county (imported)
Blattella germanica	widely distributed in buildings (imported)
P. pensylvanica	Payne south and east
Periplaneta americana	widely distributed in buildings (imported)
Supella supellectillium	widely distributed in households (imported)
GRYLLIDAE	
Acheta assimilis	widely distributed, occasionally a pest
Gryllotalpa major	widely distributed
MANTIDAE	
Stragomantis carolina	widely distributed
PHASMIDAE	
Diapheromera velii	widely distributed
Manomera blatchleyi	widely distributed
Parabacillus coloradus	
TETTIGONIIDAE	
A. oblonifolia	Latimer, LeFlore
Conopephalus fasciatus	LeFlore
O. silvaticum	Pittsburg
P. f. furcata	LeFlore
S. f. furcata	LeFlore
S. texensis	LeFlore, Pittsburg
HOMOPTERA: APHIDAE	
Aphis gossipii	melon aphid on cucumbers, melons
A. maidis	corn leaf aphid
A. pawneepae	redbud aphid
Cinaria thujafilina	arbor vitae aphid
E. rileyi	woolly elm bark aphid
Hysteroneura setariae	brown plum aphid
Longistigma caryae	sycamore aphid on pecans
Macrosiphum pisi	pea aphid on alfalfa, peas
M. rosae	rose aphid
M. sanborni	chrysanthemum aphid
Toxoptera graminum	greenbug on wheat, barley, etc.
Tuberculatus ulmifolii	elm leaf aphid
COCCIDAE	
Aspidiotus ancylus	peach scale
A. juglans-regiae	walnut scale
A. perniciosus	San Jose scale on apples, peaches
Cerococcus koebeli	on ornamentals
Chionaspis americana	elm scurfy scale
Diaspis carueli	juniper scale
Hemichionaspis aspidistrae	fern scale
Lecaneum corni	European fruit scale on elms, maples, pecans
L. nigrofasciatum	terrapin scale in orchards
Pulvinaria amygdali	maple leaf scale

MEMBRACIDAE

Archasia galatea	Atoka, Pittsburg
Campylenchia latipes	from Cleveland and Payne east and south
Cyrtolobus arcuatus	Coal, Latimer,
C. clarus	Latimer
C. discoidalis	Latimer, LeFlore
C. dixianus	Atoka, Coal, Haskell
C. flavolatus	LeFlore
C. fuliginosus	Payne and Pontotoc east and south
C. inermis	Atoka, Haskell, Latimer, LeFlore
C. maculifrontis	Atoka, Coal, Pittsburg
C. pallidifrontis	Atoka, Coal, Pittsburg
C. tuberosus	Atoka, Coal, Creek, Latimer, Pittsburg
C. vau	Latimer, LeFlore, Pittsburg
Entylia bactriana	Atoka
G. turriculatus	LeFlore
Micrutalis calva	LeFlore
Ophiderma definita	LeFlore
O. evelyna	LeFlore
O. flavicephala	LeFlore
O. pubescens	Cleveland and Payne east and south
Palonica pyramidata	Latimer
Platycotis vittata	Latimer
Spissistilus borealis	LeFlore
S. festinus	Atoka, LeFlore
S. constans	LeFlore
S. lutea	Atoka, LeFlore
S. palmeri	Latimer, LeFlore
S. taurina	Latimer
T. concava	Latimer
T. extrema	Latimer
Tortistilus curvata	Latimer
T. inermis	Atoka, Latimer, LeFlore, Pittsburg
X. nitidus	LeFlore

(AQUATIC AND SEMI-AQUATIC) HEMIPTERA: COREIDAE

A. femorata	Coal, LeFlore
A. terminalis	most counties
Alydus eurinus	Latimer, LeFlore
Anasa tristis	most counties
Archimerus alternatus	Latimer
Chariesternus antennator	many counties
Chelinidea vittiger	LeFlore
C. lateralis	many counties
Euthochtha galeator	many counties
Harmostes reflexulus	many counties
Jadera haematoloma	many counties
Leptocoris trivittata	
Leptoglossus clypealis	
L. oppositus	LeFlore
L. phyllopus	many counties
Megalotomis quinquespinosus	Latimer, LeFlore
Merocoris distinctus	LeFlore

GERRIDAE

Gerris canaliculatus	LeFlore
G. marginatus	Latimer
G. remigis	LeFlore
Limnogonus hesione	LeFlore
Metrobates hesperius depilatus	LeFlore
R. rileyi	LeFlore
R. trulliger	LeFlore
T. knighti	LeFlore

LYGAEIDAE

Antillocoris pilosulus	LeFlore
Delochilocoris umbrosus	LeFlore
Cymus angustatus	LeFlore
Heraeus plebejus	LeFlore
Hypogeocoris imperialis	Coal
Lygaeus kalmii	Pittsburg
Melanocoryphus bicrucis	LeFlore, Pittsburg
Myodocha serripes	LeFlore
Nysius californicus	LeFlore, Pittsburg
N. ericae	LeFlore
Onacopeltus fasciatus	LeFlore
Ozophora picturata	Latimer

Many Families (water scorpions, water striders, shore bugs, backswimmers and stinkbugs)

R. nigra	LeFlore
Buenoa margaritacea	Latimer
Notonecta indica	Latimer
N. irrorata	LeFlore
N. undulata	Latimer
Micracanthia humilis	Atoka, Coal, LeFlore
Pentacora ligata	Latimer
Microvelia americana	Latimer, LeFlore
R. knighti	LeFlore
R. rivale	Atoka
Gelastocoris oculatus	
Hebrus consolidus	
Merragata hebroides	
Hydrometra hungerfordi	
H. martini	
Pelocoris femoratus	
Ochterus americanus	
Mesovelia cryptophila	
M. mulsanti	
J. wickhami	LeFlore
Euschistus tristigmus pyrrhocerus	LeFlore
Arhaphe carolina	Latimer

REDUVIOIDEA - Many Families

Systelloderes biceps	Latimer
N. roseipennis	Latimer
Phymata americana coloradensis	Atoka, LeFlore, Pittsburg
P. fasciata georgiensis	Pittsburg
Emesaya brevipennis	LeFlore
Apiomerus crassipes	Pittsburg
Arilus cristatus	Coal
Melanolestes abdominalis	Latimer
M. picipes	Latimer, LeFlore
Narvesus carolinensis	LeFlore
P. cinctus	Latimer
Rasahus hamatus	Latimer, LeFlore
Stenopoda cinerea	LeFlore
Triatoma sanguisuga	LeFlore
Zelus cervicalis	Pittsburg

COLEOPTERA: CARABIDAE

Evarthrus seximressus	LeFlore
Harpalus caliginosus	LeFlore
H. erythropus	LeFlore
P. elongatus	LeFlore

CERAMBYCIDAE

Acanthocinus fasciata	LeFlore
Aegoschema modesta	LeFlore
Ataxia crypta	Latimer, LeFlore
Batyleoma suturale	Atoka, Latimer, LeFlore, Pittsburg
Callichroma plicatum	LeFlore
Dectes spinosus	Coal
Democerus palliatus	Latimer, LeFlore
Derancistrus taslei	Latimer
Derobrachus brunneus	Latimer
Distenia undata	Atoka, LeFlore
Eburia haldemani	LeFlore
E. quadrigeminata	LeFlore
Ecyrus dasycerus	LeFlore
Elaphidion macronatum	Latimer, LeFlore
E. paralleslus	Latimer
Euderces pini	Latimer
E. reichei	Pittsburg
Goes pulcher	LeFlore
G. pulverulentus	Latimer
Hemierana flammata	Latimer
Heterachthes quadrimaculatus	LeFlore
Hippopsis lemniscata	Atoka, LeFlore, Pittsburg
Leptura emarginata	Haskell, Latimer, LeFlore
Lepturges confluens angulatus	LeFlore

Mecas inornata	Latimer
M. saturnina	Latimer, LeFlore, Pittsburg
Molorchus bimaculatus	Pittsburg
Monochamus titillator	Latimer, LeFlore
N. macronatus	Latimer, LeFlore
N. scutellaris	Latimer
O. ocellata	Latimer, Pittsburg
Obrium maculatum	LeFlore
O. rufulum	LeFlore
O. evanescens	Pittsburg
O. famelica	LeFlore
O. luteicornis	Latimer, LeFlore
O. sexnotata	Latimer, LeFlore
O. texana	Latimer, LeFlore, Pittsburg
P. imbricornis	LeFlore
P. laticollis	LeFlore
P. palparis	Latimer
Psapharochrus quadrigibbus	LeFlore
Psyrassa unicolor	LeFlore
Romaleum atomarium	LeFlore
S. discoidea	Pittsburg
S. lateralis	Latimer
Tetrops expurgata	LeFlore
Tragidion coquus	LeFlore
T. confluens	Atoka
T. lunulata	Latimer
T. sinuata	Atoka, LeFlore, Pittsburg
T. standishi	Atoka, LeFlore
T. trimaculatus	LeFlore
Xylotrechus colonus	Latimer, LeFlore

CHRYSOMELIDAE

Anomoea hogei	Atoka, Latimer, LeFlore
A. laticlavia	LeFlore
Babia quadriguttata	Latimer
Calligrapha bidenticola	Pittsburg
Colaspis brunnea	Latimer
Chrysochus auratus	Pittsburg
Donacia hypoleuca	LeFlore
Fidia viticida	LeFlore
G. squamulata	Latimer
Leptinotarsa decemlineata	Coal, Latimer, LeFlore
Myochrous denticollis	Coal
N. tristis	LeFlore
Z. exclamationis	Pittsburg

CICINDELIDAE

C. duodecimguttata	Latimer
C. obsoleta	Pittsburg
C. p. punctulata	Widespread in region, common in upland fields

C. repanda	Widespread in region, abundant on damp sand beside streams
C. schauppi	Coal
C. scutellaris unicolor	Latimer
C. sexguttata	Latimer, LeFlore
C. splendida	Latimer, LeFlore
C. tranquebarica	Haskell, Latimer, LeFlore
Megacephala carolina	LeFlore

DRYOPOIDEA - Super families

H. lithophilus	Cleveland and eastward
Ancyronyx variegata	LeFlore
D. minima	Atoka
Heterelmis vulnerata	Atoka, Coal
Macronychus glabratus	Pontotoc and eastward
Microcylloepus pusillus	Coal, LeFlore
S. exilis	LeFlore
S. parva	Latimer
Stenelmis spp.	Atoka, Coal, Latimer, LeFlore
Ectopria nervosa	LeFlore
Psephenus herricki	Latimer, LeFlore

(Aquatic and Riparian Beetles other than Riffle Beetles)

Many Families

D. vittatus	LeFlore
H. pusillus	LeFlore
Tropisternus lateralis	LeFlore
T. mexicanus	LeFlore
Acropteroxys gracilis gracilis	LeFlore
Languria mozardi	Coal, Latimer
A. lecontei	Latimer
Canthon chalcites	Latimer
C. laevis	Latimer
C. nigricornis	Atoka
Dichotomius carolinus	Atoka, LeFlore
O. hecate hecate	Latimer
O. oklahomensis	Latimer
O. pennsylvanicus	LeFlore
O. striatulus striatulus	Latimer
P. vindex	Latimer

LEPIDOPTERA: ARCTIIDAE

Apantesis oithona	LeFlore
Hyphantria cunea	(larvae reported in most counties)

Many Families (Pests)

Acrobasis caryae	pecan casebearer
Alabama argillacea	cotton leafwarm
Ancylis sp.	strawberry leafroller

Carpocapsa pomonella	codling moth (on apples, pears)
Catocala viduata	alligator worm on pecans
Celama sorghiella	sorghum webworm on grain sorghums
Chorizagrotis auxiliaris	army cutworm on wheat, oats, barley, rye
Cirphis unipuncta	army worm, especially on wheat and oats
Coleophora caryaefoliella	pecan cigar casebearer
Datana integerrima	walnut caterpillar on pecans and walnuts
Desmia funeralis	grape leaf folder (also on Virginia creeper, etc.)
Euxoa spp., Lycophotia, Prodenia	cutworms on cotton, corn, melons, alfalfa, etc.
Gelechia cercerisella	redbud leaf roller
Heliothis armigera	corn earworm
Heliothis obsoleta	cotton bollworm
Hyphantria, Loxostege spp.	fall and garden webworms on alfalfa, cotton, etc.
Malacosoma americana	tent caterpillars on pecans and many other trees
Paleacrita vernata	spring cankerworm in orchards
Plodia interpunctella	Indian meal moth in stored grain, etc.
Protoparce, Celerio spp.	horn worms on tomatoes, grapes, etc.
Thyridopteryx ephemeraeformis	bagworms on evergreens
Tinea, Tineola spp.	clothes moths

DIPTERA: Many Families - Aquatic

Chaoborus sp.
Culicoides sp.
Simulium vittatum
Tabanus sp.
Chrysops sp.
Tendipes attenuatus, T. riparius

CULICIDAE (mosquitoes)

A. alleni	LeFlore
A. canadensis	Atoka
A. nigromaculis	Common throughout region
A. sticticus	Pest in southeastern counties
A. triseriatus	Treehole breeder throughout region
A. trivittatus	Throughout region, commoner in east
A. vexans	Common pest throughout region
A. crucians	Coal, LeFlore
A. punctipennis	Very common pest throughout region
A. quadrimaculatus	Potential malaria vector throughout region, abundant in southeastern counties (thrives in impoundments)
Culex apicalis	Common throughout eastern counties
C. erraticus	Throughout region, very common in east
C. peccator	Atoka (rare)
C. quinquefasciatus	Throughout region
C. restuans	Common throughout region
C. salinarius	Common pest throughout region

C. tarsalis	Abundant throughout region
Megarhinus septentrionalis	Southeastern counties (not a pest)
Psorophora ciliata	Common pest throughout region
P. confinnis	Common pest throughout region
P. cyanescens	Common worst pest throughout region
P. discolor	Widespread but not very common
P. ferox	Pest in wooded regions
P. horrida	Widespread pest but not very common
P. howardi	Coal, (uncommon)
P. signipennis	Very common throughout region
Theobaldia inornata	Throughout region, abundant in winter
Uranotaenia sapphirina	Throughout eastern half of state
U. syntheta	Coal

ASILIDAE

Asilus rubicundus	Coal
Efferia aestuans	Statewide
E. albibarbis	LeFlore
E. interrupta	Coal, Latimer
E. prairiensis	Pittsburg
E. snowi	Latimer
E. texana	Haskell, Latimer, Pittsburg
Mallophora orcina	Latimer
Ommatidius tibialis	Latimer
Philonichus limidipennis	LeFlore
Proctacanthella cacopiloga	Statewide
Proctacanthus brevipennis	Latimer
P. milberti	Haskell
Promachus bastardii	Latimer, LeFlore
P. fitchi	LeFlore
P. hinei	LeFlore
T. notatus	Haskell
T. prairiensis	Pittsburg
T. snowi	LeFlore

HYMENOPTERA: FORMICIDAE (bees, wasps, ants)

A. interjectus	Latimer
A. tennesseensis	Atoka, Latimer
A. texana	Latimer
A. treatae	Latimer, LeFlore
Camponotus americanus	Latimer
C. caryae discolor	Coal
C. castaneus	Latimer, LeFlore
C. nearcticus	Latimer
C. pennsylvanicus	Widespread in region
C. rasilis	Latimer
Crematogaster ashmeadi	Latimer, LeFlore
C. laeviuscula	Widespread in region
C. lineolata	Throughout region
C. minutissima missouriensis	Latimer
Dorymyrmex pyramicus	Widespread in region
E. melsheimeri	Latimer

E. nigrescens	Latimer
E. pilosum	Latimer, LeFlore
Forelius foetida	Coal, Pittsburg
F. schaufussi dolosa	Latimer
Iridomyrmex pruinosum analis	Widespread in region
L. niger neoniger	Pittsburg
L. schaumi	Latimer
L. texanus	Latimer
Monomorium minimum	Throughout region, a serious household pest
Mymecina americana	Latimer
Myrmica pinetorum	Latimer
Paratrechina logicornis	Pittsburg
P. melanderi	Latimer
Pheidole bicarinata vinelandica	LeFlore
P. dentata	From Payne to Atoka and east
P. sitarches campestris	Latimer
Pogonomyrmex barbatus	Latimer
Ponera trigona opacior	Latimer
Prenolepis imparis	Latimer
Solenopsis molesta	Latimer
S. xyloni (this pesky ant is aggressive, has a painful sting, and may kill hatchling birds such as quail and chickens)	Latimer, LeFlore
Trachymyrmex septentrionalis seminole	Latimer

Many Families - other than Ants

Epyris sp.
Perisierola cellularis
Apanteles sp.
A. ensiger
A. forbesi
A. marginiventris
A. terminalis
Aphidius multiarticulatus
Aspilota sp.
Bracon sp.
B. curtus
B. mellitor
B. nuperus
B. platynotae ?
B. pyralidiphagus
Chelonus texanus
Heterospilus sp.
Microplitis maturus
Opius spp.
Orgilus sp.
Polystenidea parksi
Rhaconotus graciliformis
Aphanogmus sp.

Ceraphron sp.
Dirhinus texanus
Haltichella xanticles
Spilochalsic dorsata
S. sanguiniventris
Elampus marginatus
Hexacola sp.
Aclista sp.
Trichopria spp.
Elasmus marylandicus
Anagyrus sp.
Chalcaspis pergandei
Chrysopophagus compressicornis
Microterys marginatus
Ooencyrtus johnsoni
Paraphaenodiscus sp.
Pseudleptomastix sp.
Xanthoencyrtus sp.
Encarsia sp.
Prospaltella sp.
Tetrastichus spp.
T. ainsliei
T. gibboni
T. pulchriventris
Tumidiscapus falvus
Eupelmus sp.
E. allynii
Eurytoma sp.
Prosaspicera sp.
Halictus sp.
H. ligatus
Lasioglossum pruinosiforme
Gelis sp.
Tromatobis rufopectus
Megachile brevis
Dasymutilla quadriguttata
Acmopolynema bifasciatipennis
Lymaenon spp.
Polynema sp.
P. enchenopae
Amblyaspis sp.
Brachinostemma sp.
Colotrechnus ignotus
Merisus sp.
Muscidifurax sp.
Acoloides sp.
Ceratoteleia marlattii
Macroteleia macrogaster
Telenomus sp.
T. chrysopae
T. dimmocki
Didineis texana
Pluto suffusus
Thysanus niger
Torymus sp.
Oligosita sp.
O. sanguinea
Polistes fuscatus

Attachment 15

Public and Agency Response

1. Response Requested - Letters and Mailing List.

2. Comments Received -

    a. Groups and Individuals
    b. Coal Companies
    c. State and Local Agencies
    d. Federal Agencies and Offices

Response Requested

IN REPLY REFER TO
1791

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
DISTRICT OFFICE
3550 Pan American Freeway, N. E.
Albuquerque, New Mexico 87107

November 6, 1974

Gentlemen:

We are in the process of writing an environmental analysis record involving Federal coal lease areas in southeastern Oklahoma.

The Bureau of Land Management's New Mexico State Office (Santa Fe) and Albuquerque District Office have the responsibility of leasing Federally owned coal and insuring adequate protection of surface resources should coal mining occur on the lease areas.

The National Environmental Policy Act of 1969 requires that each Federal action be reviewed to determine the impacts the action will have on the existing environment.

Oklahoma counties involved are Atoka, Coal, Haskell, Latimer, LeFlore, and Pittsburg, as shown on the attached map. This area contains approximately 269,900 acres of Federal coal. Most of the surface acres in this area are privately owned. There is a large amount of privately owned coal in the above-named counties.

The environmental analysis record will discuss the proposed actions of strip mining, underground mining and associated activities, the existing environment, impacts on the existing environment and ways to reduce or eliminate adverse impacts. As a result of this environmental analysis record, stipulations will be developed to protect wildlife habitat, archaeological or historical sites, water quality and watershed, recreation, grazing and timber values.

We are seeking your comments, opinions, ideas and/or information which you may want to provide concerning coal mining in southeastern Oklahoma. Some things you may want to consider are impacts on the environment, local economy, and communities.

Comments should be returned to the Bureau of Land Management by November 22, 1974. The address is:

Bureau of Land Management
c/o District Manager
3550 Pan American Freeway, N.E.
Albuquerque, New Mexico 87107

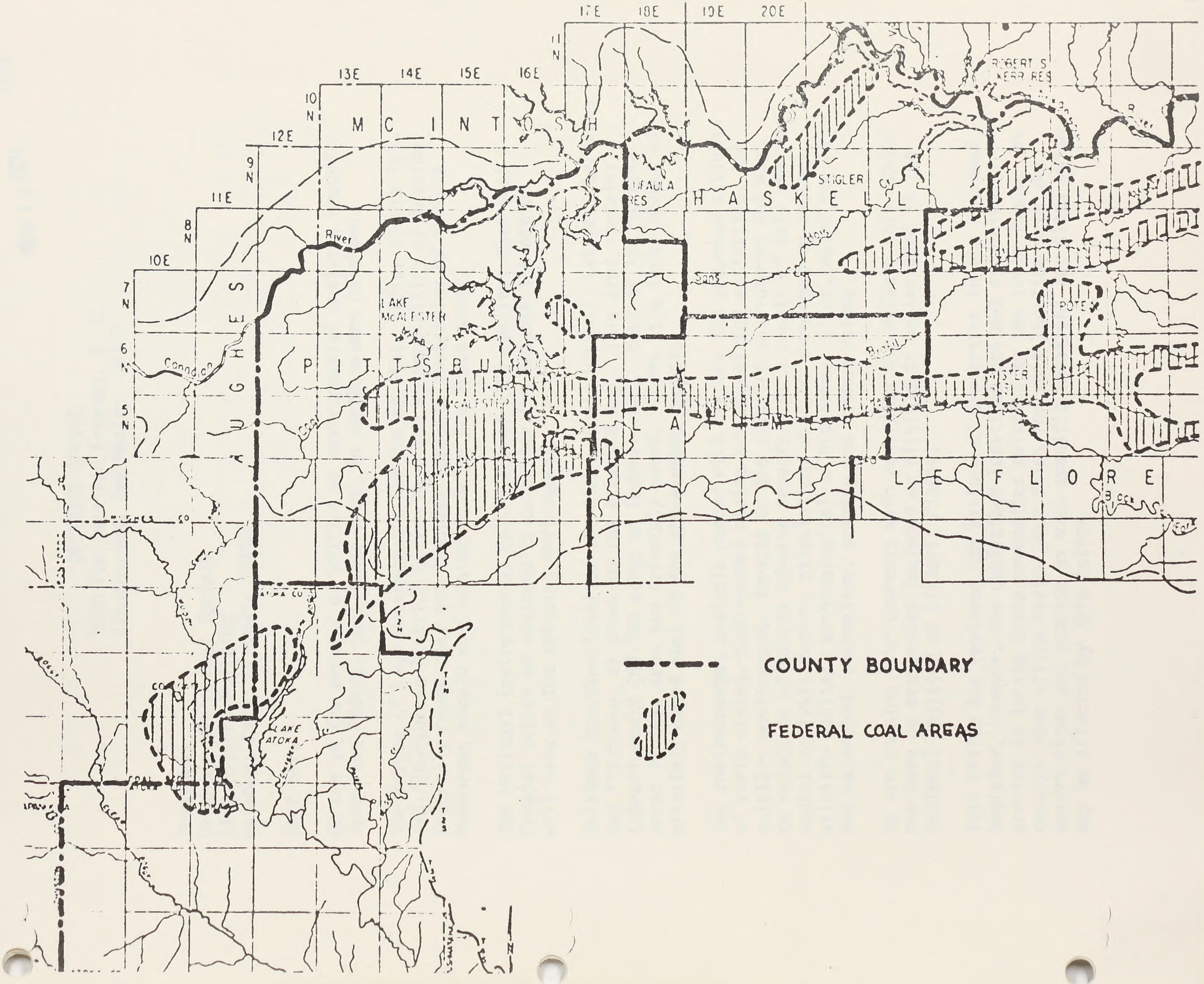
If further information is needed or desired, it may be obtained by writing to the above address or calling the Bureau of Land Management, 505-766-2455 in Albuquerque, New Mexico, and asking for Area Manager, Lloyd Eisenhauer.

Thank you.

Sincerely yours,

R. Keith Miller
R. Keith Miller
District Manager

Attachment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H U G H E S
River
Canadian
LAKE McALESTER
McALESTER
EUFAULA RES
STIGLER
ROBERT S. KERR RES
POTEAU
WISTER
Sans
Coal
LAKE ATOKA
ATOKA CO
COUNTY BOUNDARY
FEDERAL COAL AREAS

1791

NOV 13 1974

DISTRICT OFFICE
3550 Pan American Freeway, N. E.
Albuquerque, New Mexico 87107

President
Oklahoma Historical Society
1108 Colcord Building
Oklahoma City, Oklahoma 73102

Dear Sir,

We are in the process of writing an environmental analysis record involving Federal coal lease areas in southeastern Oklahoma.

The Bureau of Land Management's New Mexico State Office (Santa Fe) and Albuquerque District Office have the responsibility of leasing Federally owned coal and insuring adequate protection of surface resources should coal mining occur on the lease areas.

The National Environmental Policy Act of 1969 requires that each Federal action be reviewed to determine the impacts the action will have on the existing environment.

Oklahoma counties involved are Atoka, Coal, Haskell, Latimer, LeFlore, and Pittsburg, as shown on the attached map. This area contains approximately 269,900 acres of Federal coal. Most of the surface acres in this area are privately owned. There is a large amount of privately owned coal in the above-named counties.

The environmental analysis record will discuss the proposed actions of strip mining, underground mining and associated activities, the existing environment, impacts on the existing environment and ways to reduce or eliminate adverse impacts. As a result of this environmental analysis record, stipulations will be developed to protect wildlife habitat, archaeological or historical sites, water quality and watershed, recreation, grazing and timber values.

We are seeking your comments with regard to the effects this action may have on properties included or eligible to be included in the National Register of Historic Places.

This office has reviewed the history of properties in the National Register, however, the publicized locations are not sufficiently precise to locate these properties relative to the lease lands. We request your office review your files for this location data and descriptions and provide us with specific locations for sites which may be affected by this action.

If possible, please return your comments by December, 13, 1974 to

Bureau of Land Management
District Manage
3550 Pan American Freeway, NE
Albuquerque, New Mexico 87107

If further information is needed or desired, it may be obtained by writing the above address or call the Bureau of Land Management, Area Code 505 - 766-2455 in Albuquerque, New Mexico and ask for Bob Armstrong, Environmental Coordinator.

Thank you.

Sincerely yours,

R. Keith Miller
District Manager

BA:sat (11/13/74)
Armstrong

By:

Acting

IN REPLY REFER TO

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
DISTRICT OFFICE
3550 Pan American Freeway, N. E.
Albuquerque, New Mexico
87107

6232

DEC 17 1974

C. E. Metcalf
Director, Historic Sites Division
Oklahoma Historical Society
Historical Building
Oklahoma City, Oklahoma 73105

Dear Mr. Metcalf:

Thank you for your letter of November 19, 1974 and for the copy of the Oklahoma Historical Society's Annual Preservation Program.

Our research has indicated many sites that lie in or close to the coal lease areas. In order to best determine the direct and indirect effects that might occur to these sites, we need specific locations indicating township, range, section, and quarter section. On December 12 your office indicated in a telephone conversation with Cassandra Richard of this office that you would provide the available information for a site list.

Would you please provide the legal location, to the ¼ section, for the following sites listed in your Annual Preservation Program and the 1971 U.S. Army Corps of Engineers' report on Central Oklahoma:

Choctaw Courthouse (Atoka)
Chief Ben Smallwood
Hurley Birthplace
Lehigh Field
Camp Pike
Cooper Creek
Iron Bridge
McCurtain Home
McKee King Grave
Old Trail (Trail of Seminoles from Florida in 1855)
Pleasant Bluff
San Bois County Courthouse & School
San Bois Creek Engagement
Choctaw Nation Courthouse (Panola)
Civil War Confederate Camp
Edwards' Store
McLaughlin Mound
Riddle Station
Backbone Mountain Battle Site
Brazil Creek Bridge
Cameron Institute
Choctaw "Pine Ridge School"

Heavener Runestone
"Indian Rock"
Jesse Riddle Tollgate
New Hope Seminary
Reynolds Residence
Skullyville County Courthouse & Jail
Choctaw Courthouse (McAlester)
First Coal Mine
Jones Academy
White Chimney House

Thank you for your cooperation.

Sincerely yours,

R. Keith Miller
District Manager

March 3, 1849

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
DISTRICT OFFICE
3550 Pan American Freeway, N. E.
Albuquerque, New Mexico
87107

IN REPLY REFER TO
6232

JAN 16 1975

C. E. Metcalf, Director
Historic Sites Division
Oklahoma Historical Society
Historical Building
Oklahoma City, Oklahoma 73105

Dear Sir:

Thank you for your letter dated January 6, 1975.

We share your concern and recognize the need for survey of the lands in question. Our recent correspondence has not meant to imply that a concern for only the sites in your files would be adequate to meet our legislative responsibilities in the area of historic preservation.

We are obliged under Title 36 Code of Federal Regulations Part 800 Paragraph 4(a)(2) to consult with the appropriate State Historic Preservation Officer to identify properties which are known to be eligible for inclusion in the National Register of Historic Places. Our efforts to date have been concerned solely with meeting that responsibility. It will be necessary, of course, to take additional measures, such as the surveys you suggest, to complete the inventory of cultural resources in the coal lease areas.

In the present stage of planning, we wish to deal with the known cultural resources in the area. Information on these resources, if accurate, may require us to exclude some areas for coal lease if there exist serious conflicts with cultural resources. Information from existing surveys will also aid us in planning to complete the inventory.

You can appreciate, I'm sure, the difficulty we will have in preparing plans for future studies in the coal lease area if we cannot discuss with some precision and confidence the cultural resources which have already been identified by your office.

In response to your letter of January 6, we have listed the sites we are concerned about in a county by county form.

Atoka County:
  Choctaw Courthouse

Coal County:
  Chief Ben Smallwood Homeplace
  Hurley Birthplace
  Lehigh Field

Haskell County:
  Camp Pike
  Cooper Creek
  Iron Bridge
  McCurtain Home
  McKee King Grave
  Old Trail (Trail of Seminoles from Florida in 1855)
  Pleasant Bluff
  San Bois County Courthouse & Jail
  San Bois Creek Engagement

Latimer County:
  Choctaw Nation Courthouse
  Civil War Confederate Camp
  Edward's Store
  McLaughlin Mound
  Riddle Station

LeFlore County:
  Backbone Mountain Battle Site
  Brazil Creek Bridge
  Cameron Institute
  Choctaw "Pine Ridge School"
  Heavener Runestone
  "Indian Rock"
  Jesse Riddle Tollgate
  New Hope Seminary
  Reynolds Residence
  Skullyville County Courthouse & Jail

Pittsburg County:
  Choctaw Courthouse
  First Coal Mine
  Jones Academy
  White Chimney House

We hope the new listing will allow your staff to more easily locate the site records. The information we most urgently need is the sites' location. We would find legal locations most in keeping with our records. However, location by latitude and longtitude, as required by the nomination form for the National Register of Historic Places, would be adequate.

As our study of the coal lease area continues, we will undoubtedly require further consultation with your office. I very much appreciate the time and effort you and your staff have devoted to answering our inquiries.

Sincerely yours,

R. Keith Miller

R. Keith Miller
District Manager

March 3, 1849

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
DISTRICT OFFICE
3550 Pan American Freeway, N.E.
Albuquerque, New Mexico 87107

IN REPLY REFER TO
1791 (N-2)

JAN 14 1975

American Smelting and Refining Co.
Legal Department
120 Broadway
New York, New York 10005

Gentlemen:

On December 1, 1974, your company acquired five Bureau of Land Management coal leases in southeastern Oklahoma from Garland Coal Company of Fort Smith, Arkansas.

The leases are administered by the Bureau of Land Management, District Office, Albuquerque, New Mexico. In the latter part of October, 1974, this District Office started collecting data, information, opinions, and ideas from interested groups and individuals in preparation of an environmental analysis record involving the Federal coal reserves in southeastern Oklahoma. One phase of the environmental analysis record is to contact all present coal lessees involved and obtain any input they care to make.

On November 6, 1974, you were not a lessee of record and you did not receive a copy of the enclosed letter.

Since you are now involved in this coal leasing area, a copy of the November 6, 1974 letter is enclosed for you. The suggested November 22, 1974 reply date does not apply, but if possible, could you have any response you care to make returned by January 31, 1975 to this office.

Sincerely yours,

R. Keith Miller
District Manager

Enclosure

Oklahoma Game and Fish
1801 North Lincoln
Oklahoma City, OK 73105
Attention: Byron Moser

Oklahoma Wildlife Federation
1014 N. Flood
Norman, OK 73069
Attn: George H. Hulsey

Oklahoma Conservation Comm.
114 State Capitol Bldg.
Oklahoma City, OK 73105
Attn: Don Dudley

Oklahoma Historical Society
Historical Building
2100 Lincoln Blvd.
Oklahoma City, OK 73105

Office of Community Affairs
and Planning
4901 North Lincoln
Oklahoma City, OK 73105

State Tourism and Recreation
4020 North Lincoln
Oklahoma City, OK 73105
Attn: Jim Reed

Kiamichi Economic Development
District of Oklahoma
Eastern Oklahoma A & M College
Wilburton, OK 74578

Eastern Oklahoma Development
District
P.O. Box 1367
Muskogee, OK 74401

Southern Oklahoma Development
Association
P.O. Box 3125, Ardmore Air Park
Ardmore, OK 73041

COEDD
16 East 9th Street
Shawnee, OK 74801

Oklahoma State Highway Comm.,
Director
Jim Thorpe Building
2101 North Lincoln
Oklahoma City, OK 73105

Chief Mine Inspector
c/o Ward Padgett
State Capitol Bldg.
Oklahoma City, OK 73105

Commissioners of the Land Office
c/o Bob Shipman
Jim Thorpe Building
2101 N. Lincoln
Oklahoma City, OK 73105

Dr. Paul G. Risser
Okla. Biological Survey
University of Oklahoma
770 South Oval Room 19
Norman, OK 73069

Oklahoma Historical Society
1108 Colcord Building
Oklahoma City, OK 73102

Oklahoma Archeological Survey
c/o Larry Neal
1335 South Asp Avenue
Norman, OK 73069

Oklahoma Dept. of Poll. Control
c/o Tom Peace
P.O. Box 53504
N.E. 10th & Stonewall
Oklahoma City, OK 73105

Oklahoma Geological Survey
Charles J. Mankin, Director
830 Van Fleet Oval, Rm. 163
The University of Oklahoma
Norman, OK 73069

George Lynn Cross Research
c/o George M. Sutton
University of Oklahoma
1335 Asp Avenue, Room 100
Norman, OK 73069

Industrial Development Commission
c/o Director - Ben Langdon
Will Rogers Building
Oklahoma City, OK 73105

Oklahoma Department of Energy
4400 N. Lincoln
Oklahoma City, OK 73105

Division of State Parks
Oklahoma Tours & Recreation Dept
500 Will Rogers Building
Oklahoma City, OK 73105

Bureau of Reclamation
Post Office Bldg.
320 SW 5th
Oklahoma City, OK 73135

Bureau of Mines
Robert H. Arent - Geologist
168 P.O. Building
NW Third Street
Oklahoma City, OK 73102

Army Corp of Engineers
P. O. Box 61
c/o Jerry O'Brian
Tulsa, OK 73101

U.S. Geological Survey
50 Penn Place
Suite 404
Oklahoma City, OK 73118

U. S. Forest Service
LeRoy Bond
1720 Peachtree Rd. NW
Atlanta, GA 30309

Environmental Protection
Authority
c/o George Putnicki, Duputy
Regional Admin.
1600 Patterson
Dallas, TX 75202

Bureau of Sports Fisheries
and Wildlife
168 P.O. Building
NW Third Street
Oklahoma City, OK 73102

Corps of Engineers
224 South Boulder
Tulas, OK 74103

Soil Conservation Service
Stillwater, OK 74074
Attn: Wes Fuchs

Garland Coal Company
P.O. Box 186
Fort Smith, AR 72901

Evans Coal Company
P.O. Box 711
Fort Smith, AR 72901

Lone Star Steel Company
P.O. Box 35888
Dallas, TX 75235

Petroleum International, Inc.
1605 National Bank of Tulsa
Building
Tulsa, OK 74103

Cameron Coal Co.
P.O. Box 186
Fort Smith, AR 72901

A. James Gorden
P.O. Box 58
McAlester, OK 74501

Midwest Mining Co.
P.O. Box 190
Poteau, OK 74953

United Electric Coal Co.
307 No. Michigan Ave.
Chicago, IL 60601

S. E. Evans, Inc.
P. O. Box 903
Fort Smith, AR 72901

The Pacola Co.
P. O. Box 186
Fort Smith, AR 72901

Paul Rees Coal Co.
P. O. Box 1526
Fort Smith, AR 72901

Mr. Bill McCain
Route 3
Idabel, OK 74745

Fenley James
Route 1
Valliant, OK 74764

Mr. Dale Zachary
1101 S. E. 11th
Wagoner, OK 74467

Mr. Dale Curry
401 S. 8th St.
Okemah, OK 74859

Mr. Lem Due
Route 3, Box 79-B
Wagoner, OK 74467

Foreman Carlile
Game Supervisor
Depart. of Wildlife Conservation
P.O. Box 49
Warner, OK 74469

Crockett Lowrey
Route 1
Atoka, OK 74525

Keystone Sportsmen Club
Harry Wyatt, Secretary
Box 1046
San Springs, OK 74603

Dr. Bryon Glass
Zoology Department
Oklahoma State University
Stillwater, OK 74074

Frank Buturla
2910 Ridgecrest
Casper, Wyoming 82601

Dr. Frank Hester
Chelsea, OK 74016

Jack Gillespie
3404 Morris
Pueblo, CO 81008

Kenneth S. Beam
5801 S. 29th
Fort Smith, AR 72901

The Duncan Garden Council
President, Ms. E. M. Holcomb
Duncan, OK 73533

American Smelter & Refining Co.
Legal Department
120 Broadway
New York City, NY 10005

Ada Field Trail Club
Lee Roy Mapp
915 S. Constant
Ada, Oklahoma 74820

9er Archery Club
Ida Pevis-Secretary
500 E. Vilas
uthrie, OK 73044

DAIR CO SPORTSMEN CLUB
L. ARNOLD, SEC.
TILLWELL, OKLAHOMA 74960

LLEN SPORTSMEN CLUB
. M. MCDONALD, SEC.
OX 275
LLEN, OKLAHOMA 74825

IONA SPORTSMENS CLUB
OREN L. WEST, PRES.
INGFISHER, OKLAHOMA 73750

LTUS TRAP & SKEET CLUB
R. BEN WRAY, PRES.
12 LAKESIDE DR.
LTUS,OKLAHOMA 75321

RYLLIS GARDEN CLUB
S. BYRON J. COOK
17 CARLTON WAY
KLAHOMA CITY, OKLAHOMA 73107

BER SPORTSMANS CLUB
RRY RIDGE, SEC.
X 126
BER, OKLAHOMA 73004

ADARKO GUN CLUB
LI B. YOUNG, PRES.
X 661
ADARKO, OKLAHOMA 73005

ANADARKO JR. RIFLE CLUB
J. K. TAYLOR
608 MISSION PL
ANADARKO, OKLAHOMA 73005

ANTIOCH SPORTSMEN CLUB
WILLIAM HOMER
224 S. BROADWAY
MOORE, OKLAHOMA 73060

ARAPAHO SPORTSMEN CLUB
ALAN HOWENSTINE
BOX # 364
ARAPAHO, OKLAHOMA 73620

ARBUCKLE COON HUNTERS CLUB
JOE H. RANKIN, SEC.
DAVIS, OKLAHOMA 73030

ARDMORE ARCHERY CLUB
JEANNINIE REHWALT-SEC
1417 B NW
ARDMORE, OKLAHOMA 73401

ALTUS BASSMASTERS FISHING CLUB
ED PAVE, SEC-TRES.
P.O. BOX 908
ALTUS, OKLAHOMA 73521

ARDMORE FIELD TRIAL CLUB
JULIAN NOLAND
BOX 489
ARDMORE, OKLAHOMA 73401

ARKOMA SPORTSMEN CLUB
JOY WARNOCK, PRES.
BOX 231
ARKOMA, OKLAHOMA 74901

ATA CAPITOL CITY GUN CLUB
JIMMY HARDING, MGR
200 NE 44th. ST.
BOX 18503
OKLAHOMA CITY, OKLAHOMA 73015

ATOKA ROD & GUN CLUB
JAMES WILLIAMS, PRES.
BOX 113
ATOKA, OKLAHOMA 74525

ATOKA ROD & GUN CLUB
F. C. LOWRY
RT. 1
ATOKA, OKLAHOMA 74525

BEN CLARK RIFLES
SAM GRIESEL, PRES
618 S. WILSON
EL RENO, OKLAHOMA 73036

BIG FOUR SPORTSMENS CLUB
JAMES FOSTER, PRES.
KINGFISHER, OKLAHOMA 73750

BIXBY CONSERVATION CLUB
CLUADE JONES, SEC.
RT. 1
BIXBY, OKLAHOMA 74008

BLUE RIVER COONHUNTERS
JAMES MCGLOCKLIN, PRES.
MILBURN, OKLAHOMA 73450

BLUEJACKET SPORTSMEN CLUB
OWEN HUDSON, SEC.
BLUEJACKET, OKLAHOMA 74333

BLUES HUNTING RESORT
JIM PALMER
RT. 1
LUTHER, OKLAHOMA 73054

BLUESTEM FIELD TRIAL ASSN.
A. LEON SMITH
1836 S. VIEW
BARTLESVILLE, OKLAHOMA 740

BRISTOW SPORTSMANS CLUB
DR. F. D. CHAPMAN
BOX 750
BRISTOW, OKLAHOMA 74010

BROKEN BOW SPORTSMENS CLUB
ROD & GUN CLUB
R. E. VAUGHT PRES.
RT.2 BOX 321
BROKEN BOW, OKLAHOMA 74728

BRUSH CREEK BOWMEN
BILL BLAIR, PRES.
BOX 3066
FT. SILL, OKLAHOMA 73503

BRYAN CO. SPORTSMEN CLUB
ROBERT L. DORATY, SEC.
1818 W. CEDAR
BENNINGTON, OKLAHOMA 74701

FT. COBB SPORTSMENS CLUB
JIM DESEL, PRES.
BOX 86
FT. COBB, OKLAHOMA 73038

BURNS FLAT SPORTSMEN CLUB
ALBERT DUDGEON
FOSS, OKLAHOMA 73647

CANADIAN CO. CONSERV. CLUB
PHIL C. KIDD, JR. SEC.
P.O. BOX 1288
NORMAN, OKLAHOMA 73069

CANADIAN CO. WILDLIFE ASSN.
J.D. MITCHELL PRES
1406 W. WALNUT
EL RENO, OKLAHOMA 73036

CAPITOL HILL SPORTSMEN
CLAUD DAVIS
3114 SE 19TH
DEL CITY, OKLAHOMA 73115

CARNEGIE GUN CLUB
BOX 235
CARNEGIE, OKLAHOMA 73015

CARTER CO AMATEUR QUAIL
BOB STANLEY
1737 TWERTON
ARDMORE, OKLAHOMA 73401

CARTER CO. QUAIL HUNTERS
T FRED COLLINS
P.O. BOX 1781
ARDMORE, OKLAHOMA 73401

CARTER SPORTSMEN CLUB
MELTON ROLES
P.O. BOX 304
CARTER, OKLAHOMA 73627

CASHION SPORTSMENS CLUB
WAYNE HASENFRATZ, SEC.
KINGFISHER, OKLAHOMA 73750

CENTRAL U S FIELD TRIAL
[illegible]. H. CRISWELL
BOX 1300
ADA, OKLAHOMA 74820

CENTRALIA SPORTSMEN CLUB
BILLIS KENRICK, PRES.
CENTRALIA, OKLAHOMA 74336

CHANDLER SPORTSMAN CLUB
E. H. ALLBRITTON, PRES.
RURAL ROUTE 2
CHANDLER, OKLAHOMA 74834

CHECOTAH SPORTSMEN CLUB
W. W. HUNTER, PRES.
POSTMASTER
CHECOTAH, OKLAHOMA 74426

CHELSEA ROD & GUN CLUB
C. J. FRALEY, SEC.
BOX 107
CHELSEA, OKLAHOMA 74016

CHEROKEE CO. SPORTSMAN CLUB
FRED ADAMS
E SHAWNEE
TAHLEQUAH, OKLAHOMA 74464

CHEROKEE STRIP ARCHERS
MARJORIA GRANTHAM-SEC.
513 N. 13TH
ENID, OKLAHOMA 73701

CHEROKEE STRIP MUZZLE CLUB
CHARLES R. CAMPBELL
2201 E. EUCALYPTU
ENID, OKLAHOMA 73701

CHEROKEE STRIP FIELD TRIAL
DOYESS BOYETT, PRES.
400 S. PEACHTREE
PONCA CITY, OKLAHOMA 74601

CHICKASHA FIN & FEATHER
DOYLE POE-SECRETARY
OKLA NATL BANK
CHICKASHA, OKLAHOMA 73018

CHIEFTAIN SHOOTING DOG
C. J. HIBBERT, PRES.
5108 N. BEAVER
BETHANY, OKLAHOMA 73008

CHISHOLM TRAIL BASS CLUB
205 N 30TH
DUNCAN, OKLAHOMA 73533

CHOCTAW CO FIN & FEATHER
BILL BALDWIN, PRES.
113 HUGHES AVE.
HUGO, OKLAHOMA 74743

CHOCTAW CO. SPORTSMEN CLUB
CHARLES DOWNEY PRES
P.O. BOX 633
HUGO, OKLAHOMA 74743

CIMARRON RIFLE & PISTOL
CHESTER SMITH PRES
1438 E. MOSES
CUSHING, OKLAHOMA 74023

CLEVELAND CO. BIRD CLUB
P.O. BOX 2666
NORMAN, OKLAHOMA 73069

CLEVELAND CO. SPORTSMAN
EARL JOHNSON, PRES.
RT. 4
NORMAN, OKLAHOMA 73069

COAL COUNTY SPORTSMEN CLUB
MASON SMITH
BOX 131
COALGATE, OKLAHOMA 74538

COLE SPORTSMEN CLUB
DONALD WAGGONER
RT. 2
BLANCHARD, OKLAHOMA 73010

COLLEGE HILL SPORTSMEN CLUB
WAYNE HASENFRATZ, PRES.
NORTH OF CITY
KINGFISHER, OKLAHOMA 73750

CORDELL ROD & GUN CLUB
JAMES V SON, PRES
720 N. TEMPLE
CORDELL, OKLAHOMA 73632

COYLE SPORTSMENS CLUB
LEON DEAR PRES
RT. 2
COYLE, OKLAHOMA 73027

CRESCENT SPORTSMEN CLUB
KENDALL RYLAND, SEC.
515 E. FORREST
CRESCENT, OKLAHOMA 73028

CTRL OKLA COONHUNTERS ASSN.
FREELON CRICK, PRES
2114 W. OKLA
GUTHRIE, OKLAHOMA 73044

CUSHING BOBWHITE SPORTSMEN
KENNETH BOYD, SEC.
RT 2
CUSHING, OKLAHOMA 74023

CUSHING ROD & GUN CLUB
JOHN GREEN JR.
1022 E. 11TH. ST.
CUSHING, OKLAHOMA 74023

DAVIS SPTS CLUB
NEAL VAN HOOSER PRES
BOX 191
DAVIS, OKLAHOMA 73030

EER CREEK GUN CLUB
D MCDONALD PRES
18 N MISSOURI
THOMAS, OKLAHOMA 73669

EEP FORK COONHUNTERS ASSN.
AUL JUSTICE, PRES.
T. 3, box 24
RISTOW, OKLAHOMA 74010

L CITY SPORTSMAN CLUB
OSS L. GORSY, SEC.
14 S. SUNNYLANE
L CITY , OKLAHOMA

. D. S. QUAIL CLUB
AMES K. MCELLDOWNEY PRES
25 PARK AVE.
OKLAHOMA CITY, OKLAHOMA 73102

DIAMOND D HUNTING CLUB
RADY DELLING PRES
3716 BELLA VISTA
KLA CITY, OKLAHOMA

G & HOPE GARDEN CLUB
04 HOLLY
CAN, OKLAHOMA 73533

LL CITY ROD & GUN CLUB
A. CLAYTON, PRES.
LL CITY, OKLAHOMA 73641

UMRIGHT SPORTSMANS CLUB
IM KESSEL, SEC.
21 EAST
RUMRIGHT, OKLAHOMA 74030

DUCKS UNLIMITED
PAUL NEWSOME PRES
5713 S. SHARTEL
OKLAHOMA CITY, OKLAHOMA 73109

DUNCAN ARCHERY CLUB
KENNETH THOMAS -SEC
311 E CHESTNUTT
DUNCAN , OKLAHOMA 73533

DUNCAN GUN CLUB
NORMAN FREEMAN, PRES.
1124 N. 11th. ST.
DUNCAN, OKLAHOMA 73533

EAKLEY GUN CLUB
C. B. SINS
BOX 532
EAKLEY, OKLAHOMA 73033

EAST CTRL OKLA ARCHERS
NOWETA MELTON, SEC.
RT. 3, BOX 93
OKEMAH, OKLAHOMA 74948

EASTERN OKLA COONHUNTERS
RAY YOARKUM, PRES
RT 3
MULDROW, OKLAHOMA 74948

EASTERN OKLA GUN CLUB
CHRIS J GOUSKOS, PRES
BOX 1402
TULSA, OKLAHOMA 74101

ECONTUCKA SPORTSMEN CLUB
BILL CLEERE, PRES
RT 1
EARLSBORO, OKLAHOMA 74840

EDMOND FIELD TRAIL CLUB
DELMAR SMITH
RT. 3, BOX 257
EDMOND, OKLAHOMA 73034

EL RENO GUN CLUB
DON DAVIS, PRES.
609 HOLBROOK
EL RENO, OKLAHOMA 73036

EL RENO GUN DOG CLUB
THOMAS BROWER, SEC.
600 S. EL RENO
EL RENO, OKLAHOMA 73036

ELCAPATAN SPORTSMEN CLUB
ARTEY A ELLIS
1530 NW 28TH
OKLAHOMA CITY, OKLAHOMA 73106

ELDORADO SPORTSMEN CLUB
JOHNNY FREEMAN, SEC.
ELDORADO, OKLAHOMA 73537

ELMER SPORTSMEN CLUB
TOMMY BEACH
BOX 316
ELMER, OKLAHOMA 73539

ELMORE CITY ROD & GUN CLUB
T. H. VAUGHN, PRES.
RT. 1 BOX 69
ELMORE CITY, OKLAHOMA 73035

ENID SKEET & TRAP CLUB
C. L. ROBERSON, PRES.
1926 HERON
ENID, OKLAHOMA 73701

FAA GUN CLUB
BILL CHAPMAN
1711 MARION DR.
NORMAN, OKLAHOMA 73069

FAIRFAX ROD & GUN CLUB
C. C. MORGAN, SEC
BOX 186
FAIRFAX, OKLAHOMA 74637

FAIRLAND SPORTSMANS CLUB
WARREN THOMURE, PRES
R R 2
FAIRLAND, OKLAHOMA 74343

FER-DU-LAC MATCH CHAIRMAN
NATL MUZZLELDG RIFLE
LEE T GOOD
208 MONTCLAIR
TULSA, OKLAHOMA 74104

FFA SPORTSMEN CLUB
BOX 431
PURCELL, OKLAHOMA 73080

FLEETWOOD MEM FIELD TRIAL
DELMAR SMITH
RT. c, Box 257
EDMOND, OKLAHOMA 73034

FLETCHER SPORTSMEN CLUB
JAY ROWBARTS, PRES.
BOX 426
FLETCHER, OKLAHOMA 73541

Geary Rod and Gun Club
Route 3
Geary, Oklahoma 73040

Gen. Electric Rod & Gun Club
J. Galbreath
1308 James Drive T
Oklahoma City, OK 73119

Goff Place Club
Lightning Gun Club
Willard Collier
Stroud, Oklahoma 74079

Grand National Gun Club
Hugh Thurman
802 South Hayes
Enid, Oklahoma 73701

Grand River Bow Hunters
Dallas Plumlee-Secretary
Route 1
Salina, Oklahoma 74365

Granite Sportsmen Club
Wendell Berry
Granite, Oklahoma 73547

Great Plains Field & Stream
P.O. Box 1395
Lawton, Oklahoma 73501

Greater Oklahoma Limited
Ralph McReynolds
2520 NW 120
Oklahoma City, OK 73107

Greer County Wildlife Club
Wade Tyler Jr., President
213 East Madison
Mangum, Oklahoma 73554

Green Country Bow Hunters
Marylen Summers, Secretary
11842 East 16th Street
Tulsa, Oklahoma 74145

Grove Bowhunters
James Lucken, Secretary
27 West 3rd Street
Grove, Oklahoma 74344

Harrah Coonhunters Assn.
Ed Harris, President
3501 S.W. 40th
Oklahoma City, OK 73119

H.C. Hitch Spts. Club
Roy V. Bailey, Secretary
1307 Canyon
Guymon, Oklahoma 73942

Heavener Bass & Sptsman Club
c/o Cox Real Estate Co.
Heavener, Oklahoma 74937

Henryetta Archery Club
Harry Nichols, Secretary
Route 2, Box 53-B
Henryetta, Oklahoma 74437

Hensley-Hicks Hunting Club
Dick Medley
1700 N. Western
Oklahoma City, OK 73102

Hill Top Archers
Bill Orrell, Secretary
Box 209
Ft. Cobb, Oklahoma 73038

Hillsdale Sportsmen Club
Dale Hayes, President
Box 206
Hillsdale, Oklahoma 74743

Hinton Road & Gun Club
Box 253
Hinton, Oklahoma 73047

Hobart Gun Club
Fred Noske
320 N. Broadway
Hobart, Oklahoma 73651

Hollis Sportsman Club
J. R. Horton, President
224 E. Lamar
Hollis, Oklahoma 73550

Hominy Sportsman Club
Flynn Clark, Secretary
702 West First
Hominy, Oklahoma 74035

Hughes Co. Sportsmen Club
P.O. Box 816
Holdenville, Oklahoma 74848

Hurrah Coon Hunters
3501 S.W. 40
Oklahoma City, OK 73119

Isaac Walton League, Jr.
Willard Mote
2100 Mary Street
Ponca City, Oklahoma 74601

Jefferson Co. Sportsmen Clb.
Dennis Martin
Ryan, Oklahoma 73565

Jones Academy Archery Club
Ginger McCarty
Box 8
Hartshorne, Oklahoma 74547

Johnston Co. Quail Hunters
E.A. Saxon, President
P.O. Box 31
Mannsville, Oklahoma 73447

Kiamichi Coonhunters Assn.
D.L. Clymer
Box 474
Antlers, Oklahoma 74523

Kiamichi Rod & Gun Club
S.C. Mitchell, President
Box 181
Antlers, Oklahoma 74523

Kingston Spts Club
Ross McCorstin
General Delivery
Kingston, Oklahoma 73439

Ki-Wash Rod & Gun Club
W.J. Thiessen
Box 264
Gotebo, Oklahoma 73041

Kiowa Sportsman's Club
Fred Lacey, President
844 North Pine
Midwest City, Oklahoma 73130

Konawa Sportsmen
Don Starkey, Secretary
401 South Madison
Konawa, Oklahoma 74849

Lacy Gun Club
Harold Bullis
Hennessey, Oklahoma 73742

Lake Area Sportsmen Club
Jesse Waller, Secretary
Checotah, Oklahoma 74426

Lake Elmer Sportsmen's Club
Wayne Rosenfratz, Secretary
Kingfisher, Oklahoma 73750

Lake Ft. Gibson Sptsm Club
E.E. Franke, President
1404 S. 103 E. Avenue
Tulsa, Oklahoma 74128

Lake Hefner Bowmen
Marelyn Tahkefper, Sec.
3618 NW 22
Oklahoma City, OK 73107

Lake Hudson Association
Route 2
Adair, Oklahoma 74330

Lake Raymond Gary Rod Club
Richard Mentzel
Hugo, Oklahoma 74743

Lake Texoma Assn.
P.O. Box 1128
Denison, Texas 75020

Lakeside Gun Club
506 E. Nevada
Walters, Oklahoma 73572

Lakeview Rod & Gun Club
Radford Hewes
Star Route
Lawton, Oklahoma 73501

Latimer Co. Sportsman Club
Box 396
Wilburton, Oklahoma 74578

Lawton Quail Club
Bill Brown
1611 N.W. 46th
Lawton, Oklahoma 73501

Leflore County Spts. Club
Charles M. Collins, President
Box 588
Poteau, Oklahoma 74953

Lindsay Wildlife Club
James Harris
707 West Cherokee
Lindsay, Oklahoma 73052

Lindsay Jr. Wildlife Club
Mart Harris, Secretary
707 West Cherokee
Lindsay, Oklahoma 73052

Little Dixie Bowmen
Deloris Johnson, Secretary
125 E. Harrison
McAlester, Oklahoma 74501

Little Dixie Field Trial
Les McAbee, President
Box 29
Hugo, Oklahoma 74743

Locust Grove Sportsmen
Arvis Taylor, Secretary
Route 2, Box 74
Locust Grove, Oklahoma 74352

Logan County Sportsmen Club
General Delivery
Marshall, OK 73056

Love Co Amateur Quail Club
George Harkey, Sec.
204 NW 4th St.
Marietta, OK 73448

Loyal Sportsmens Club
Ben Musick, President
722 S. 7th St.
Kingfisher, OK 73750

Luther Sportsmen Club
Tom Hartman, President
Luther, OK 73054

Madill Gun Club
James Howell
Madill, OK 73446

Mannford Sportsmen Club
Demar R. Hodgins, Sec.
101 Gardenia Cr., Box 155
Mannford, OK 74044

Meramec Sportsmen Club
Harvey Black, Secretary
Maramec, OK 74045

[illegible] Rod & Gun Club
[illegible] Thompson, President
[illegible] W. Arapahoe
Marlow, OK 73055

Logan County Sportsmen Club
Marshall Chapter
William Cox
Marshall, OK 73056

Marshall Co Quail Club
Jeff Stark, President
Madill, OK 73446

Marshall Co Sportsmans Club
A. R. Newhart, President
607 W. Lillie
Madill, OK 73446

Martha Beaucheaump Club
Henry Smith, President
218 W. 13th
Chandler, OK 74834

Maud Sportsmen Club
Ray Odaniel, President
Box 480
Maud, OK 74854

Mayes Co. Sportsmen Club
Max Trout, Secretary
508 E. Elliott
Pryor, OK 74361

Haileyville Bow Hunters
Gary McCullar
Box 312
Haileyville, OK 74547

McCurtain Co. Sportsmen Club
Troy Estes, Secretary
Idabel, OK 74745

Metcalf Sportsmen Club
Lloyd Stephens
Route 3
Hollis, OK 73550

Miami Bobwhite Club
Ryvers Wooldridge, President
45 Ranch Ent.
Miami, OK 74354

Mount Scott Rod & Gun Club
R. D. Rankin, Jr.
Star Route
Lawton, OK 73501

Mt. Fork Quail Hunters Club
Doug Williams, President
Smithville, OK 74957

Muldrow Sportsmens Club
Ralph Roberts
Route 1
Muldrow, OK 74948

Muskogee Coonhunters Assn.
C. C. Divelbiss, President
Route 3, Box 19
Muskogee, OK 74401

N. A. A. Rod & Gun Club
9760 East 4th Place
Tulsa, OK 74128

N E Okla. Bobwhite Club
Warren Wilbur, President
Route 2
Miami, OK 74354

N. E. Okla. Sportsman Club, Inc.
Box 444
Miami, OK 74354

N. Kingfisher Sportsmen Club
Emil Boeckman, President
Kingfisher, OK 73750

N. W. Okla. Sportsmen Jr. Rifle
W. L. Otis
418 E. Randolph
Enid, OK 73701

Nicoma Park Sportsmans Club
Mrs. Cloann Daves, President
10140 Lejean Dr.
Midwest City, OK 73130

Nomad Camping Club
8333 NW 35th St.
Bethany, OK 73008

[illegible] SPTS CLUB
GEORGE HULSEY, PRES
[illegible] LOOD
NORMAN, OKLAHOMA 73069

NORTH FORK QUAIL CLUB
WILLIE P. REYNOLDS
2832 PEMBROKE
OKLAHOMA CITY, OKLAHOMA 73116

NORTHEAST CRAIG CO GUN CLUB
BILL POLSON PRES
BOX 34
WELCH, OKLAHOMA 74369

NORTHEAST OKLA COONHUNTERS
ED ODLE PRES
RT. 2 BOX 103
PRYOR, OKLAHOMA 74361

NORTHEAST OKLA CHAPTER
JOHN SALLINGS, SEC.
[illegible]202 HARVARD
MIAMI, OKLAHOMA 74354

NORTHERN OKLA BRITTANY CLUB
DON NORRIS
[illegible]303 CAROL
OKLAHOMA CITY, OKLAHOMA 73127

NORTHERN OKLA SPORT CLUB
P.O. BOX 384
PERRY, OKLAHOMA 73077

N E OKLA SPTS CLUB INC.
P.O. BOX 444
MIAMI, OKLAHOMA 74354

NORTHWEST OKLA SPORTSMENS
PERRY CHAPTER
[illegible] L. FUESER
[illegible] PARK DR.
PERRY, OKLAHOMA 73077

[illegible]TA SPORTSMEN CLUB
[illegible] S. MAPLE
[illegible], OKLAHOMA 74048

[illegible] SPORTSMEN CLUB
[illegible], SEC
[illegible]
[illegible], OKLAHOMA 74820

OCHELATA SPORTSMEN CLUB
WESLEY WARD, SEC.
RT. 1
RAMONA, OKLAHOMA 74061

OIL CAPITOL ROD & GUN CLUB
P.O. BOX 3631
TULSA, OKLAHOMA 74114

OK 89er G.S.P. CLUB
JOE REALE
716 N W 54TH
OKLAHOMA CITY, OKLAHOMA 73132

OKLA ACADEMY OF SCIENCE
DR. PAUL BUCK
DEPT LF SCIENCES
UNIVERSITY OF TULSA
TULSA, OKLAHOMA 74106

OKLA BIOLOGICAL STATION
730 VAN VLEET OVAL O.U.
LOREN G HILL
NORMAN, OKLAHOMA 73069

OKLAHOMA AMATEUR FIELD TRIAL
ASSOC. INC.
JOHN FLOYD
1101 STANLEY
STILLWATER, OKLAHOMA 74074

O.C. AMATEUR SHOOTING DOG
HAL HORTON, SEC
1806 NE 67TH
OKLAHOMA CITY, OKLAHOMA 73139

OKLAHOMA CITY AMATEUR
BILL TRABUE
9041 S. SANTA FE
OKLAHOMA CITY, OKLAHOMA 73139

OKLA CITY AUDUBON
VIC VACIN
RT. 2 BOX123
OKLAHOMA CITY, OKLAHOMA

OKLA CHAPTER OZARK SEC
J LAMAR TEATE, SEC
OKLA ST. UNIV.
STILLWATER, OKLAHOMA 74074

OK CHAPTER WILDLIFE SOC.
JIM LEWIS
OSU ZOOLOGY DEPT
STILLWATER, OKLAHOMA 74074

OKLA CITY GUN CLUB
128 BLOSSOM
MIDWEST CITY, OKLAHOMA 73110

OKLA CO COONHUNTERS ASSN
RICHARD LUKER, SEC.
330 S. E. 64TH
OKLAHOMA CITY, OKLAHOMA 73149

OK FIELD TRIAL CLB ASSOC INC.
THURMAN THOMPSON, PRES
3612 N. MAXWELL DR.
OKLA. CITY, OKLAHOMA

OKLA GARDEN CLUB INC.
MRS. O. E. ZUMWALT
RT # 2
INDIAHOMA, OKLA 73552

OKLA GARDEN CLUB INC.
MRS. LEO JOHNS, PRES
3756 E. 48TH PL
TULSA, OKLAHOMA 74135

OKLA GARDEN CLUB, INC.
MRS. HOWARD FERRELL
743 N. E. 29TH
OKLAHOMA CITY, OKLAHOMA 73102

OKLA NATL CAMPERS & HIKERS
BILL & PATTI SPRAGUE
4504 KENYON DR.
OKLAHOMA CITY, OKLAHOMA 73127

OKLA ORNITHOLOGICAL SOC.
1817 FREMONT ROAD
BARTLESVILLE, OKLAHOMA 74003

OK ORNITHOLOGICAL SOC.
EVERETT M. GRIGSBY
DIV NATURAL SCI
NE STATE COLLEGE
TAHLEQUAH, OKLAHOMA, 74464

OKLA RIFLE ASSN.
ROBT E. HINES PRES
2215 S ST. LOUIS
TULSA, OKLAHOMA

OKLA SCUBA DIVERS INC.
ED RALSTON
3401 MERIDIAN CT
OKLA CITY, OK 73122

OKLA STATE ARCHERY ASSN.
BYRON INGRAM, PRES.
339 WOODREST DR.
NORMAN, OK 73069

OKLA ST COONHUNTERS ASSN.
TOM ROBERTS, PRES.
1215 E. NORTHWEST
ARDMORE, OK 73401

OKLA ST SKEET ASSN.
DAN HILL, PRES.
6701 TIMBERLANE
TULSA, OK 74105

OKLA TRAP SHOOTERS ASSN.
ROGER JACK, PRES.
223 NW 23RD
OKLA CITY, OK 73127

OKLA WILDLIFE FED
BILL HOWARD
BOX 1262
NORMAN, OK 73069

OKLA WOODS & WATERS CLUB
FLOYD D PICKARD
BOX 1262
NORMAN, OK 73069

OKMULGEE QUAIL CLUB
C L PUGSLEY, SEC.
BOX 128
OKMULGEE, OK 74447

OKMULGEE SPORTSMEN CLUB
JOHN GRANDFIELD, PRES.
1235 E. 11TH ST.
OKMULGEE, OK 74447

OKMULGEE UPLAND GAME CLUB
H B POWELL
1904 VALLEY VIEW
OKMULGEE, OK 74447

OLUSTEE GUN CLUB
ALVIN WATSON
BOX 673
OLUSTEE, OK 73560

ONEY ROD & GUN CLUB
ROBERT NELSON, PRES.
FT. COBB, OK 73038

OSAGE TERRITORY MUZZLE-
LOADERS, INC.
912 S CANTON
TULSA, OK 74112

OTTAWA COUNTY BASS CLUB
JACK HAYES, PRES.
720 N. NW
MIAMI, OK 74354

OZARK SOC N E OK CHAPTER
JACK VAN NEST, CHAIRMAN
4998 E 27TH
TULSA, OK 74114

PANHANDLE FARMERS CLUB
GLENN JOHNSTON, SEC-TREAS.
BOX 276
HOOKER, OK 73945

PANHANDLE ROD & GUN CLUB
MARVIN TIBBITS, SEC.
LAVERNE, OK 73848

PAULS VALLEY CONSERVATION
C. T. LOFTIN
104 E. PAUL
PAULS VALLEY, OK 73075

PAULS VALLEY GUN CLUB
DOUG STRICKLAND
BOX 83
PAULS VALLEY, OK 73075

PAYNE COUNTY AUDUBON SOC.
c/o ZELLA MOOREMAN
RT 2
PERKINS, OK 74059

PERRY ROD & GUN CLUB
C/O JERRY HOUSKA
721 8TH
PERRY, OK 73077

PIEDMONT SPORTSMAN CLUB
L A PRESTON, PRES.
PIEDMONT, OK 73078

PIONEER 4-H CLUB
TAMMY SEHROD, SEC.
DOUGLAS, OK 73733

PITTSBURG CO COONHUNTERS
DON ROGERS
2109 N. 15TH ST.
McALESTER, OK 74501

PITTSBURG CO SPORTSMEN CLUB
JERRY FUGITT
HIWAY LODGE
McALESTER, OK 74501

POCOLA SPTS CLUB
F J WARN, PRES.
P.O. BOX 308
POCOLA, OK 74902

PONCA BOWMEN FIELD ARCHERY
NORMAIE STEPHENSON, SEC.
1000 N. OAK ST.
PONCA CITY, OK 74601

PONCA CITY CHAPTER IWL
ELLIS [illegible]
RURAL ROUTE
PONCA CITY, OK 74601

PONTOTOC CO COONHUNTERS
LUTHER GREEN, SEC.
ROUTE 3
ADA, OK 74820

PONY PASTURE ARCHERY CLUB
JACQUE HOWARD, SEC.
112 N. 4TH, BOX 36
CYRIL, OK 73029

POTTAWATOMIE CO COONHUNTER
[illegible]
[illegible] N. BEARD ST.
SHAWNEE, OK 74801

POTTAWATOMIE CO SPORTSMEN
KENT HILL, SEC.
123 N. BEARD
SHAWNEE, OK 74801

POWDER & STRINGS SPORTSMEN
P.O. BOX 276
HENNESSEY, OK 73742

PRAGUE SPORTSMEN CLUB
JOYCE HUFF, SEC.
BOX 991
PRAGUE, OK 74864

PRAGUE WILDLIFE CLUB
BOX 101
PRAGUE, OK 74864

PURCELL SPORTSMANS CLUB
GEORGE DOUGHTY, PRES.
606 N. 6TH
PURCELL, OK 73080

QUAIL HUNTERS CLUB OF OKC
DR. D MCGINNIS, PRES.
5028 NW 26TH
OKLA CITY, OK 73122

RATTAN COON CHASERS
JESS GANN, PRES.
RATTAN, OK 74562

RATTAN SPORTSMEN CLUB
LEO SMALLWOOD, SEC.
C/O RATTAN HIGH
RATTAN, OK 74562

RED RIVER COON HUNTERS
TOMMY WILLIAMS, PRES.
BOX 846
TERRAL, OK 73569

RED RIVER BOWHUNTERS
DR. CARL REED, SEC.
112 N. JULIAN
ALTUS, OK 73521

RED RIVER HUNTING CLUB
TOMMY BEACH
BOX 316
ELMER, OK 73539

RED ROCK SPORTSMEN CLUB
KEIL CLARK, SEC.
RED ROCK, OK 74651

RED TOP SPORTSMAN CLUB
C E ALSPAUGH
701 N. 11TH
DUNCAN, OK 73533

RIVERDALE SPORTSMEN CLUB
JAMES ISAACS, SEC.
MEDFORD, OK 73759

ROCK CREEK GUN CLUB
BOB MORGAN, OWNER
R R 3
SHAWNEE, OK 74801

ROCKY JR GUN CLUB
EDDIE DIFFENDAFFER, PRES.
ROUTE 1
ROCKY, OK 73661

ROCKY SPORTSMENS CLUB
L R BACON, PRES.
BOX 56
ROCKY, OK 73661

ROGERS COUNTY BOWHUNTERS
RONNIE WOOD, SEC.
RT 6, BOX 350
CLAREMORE, OK 74017

ROGERS CO CHAPTER IWLA
BOBBY G FOX, SEC.
316 FALLETTI
CLAREMORE, OK 74017

ROGERS CO SPORTSMEN CLUB
P O BOX 912
CLAREMORE, OK 74017

RON SPORTSMEN CLUB
R.M. HEFLIN
ROUTE 2
HOLLIS, OK 73550

ROSE VALLEY SPORTSMEN CLUB
J R BUCKLAND, SEC.
WAYNOKA, OK 73860

RYAN ROD & GUN CLUB
OTTO G, BOUND
RYAN, OK 73565

S CLEVELAND CO SPORTSMEN
JULIAN L CENTER
LEXINGTON, OK 73051

S COFFEYVILLE SPORTSMEN
GEORGE ELLIOTT, SEC.
BOX 187
COFFEYVILLE, OK 74072

S KINGFISHER SPORTSMENS
WAYNE HANSENFRATZ, SEC.
KINGFISHER, OK 74955

SALLISAW SPORTSMEN CLUB
REV D H CORWIN, PRES.
BOX 278
SALLISAW, OK 74955

SAN BOIS SPORTSMEN CLUB
VIRGIL MATTHEWS
ROUTE 1
KINTA, OK 74552

SANBORN CHAPTER IWLA
P.O. BOX 544
STILLWATER, OK 74074

SAND CREEK GUN CLUB
[illegible] JONES, SEC.
R ROUTE
WAKITA, OK 73771

SAND SPRING SPORTSMEN
4818 BERMUDA AVE., BOX 383
ROBERT BYNUM
SAND SPRINGS, OK 74063

SCENIC RIVERS ASSN. OF OK.
D R STRICKLAND, PRES.
1509 N. MAIN ST.
MUSKOGEE, OK 74401

SENTINEL ROD & GUN CLUB
[illegible] MASON, PRES.
BOX [illegible]
SENTINEL, OK 73664

SHAWNEE BASS CLUB
FRED LOVELAND, JR.
1 MOJAVE DR.
SHAWNEE, OK 74801

SHAWNEE RIFLE & PISTOL
WAYNE CARLTON
203 PATRICIA
TECUMSEH, OK 74873

[illegible] SPORTSMEN CLUB
[illegible] DAVIS, SEC.
[illegible] 502
[illegible]DLER, OK 74652

SICKLES GUN CLUB
GLENN TAPPER
RT 1, BOX 80
LOOKEBA, OK 73053

SIERRA CLUB - OKLA GROUP
ROBT J PERSON
4101 WOODS DRIVE
OKLA CITY, OK 73111

SILVER CITY SPORTSMEN CLUB
SAM EWING, SEC.
BOX 431
PURCELL, OK 73080

SKIATOOK SPORTSMENS CLUB
CATLE E ROBERTS, PRES.
BOX 326
SKIATOOK, OK 74070

SNAKE CREEK COONHUNTERS
JAMES LOCKE, PRES.
36 S 205 E AVE.
TULSA, OK 74105

SOONER BRITTANY CLUB
P.O. BOX 94
HOLLIS, OK 73550

SOONER GUN CLUB, INC.
MAURICE V BARNES, SEC.
1407 E 41 PL
TULSA, OK 74105

SOONER RETRIEVERS CLUB
MARGARET PATTON
C/O DICK COOK
STILLWATER, OK 74074

SOUTH OKLA BRITTANY CLUB
P.O. BOX 764
ARDMORE, OK 73401

SOUTHSIDE JR GUN CLUB
920 SW 69TH ST
OKLA CITY, OK. 73139

SOUTHWEST ROUNDERS
D STANTON
819 NW 41
LAWTON, OK 73501

SPORTSMAN CLUB
GLEN KELLER, PRES.
RT 6, BOX 7
EDMOND, OK 73034

SPORTSMANS CLUB OF TRI-STATE
R L PRACHT, PRES.
123 MEDICAL DR.
GUYMON, OK 73942

SPORTSMENS CLUB WATONGA
JAMES P STEPHENSON PRES.
717 N. WIKOFF
WATONGA, OK 73772

SPORTSMENS COUNTRY CLUB
E HART FEATHER, MGR
713 HARDING CT
EDMOND, OK 73034

SPRING RIVER BOWMEN
RON WOOLDRIGE, SEC.
712 HARNED
MIAMI, OK 74354

SPRING VALLEY SPORTSMENS
LOREN L WEST, PRES.
KINGFISHER, OK 73750

STATE WILDLIFE RANGE INC.
R H WEB[illegible]
1135 N ROCKWELL
OKLA CITY, OK 73127

STEPHENS CO QUAIL CLUB
RICHARD PASS, SEC.
ROUTE 2
COMANCHE, OK 73529

STERLING ROD & GUN CLUB
WELDON COSGROVE
BOX 241
STERLING, OK 73567

STILLWATER BRITTANY CLUB
NOLEN CAT[illegible], PRES.
BOX 614
STILLWATER, OK 74074

STILLWATER FIELD TRIAL CLUB
JOHN FLOYD
1101 STANLEY
STILLWATER, OK 74074

STONEWALL SPORTSMEN CLUB
SAM TOWNSEND, SEC.
BOX 365
STONEWALL, OK 74871

STONY POINT ROD & GUN CLUB
HALSEY BURNS, PRES.
STAR RT.
LAWTON, OK 73501

STRAIGHT ROD & REEL CLUB
ROUTE 1
GUYMON, OK 73942

STRATFORD SPORTSMEN CLUB
E U MCGAR, PRES.
NORTH ELM STREET
STRATFORD, OK 74872

SULPHUR ROD & GUN CLUB
[illegible] BLACKBURN, PRES.
310 E OKLA
SULPHUR, OK 73086

SUNSET SPORTSMEN CLUB
BILL WHEATLEY, SEC.
P.O. BOX 11
DARROUZETT, TX 79024

TAHLEQUAH BOWHUNTERS
HELEN THORNTON, SEC.
BOX 805
TAHLEQUAH, OK 74464

TALIHINA SPORTSMEN CLUB
RON PETTER
BOX [illegible]
TALIHINA, OK 74571

TALOGA SPORTSMEN CLUB
GENE THOMSEN, SEC.
TALOGA, OK 73667

TECUMSEH SPORTSMEN CLUB
CLYDE WARD
BOX 224
TECUMSEH, OK 74873

TERRITORIAL GUN COL. ASSN.
D L COOPER
8024 NW 27TH ST.
OKLA CITY, OK 73127

TEXHOMA SPORTSMEN CLUB
S W HAMBY, JR., SEC.
TEXHOMA, OK 73949

THIRTY SPORTSMEN CLUB OF
BARTLESVILLE, INC.
537 SE GREYSTONE, BOX 3022
BARTLESVILLE, OK 74003

THUNDERBIRD ARCHERY CLUB
PAT KEYES, SEC.
1410 E BOYD
NROMAN, OK 73069

THUNDERBIRD SPORTSMAN CLUB
P.O. BOX 214
NORMAN, OK 73069

TINKER ROD, GUN & BOW CLUB
P.O. BOX 45511
TINKER AFB, OK 73145

TONKAWA CHAPTER IWL
DR. M L BERGSTEN, SEC.
BOX 432
TONKAWA, OK 74653

TONKAWA SPORTSMEN CLUB
RONNIE BLUEBAUGH
BOX 66
TONKAWA, OK 74653

TRI-CITY BASS CLUB
PHILLIP GORDON, V-PRES.
3045 DEL RANCHO
DEL CITY, OK 73115

TROSPER ARCHERS
JIM VAUGHN, SEC.
2129 SW 77TH ST.
OKLA CITY, OK 73159

TULSA ANGLERS CLUB INC.
JIM STILWELL
1228 S CANTON
TULSA, OK 74112

TULSA ARCHERY ASSN.
TWYLA HICKS, SEC.
P.O. BOX 35
COLLINSVILLE, OK 74021

TULSA AUDUBON SOCIETY
TOM BUTLER, PRES.
BOX 119
LIMESTONE, ARK 72646

TULSA BOW HUNTERS INC.
BEN BISHOP, SEC.
6347 W 41ST
TULSA, OK 74107

TULSA CANOE & CAMPING CLUB
REED FLINN
5338 E. 28TH
TULSA, OK 74114

TULSA BASS CLUB
P.O. BOX 45431
TULSA, OK 74129

TULSA GUN CLUB
W F AUTRY, PRES.
4413 E 23RD ST.
TULSA, OK 74114

TUMBLEWEEDS SPORTSMEN CLUB
GLENN SULLIVAN
RT. 4, BOX 128
NORMAN, OK 73069

TURPIN SPORTSMEN CLUB
RALPH DIETRICK, SEC.
TURPIN, OK 73950

TUTTLE ROD & GUN CLUB
B F DOSS
BOX 163
TUTTLE, OK 73089

U S BRITTANY CHAMPIONSHIP
JOE McCRAY
1608 SW 77TH PL.
OKLA CITY, OK 73159

U S BRITTANY CLUB INC
C T YOUNG, PRES.
4336 NW 23RD ST.
OKLA CITY, OK 73107

UNION CITY SPORTSMEN CLUB
CLIFFORD BROMBOU
UNION CITY, OK 73090

VERDEN QUAIL CLUB
DON GRAHAM, PRES.
BOX 31
VERDEN, OK 73092

VICTORY GUN CLUB
KAY FREEMAN, SEC.
AMORITA, OK 72719

VINSON GUN CLUB
BOBBY BROWN
BOX 53
VINSON, OK 73571

WAKITA GUN CLUB
LOUIS W BRUNER, SEC.
WAKITA, OK 73771

[illegible] K GUN CLUB
CHARLIE [illegible], SEC.
[illegible] W 10TH
GUYMON, OK 73942

WALNUT CREEK SPORTSMEN CLUB
HARVEY BAIRD, SEC.
RT 2, BOX 54
WAYNOKA, OK 73860

WASHINGTON SPORTSMEN CLUB
CLYDE L. WARD
BOX 117
WASHINGTON, OK 73093

WASHITA VALLEY ARCHERS
[illegible], SEC.
RT [illegible], BOX [illegible]
ANADARKO, OK 73005

WAURIKA SPORTS CLUB
LOY H STOUT
315 E. B STREET
WAURIKA, OK 73573

WAYNOKA COONHUNTERS ASSN.
J E BRADFORD, PRES.
316 S. MISSION
WAYNOKA, OK 73860

WEATHERFORD SPORTSMEN CLUB
L L DUNN
BOX 105
WEATHERFORD, OK 73096

WEBB CITY SPORTSMANS CLUB
JOE CURNETT, PRES.
BOX 65
SHIDLER, OK 74652

WELCH ROUNDUP SPORTSMEN
GEORGE W CHANEY, SEC.
WELCH, OK 74369

WELEETKA SPORTSMEN CLUB
ORVEL JONES, SEC.
BOX 265
WELEETKA, OK 74880

WESTERN ARCHERS
DAVE BISHOP
7800 NW 6TH
OKLA CITY, OK 73125

WESTERN ELEC. FISHING CLUB
EURETA SMITH, PRES.
16 B STREET
NORMAN, OK 73069

WESTERN ELEC GUN CLUB
4632 NW 36TH
OKLA CITY, OK 73122

WESTPOINT BOWMEN
RICHARD DAHLGREN, SEC.
617 S. 8TH
YUKON, OK 73099

WETUMKA SPORTSMEN CLUB
F C CALLISON, PRES.
520 E. ST. LOUIS
WETUMKA, OK 74883

WEWOKA SPORTSMEN CLUB
MICKEY McGUIRE, SEC.
1720 S OCHEESE
WEWOKA, OK 74884

WICHITA MTN COONHUNTERS
BUX THIMPSON, PRES.
906 JEFFERSON
LAWTON, OK 73501

WICHITA MTN ROD & GUN CLUB
MRS. LUDIE CALVIN
BOX 272
CACHE, OK 73527

WICHITA MOUNTAINS SPTS CLUB
BOX 296
SNYDER, OK 73566

WILLOW SPORTSMEN
C L McMURTRY, SEC.
BOX 206
WILLOW, OK 73673

WOODWARD CO CHOOTING DOG
C W TAYLOR, PRES.
1211 CEDAR PLACE
WOODWARD, OK 73801

WOODWARD GUN CLUB
JIM BERRY, PRES.
BOX 38
BUFFALO, OK 73834

WOODWARD ROD & GUN CLUB
N J BEAVERS, SEC.
WOODWARD, OK 73801

ZANIES QUAIL CLUB
TOM TIPPS, PRES.
804 CARTER
ARDMORE, OK 73401

Groups and Individuals

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Bureau of Land Management
District Manager

Dear Sir:

The Duncan Garden Council wishes to go on record, as to our feeling of strip mining. We dont object to mining but to the way the land is reclaimed. This is the main concern of 125 member Council.

The southeastern part of our state have a big problem with flooding each year. I observed during the flood in Oct. the amount of silt the water was carrying away.

This area should be reclaimed, with trees and ground cover immediately so there is as little damage to the landscape as possible such as watershed, wildlife habitat etc.

If we have laws Concerning the mining and reclaiming the area, we would like to see these laws enforced.

Sincerely

Garden Council Pres.
Mrs E.M. Holcom Sr.
G.C. Sec.
Mrs C.L. McIlvain

GROVE AUTO SUPPLY
27 West 3rd • Grove, Oklahoma 74344 • (918) 786-2293

BLM
ALBUQUERQUE
NOV 14 1974
FILE

Dear Sir,

I'm writing in Reply to U.S. [illegible] Time [illegible] 11-6-74. I know we need more fuel especially Coal. It's too bad we can't get the coal and not Effect the top surface. All the Area disturbed are prime Deer Habitt as well as other animals. I've never seen any land Ever put back Even Close to the Original Surface. just north of us in Kansas where they did strip mining it is awful. If they leave some way to be sure and cover with top soil not spreading that won't hardly grow vegetation, and made smooth and or level. Where you can walk over with out stumbling and falling. also while mining is in progress, wildlife will totally be destroyed, then will have to be Restocked. it will pump more taxes into the local Economy & County but then when its over it hurt towns. If there was a sure way of putting the land back in good shape I would want the Coal out.

Yours Truly
James [illegible]
Pres. Grove Bowhunters
Box 3 GROVE, OKLA
74344

Haileyville Bowhunters Club
Haileyville, Oklahoma 74546

November 19, 1974

Bureau of Land Management
3550 Pan American Freeway, N.E.
Albuquerque, New Mexico 78107

Gentlemen:

Our organization feel that the coal mining industry would be of great benefit to our economy in this area, due to the fact that on an over-all average, this is a low income community.

However, we wish to go on record as being assured that the 1969 Federal Act would be strictly enforced. This area has suffered in previous years by mining operations.

We feel that if there is going to be a displacement of our wildlife, there must be a program submitted to our state Wildlife Department in order that plans may be formulated to preserve it.

There are many concerned sportsmen in this vicinity as to how this will affect our recreation and hunting areas. We have your maps, but would like further information concerning this matter.

Our club sincerely feesl that our area will be left in a condition of improvement and appreciate your inviting our comments.

Yours truly,

Vernon E. McCarty
Park Commission Chairman
Haileyville Bowhunters Club

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ROB RCN

SUNOCO

SUN OIL COMPANY

November 14, 1974

United States Department of the Interior
Bureau of Land Management
3550 Pan American Freeway, N. E.
Albuquerque, New Mexico, 87107
Attention: Mr. R. Keith Miller

Dear Mr. Miller:

This has reference to your letter of November 6, concerning environmental control of proposed coal leases in southeast Oklahoma.

I have enclosed a pamphlet periodical published by the company I work for that you may find interesting -- refer to page 5.

Strip mining, if controlled and the area stripped receives the proper treatment, as you undoubtedly know, will not be a detriment to the area; in fact, in this particular area I personally believe the area would be improved over the condition that exists today.

If I can be of any service to you or your area manager, please inform.

Yours verty truly,

B. E. Franke
President, Lake Fort Gibson
Sportsman Club

BLM
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Enclosure

DX — SYMBOL OF SUN OIL COMPANY QUALITY PRODUCTS IN MIDWESTERN STATES

SOONER GUN CLUB, Inc.
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OKLA.

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ALBUQUERQUE
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1407 E. 41st Place
Tulsa, Okla. 74105
19 November 1974

Bureau of Land Management
% District Manager
3550 Pan American Freeway, N. E.
Albuquerque, New Mexico 87107

Gentlemen:

The Sooner Gun Club, Inc. acknowledges receipt of your letter dated 6 November 1974.

The land area Sooner Gun Club has leased for rifle range and picnic purposes lies in Rogers County, Oklahoma, and is well outside the Federal Coal area indicated on your map.

Though our rifle range - picnic area is outside the Federal Coal area indicated our comments are:

As a rifle club our interest is surface usage of the land for recreation as chartered by the National Rifle Association of America. Sooner Gun Club must command range control, and have undisputed access to and from the rifle range - picnic area as specified in our contract with the land owner. It is hoped that our club members would never be locked out of the rifle range or picnic area by either union or company action. We would ask that each club member be free to enjoy club membership, limited only by Sooner Gun Club range rules.

Finally we would ask that the surface land of any depleted coal mining area be restored to a condition equivalent to that before mining operations began.

Sincerely yours,

Maurice V. Barnes,

Maurice V. Barnes
President
Sooner Gun Club, Inc.

Copies furnished:

Bob Moore	Land owner
Lester L. Updegraff	Club secretary - treasurer
C. G. Hargrave	Club director
Ray Pooler	" "
Walter Hummel	" "
Mahlon B. Robertson	" "

November 25, 1974

Bureau of Land Management
3550 Pan American Freeway, N. E.
Albuquerque, New Mexico 87107
Mr. R. Keith Miller

Dear Mr. Miller,

After seeing a copy of your letter asking for public comment of the BLM plan to make an environmental analysis study of federally owned coal in Oklahoma, I wanted to write you my views.

As an interested party in the mining business and also the welfare of the Nation, I feel that a plan of this kind would be a disastrous blow to the mining industry and the people in the area.

As you are well aware the mining industry has more than its share of Federal and State mining laws and regulations, most of which serve very little if any significant benefits to the industry.

For the BLM to make an environmental analysis before making leases on government owned coal would virtually stop the mining of coal on government land, therefore defeating the purpose and wisdom of those men who had the foresight to buy these reserves seventy five or eighty years ago, to insure that this coal would be available when needed.

I would like to suggest that the Office of BLM spend their energy on trying to accelerate the backlog of requests that they now have for leases.

Yours Truly

Kenneth S. Beam

Kenneth S. Beam

5801 S. [illegible]
[illegible], Ok.

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December 2, 1974

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Bob A.

RS Last

Mr. R. Keith Miller
District Manager
Bureau of Land Management
3550 Pan American Freeway N.E.
Albuquerque, New Mexico 87107

Dear Mr. Miller:

I am responding to your invitation for public comment to be considered in your writing an environmental analysis record involving Federal coal lease areas in Southeastern Oklahoma.

Considering the recent draft envirnomental statement DES 74-53 recently completed by the Bureau of Land Management, it eludes me why further environmental analysis is needed by the Bureau. Statements made on page I-7 of the subject report definitely include southeastern Oklahoma in the subject report. If they are not included, why was so much money spent on the report that left out this area? Your request for environmental comments seems belated under this premise.

While your letter makes obvious mention of the envirnomental hazards of mining you fail to mention that Oklahoma has the most rigid land reclamation law requiring backfilling to an acceptable topography. In addition most of the coals of Southeastern Oklahoma will require underground mining.

I fully recognize the requirement placed on the Bureau by NEPA Public Law 91-190. Nevertheless, I wish to point out that unless the Bureau of Land Management recognizes the importance of the mining industry on our nations global well being there will be no tax dollars left in our bankrupt economy to support any of our nations noble goals.

Even the Bureau's program of EMARS (Energy Minerals Allocation Recommendation System) has achieved zero results in eliminating the punitive role of the Bureau. If it is the goal of the Federal Government to take over all mineral industries -- it would be well to inform the mineral industries now. A great deal of hard work and planning seems to be hindered by a clear directive on the part of Federal agencies to support our nations mineral industries.

A day may come when the Bureau rushes out to the pitcher's mound and yells "Play Ball" only to find out all the ball players have gone home.

It is sincerely hoped that this letter will offer some counter points to the negative comments you so carefully sought in your invitational letter.

Sincerely,

Frank Buturla

Frank Buturla
2910 Ridgecrest
Casper, Wyoming 82601

Warner Oklahoma
November 10, 1974

Bureau of Land Management -
Dear Sirs:

The impression I got on reclamation in Haskell County was good -

I live in Muskogee County in the production area of this county - I am not sure what will be results up here - Be sure they are being watched.

I have watched effects of terrible destruction in Sequoyah & other northeastern counties i.e. Nowata and Rogers.

Government agencies tend to have too much paper for writing memorandums and often short on back bone -

I try to appreciate the practical economical use of our resources - my main efforts have been concerned with soil grass & population resources -

Foreman Carlile

Monitoring

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November 21, 1974

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Mr. R. Keith Miller
District Manager
Bureau of Land Management
3550 Pan American Freeway N.E.
Albuquerque, New Mexico 87107

Refer to 1791

Dear Mr. Miller:

I am responding to your invitation for public comment to be considered in your writing an environmental analysis record involving Federal coal lease areas in Southeastern Oklahoma.

The National Environmental Policy Act of 1969 is cited as the authority requiring the exercise you propose. When one considers that the subject lands were designated by the Government as principally valuable for coal about 80 years ago, and subsequently confirmed and purchased from the Indian nations to promote leases for the coal values, one can hardly ignore that Federal action was long-standing rior to the NEPA of 1969. To suggest NEPA frustrates the continued issuance of coal leases on subject lands as provided in the prior Government committments parallels the absurdity that NEPA renders further navigation on the Arkansas River Navigation Project invalid until a like environmental analysis is recorded or that no more power can issue from the Hoover Dam until the same requirements are met. Even assuming the BLM is priviledged to engage in the broad interpretation implied by the illustration, one can hardly excuse the BLM for waiting 5 years to exercise its priviledge - at just the moment the coal should be utilized to relieve a good many of the economic pressures currently suffered by the State of Oklahoma and the Nation. The priviledge could as well have been exercised and the analysis written in 1970 to relieve the since-standing inaction on applications for leasing Federally-owned coal.

Such arbitrary and incredible exercise at Bureau authority constitutes a significant portion of the disincentives that produce "energy crises", "economic crises" and an unstable environment in which industry is reluctant to commit the massive quantities of high risk capital to develop the fundamental resources needed for human economic activity.

Agency performance in administering the Multiple Use Act of 1960 and 1964, National Environmental Act of 1969, MESA of 1969, OSHA of 1970, the proposed Forest Service Mining Regulations of 1974 and the proposed BLM version of Mining Regulations currently in the mill and perhaps others have been punitive in ttitude toward industry. The Mining and Minerals Policy Act has been essentially ignored. That attitude in enforcement has produced many nebulous contingencies a free-enterprise oriented industry is unable to appraise with any fair degree of confidence. That Governmental attitude must change before industry can produce the necessary fundamental economic resources to lift the nation from its current throes of economic afliction.

With regard to your stated purposes of the analysis that "...stipulations will be developed to protect..." the aesthetic values and the resource values, I would caution that cosmetic and aesthetic values exist only in a condition of social affluence - a condition that exists only as a result of the efficient utilization of the wasting and renewable resource values. Any rational environmental analysis must acknowledge and maintain that distinction.

In further regard to your stated purpose of the analysis, I sense the stipulation to be derived, in the BLM view, will require additional regulation and enforcement. The statement implies industry and the community can coexist only with the assistance of a remote Government specialist to define the beneficial parameters. Hopefully, an unbiased reading of the data proves the opposite, and that the bureau will be enabled to concentrate its energy in streamlining systems to accelerate the acceptance of leases and approval of exploration and mining plans so the nation can have the benefits of the sorely needed coal. Currently, on existing leases layer upon layer of superficial bureau review is required for approval. I have talked to no one able to explain the process or who can say who ultimately makes the approval. My observation suggests too much production time is consumed in getting a simple surface mining plan approved in which the government has no interest in surface resources. The process is another example of bureau zeal to dictate the parameters it decides is beneficial to the community - a seemingly unnecessary encroachment in light of the environmentally aware public and industry you are dealing with today.

Hopefully, this frank missile will assist you and your agency to develop an attitude less punitive to industry, more credible than has been apparent in the recent past and more responsive to the needs of the nation than the dubious and superficial environmental analysis you propose in the referenced situation.

Sincerely,

Jack Gillespie

Jack Gillespie
3404 Morris
Pueblo, Colorado 81008

Coal Companies

Producing Coal Since 1925

Garland Coal & Mining Co.

AREA CODE 501 783-8914
P.O. BOX 186 – 88 SOUTH FOURTH STREET
FORT SMITH, ARKANSAS 72901

November 19, 1974

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Gentlemen:

It is our position that coal mining in southeastern Oklahoma would carry economic benefits far outweighing any possible environmental damage. The areas delineated in your letter of November 6 are characterized by chronic unemployment and low per capita income. Coal mining offers wages of up to $50 per day, investments of up to $20 per ton of annual capacity, and supply requirements of $5 or more for every ton produced. Therefore the economic impact of mining would be both substantial and highly favorable.

It is also submitted that any environmental damage may be strictly limited by proper reclamation requirements. Much of the land in the counties in question is unimproved. Even surface mining may improve such property if topsoil is replaced and the area is seeded and fertilized. With regard to acreage which has been improved, enforcement of standards set forth above should preclude any lasting damage. Moreover, the fact that higher personal income levels tend to lead to the improvement of other land not directly involved in mining is often overlooked and never assigned adequate weight.

We certainly appreciate this opportunity to set forth our feelings, and will be most happy to cooperate with the BLM in any way possible in the continuation of your investigations. If you will keep us advised we will most appreciate it.

Sincerely,

J F Potter III

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6
UNITED STATES GOVERNMENT

Memorandum

3040
A-12

TO : EAR on Oklahoma Federal Coal Reserves **DATE:** December 16, 1974

FROM : Environmental Coordinator

SUBJECT: Meeting on 12/11/74 with Representatives of Lone Star Steel Co. Concerning their involvement in coal leases, applications, and future plans in southeastern Oklahoma.

Attending the meeting were:

Paul Savage - Lone Star Steel Co.
Jerry Fulton - Lone Star Steel Co.
Bill Egan - BLM - N.M.S.O.
Don Fisher - BLM - N.M.S.O.
John Rhodes - Albuquerque District Office-BLM
Rob Nauert - Albuquerque District Office-BLM
Bob Armstrong - Albuquerque District Office-BLM

During the meeting the purpose, scope, and proposed time frame were explained to Mr. Savage. At this time it is anticipated that the environmental analysis report will be completed in January 1975, at which time a recommendation would be made by the BLM in the Albuquerque District Office on whether or not an environmental impact statement would be needed.

Mr. Savage was very cooperative in offering information involving coal deposits in areas where his company has coal leases.

They explained the present strip mining operations of Lone Star Steel Co. (one on Federal Coal lease approximately 2 miles north of Stigler, Oklahoma and one on privately owned coal approximately 4 miles east of McAlester, Oklahoma) have satisfactory deposits to last another 2 to 3 years. At the conclusion of mining in these two areas his company will move onto other areas of leased or owned coal and involving Federal coal leases.

Methods of condemnation proceedings by coal companies in this area were discussed. Mr. Savage said that this company operated under the <u>Indian Nations Act</u> which applies to segregated coal (Federal Coal) which has been up held in court proceedings. Mr. Savage is sending BLM Albuquerque a copy of what he has pertaining to this law.

He also provided us with technical information on coal deposits which was given to Bill Egan.

Robert K. Armstrong

WARD PADGETT
CHIEF MINE INSPECTOR

[illegible] CA[illegible]L BUILDING
OK[illegible] CITY, OKLAHOMA 73105

EL: 405 521-3859

STATE OF OKLAHOMA
DEPARTMENT OF MINES

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November 13, 1974

Mr. R. Keith Miller
District Manager
Bureau of Land Management
3550 Pan American Freeway, N. E.
Albuquerque, New Mexico 87107

Dear Mr. Miller:

Reference is made to your letter of November 6 asking for comments, opinions, ideas, etc., to be used in an environmental analysis of Federal coal lease areas in southeastern Oklahoma.

The impact which may be expected will largely depend on what the Federal Government imposes on the mining industry. For instance: To get a plan approved for mining of coal is now taking from four to six months, and this seems excessive.

I am sure you are aware that we have a reclamation law in Oklahoma, a law which we feel is working quite well even though we plan to ask the legislature to amend some sections for a more stringent law.

On September 18 and 19 a two-day inspection trip of surface mined and reclaimed areas in Oklahoma was arranged largely for the benefit of certain critics and skeptics. People on this tour were from the Sierra Club, Wildlife Federation, Pollution Control, League of Women Voters, EPA from Washington, Oklahoma legislators and other interested persons. A group such as this could be expected to criticize the manner in which land was being reclaimed. During the trip and after the trip was completed, we had no adverse criticism from any of the people making the tour except that perhaps we were doing too much. So far as we are concerned, we would much rather be in the position of doing too much than not enough.

As you are aware, Oklahoma coal seams, unlike those in many other states, are thin and most seams pitch from zero to 90 degrees thus limiting surface mining areas. It would be disastrous, therefore, for the State if the Federal Government passed reclamation laws fitted to conditions in the eastern states such as West Virginia, Pennsylvania and Kentucky. The Oklahoma mining industry could not comply with such rules and regulations.

It is my opinion that the people of the State of Oklahoma are not only capable but willing to take care of their own reclamation problems without the interference of Federal laws.

Enclosed is a copy of a paper by Dr. Kenneth S. Johnson of the Oklahoma Geological Survey which may be of interest to you.

If I can be of any other assistance, please feel free to call on me.

Sincerely,

Ward Padgett

WARD PADGETT

WP:eh

Enclosure

State and Local Agencies

STATE OF OKLAHOMA
DEPARTMENT OF ENERGY
4300 North Lincoln Boulevard Suite 251
Oklahoma City, Oklahoma 73105
Phone (405) 521-2995 521-3941

DAVID HALL
GOVERNOR

RICHARD G. HILL
DIRECTOR

CHARLES [illegible]
[illegible]

December 26, 1974

ALBUQUERQUE
DEC 30 1974

Bob A.

Mr. R. Keith Miller
District Manager
Bureau of Land Management
3550 Pan American Freeway, N. E.
Albuquerque, New Mexico 87107

Dear Mr. Miller:

Your letter of November 6, 1974, regarding coal mining in southeastern Oklahoma was received in our office this date.

As the Oklahoma Department of Energy does not have access to the information you requested, I am forwarding your letter to Mr. Ward Padgett, Chief Mine Inspector, Department of Mines.

I am sure Mr. Padgett will be in touch with you in the near future.

Sincerely,

Dick Hill

Richard G. Hill

RGH:fw

STATE OF OKLAHOMA
Office of the Governor
DEPARTMENT OF INDUSTRIAL DEVELOPMENT
OKLAHOMA CITY, OKLAHOMA 73105

Ben Langdon, Director
405/521-2401

500 Will Rogers Building

December 30, 1974

Mr. R. Keith Miller
District Manager
U.S. Department of the Interior
Bureau of Land Management
3550 Pan American Freeway, N.E.
Albuquerque, New Mexico 87107

Dear Mr. Miller:

Your letter of November 6, 1974 reached this office last week and I am taking the privilege of forwarding it to Ward Padgett, Chief Mine Inspector, State Capitol, Oklahoma City, Oklahoma 73105.

Sincerely,

Ben Langdon

Ben Langdon
Director

BL/kh
cc: Ward Padgett
Chief Mine Inspector

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OKLAHOMA GEOLOGICAL SURVEY

Charles J. Mankin, Director

November 16, 1974

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Mr. R. Keith Miller
District Manager
Bureau of Land Management
3550 Pan American Freeway, N.E.
Albuquerque, New Mexico 87107

Dear Mr. Miller:

We received your request for information, comments, and opinions concerning coal mining in parts of eastern Oklahoma. We have been actively involved in investigating the geology and coal resources in the area, and also in studying some of the environmental results of mining these coal resources, and we are forwarding to you separately the results of these studies.

Items being forwarded include:

Rec.

1. "An Investigation of the Coal Reserves in the Ozarks Section of Oklahoma"
2. "Maps and Description of Disturbed and Reclaimed Surface-Mined Coal Lands in Eastern Oklahoma"
3. "Geologic Map of Oklahoma"
4. A bibliography of selected articles and reports on coal resources and coal mining in Oklahoma.

We have been deeply concerned with the continuing and growing energy needs of our nation, and hope to see intelligent use of our resources with a minimum disturbance of the environment. We feel that it has been well demonstrated, by recent activities in parts of eastern Oklahoma and southeast Kansas, that the coal resources can be mined (surface mines or underground mines) and the land can be returned to productivity after mining has ceased. This is not the impression one obtains in looking at Oklahoma "orphan" lands mined prior to 1968, or in looking at the results of past and some present mining in other coal fields of the United States, but Oklahoma has effective legislation now and different climatic and geologic controls than are found in other coal fields.

IE UNIVERSITY OF OKLAHOMA / 830 VAN VLEET OVAL, ROOM 163 / NORMAN, OKLAHOMA 73069 / PHONE (405) 325-3031

I hope the information being sent will be of value to you in preparing an environmental analysis record. We would like to cooperate most fully in helping you in this endeavor, and would be glad to explore ways in which we can contribute our expertise to this important work. Please let me know how we may of further assistance.

Sincerely,

Charles J. Mankin

Charles J. Mankin

CJM/cbt

STATE OF OKLAHOMA
OFFICE OF COMMUNITY AFFAIRS AND PLANNING
4901 N. LINCOLN BLVD.
OKLAHOMA CITY, OKLAHOMA 73105
PHONE (405) 521-2881

OHN H. MONTGOMERY
ADMINISTRATOR

January 13, 1975

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Bureau of Land Management
c/o District Manager
3550 Pan American Freeway, N. E.
Albuquerque, New Mexico 87107

RE: 1791

Gentlemen:

This letter is in response to the subject letter regarding BLM coal lands in Southeastern Oklahoma.

We believe that the Office of Community Affairs and Planning could be more helpful in securing information relevant to your environmental analysis if you could advise us of the nature of the information you presently hold and the additional information you desire. A detailed outline of the environmental analysis record and the analytic techniques to be utilized in determining environmental impact would allow us to assist you more completely.

We would also be interested to receive complete information concerning the administrative procedures BLM proposes to follow in the preparation and distribution of EIS information as individual leases are acquired by mining companies. We believe that the November 19, 1974 letter from KEDDO made excellent recommendations in this regard.

We are looking forward to your reply and will be pleased to provide you with all possible assistance.

Yours truly,

John H. Montgomery

John H. Montgomery
Administrator

JHM/jm

Kiamichi
Economic
Development
District of
Oklahoma

"A local organization working for a greater Kiamichi Country"

Eastern Oklahoma State College
Area Code 918 465-2367
Wilburton, Oklahoma 74578

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Rob

November 19, 1974

Mr. Lloyd A. Eisenhauer
Bureau of Land Management
3550 Pan American Freeway
Albuquerque, N.M. 87107

Re: Federal Coal Reserves in Southeastern Oklahoma

Dear Mr. Eisenhauer:

Through recent discussion and correspondence with Mr. S. A. Friedemann of the Oklahoma Geological Survey Office, a number of ideas have been formulated in reference to designing a federal coal reserve policy for Southeastern Oklahoma. Additional input from local businessmen, public officials and state officials has been registered and synthesized into the following suggestions:

PREQUISITE FOR COAL POLICY STATEMENT DEVELOPMENT AND ENVIRONMENTAL ASSESSMENTS.

A. Procure a reliable mineral resource data base for federal lease holdings. Convert recently gathered information regarding Oklahoma coal reserves into computer form, or appropriate alternate, thereby enabling periodic updates to reflect new deposit discoveries and ore extractions.

B. Develop an information retrieval system regarding the data bank for use by private enterprise, local units of government, and federal offices.

C. Conduct a series of public forums to discuss the action and consequences of opening federal coal reserves to the mining industry.

Implicit in this step is:

1. Identification of individuals, organizations and units of government that would be impacted by mining of federal coal leases.

2. Preparation, circulation and collection of questionnaires that accurately address the attended topics.

3. Development of criteria to judge responses gathered through the public forum/questionnaire format.

4. Inventory surface variables which will be affected by potential mining operations. i.e. growth patterns, land use patterns, economic structure, transportation systems, etc.

5. Interview representatives of mining companies to determine the economic parameters in which firms must operate. Record suggestions that representatives may offer, relative to leasing conditions and environmental safeguards.

6. Investigate and determine environmental elements that will be impacted by projected mining. Interview soil scientists, conservationists, representatives of the Oklahoma Sierra Club and Indian Nation Trains Club, etc. within the lease area to gain insight and opinions on how to best mitigate permanent damage incurred by strip mining.

7. On a periodic basis, renew contact with public, private, and local governmental authorities to record feedback regarding mining operations being conducted on federal coal leases.

8. Compile and synthesize results of the previous steps into policy guideline recommendations for BLM's utilization.

Activation of these procedures will require extensive use of professional time, supportive staff and computer services. Familiarity with authorities within the impacted region and information recently collected on Oklahoma coal deposits would greatly assist investigation efforts. It is therefore recommended that funds be made available for study purposes at the state and substate level.

Your early response to these suggestions would be greatly appreciated.

Sincerely,

Bill H. Hill
Executive Director, KEDDO

BHH:sc

cc: Speaker Carl Albert
Mr. S. A. Friedemann
Mr. John Montgomery
Oklahoma Geological Survey
Senator Dewey Bartlett
Senator Henry Bellmon
State Legislators

KIAMICHI COUNTRY

RECREATIONAL PARADISE, POTENTIAL INDUSTRIAL EMPIRE AND THE HOME OF

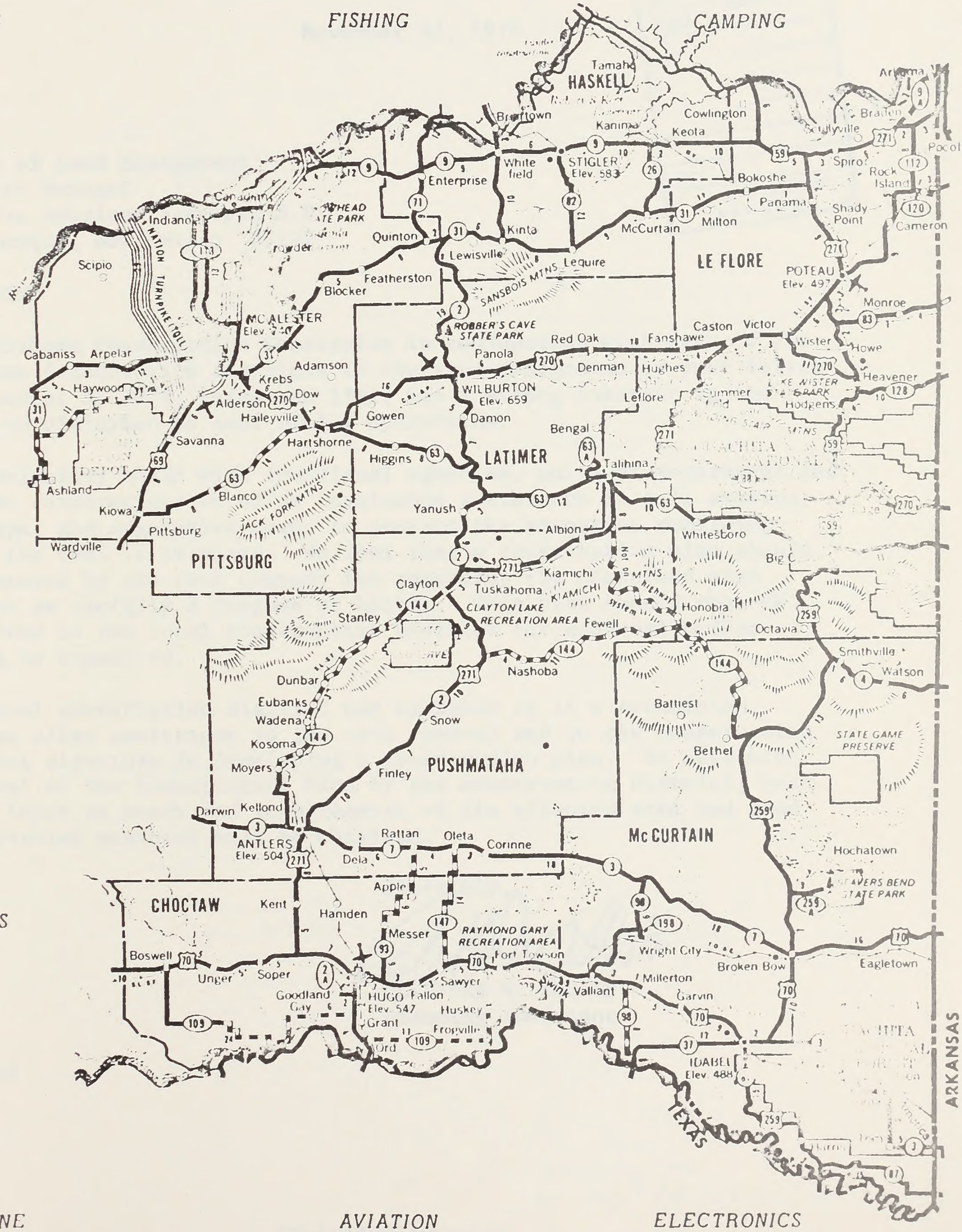
141,000 FRIENDLY PEOPLE

HUNTING *FISHING* *CAMPING* *GAS*

LUMBER

WATER

PLASTICS



LIMESTONE *AVIATION* *ELECTRONICS* *COA*

ONARD A. SOLOMON
Executive Director

DON DUDLEY
Assistant Director

OKLAHOMA CONSERVATION COMMISSION
114 STATE CAPITOL BUILDING
OKLAHOMA CITY, OKLAHOMA 73105
PHONE 521-2384

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ALBUQUERQUE
NOV 15 1974
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AS ✓ Bob Armstrong
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✓ = INFO.

November 13, 1974

Bureau of Land Management
District Manager
3550 Pan American Freeway, N.E.
Albuquerque, New Mexico 87107

Dear Sir:

The Oklahoma Conservation Commission in conjunction with each of the Oklahoma Conservation Districts in the area designated by your letter of November 6, 1974, reference 1791, has a strong interest in the lands so disturbed by coal mining operations.

On a voluntary basis with individual agencies, units of government and private corporations we offer invaluable assistance in soil erosion, drainage, and vegetation cover to protect the resources remaining after the coal is so mined. We feel that a conservation plan should be prepared by the coal company for returning the disturbed area back to as usefully a purpose or better. This plan should then be submitted to the local conservation district for approval before mining is commenced.

The local conservation district has assigned to it a technician who can offer assistance to the coal company and to the conservation district directors in developing a conservation plan. By obtaining approval of the Conservation Plan by the conservation district, both local input on needs and requirements of the effected area and good conservation measures will be obtained.

Sincerely,

Clifford W. LeGate

CLIFFORD W. LeGATE
Planning Assistant

CWL/pal

The
University of Oklahoma
1335 South Asp Avenue Norman, Oklahoma 73069

Oklahoma Archaeological Survey

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November 19, 1974

R. Keith Miller
District Manager
Bureau of Land Management
Albuquerque, N.M. 87107

Dear Mr. Miller:

We have checked our files of known sites for the areas indicated on the map you enclosed. Most of these sites found in your areas were found as a result of surveys funded by the U.S. Corps of Engineers. Some areas do not have sites known from them, but this may be due to a lack of surveys in that particular area. In some cases, it may be due to adverse terrain features as well. A more detailed map would allow a better determination of an area's potential. I might point out, that under P.L. 93-291 you are allowed to fund surveys of land under your control, as per Executive Order 11593.

The list we made up from our files condenses as follows:

1. On the lands in LeFlore County that are shaded in, there is a total of 79 archaeological sites.

2. On the lands in Latimer County, there is a total of 8 archaeological sites.

3. On the lands listed in Pittsburg County, there is a total of 6 archaeological sites.

4. On the lands listed in Haskell County, there is a total of 2 archaeological sites.

There were no sites listed for lands under your control in Coal or Atoka counties; however, there are some sites within a couple of miles on creeks that will be a focus of major Corps of Engineers' projects in future years. On this basis, I would recommend surveys for all the lands under your control before mining leases are let.

Sincerely,

Larry Neal

Larry Neal
Acting State Archaeologist

LN:sjb

OKLAHOMA HISTORICAL SOCIETY
Historical Building
Oklahoma City, Oklahoma 73105
Historic Sites

March 24, 1975

Mr. Rob Nauert
Bureau of Land Management
3550 Pan American Freeway
Alberquerque, New Mexico

Dear Mr. Nauert:

I have carefully reviewed your statement calling for a study of cultural resources to preserve the Archeological and Historical Sites within a leased area.

If your statement would include the exact laws that provide for the protection of Historic and Archeological Sites, it would have more impact.

May I suggest the third sentence state, "The study shall conform to the requirements of historic and cultural resources preservation as provided in PL 89-665 and Executive Order 11593 and in 36 CFR Sub-part 800."

The point of reviewing a limited number of acres within a lease as opposed to all land within a lease, was brought to my attention. It would be my recommendation that all sections within the leased area be studied rather than just a portion of the land involved because mining operations do have an effect on all of the lease area.

I hope this information will be helpful to you in establishing methods of preserving history.

Respectfully,

C E Metcalf
C.E. Metcalf
Director,
Historic Sites Division

BLM
ALBUQUERQUE
MAR 27 1975

RG X Rob

X = ACTION
✓ = INFO.

OKLAHOMA HISTORICAL SOCIETY
Historical Building
Oklahoma City, Oklahoma 73105
Historic Sites

January 24, 1975

Mr. R. Keith Miller
District Manager
Bureau of Land Management
U.S. Dept. of the Interior
3550 Pan American Freeway N.E.
Alberquerque, New Mexico 87107

Dear Mr. Miller:

Enclosed is the location of sites listed by county.

Some locations have been omitted as they do not appear on our existing records.

I sincerely hope this information will be sufficient for your needs.

Respectfully,

C.E. Metcalf
Director,
Historic Sites Division

CEM:emh
Enclosure

JAN 27

L. Elson.
FIYAN

County

Choctaw Courthouse - In Atoka

Coal County

Chief Ben Smallwood Homeplace - West of Lehigh
Hurley Birthplace - West of Lehigh on Smallwood farm
Lehigh Field - At Midway

Haskell County

Camp Pike - ?
Cooper Creek - ?
Iron Bridge - 3 miles SW of Keota on San Bois Creek
McCurtain Home - 4 miles east, 1 mile north of Kinta
McKee King Grave - ½ mile south of Kinta
Old Trail (Trail of Seminoles from Florida in 1835) - Traces near McKee King Burial plot, South side of ridge ½ mi S. of Kinta.
Pleasant Bluff - Sec 28, T11N, R22 E
San Bois County Courthouse & Jail - Next to McCurtain home
San Bois Creek Engagement - ?

Latimer County

Choctaw Nation Courthouse - 21 T5E R 20 N
Civil War Confederate Camp - Graves about 1 mile east of Panola
Edward's Store - 15 T6N R 22E, near north section line
McLaughlin Mound - State Archeological survey
Riddle Station - 12 T5N R19E

LeFlore County

Backbone Mountain Battle Site -"Near the mountain, on road"
Brazil Creek Bridge - ½ mile north of Brazil community
Cameron Institute - East edge of Cameron
Choctaw "Pine Ridge School" at Milton
Heavener Runestone - in State Park of same name
Jesse Riddle Tollgate - 31 T9N R26E
New Hope Seminary - 2½ East of Spiro
Reynolds Residence - East edge of Caneron
Skullyville County Courthouse & Jail - 7 T8N R25E

Pittsburg County

Choctaw Courthouse - North Edge of McAlester
First Coal Mine - 4-T5N-R14E
Jones Academy - 2 miles NE of Hartshorne
White Chimney House - 8 T5N-R12E

OKLAHOMA HISTORICAL SOCIETY
Historical Building
Oklahoma City, Oklahoma 73105
Historic Sites

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ALBUQUERQUE
JAN 9 1975

L. Flynn

January 6, 1975

Mr. R. Keith Miller, District Manager
Bureau of Land Management, District Office
3550 Pan American Freeway, N. E.
Albuquerque, New Mexico 87107

Dear Sir:

Thank you for your letter dated December 17, 1974, and your confidence in our files.

It would be helpful if you could send us your list of Sites that may be affected adversely by coal mining efforts in a county by county form rather than name. The staff person may quickly locate records on the Site as these are filed on a county basis.

Also our records do not always give exact section, township and range locations; some are related to the nearest settlement or paved road.

Another problem is that there may be other potential National Register properties not as yet listed in our files. For this reason the Oklahoma Historical Society requests that a survey be made by the Department of the Interior to locate and list such potentially significant Sites if this has not already been done under Executive Order 11593.

Thank you for your efforts to preserve our Nation's Heritage.

Respectfully,

CEMetcalf

C. E. Metcalf, Director
Historic Sites Division

edp:CEM

cc: G. Shirk
M. Bureman

OKLAHOMA HISTORICAL SOCIETY
Historical Building
Oklahoma City, Oklahoma 73105
Historic Sites

BLM
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NOV 27 1974
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November 19, 1974

R. Keith Miller
District Manager,
Bureau of Land Management
U.S. Dept. of the Interior
3550 Pan American Freeway, N.E.
Albuquerque, New Mexico 87107

Dear Mr. Miller:

Due to the large number of known Historic Sites and Archeological Sites in the wide area being considered for this Environmental Impact Study, plus the fact that not all the mining activities would likely begin at the same time, the Oklahoma Historical Society respectfully submits the preservation program that lists most known Historic Sites for your use. (Your letter, paragraph 7.)

The Oklahoma Historical Society further requests that the funding agency of the U.S. Government, survey the area in question for Sites potentially suitable and qualified for National Register status. This should be done prior to the publishing of the Environmental Impact Study, and the results of such a survey be included in the Impact Statement. (Your letter, paragraph 5 & 6.)

Thank you for allowing us to review this project and we stand by to assist you in any way we can.

Respectfully,

C E Metcalf
C.E. Metcalf
Director,
Historic Sites Division

For Mr. George Shirk, President,
Oklahoma Historical Society

[illegible]
(P. [illegible] 665)
1975 [illegible]

cc: Mr. Jack Wettengel
Mr. George Shirk
Mr. Mike Bureman

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

1791 (N-2)

TO : EAR on Oklahoma Federal Coal Reserves

DATE: January 15, 1975

FROM : Robert C. Nauert, Natural Resource Specialist,
Rio Grande - Las Vegas Resource Area

SUBJECT: Telephone Interview of Mr. John Meyers -
Oklahoma Fish and Wildlife Department

On November 22, 1974, I received a call from Mr. John Meyers of the Oklahoma Fish and Wildlife Department in Oklahoma City. The contact was made in reference to the letter the EAR team sent out requesting information and opinions concerning coal mining in Oklahoma. Mr. Meyers mentioned that he had no particular objections to coal mining in Okahoma since he had attended a seminar held by the Bureau of Mines on the subject. He did, however, mention that he was concerned over the fact that Wister Reservoir was located within present coal boundaries in LeFlore County, and also several other streams were so located. Other than citing this fact, he offered no particular information or opinions on coal mining and seemed assured that the BLM was doing its part in protecting the environment in conjunction with coal mining in Oklahoma.

Robert C. Nauert

March 3, 1849

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
DISTRICT OFFICE
3550 Pan American Freeway, N.E.
Albuquerque, New Mexico
87107

IN REPLY REFER TO
1791

JAN 21 1975

MEMORANDUM

To : EAR on Oklahoma Federal Coal Reserve (File)

From : Robert E. Armstrong, Environmental Coordinator, Albuquerque

Subject: Interview of Tom Throckmorton, Kiomichi Economic Development District of Oklahoma (KEDDO) on October 24, 1974.

The following is a brief summary of comments received when all members of the interdisciplinary team discussed coal in southeastern Oklahoma with Mr. Throckmorton.

1. The KEDDO organization is mainly involved in planning.
2. Some information was provided on publications available from KEDDO, along with copies of two publications.
3. His general conclusion for the immediate area that is affected by coal mining in the seven-county KEDDO district is simple. If the local people were faced with a choice of coal mining without surface protection stipulations, or no mining at all due to the lack of surface protection stipulations, they would choose the mining without surface protection because of their need for employment and improved economy.

Robert E. Armstrong

March 3, 1849

United States Department of the Interior

IN REPLY REFER TO
1791

BUREAU OF LAND MANAGEMENT
DISTRICT OFFICE
3550 Pan American Freeway, N.E.
Albuquerque, New Mexico
87107

JAN 21 1975

MEMORANDUM

To : EAR on Oklahoma Federal Coal Reserves (File)

From : Robert E. Armstrong, Environmental Coordinator, Albuquerque

Subject: Interview of Byron Moser, Oklahoma Fish and Wildlife Department, on October 21, 1974.

The following is a brief summary of an interview by interdisciplinary team personnel Rob Nauert, George Hollis, Carol Scussel and Bob Armstrong.

1. A partial list of rare and endangered species which are believed to inhabit or have habitats near the Federal Coal Reserves.
2. Provided a copy of Fish and Wildlife Department mailing list with current addresses of different groups interested in wildlife and recreation.
3. Provided publication lists and other information concerning Oklahoma wildlife and State agencies to contact.

Robert E. Armstrong

Federal Agencies and Offices

DEPARTMENT OF DEFENSE UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
TULSA DISTRICT, CORPS OF ENGINEERS
POST OFFICE BOX 61
TULSA, OKLAHOMA 74102

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NOV 25 1974
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BC

Rob RCM

SWTED-PE November 1974

Mr. R. Keith Miller
District Manager, Bureau of Land Management
3550 Pan American Freeway, N. E.
Albuquerque, NM 87107

Dear Mr. Miller:

Coal mining in the Federal coal lease areas outlined in your 6 November letter could affect Corps of Engineers studies or projects.

The proposed alignment of the Central Oklahoma water conveyance facility, which is now under study, will cross the Federal coal area in Coal and Atoka Counties. The proposed Brazil damsite, on Brazil Creek in LeFlore County, is in the long-range category to be restudied later. Approximate locations of both projects are shown on the inclosed map (Incl 1). Existing Corps projects which could also be affected by coal mining activities include Eufaula, Wister, Robert S. Kerr Lakes, and the McClellan-Kerr Arkansas River Navigation System.

Since the Federal coal areas under consideration are all located in areas of sharp topographical changes and since this mountainous terrain has a rock base overlain with very little topsoil, any mining activity which would strip away this topsoil on these steep slopes would be deleterious to the environmental setting. Once the topsoil was removed, revegetation would be a very lengthy process. This would be a very important consideration in areas where forest products are one of the prime economic resources.

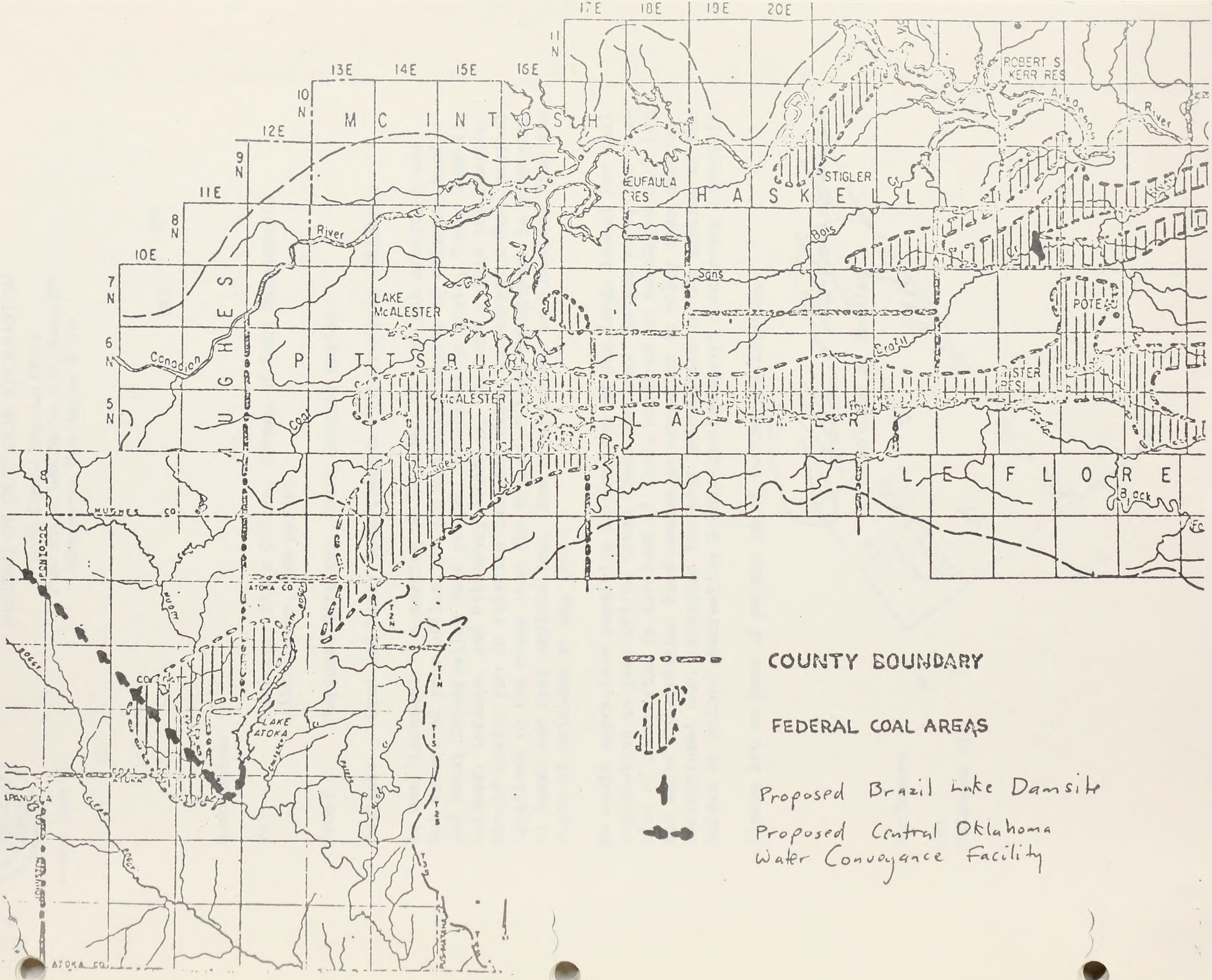
For any surface mining activity on Federal lands, the Government should require premining planning, erosion control, revegetation, and diversion of surface waters away from the mine site. Care should be taken to prevent pollution of surface and subsurface water by acid mine drainage. Disturbed lands should be reclaimed as quickly as possible to restore land for useful purposes and to replace lost wildlife habitat.

The production of a significant amount of coal would probably result in an increased use of the McClellan-Kerr Arkansas River Navigation System. Previously, lack of economic transportation hindered mine development in the area. The general economy of the area would be helped if a stable mining industry develops.

Sincerely yours,

for Donald R. Henderson
WELDON M. GAMEL
Chief, Engineering Division

1 Incl
As stated


COUNTY BOUNDARY
FEDERAL COAL AREAS
Proposed Brazil Lake Damsite
Proposed Central Oklahoma Water Conveyance Facility
MCINTOSH
HASKELL
HUGHES
PITTSBURG
LATIMER
LEFLORE
HUGHES CO.
ATOKA CO.
PONTOTOC
COAL
JOHNSTON
PUSHMATAHA
LAKE McALESTER
McALESTER
EUFAULA RES
STIGLER
ROBERT S. KERR RES
POTEAU
WISTER RES
LAKE ATOKA
Canadian
River
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March 3, 1849

United States Department of the Interior

BUREAU OF OUTDOOR RECREATION

South Central Regional Office
Patio Plaza, 5000 Marble N.E., Room 211
Albuquerque, New Mexico 87110

IN REPLY REFER TO:

DEC 20 1974

Memorandum

To: Director, State Office, Bureau of Land Management,
Albuquerque, New Mexico

From: Regional Director, South Central Region

Subject: Land and Water Conservation Fund Projects--Oklahoma

As was discussed in a meeting on December 17 with Bob Armstrong and Rob Nauert of your office, we are enclosing copies of existing Land and Water Conservation Fund project locations in Atoka, Coal, Haskell, Latimer, Leflore, and Pittsburg counties, Oklahoma. This information should assist you in relating Land and Water Conservation Fund project locations to the areas that the Bureau of Land Management is proposing to lease for coal exploration. New projects may be submitted from the State of Oklahoma at any time.

We would appreciate receiving information on any lands leased for coal exploration as your office takes these actions. As you know, the question of conversion is involved if lands acquired or developed with Land and Water Conservation Fund monies are converted to other than outdoor recreational use. Attached for your information is the section of the Bureau of Outdoor Recreation Grants-in-Aid Manual concerning conversion.

Please let me know if we can be of further assistance.

Rolland B Handley

Rolland B. Handley

BLM
ALBUQUERQUE
DEC 23 1974

Bob Armstrong

Rob RAN

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RG x BL

Enclosure

cc:
Oklahoma SLO

.1 Purpose. The responsibilities of the State following completion of a project are covered in this chapter and in this Part.

.2 Applicability. The rules given in this Part apply to each area or facility for which assistance is obtained from the Fund, regardless of the extent of participation of the Fund in that area or facility.

That is, in cases where assistance is provided only for an acquisition, the entire park or recreational area involved, including developments on the lands so acquired, are subject to the provisions of this Part. Where development assistance is given, the lands of the park or recreation area within which the development is located are subject to this Part.

.3 State Responsible. Responsibility for enforcement of the provisions of this Part rests with the State. The Bureau will inspect assisted areas and facilities from time to time, but it shall conduct such visits in concert or through consultation with the State Agency or official designated by the Governor to deal with the Bureau for purposes of the Act.

.4 Penalties. Failure to comply with the provisions of this Part shall be considered cause for the Director, at his election, to:

A. Withhold future payments being made to the State on current projects of the participant responsible for the infraction in question; or

B. Withhold future payments to the State on any or all current projects until the situation involved is corrected; or

C. Withhold action on all pending projects of the State and/or participant responsible for the infraction in question.

D. Withhold from current or future reimbursements due to the State the amount of assistance previously paid out for the project or projects involved.

This release supersedes all amendments,
program directives and releases issued
prior to this date.

Chapter 2 Retention, Operation, Maintenance and Use 685.2.1

.1 Retention and Use. Property acquired or developed with assistance from the Fund shall be retained and used for public outdoor recreation. Any property so acquired or developed shall not be wholly or partly converted to other than public outdoor recreation uses without the approval of the Director. (See Sec. 6(f) of the Land and Water Conservation Fund Act, as amended, and 248 DM 1.1F). Such approval will be given only upon such conditions as the Director deems necessary to assure the substitution of other outdoor recreation properties of at least equal fair market value and of reasonably equivalent usefulness, quality, and location. (See attachment N of OMB Circular A-102 for regulations concerning disposition of personal property.)

A. Proposed Uses. Non-recreational uses anticipated at the time of approval or for which a request for conversion will be made subsequent to project approval will be subject to the conditions above.

B. Existing Uses. These provisions do not apply to non-recreational uses being made of an area or facility at the time the Fund-assisted project is approved when such uses are known to and approved by the Director and documented in the project proposal.

.2 Changes in Recreational Uses. The use of property acquired or developed with assistance from the Fund may not be changed from that contemplated and approved when assistance was obtained, unless prior approval is obtained from the Director.

.3 Operation and Maintenance. Property acquired or developed with assistance from the Fund shall be operated and maintained as follows:

A. The property shall be maintained so as to appear attractive and inviting to the public.

B. Sanitation and sanitary facilities shall be maintained in accordance with applicable health standards.

C. Properties shall be kept reasonably safe for public use. Fire prevention, lifeguard, and similar activities should be maintained for proper public safety.

This release supersedes all amendments, program directives and releases issued prior to this date.

D. Buildings, roads, trails, and other structures and improvements shall be kept in reasonable repair throughout their estimated lifetime to prevent undue deterioration and to encourage public use.

E. The facility shall be kept open for public use at reasonable hours and times of the year, according to the type of area or facility.

.4 Availability to Users.

A. Non-discrimination. Property acquired or developed with assistance from the Fund shall be open to entry and use by all persons regardless of race, color, religion, sex, or national origin, who are otherwise eligible. Discrimination on the basis of residence, including preferential reservation or membership systems, is prohibited, except to the extent that reasonable differences in admission or other fees may be maintained on the basis of residence.

B. Reasonable Use Limitations. Participants may impose reasonable limits on the type and extent of use of areas and facilities acquired or developed with Fund assistance when such a limitation is necessary for maintenance or preservation. Thus, limitations may be imposed on the numbers of persons using an area or facility or the type of users, such as hunters only or hikers only. All limitations shall be in accord with the applicable grant agreement and amendments.

This release supersedes all amendments, program directives and releases issued prior to this date.

Chapter 3 Post Completion Inspections 685.3.1

.1 Post Completion Inspections. In order to determine whether properties acquired or developed with Fund assistance are being retained and used for outdoor recreation purposes in accordance with the project agreement and other applicable program requirements, inspections are to be made by the States at least triennially.

The following points should be taken into consideration during inspection of properties that have been developed for public use:

A. Retention and Use. Is the property being used for the purposes intended.

B. Appearance. Is the property attractive and inviting to the public.

C. Maintenance. Is upkeep and repair of structures and improvements adequate. Is there evidence of poor workmanship or use of inferior quality materials or construction. Is vandalism a problem.

D. Management. Does staffing and servicing of facilities appear adequate.

E. Availability. Is there evidence of discrimination. Is the property readily accessible and open to the public during reasonable hours and times of the year.

F. Environment. Is the quality of the area being maintained.

G. Signing. Is the area properly signed to allow for user information and safety, and proper acknowledgement of the Land and Water Conservation Fund assistance received.

Where lands have been acquired but not yet developed, the inspection should determine whether the interim use being made of the property, if any, is as agreed to by the Bureau.

Upon completion of an inspection, the State Liaison Officer should submit a written report to the Regional Office giving the date of inspection and describing any discrepancies and the corrective actions taken.

.2 Costs. State costs of making post completion inspections are allowable overhead costs.

.3 Bureau Inspection. Properties acquired or developed with Fund assistance shall be avaliable for inspection by the Director or his representative.

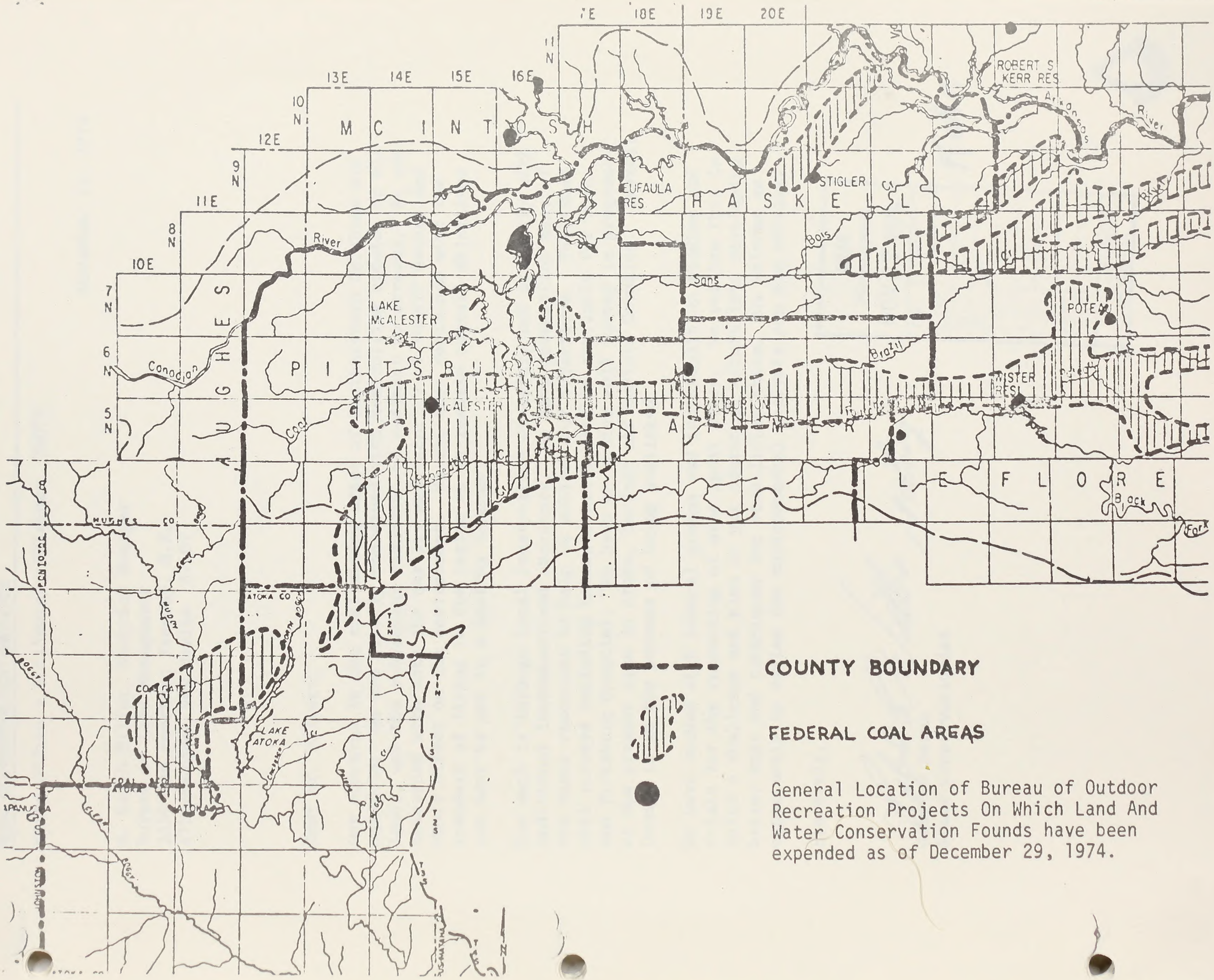
This release supersedes all amendments, program directives and releases issued rior to this date.

.1 Reason for Acknowledgment. Suitable permanent public acknowledgment of Land and Water Conservation Fund assistance at project sites is required by the Bureau. Display of acknowledgment is optional on acquisition projects unless the acquisition is an expansion of an existing developed recreation area. Such acknowledgement will represent a Federal-State-local partnership role in creating new high-quality outdoor recreation areas and facilities.

.2 Use of Symbol. The symbol shown as Illustration 1 is optional. However, we encourage its use as a part of the acknowledgment of Fund assistance, at entrances to outdoor recreation sites, at other appropriate on-site locations, and in folders and park literature. While the symbol format may not be altered, such considerations as color combinations, method of sign construction, size, and placement are matters for determination by the State. The presence of acknowledgement of Land and Water Conservation Fund assistance shall be a matter checked during compliance inspections.

.3 Allowable Cost. Costs related to project acknowledgment are all allowable cost, as part of initial capital investment, and may be shared by Fund assistance (see 670.1.8G). Replacement costs as a part of post project operation and maintenance are not allowable.

This release supersedes all amendments,
program directives and releases issued
prior to this date.



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COUNTY BOUNDARY
FEDERAL COAL AREAS
General Location of Bureau of Outdoor Recreation Projects On Which Land And Water Conservation Founds have been expended as of December 29, 1974.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

State Office - Stillwater, Oklahoma 74074

November 22, 1974

R. Keith Miller, District Manager
Bureau of Land Management
3550 Pan American Freeway, N.E.
Albuquerque, New Mexico 87107

Dear Mr. Miller:

Our concerns in the coal mining areas of Southeastern Oklahoma are manyfold. We are vitally concerned with controlling erosion on all lands, and the subsequent reduction of sediment in streams. We are concerned with both the quality and quantity of runoff waters and their effect on the environment. We are also concerned with the standard of living in the region as we realize overall objectives can best be met in a healthy economy.

Our work is through local conservation districts and primarily with individual landowners and operators. We have inventoried many of the basic resources to help us achieve our objectives. Published soil surveys including interpretative data is available for Coal and Pittsburg Counties. We have an active soil survey in progress at the present time in Atoka, Latimer and LeFlore Counties. Haskell County is in the process of being published.

We have worked with several groups and individuals on studies and trials for the vegetating of mine spoil areas. We realize this is quite a challenge and plan to put continual effort into developing better ways and techniques for stabilizing these. We welcome an opportunity to review the environmental analysis you are writing.

Sincerely,

Lalond L. Wilbo, acting

Hampton Burns
State Conservationist

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1600 PATTERSON, SUITE 1100
DALLAS, TEXAS 75201

December 3, 1974

Mr. R. Keith Miller
District Manager
Bureau of Land Management
3550 Pan American Freeway, N.E.
Albuquerque, New Mexico 87107

Dear Mr. Miller:

This is in response to your letter concerning the writing of an environmental analysis record involving Federal coal lease areas in southeastern Oklahoma (Atoka, Coal, Haskell, Latimer, Le Flore, and Pittsburg Counties). Approximately 269,900 acres are involved.

Due to the limited information provided in your letter, we will be unable to furnish you with a detailed response at this time. However, in further development of the environmental analysis record, we would like to call your attention to the importance of considering adequate controls for abating air, water, and noise pollution. The impacts on the air and water quality in the area should be fully considered, particularly with regard to soil erosion and revegetation.

We appreciate your interest in assuring that environmental quality is maintained at the proposed site.

Sincerely yours,

Clinton B. Spotts

Clinton B. Spotts
Regional EIS Coordinator

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Bob A.

Rob RAN

MARCH 3, 1849

United States Department of the Interior

BUREAU OF MINES

Liaison Office
Oklahoma
405-231-4521

168 Old Post Office Building
Oklahoma City, Oklahoma 73102

January 17, 1975

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Bob A

Memorandum

To : Bob Armstrong
Bureau of Land Management
Albuquerque, New Mexico

From : Liaison Officer - Oklahoma

Subject: Field Trip of Strip Mining and Reclamation Operations in Oklahoma

In looking over the memo concerning the field trip for strip mining, I note there are only six comments from trip members that I thought worth repeating; however, you may be able to utilize the concept of the cross section of interests that were represented. The list of participants shows that there were 34 on the bus, but at one time or another there were other company representatives for purposes of conducting the tour. In all, probably 40 or 45 people were involved. Only the State Geological Survey has responded in writing with a report in the forthcoming <u>Oklahoma Geology Notes</u>. I'll send a copy of this when it is available.

The results included a partial lifting of pressure to write stricter reclamation laws than we have in Oklahoma; however, the concept of reclamation of the orphan lands has not been abandoned by the chairman of the State Department of Pollution Control. Fortunately, I shall be able to review his contemplated presentation to the governor next week or the week after. The mining industry itself is backing a request to tighten the reclamation law and taking an active part in drawing up the necessary documents.

I think the general effect here has been to make the participants aware of the actual conditions in the field and to appreciate better the problems that are inherently part of current strip mine and orphan land reclamation.

If I can be of any additional help, keep coming with the questions.

Robert H. Arndt

Robert H. Arndt
Liaison Officer - Oklahoma

Encl.

Liaison Office
Oklahoma
405-231-4521

168 Old Post Office Building
Oklahoma City, Oklahoma 73102

September 20, 1974

Memorandum

To : Richard Mote
Chief, Liaison Program Office
Washington, D.C.

From : Liaison Officer - Oklahoma

Subject: Field Trip of Strip Mining and Reclamation Operations

Several members of the State Legislature, concerned Oklahoma state agencies, private citizens groups and representatives of the coal producing industry, supported by representatives of federal agencies, visited five coal strip mines and several unreclaimed strip mine areas in eastern Oklahoma on Wednesday and Thursday, September -19. The trip was designed to introduce members of a legislative committee signed to upgrading the State's surface mine reclamation law, and interested citizens to all the physical conditions and problems involved in mining and reclaiming coal lands.

The past legislature, at the request of the State's Department of Pollution Control, ordered a study of reclamation. Pollution Control had specifically singled out reclamation of the orphan lands as a major objective. Through discussions of mine reclamation with members of the Department of Pollution Control and with members of the Division of Parks and Recreation, it became obvious that the concerned personnel had never seen strip mining and reclamation operations and had derived most of their impressions from TV documentary programs, information from groups such as the Sierra Club and Wildlife Federation, and from statements made during Congressional inquiries to support the drafting of Federal legislation. Obviously, education in the field was required. Agency members and members of the assigned Soil and Water Resources Committee expressed positive interest in a field trip. The Governor's office gave assurances such a trip was indeed appropriate, the Speaker of the State House of Representatives endorsed the project, and approval was obtained for the trip from the Liaison Program Office.

Garland Coal and Mining Company, Lone Star Steel Co., McNabb Coal Co., Peabody Coal Co., and Sierra Coal Co. agreed readily to cooperate by displaying their mining and reclamation activities and answering questions. In addition, Garland and Peabody agreed to provide lunch in the field for members of the party on successive days. Department of Agriculture - Soil Conservation Service; Interior - Bureau of Outdoor Recreation, Geological Survey and Bureau of Mines; Ozarks Regional Commission -

Kansas Mined Land Redevelopment Project; and the Oklahoma Geological Survey provided participants, materials and information to support the field trip.

An intensive telephone and letter campaign finally resulted in participation by those named on the accompanying trip roster,

In the course of the trip, participants viewed mining in progress, earth grading for reclamation and reclaimed lands successfully returned to grass with and without replaced topsoil, with and without the application of fertilizer, and sown both by air and by seed drill. Orphan spoils created between 1891 and 1967, in all stages of erosion, voluntary revegetation, and amenability to grading and planting received special attention in view of the apparent blanket request for reclamation by grading and planting. Use of permanent ponds in unfilled last cuts for wildlife, fishing, and even as water supply for farm and municipal use was illustrated. Contrasting geological conditions at opposite ends of the coal belt in Oklahoma were emphasized and viewed in respect to contrasting procedures required in reclamation.

Wednesday evening Dr. Kathleen Camin of Wichita State University, and Project Leader of the Kansas Mined Land Redevelopment Project, used slides to describe their objectives, methods, successes and shortfalls in reclaiming orphan spoil banks. Wilton Johnson, of the Bureau of Mines Division of Environment, spoke about the patterns in state strip mine reclamation laws and some of the factors in federal legislation. Mr. P. M. Glenn, of the Bureau of Outdoor Recreation regional office in Albuquerque, summarized possible uses of orphan lands for outdoor recreation and means for obtaining financial aid for developing such activities through the Bureau of Outdoor Recreation. John Beard, Area Conservationist, for Soil Conservation Service, described vefy briefly their rather extensive cooperation with several mining companies in the reclamation of coal spoils and sand and gravel pits.

Most significant is the reaction towards the trip. Participants were friendly, not antagonistic. Discussion was very civil. Questions far outweighed position statements. People with contrasting opinion communicated freely.

The following are a few of the interesting statements made to me. Note that they relate to a blanket law to reclaim orphan lands, to processes of revegetating fresh spoils, and to the relation between current federal legislation and state regulation of strip mining.

A Sierran:

> I'm quite willing to grant that some of the orphan lands we have seen should be retained as wildlife refuges and scenic areas rather than be levelled and graded.

A State department head:

> There is no reason to reclaim many of the wooded spoil areas that serve as wildlife refuge. No one has ever shown me the positive values of spoil areas such as these, only the negative ones.

State environmental chairman of a citizens group:
I was astonished to learn that water in the last cut of stripped coal areas has been used for public water supply in small municipalities. I had been led to believe all water in strip pits was acid, only to find there is practically none such in Oklahoma.

An environmental coordinator in a state university:
It seems unbelievable that a complete grass cover can be established on spoil consisting entirely of fine-sized shale fragments without first returning the topsoil. My entire concept of strip mining has to be changed.

A member of the state legislature:
The State will have to provide its own strip mine law. A national law won't suit conditions in Oklahoma.

A university professor:
The members of the trip provide an excellent cross section of interest in strip mine problems.

The trip could not have been accomplished without the cooperation of a number of firms, agencies and individuals. Among these are Dr. Charles Mankin, Director of Oklahoma Geological Survey, and deeply involved members of his staff. Mr. E. S. Stephens of Garland Coal and Mining Co., a staunch supporter of the mining industry and long-time participant in the evolution of strip mine reclamation law in Oklahoma. Mr. J. Paul Savage, Construction Control Officer, Lone Star Steel Co., modern pioneer in exceeding the requirements of Oklahoma law in strip mine reclamation. Mr. Frank Podpechan, Sierra Coal Company, who practices reclamation of existing orphan banks along with current mining. Mr. Frank McNabb, McNabb Coal Co., the pioneer in Oklahoma, having commenced reclaiming spoil banks in 1958. Mr. Alten Grant, Peabody Coal Co., who is dedicated to reclamation and sensible land management. Rolland Handley, Regional Director of Bureau of Outdoor Recreation, sent Mr. Glenn to the meeting. The State Conservationist provided the participation of John Beard. And, of course, Jim Paone requested Wilton Johnson to be with us. Ward Padgett, our State Chief Mine Inspector, helped smooth the way as only an old hand can. Kay Camin drove until 1:00 A.M. of the morning of departure in order to be able to participate.

Robert H. Arndt

Robert H. Arndt
Liaison Officer - Oklahoma

Encl.

cc:
Dr. Tom Falkie
Director, Bureau of Mines

FIELD TRIP to COAL STRIP MINES and RECLAIMED MINED LANDS in EASTERN OKLAHOMA

Sponsored by U. S. Bureau of Mines

September 18-19, 1974

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also FARNSWORTH, Frank
BENSON, Larry

Attachment 16

UNITED STATES DEPARTMENT OF AGRICULTURE
Rural Electrification Administration

MAR 27 1972

REA BULLETIN 61-10

SUBJECT: Powerline Contacts by Eagles and Other Large Birds

State and Federal agencies concerned with the protection of wildlife have requested that REA and its borrowers cooperate in reducing the loss of eagles and other large birds due to accidental electrocution by powerlines.

Reports indicate that this problem exists primarily on distribution lines in localized areas of the western and southwestern states. However, it may exist to a lesser extent in other parts of the country. Because of greater clearances, transmission lines apparently do not present a significant threat to large birds.

Since the bald eagle is in danger of extinction, and other eagles may be in trouble also, we are asking you to cooperate to the fullest extent with state and Federal agencies to minimize accidental electrocution of these birds. The attached report discusses the causes of electrocution on distribution lines of REA standard designs and offers suggestions for modifying existing structures and constructing new lines in areas where eagle electrocutions have occurred.

David G. Hamil
Administrator

Attachment

Index:
  DESIGN, SYSTEM
    Powerline Contacts by Large Birds

EDISON ELECTRIC INSTITUTE
90 PARK AVENUE • NEW YORK 10016 • (212) 986-4100

JUN 29 1972

BLM
DM
✓
OP.
RP
RG
X = ACTION
✓ = INFO.

June 28, 1972

To Environmental Personnel
Member, Companies

Subject: Eagle Protection

For a number of months, the EEI staff and a special industry task force have been working with an ad hoc group representative of government agencies and several national wildlife conservation groups to study ways to protect eagles around electric utility lines, particularly in the western part of the country. Ralph Sargent of Public Service Co of Colorado is temporary Chairman of the ad hoc group. In order to better determine the extent of the problem, the members of the group have agreed to distribute the attached Raptor Mortality Report form designed by the Division of Wildlife Services, Bureau of Sport Fisheries and Wildlife, U S Dept of Interior. Also enclosed are the appropriate Federal statutes, and the addresses of State Supervisors to whom reports should be sent. We understand that the National Audubon Society has circulated copies of the report form to its affiliates.

Available data so far indicates that this is primarily a problem of distribution and service lines of 4KV through 34KV with few if any cases of harm to eagles from lines where the voltage has exceeded 34KV. The predominant area where the problem has been noted is the intermountain area in the West, extending from Texas to the Canadian Border, where eagle populations are high and power poles are preferred perches. A number of techniques are available to minimize or completely relieve this problem. The REA has developed guidelines for this purpose, which are also enclosed.

Since eagles are afforded Federal protection, and one species, the bald eagle, is the national bird as well as an endangered species, the best protection is warranted. If you have any questions or care to discuss this problem in any detail, please contact Richard S Thorsell, Environmental Projects Manager, Edison Electric Institute.

Very truly yours

H J Young

H J Young
Vice President and Secretary

enclosures
cc: T & D Committee

UNITED STATES DEPARTMENT OF AGRICULTURE
Rural Electrification Administration

REA BULLETIN 61-10

SUBJECT: Powerline Contacts by Eagles and Other Large Birds

I. Introduction: In areas frequented by eagles and other large birds of prey, primarily herons and pelicans, power poles are often favorite perches. Occasionally through contact with wiring and fixtures on distribution line poles birds are electrocuted. Such contact also causes momentary or sustained outage of the powerline. Both of these incidents are undesirable and may be minimized by relatively inexpensive modifications in distribution structure design and fixtures by the power supplier. Because of their greater clearances, transmission line structures do not present a significant hazard to either small or large birds.

II. The Problem: Powerline contacts by large raptors, such as eagles and red-tailed hawks, in general are limited to localized areas where these birds hunt and nest. On any given system, it appears that remedial modification to frequently used power poles, within relatively short stretches of line, will greatly reduce the incidents of electrocution. It is probable that linemen and other operating personnel, after a short orientation, can readily identify the poles potentially most hazardous to birds. State and Federal wildlife authorities are available to conduct these orientations.

III. Behavior of Large Birds of Prey: In general, predatory birds select for perching those poles that give them the best view of the habitat of their quarry. Therefore, the poles selected often are the most elevated poles in areas heavily populated by ground squirrel, other rodents, and game within reasonable flying distance of the eyrie or within the wintering habitat of the raptor. Reports indicate that the birds are most likely to make contact between energized parts and ground wire on transformer poles. However, kills have occurred on single-phase and three-phase tangent poles as well. Favorite perch poles can be specifically determined by examining the area just below the pole for mutes or droppings of the birds and for their castings. Since birds of prey cannot digest the fur, feathers or bones of their quarry, they cast or disgorge these in the form of a pellet called a casting. These castings are as large as 1.5 inches in diameter and 5.0 inches in length.

IV. Remedial Measures: The illustrations and the text that follow (1) identify those details of standard construction that seem to contribute to eagle electrocution; and (2) offer suggestions for relatively inexpensive modifications which will make the various structures less hazardous to large birds. Only the most commonly used structures are discussed, but an understanding of how these structures can cause electrocution and how they may be modified for greater safety will permit similar corrections to other less commonly used structures that may be involved in eagle electrocution.

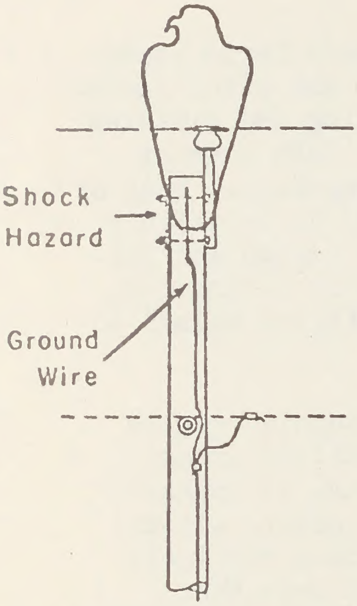


Figure 1

Single-Phase Poles Without Equipment

This structure is potentially hazardous to large birds only when the pole ground wire is extended above the neutral as shown in Figure 1. In such a case, contact could be made simultaneously between the phase conductor and pole ground wire when the bird landed on the poletop. Actually, the poletop does not seem to be a good perch because of the obstruction of the phase conductor. It is probable, therefore, that relatively few electrocutions will be experienced at these structures.

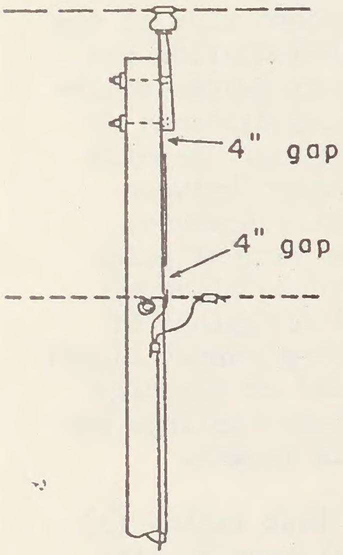


Figure 2

When electrocuted birds have been found at the base of single-phase structures, it is recommended that the ground wire be cut back to the neutral. If this is not feasible because of lightning considerations, the pole ground wire above the neutral should be double gapped as shown in Figure 2. A total of 8 inches of clear wood is believed adequate to provide safety to large birds.

Single-Phase Transformer Poles

On single-phase poles with transformers or other equipment, raptors may land on the grounded equipment tank and contact energized parts such as jumpers, open fuse links or bushing terminals. (See Figure 3.)

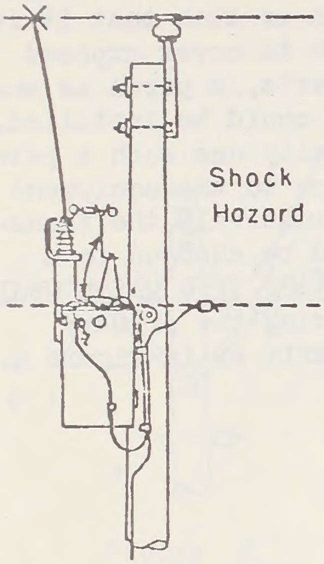
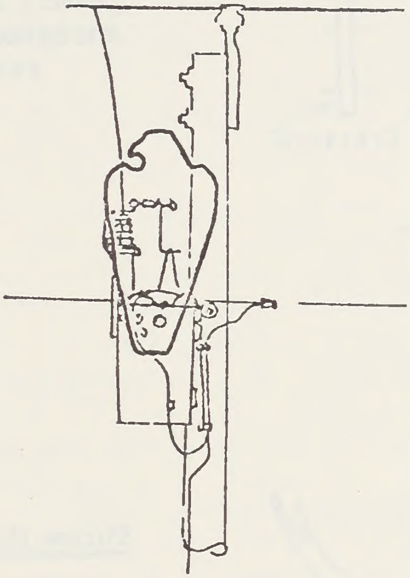


Figure 3



Depending on the type of transformer, it may be possible to cover all primary and secondary energized parts with which a bird is likely to make contact. The use of bird guards, transformers with internal fuses, and insulated conductors for primary jumpers should provide effective protection. (See Figure 4.)

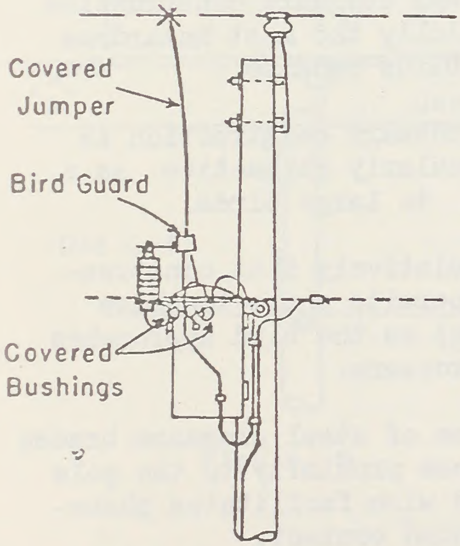


Figure 4

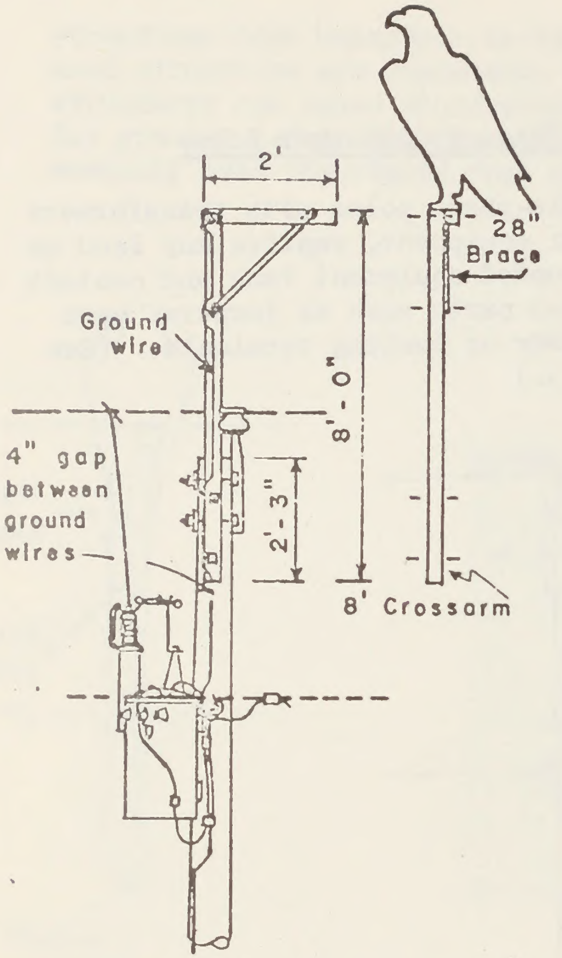
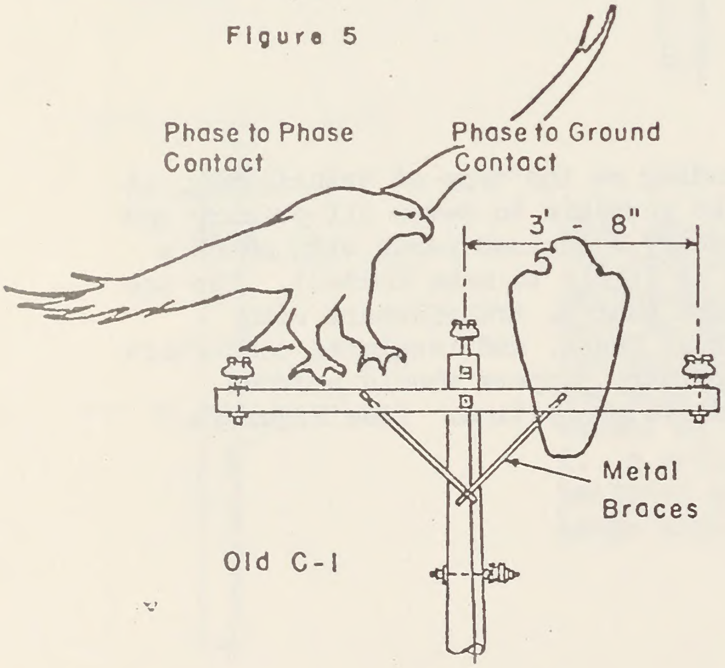


Figure 5

Where the nature of the equipment installation is such that it is not feasible to cover exposed energized parts, a perch as shown in Figure 5 could be installed. Eagles normally use such a perch in preference to the equipment tank. Alternatively the transformer could be changed to a self-protecting type which would permit covering the primary energized parts as in Figure 4.



Old single-arm assemblies

Figure 6

Three-Phase Tangent Construction

Of all REA poles in common use, pre-1962 REA standard construction is potentially the most hazardous to large birds because

- its crossarm construction is particularly attractive as a perch to large birds.
- its relatively flat construction permits phase-to-phase contact as the bird approaches the crossarm.
- the use of steel crossarm braces in close proximity to the pole ground wire facilitates phase-to-ground contact.

Both of these types of contact are illustrated in Figure 6.

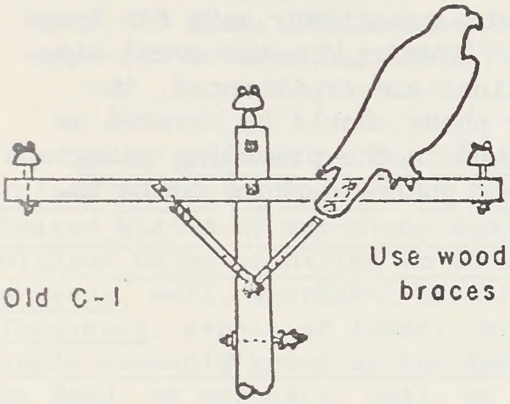


Figure 7

Bird electrocutions may be minimized on pre-1962 structures by changing the steel braces to wood braces as shown in Figure 7 and by covering the center phase for about 30 inches on either side of the insulator as shown in Figure 8. Any material used for covering the conductor need provide for only momentary contacts. However, it should not have any seams, cracks or openings on its top or sides through which a spark may jump. Several manufacturers provide "tree guards" which seem adequate for this purpose. Guards may be restrained from moving into the span by the use of a connector or other obstruction.

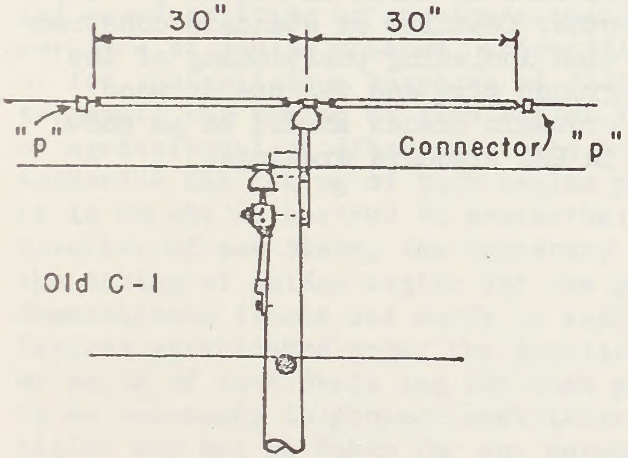


Figure 8

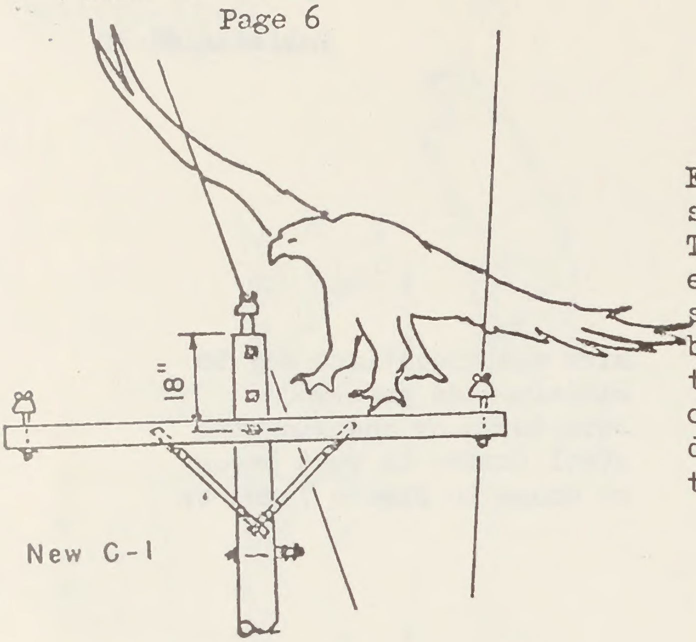
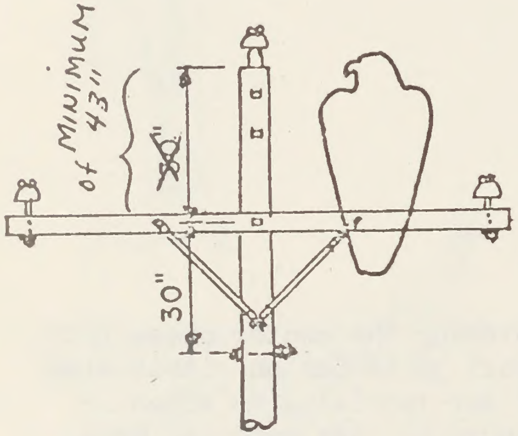


Figure 9

Figure 9 shows the post-1962 REA standard three-phase construction. The use of wood braces and the lowered crossarm should make this structure relatively safe for large birds. However, in the event electrocutions are experienced, the center phase should be covered as described in the preceding paragraph to avoid phase-to-phase contacts.



Proposed three-phase line assembly for eagle areas.

Figure 10

New Three-Phase Construction

For new construction in areas frequented by eagles and other large birds, it is recommended that the crossarm and neutral conductor be lowered as shown in Figure 9. All other features of standard construction including positioning of the ground wire and the use of wood crossarm braces should be as shown in REA standard drawings.

Other New Construction

Single-phase construction should be in accordance with Figure 2.

Single-phase transformer installations should make use of transformers which permit covering of energized parts and jumpers.

PROTECTION OF BALD AND GOLDEN EAGLES*

(Act of June 8, 1940, 54 Stat. 250, as amended by Act of June 25, 1959, 73 Stat. 143, and as further amended by Public Law 87-884, approved October 24, 1962, 76 Stat. 1246; 16 U.S.C. 668-668d)

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, Whoever, within the United States or any place subject to the jurisdiction thereof, without being permitted to do so as hereinafter provided, shall take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or in any manner, any bald eagle commonly known as the American eagle, or any golden eagle, alive or dead, or any part, nest, or egg thereof of the foregoing eagles, shall be fined not more than $500 or imprisoned not more than six months, or both: Provided, That nothing herein shall be construed to prohibit possession or transportation of any bald eagle, alive or dead, or any part, nest, or egg thereof, lawfully taken prior to June 8, 1940, and that nothing herein shall be construed to prohibit possession or transportation of any golden eagle, alive or dead, or any part, nest, or egg thereof, lawfully taken prior to the addition to this Act of the provisions relating to preservation of the golden eagle.

Sec. 2. Whenever, after investigation, the Secretary of the Interior shall determine that it is compatible with the preservation of the bald eagle or the golden eagle to permit the taking, possession, and transportation of specimens thereof for the scientific or exhibition purposes of public museums, scientific societies, and zoological parks, or for the religious purposes of Indian tribes, or that it is necessary to permit the taking of such eagles for the protection of wildlife or of agricultural or other interests in any particular locality, he may authorize the taking of such eagles pursuant to regulations which he is hereby authorized to prescribe: Provided, That on request of the Governor of any State, the Secretary of the Interior shall authorize the taking of golden eagles for the purpose of seasonally protecting domesticated flocks and herds in such State, in accordance with regulations established under the provisions of this section, in such part or parts of such State and for such periods as the Secretary determines to be necessary to protect such interests: Provided further, That bald eagles may not be taken for any purpose unless, prior to such taking, a permit to do so is procured from the Secretary of the Interior.

Sec. 3. That for the efficient execution of this Act section 5 of the Migratory Bird Treaty Act of July 3, 1918 (40 Stat. 755), as amended by the Act of June 20, 1936 (49 Stat. 1555), shall be deemed to be incorporated herein in haec verba.

Sec. 4. That as used in this Act "whoever" includes also associations, partnerships, and corporations; "take" includes also pursue, shoot, shoot at, wound, kill, capture, trap, collect, or otherwise willfully molest or disturb; "transport" includes also ship, convey, carry, or transport by any means whatever, and deliver or receive or cause to be delivered or received for such shipment, conveyance, carriage, or transportation.

Sec. 5. That moneys now or hereafter available to the Secretary of the Interior for the administration and enforcement of the aforesaid Migratory Bird Treaty Act of July 3, 1918, shall be equally available for the administration and enforcement of this Act.

---

*Note: <u>Preamble to Act of June 8, 1940 reads as follows:</u>

"Whereas the Continental Congress in 1782 adopted the bald eagle as the national symbol; and

"Whereas the bald eagle thus became the symbolic representation of a new nation under a new government in a new world; and

"Whereas by that Act of Congress and by tradition and custom during the life of this Nation, the bald eagle is no longer a mere bird of biological interest but a symbol of the American ideals of freedom; and

"Whereas the bald eagle is now threatened with extinction: Therefore"

<u>Preamble to Public Law 87-884 reads as follows:</u>

"Whereas the population of the golden eagle has declined at such an alarming rate that it is now threatened with extinction; and

"Whereas the golden eagle should be preserved because of its value to agriculture in the control of rodents; and

"Whereas protection of the golden eagle will afford greater protection for the bald eagle, the national symbol of the United States of America, because the bald eagle is often killed by persons mistaking it for the golden eagle: Now, therefore....."

STATE ______________________

RAPTOR MORTALITY REPORT

1. Date of discovery

2. Approximate date when mortality occurred

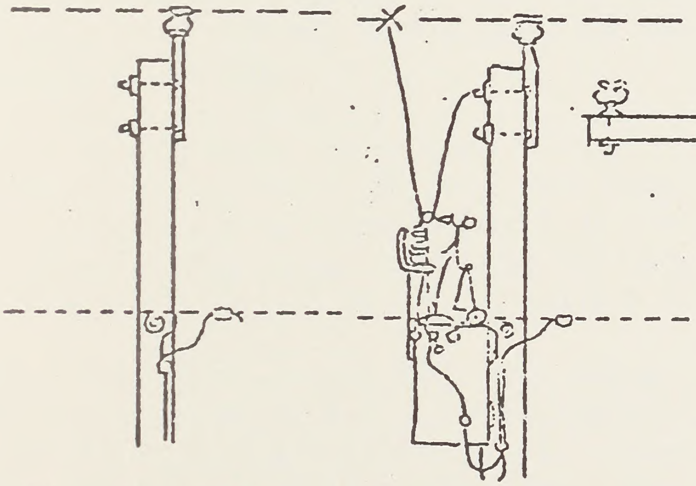
3. Location (county, nearest post office, township, name of electric utility and pole number)

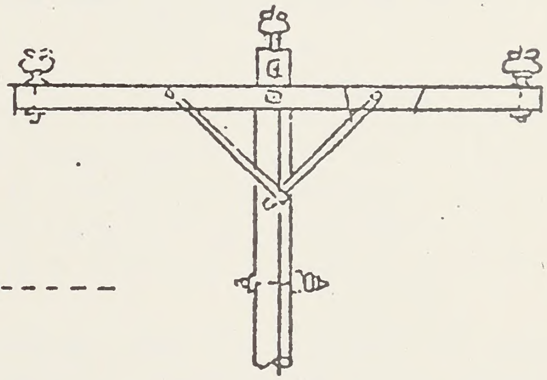
4. Species, age, sex (if known) of each bird found

5. Probable cause of mortality (electrocution, gunshot, etc.)

6. Vegetation (forest, grassland, etc.) and terrain (hilly, flat, etc.)

7. Check pole type from those below





___ No crossarm

___ No crossarm, but transformer present

___ Crossarm(s)

___ Other (describe on back)

8. Disposition of carcass (left, picked up, etc.)

9. Name, address, phone number and agency of person making report

Send Report to: State Supervisor
Division of Wildlife Services

POWER LINES AND BIRDS OF PREY

presented at the

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION

Engineering and Operating Conference
Yakima, Washington

April 22, 1974

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Idaho Power Company
Wayne Anderson
Idaho Power Company
Morlan Nelson
Birds-of-Prey Consultant

POWER LINES AND BIRDS OF PREY

ABSTRACT

Presented are the actions taken by one electric utility in regards to power line electrocution of birds-of-prey. An internationally recognized expert on raptors was retained as a consultant. He used trained eagles and slow-motion photography on mock-up transmission and distribution poles in order to document the problems and to determine the effectiveness of solutions.

INTRODUCTION

In the late 1960's, a great concern for environmental protection started to build and gain support across the nation. For the first time, people as a whole started to recognize the problems of air pollution, water pollution, litter, visual impacts, land usage, etc. This concern for environmental protection continued to gain momentum, and in 1969 the "National Environmental Policy Act" (NEPA) was passed by the United Stated Congress and signed into law.

As interest developed in the preservation of the natural environment, great concern was also developing by many industries in regards to compliance with the NEPA regulations. In many instances, policies commonly thought to be desirable were being reassessed, found to be in error, and had to be reversed.

One such policy was protection for the "birds of prey" which is now a federal law. An alleged violation of this federal law (at one time encouraged by the federal government as later explained by an eagle expert) hit the news media in 1972 when Wyoming ranchers and sportsmen were accused of shooting several hundred eagles in an effort to protect young lambs and in some cases for sporting pleasure. This immediately focused attention to the present law and the necessity to preserve not only the eagle, but all birds of prey.

At that time, the management of the Idaho Power Company became concerned with the "birds of prey" problem and

Mr Glenn J Hall, Vice President, contacted Mr Morlan Nelson, an internationally recognized expert on "birds of prey", and retained him to study the problem.

Mr Morlan Nelson's qualifications and credibility are self-explanatory by his resume.

Mr Nelson worked for the Department of Agriculture, Soil Conservation Service for more than 33 years. The first ten years were as a Soil Scientist in the western states. Then he worked in research as a Snow Survey Supervisor which was the position from which he retired in December, 1971. During his career, he worked as a co-operator on the "Birds of Prey" research carried out by the University of Idaho. His interest and work in falconry resulted in his working directly with Walt Disney Productions' "True Life Adventure Series" as a technical consultant, and in training eagles and hawks for their productions.

In 1965 he was asked to participate in the International Conference on Peregrine Falcons of the World. Following this conference, a book was published by the University of Wisconsin on the subject matter covered and was entitled Peregrine Falcon Populations, Their Biology and Decline. Mr Nelson wrote two chapters in this publication concerning the birds of prey in the Northwestern United States.

During the past seven years, Mr Nelson has participated in "Man and His Total Environment" seminars, jointly sponsored by the University of California at Berkley and the "American Public Health Association".

A great amount of both his personal and professional time has been devoted to filming and studying the behavioral characteristics of the birds of prey.

Mr Nelson took early retirement in 1971 from the U S Department of Agriculture and is now working as a consultant in ecological problems with birds of prey and in the production of 16mm motion picture film for educational purposes and to release.

Mr Hall's instructions to Mr Nelson were basically this:

Over the years we have received reports of eagles being electrocuted by our power lines. How serious the problem is, we do not know. Will you make a study of our system and report back as to what the magnitude of the problem is and what we as a company can reasonably do to solve the problem.

To make the study, a program was detailed by Mr Nelson and Mr Wendell E Smith, Director of Environmental Affairs for the Idaho Power Company.

This program was set up to collect and coordinate all information available with the United States Bureau of Land Management, the United States Fish and Wildlife Service, all state agencies, the National Audubon Society, and the Idaho Power Company. To get this information, the Idaho Power Company instructed all operating employes and all transmission line patrolmen to report the location and type structure on all locations where any dead bird of prey was found.

They were further instructed to recover all dead birds of prey possible and turn them over to the Fish and Wildlife Service, as required by law, and for autopsy to determine cause of death. Some eagles had been shot and then in convulsion contacted conductors. Two eagles were found under lines, in this study, which were neither shot nor electrocuted. Poison or disease was indicated.

To get further information, arrangements were made for certain Idaho Power Company employes, who were familiar with the electrical system, to travel with Mr Nelson on a series of field trips.

These field surveys were carried out periodically from the spring of 1972 to the fall of 1973. These trips proved highly productive, as they permitted Mr Nelson to discuss and define areas which have eagle populations and their habits and mode of living.

During these field discussions, the company representatives were in a position to answer all questions as to types of structure and system voltages.

At the conclusion of the many field trips, Mr Nelson made a study of all types of structures and put them in three categories:

1. Those which were a definite hazard to the "birds of prey"
2. Structures which were a possible hazard to the "birds of prey"
3. Structures which are safe nesting sites and hunting perches with no possibility of electrocution.

After the structure types were classified, it became a matter of proving or disproving the findings by actual tests in the field with trained eagles.

The following is the report prepared by Morlan and his wife and co-author, Pat Nelson, and submitted to the Idaho Power Company:

EAGLE - POWER LINE RESEARCH.

By Morlan & Pat Nelson

Over four-thousand years ago, when our ecosystems were relatively well balanced through natural predation and use of the land, the eagle's nobility was recognized. The men who first took them for purposes of falconry came to understand and admire their intelligence and skill. Several major Asian tribes, particularly the Mongols, trained and used them as hunting partners. They were prized, protected, and occupied a place of importance in tribal life. Techniques of training falcons and eagles were introduced into Europe with the return of the Crusaders from the Middle East. At this time, the eagle was considered so magnificent that only the king could claim ownership.

A few short years later - after the invention of gunpowder - humanity's attitude toward the birds made a complete reversal. Eagles, previously so respected, were now looked upon as varmits to be hunted and killed. The sport of falconry declined almost to extinction. This worldwide change of attitude resulted directly from the invention and use of gunpowder. Man and gun could provide food for the table more efficiently than could the birds. Instead of a valued hunting partner, the eagle was now considered a competitor. Esteem for the birds continued to decline, finally hitting bottom about the time the North American West was settled. While western lands were being cleared and developed for farming and agriculture, the golden eagle and all other birds of prey were classified as vermin to be exterminated. As late as the 1940's, the United States government not only sanctioned, but encouraged shooting eagles as predators. Their numbers were also diminished by poisoning and sport shooting. With the construction of power lines the eagles faced another hazard - electrocution. However, as the birds were classed as "undesirables" at this time, their loss by electrocution caused no great concern.

Eventually, special interest groups such as Falconers, the National Audubon Society, and conservation organizations began to study the position of the eagle in our environment and the value of the birds in our ecosystem. The film industry made an important contribution toward changing the general public's attitude toward the birds. Programs such as Walt Disney's True Life Adventure Series and Wild Kingdom created understanding and appreciation for eagles as well as for other species of wildlife.

The dramatic slaughter of hundreds of eagles in Wyoming during the past few years motivated a strong renewal of effort by conservationists to achieve protective laws. Their efforts proved successful and the Congress of the United States has now passed protective legislation.

A recent effort to achieve consideration for eagles was spearheaded by the Idaho Power Company, Boise, Idaho. At their request I was happy to cooperate in study and research concerning power line electrocution of the birds. While the problem has been recognized throughout the West for many years, the significance and extent was difficult to determine. The Power Industry, National Audubon Society, Bureau of Sports Fisheries, Edison Electric Institute, and the Idaho Fish and Game Department all cooperated in the comprehensive study.

The electrocution problem is probably greater in Idaho than in some other western states because of the comparatively large golden eagle population. However, in spite of the shootings, poisoning and electrocutions, the State has a healthy population of golden eagles. During the past 25 years their numbers in Idaho have even increased slightly. The University of Idaho's Cooperative Wildlife Research studies support the conclusion that these birds are faring well in the State despite the problems and limitations they face. While Idaho is losing many eagles through illegal shooting and electrocution, the loss may be more critical in other states where the eagles are almost extinct. Nationwide, the loss of eagles by electrocution is significant, however, the solution of this problem is economically feasible and practical. Loss of habitat and shooting remain the most threatening problems to the eagles' existence.

The Department of Interior coordinated the count of how many eagles were electrocuted by power lines each year in the United States. National Audubon Society members and cooperators working in the field reported over three-hundred eagle electrocution incidents throughout the United States last year. A few of these incidents should undoubtedly have been correctly attributed to shooting as I have found cases where the bird had first been shot, spread its wings in convulsion, and was then electrocuted. The number of such incidents, however, has no significant bearing on the problem. The count also showed almost 98 percent of the electrocution victims are young birds just learning to fly. Being inexperienced, they have not yet acquired the precision and skill necessary to land safely on a cross arm supporting three or more wires.

Research, using trained eagles to document the problem and to determine the effectiveness of solutions, was conducted in my back yard. The Idaho Power Company constructed mock-up poles and lines on which we tested the young eagles' ability to land on the structure under various wind conditions and from different angles of approach. A permanent record of the work was made using 16mm slow-motion photography.

Studies of the slow-motion photography proved conclusively that electrocution would occur if an eagle with a 6' to 8' wing span could make contact with any two phase conductors or one phase conductor and a ground wire while attempting to land or take off.

To correct this, a practical solution appeared to be one of placing phase wires and the ground wire at different elevations which would prevent simultaneous contact between any two wires.

I made this suggestion to the Idaho Power Company engineers who then submitted drawings for this type structure. After a careful review, the mock-up poles and lines were changed to the new design. A permanent record of tests with trained eagles was again documented using 16mm slow-motion photography.

As the various redesigned structure types proved to be satisfactory to me, they were approved and made a part of my file and are available.

After a practical design for new construction was developed, we then proceeded to make studies on existing line and determine feasible corrective measures to prevent the electrocutions.

In the study, we did determine that the problem occurs almost exclusively on single-pole, cross-arm type construction where the conductors are near horizontal and have insufficient spacing.

Having a fairly accurate idea of the incidence, the "how" and the "why" of the eagle-powerline problem, the next step was to determine feasible corrective measures to prevent the occurrence.

As a falconer having flown trained eagles over a twenty-year period, I know eagles are extremely selective in their choice of landing sites. Determination of these preferred sites requires an intimate knowledge of the characteristics of eagles, the prevailing winds in the area, and topography. If a site has a landing position cross-wise with the wind and a good over-view of the surrounding terrain, not only one but many eagles in the area use the same landing site. From this position they hunt for prey and return to it to feed.

In many areas having no cliffs or trees, the eagles choose specific power poles for hunting sites and feeding perches. This is a common situation throughout Idaho and the West. The preferred pole is always one on which the cross arm is cross-wise with the prevailing wind and in a commanding topographic position. By examining the poles fitting this description it is possible to determine which ones have been selected by the eagles as preferred sites. Their droppings on the cross arms, the remains of rabbits - fur and feet, their regurgitated castings underneath, all identify these poles. During the course of our study, we rarely found a pole that was a good hunting site that we did not find castings and remains of rabbits underneath. This selectivity was confirmed when we found that a single pole might have up to six dead eagles, either shot or electrocuted, underneath it and no other poles along the same line for several miles would show any indication of eagle activity whatsoever. Obviously, the birds' selectivity simplifies corrective efforts by drastically reducing the number of poles requiring modification. Of the number of Idaho Power lines studied, I estimate 95 percent of the electrocutions could be prevented by correcting two percent of the poles. While these figures sound startling, they are realistic considering the selectivity of the birds in choosing landing sites.

Once the preferred poles are located, the next step is to decide upon the best method of modification. The line can be modified to a safe type design as per the engineers' drawings. If structure type design change is impractical, other methods of corrections are conductor insulation covers, or by installing perches at an elevation above the conductors. Drawings for these design corrections are also available.

These designs provide the young eagles adequate safe landing space.

A vertical separation of at least 43 inches is required between the center and outer phases, which provides adequate safety on a single-pole cross-arm type construction when an eight-foot cross arm is utilized. Young eagles may attempt to land on the insulators during their first flights. However, since their talons do not hold well on the slick surface, they rarely make a second attempt. They prefer the natural feeling of wood where their talons will hold and the structure is large enough to accommodate their very large feet.

In general, my recommendation for preference poles on existing lines is to change the structure configuration to an approved type. In those cases where this is not practical, perches or conductor insulation should be installed.

Idaho Power engineers designed efficient perches that can be installed three feet above a line where there are jumpers or where it is technically difficult to insulate or change the conductors to make the pole safe. The eagles were eager to land on the perches and immediately adopted them as preferred landing sites. They required no training nor encouragement to use them and could land or take off from any direction due to the design of the perches.

The success of these corrective modifications was documented in slow-motion photography. After correction, the poles became positive ecological factors rather than inviting, but lethal killers. The following is a typical example of a problem area, the corrections made, and the resulting benefits:

On the edge of the Owyhee River breaks, west of Jordan Valley, Oregon, Gordon Hansum of Idaho Power, found many eagle bones and feathers beneath a few poles in the same area. At the locations we discovered an eagle eyrie within a few hundred yards of the poles. During the first week of flying, the young birds would come out of the nest and land on the cliffs. In their second week of flying, they would attempt to land on one of the nearby poles - a 12,500 volt line with all conductors on the same level. In attempting to land on the cross arm, while still very unstable in the air, the fledgling eagles touched two conductors and were killed within several hundred yards of their birthplace.

This was considered a high priority and corrections were made. The center conductor was raised 43 inches on all of these poles and perches were installed where necessary. The groundwire was placed four feet below the cross arm.

The young eagles coming off the nest could learn to fly using the convenient poles to practice landing and take-off techniques without danger.

Two-pole transmission structures, so common throughout the West, and steel towers have conductors so far apart there is no danger of eagles being electrocuted. On these high-voltage lines the towers themselves are excellent nesting sites for at least five species of birds studied during this two-year period - the golden eagle, osprey, ferrugenus hawk, red tail, and the raven. As nesting sites, the towers are actually superior to the natural cliff eyries built on a south exposure. Young birds confined to the nest prior to flying, can withstand almost any amount of heat as long as their heads and shoulders are in the shade. When the temperature reaches about 96 degrees, as it often does on a south-facing cliff, the sun will kill the helpless eagles if they are totally exposed. The lines themselves or the beams above the line on which the nest is built, shade the young eagles and hawks. Since the nests built on the towers are high in the air, they also have maximum air circulation which keeps the temperatures considerably lower than on the heat-absorbing cliffs.

We filmed young birds growing up in a high-voltage line north of Glenns Ferry, Idaho, and devised some practical management practices:

When eagles construct an eyrie they may use very long sticks - sometimes six or seven feet in length. If, after placement in the nest, these dangle down too far, they can make contact and initiate an arc from the conductor back to the tower causing a switch to trip, but rarely a power outage. An Idaho Power Company engineer told me they used to destroy the tower nests, but soon learned that often they had only compounded the problem. Eagles are persistent and when they began to rebuild, were more likely to cause an outage by carrying and attempting to place a stick so long that conductor contact is made. Instead of destroying the nest, the longer sticks hanging below were trimmed for clearance. By leaving the nest intact, the eagles' yearly additions are confined to the top. If undisturbed, the birds will use the same eyrie year after year, occasionally building an alternate. They do not, however, construct a totally new home every season unless their previous one has been destroyed. When eagles mute or deficate, there is a remote possibility of the current arcing back to the tower. This seems to be rare however, and when it occurs causes an instantaneous trip which does not present any particular problem.

In November 1973, the Idaho Power Company flew the western and southern divisions of their lines as a part of the cooperative work. The area studied is roughly between Twin Falls, Idaho, and Hells Canyon, Oregon. They counted 92 eagles perched on the lines and found 32 nests. Of these, maintenance men identified 17 as eagle eyries with the remaining 15 being either eagle or large hawk nests. This is a significant extension of the habitat for birds of prey as they are located in areas having no natural nesting sites. Prey for the birds is abundant and the nests are successful as permanent breeding sites.

The toll of these magnificent birds killed by electrocution in the Intermountain West and throughout the world is high, but probably not limiting to total populations. As one who has spent his life with birds of prey, it has been gratifying to work with Idaho Power Company, make recommendations, and see the results of their engineers who designed practical solutions. Humanity's change of attitude and the Power Industry's work may prevent the problem from becoming a significant factor in the future.

RAPTOR PROTECTION PROGRAM

The Idaho Power Company has had, for several years, an active program to minimize these bird losses. Some actions taken have been:

1. Utilize the services of a nationally recognized authority on birds of prey.
2. Identify the areas inhabited by raptors.
3. Investigate where electrocutions have occurred.
4. Educate the public that many birds found near power lines have been shot or poisoned, not electrocuted.
5. Modify preferred existing structures for bird safety.
6. Design structures for new construction that provide safety.

Upon selected structures in raptor areas, the conductor separations, perches, or protectors should prevent a large bird from making simultaneous contact with two phases or a phase and a grounded object. Descriptions of some of these configurations and modifications follow. They are further illustrated in considerable detail in the Appendix.

a) The Company has adopted "armless" configuration for much of its new distribution and transmission structures. (See Appendix Pages A, B, and D) It is our belief, substantiated by the work described above, that due to the physical separation and orientation of the conductors, and the lack of suitable perches, that these new facilities should not present an electrocution hazard to raptors.

b) Safe crossarm type construction has been designed by lowering the arm which supports the two outside conductors and installing the center conductor on a pole top pin. The vertical separation required for safety is a function of the crossarm length. To gain adequate safety, an eight-foot distribution crossarm must be lowered about 43 inches below the pole top. In transmission construction, a safe structure was designed by lowering an eleven-foot crossarm 30 inches below the top of the pole (a vertical conductor separation of 38 inches was obtained). (See Appendix Pages C and D)

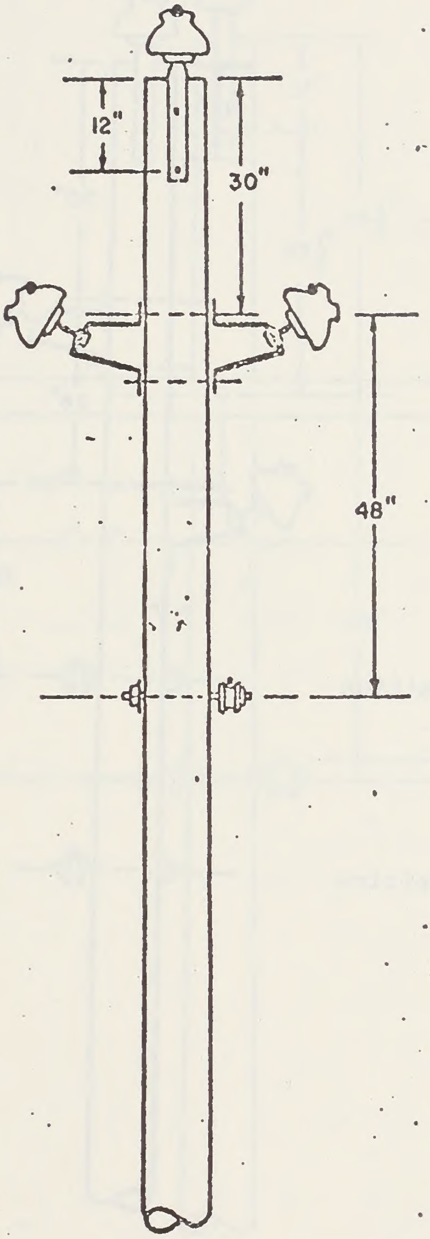
c) An existing crossarm structure might be modified to an effective configuration similar to (b) above by means of a pole top extension supporting the center phase approximately 43 inches above the top of the pole. (See Appendix Page E)

d) A wood perch, attractive to these birds, adequately mounted and oriented several feet above any energized object, is often the best solution to a complicated problem. (See Appendix Pages F and G)

e) An insulated conductor cover and insulator hood, extending about six feet each way from the insulator may sometimes be a practical solution. PVC tubing has been used for this covering. (See Appendix Pages H and I)

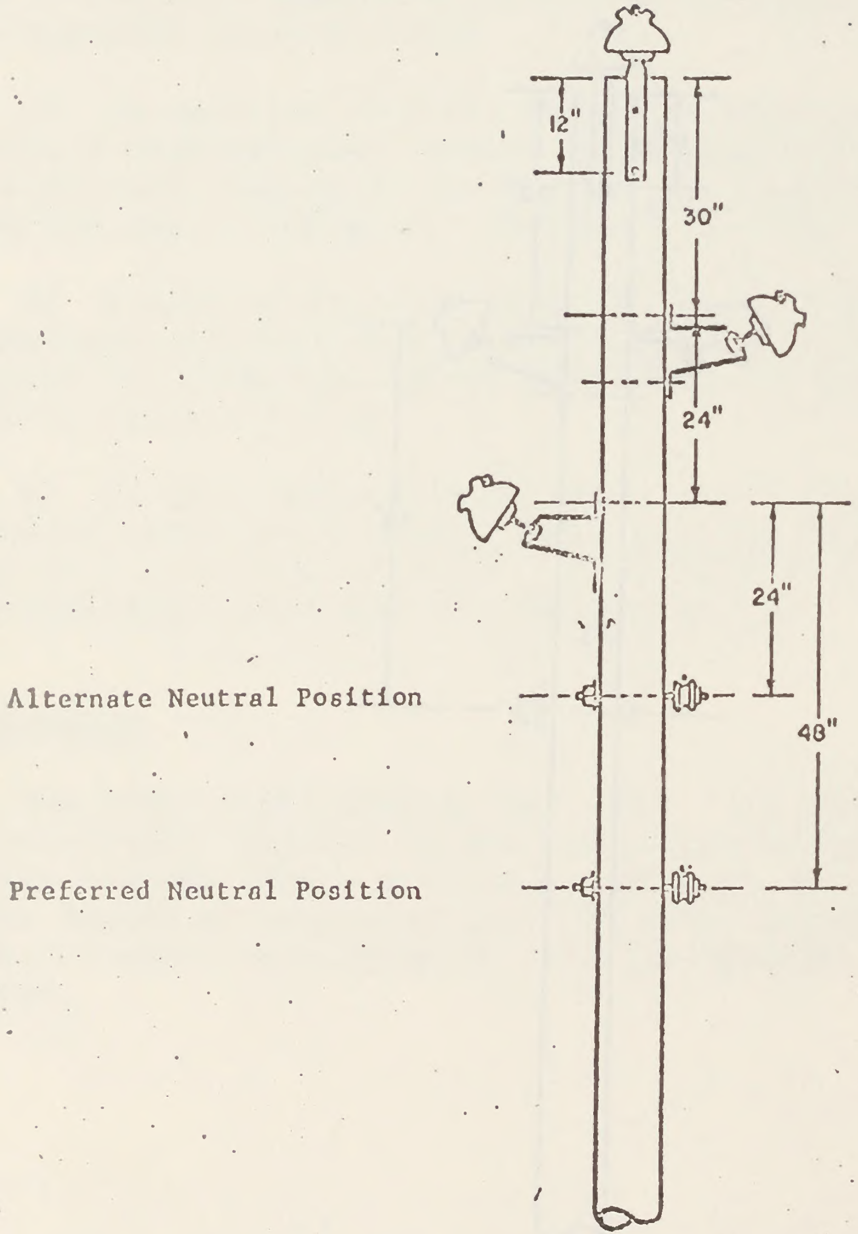
CONCLUSIONS

The Idaho Power Company has taken what we feel is a logical and reasonable approach to the raptor electrocution problem. Our studies with Mr Nelson and his eagles have concluded that with proper design of new structures and with adequate modification of preferred existing structures, this problem can be substantially reduced.



Armless Distribution
Triangular Construction

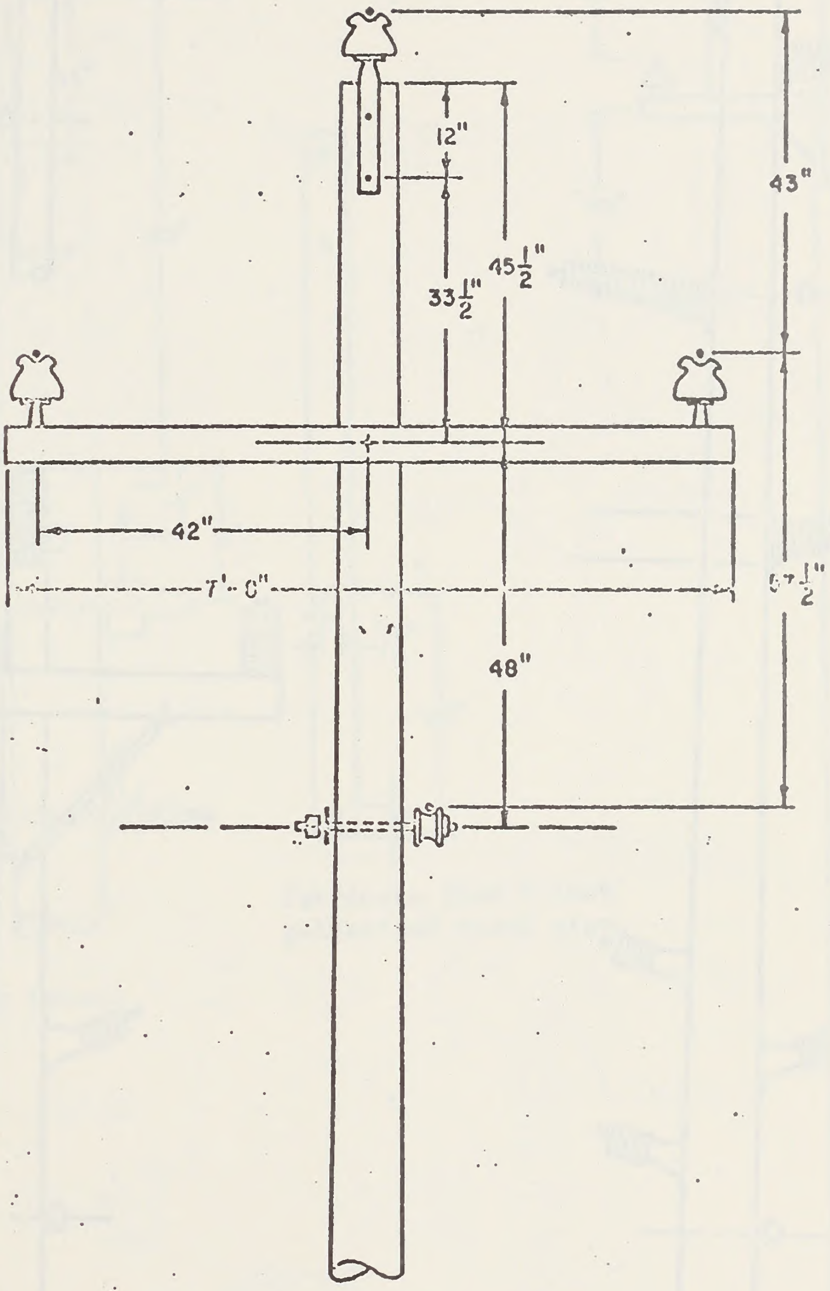
pproved type structure
o be installed in a
"Birds of Prey" area



Armless Distribution
Staggered Construction

Approved type structure
to be installed in a
"Birds of Prey" area

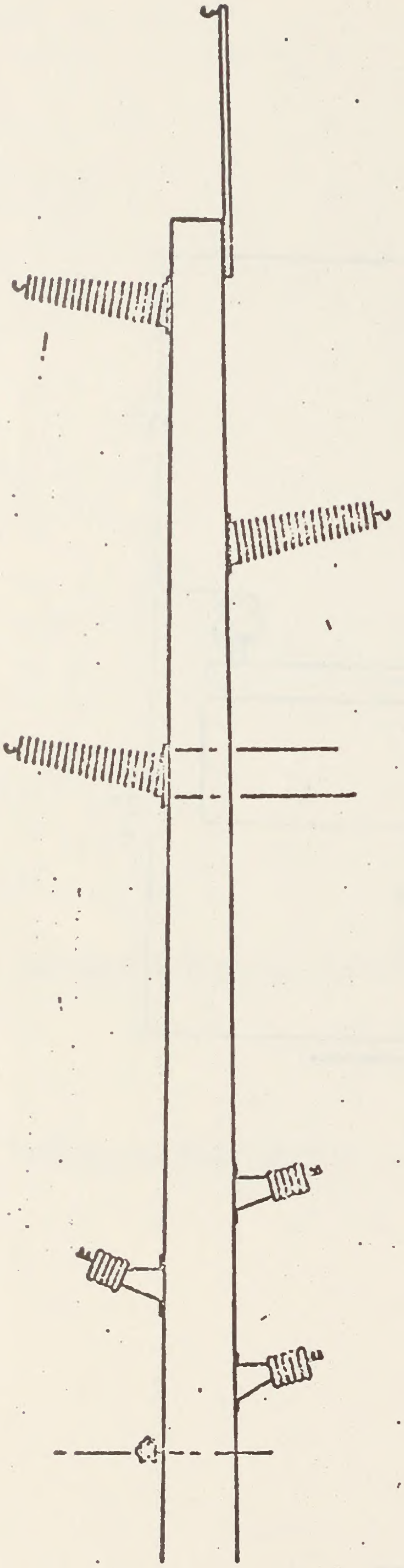
Morley W. Nelson

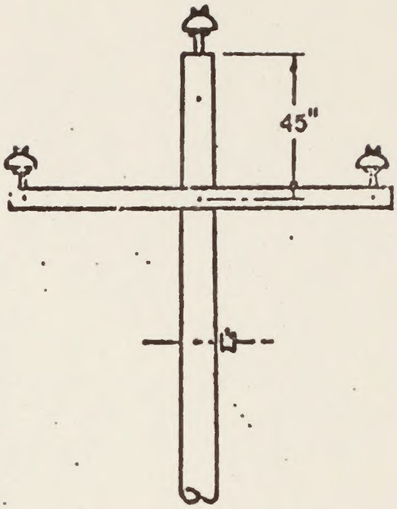


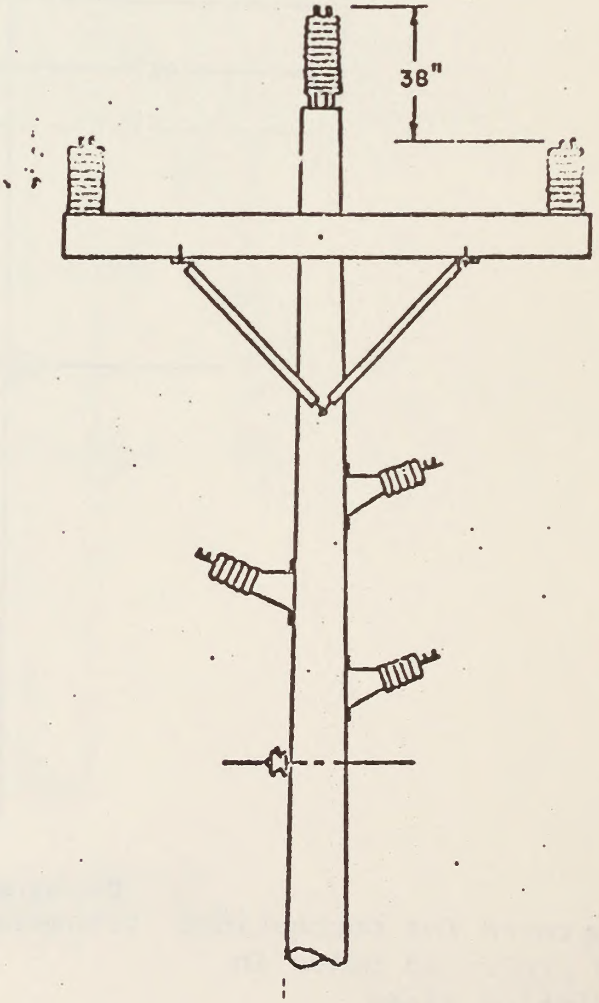
Crossarm Distribution
Triangular Construction

Approved for corrections
on preformed poles in
existing lines

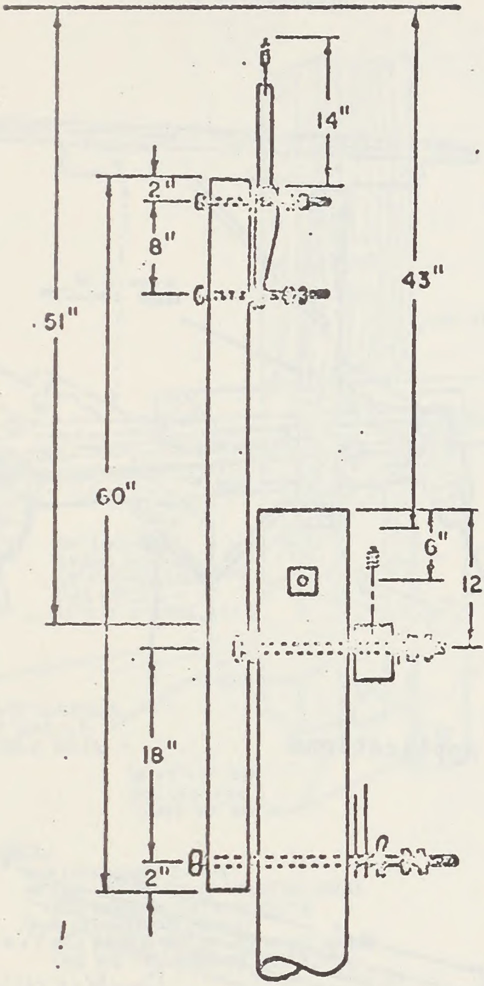
APPENDIX
PAGE D



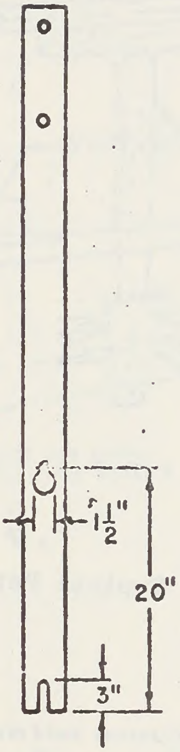




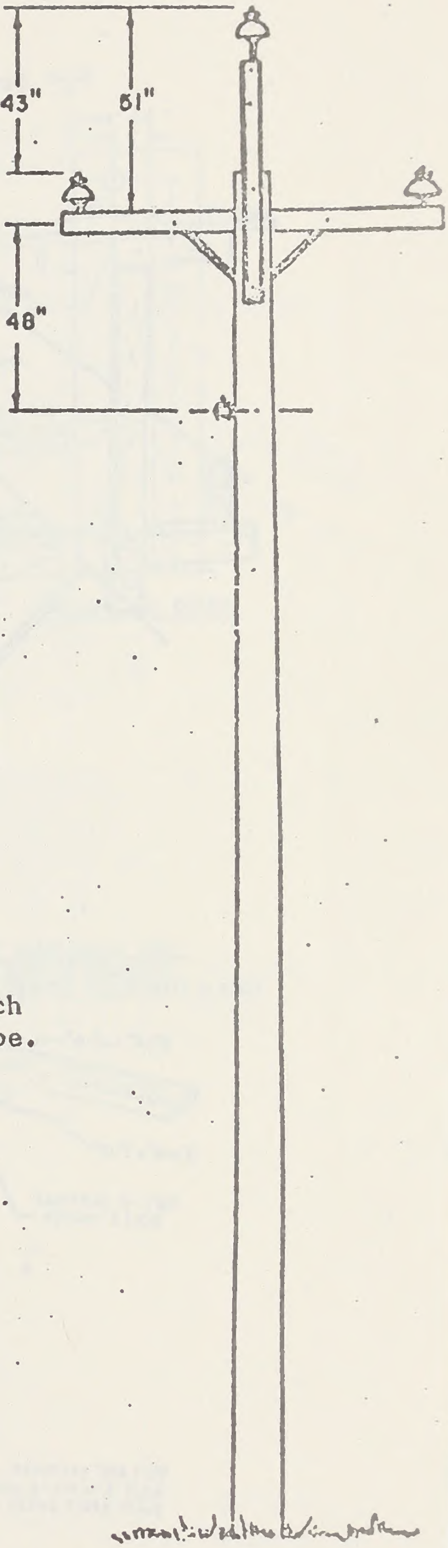
roved type structure
be installed in a
rds of Prey" area



Assembly Detail

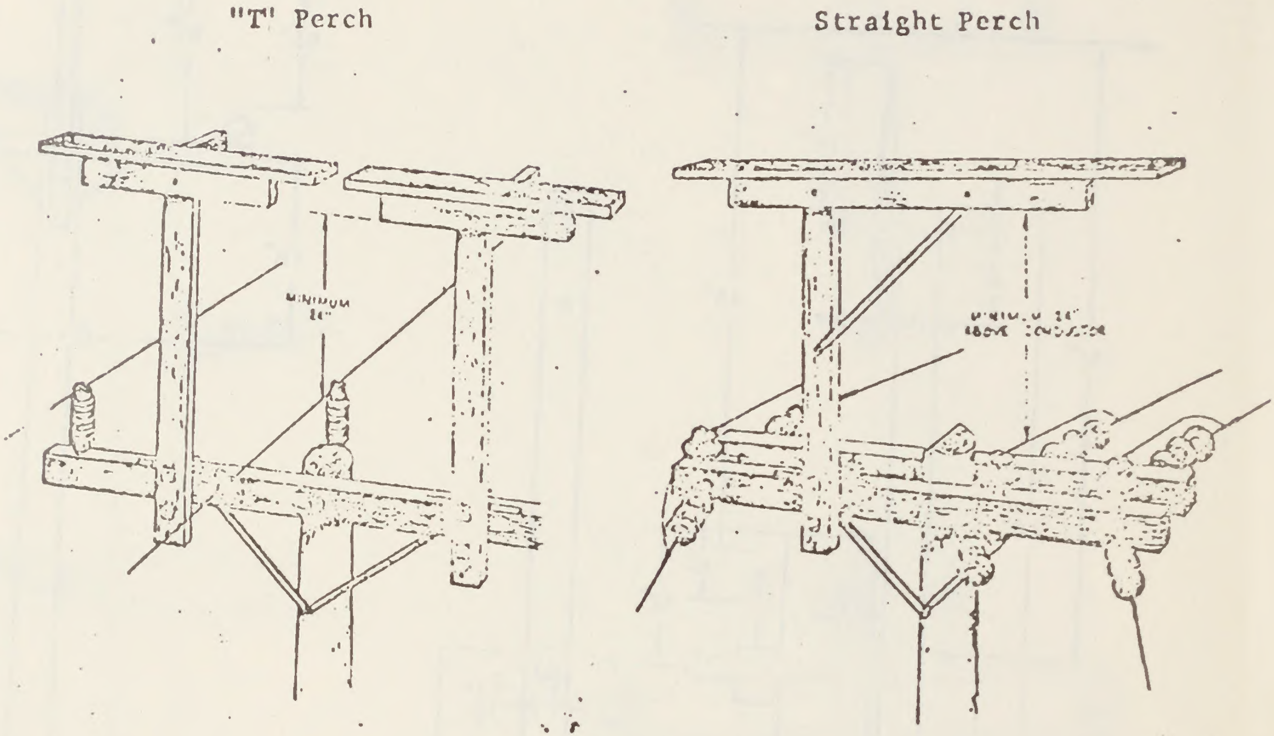


Fabricate from 3-inch galvanized steel pipe.



Center Phase Riser

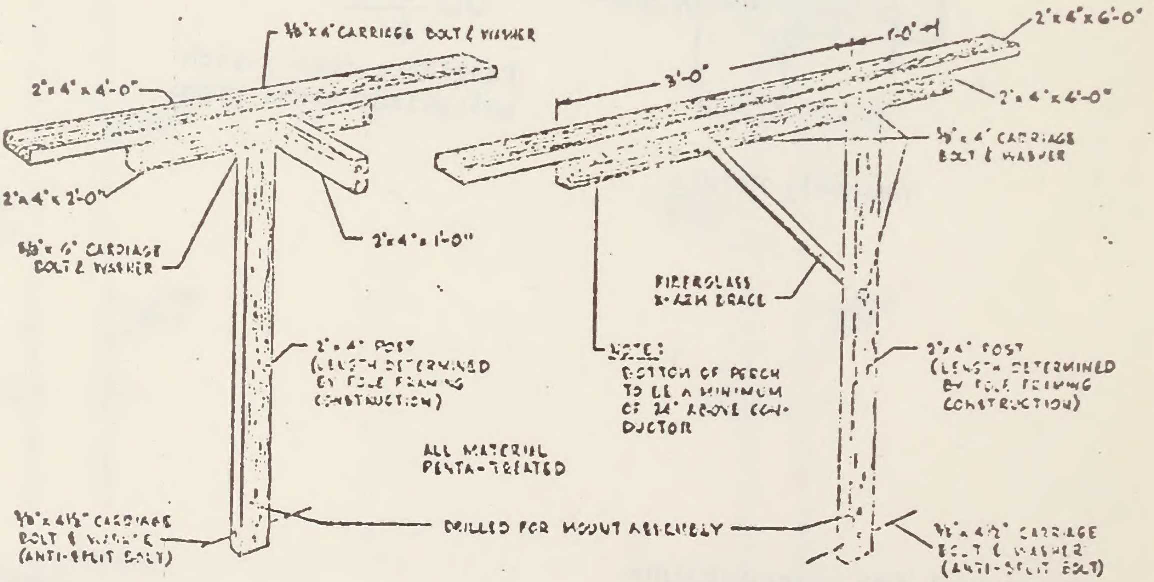
Approved for corrections
on preferred poles in
existing lines



"T" Perch

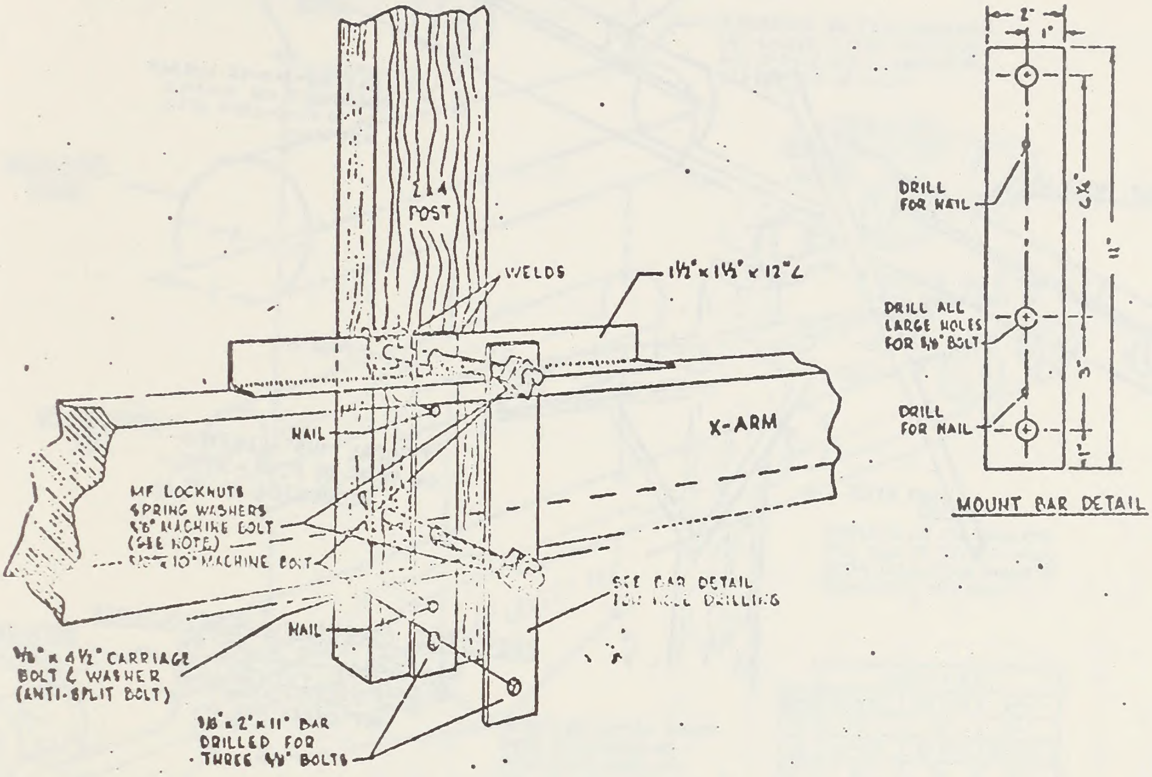
Straight Perch

Typical Perch Applications



Approved for corrections
on preferred poles in
existing lines

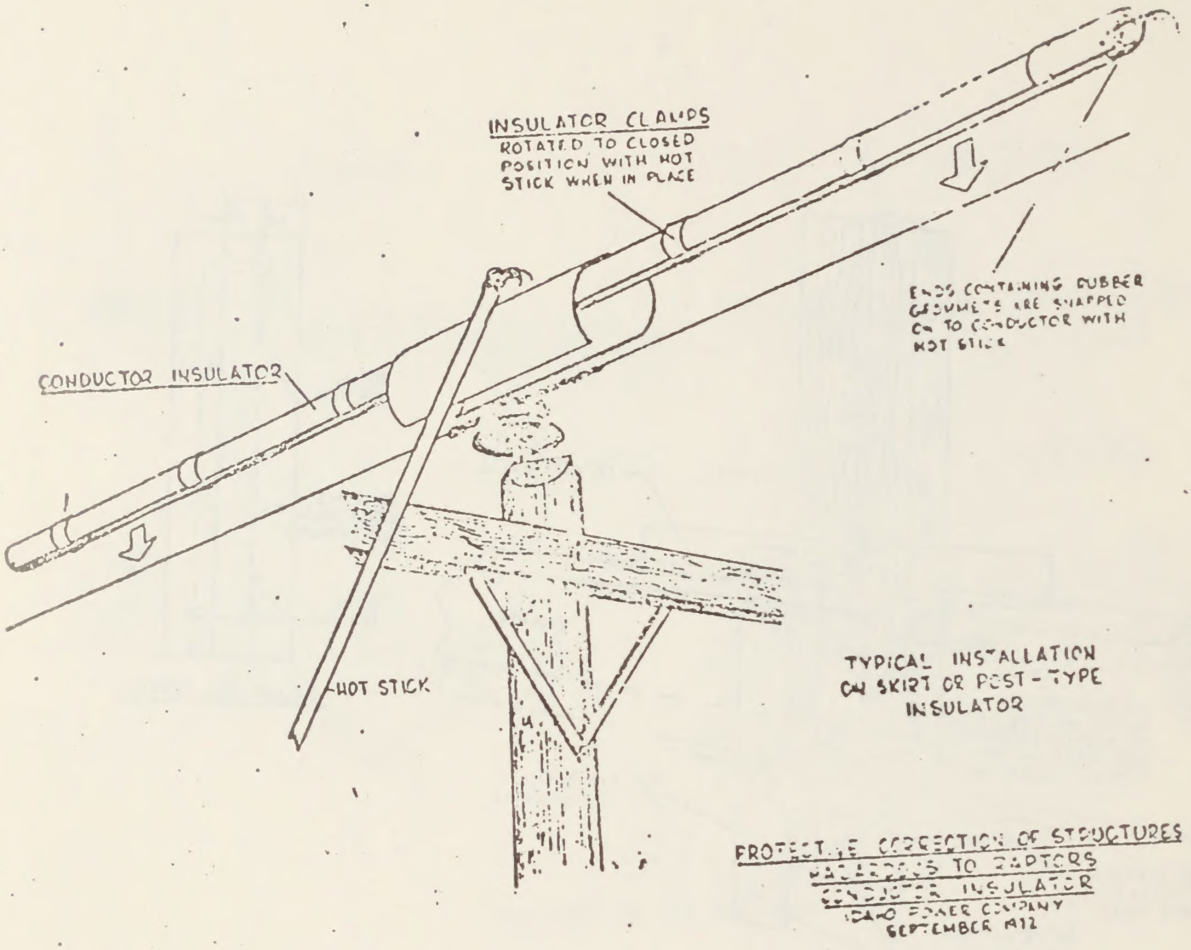
Perch Assembly Details



NOTE:
FOR LIGHT-DUTY X-ARM:
USE UPPER SET OF MOUNTING HOLES
USE 5/8" x 8" MACHINE BOLTS
FOR HEAVY-DUTY X-ARM:
USE LOWER SET OF MOUNTING HOLES
USE 5/8" x 10" MACHINE BOLTS

MOUNT ASSEMBLY FOR
TYPES ① & ② PERCHES
(SHOWN MOUNTED ON LIGHT-DUTY X-ARM)

pproved for corrections
n preferred poles in
existing lines

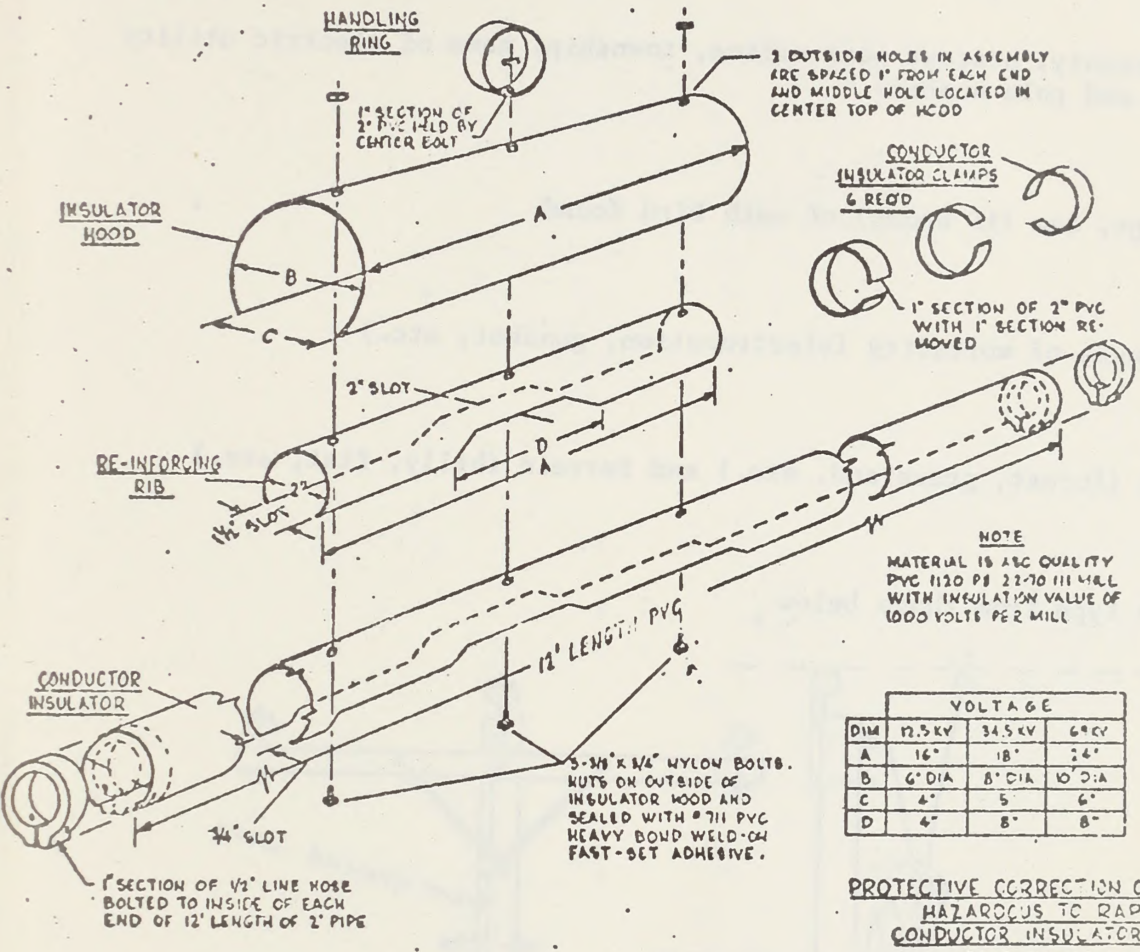


Approved for corrections
on preferred poles in
existing lines

Morlan W Nelson
Birds-of-Prey Consultant

[redacted]

APPENDIX
PAGE I



NOTE
MATERIAL IS ABC QUALITY PVC 1120 PS 22-70 111 MILL WITH INSULATION VALUE OF 1000 VOLTS PER MILL

	VOLTAGE		
DIM	12.5 KV	34.5 KV	69 KV
A	16"	18"	24"
B	6" DIA	8" DIA	10" DIA
C	4"	5	6"
D	4"	8"	8"

PROTECTIVE CORRECTION OF STRUCTURES
HAZARDOUS TO RAPTORS
CONDUCTOR INSULATOR DETAILS
IDAHO POWER COMPANY
SEPTEMBER 1972

Approved for corrections
preferred poles in
existing lines

Morlan W Nelson

RAPTOR MORTALITY REPORT

1. Date of discovery

2. Approximate date when mortality occurred

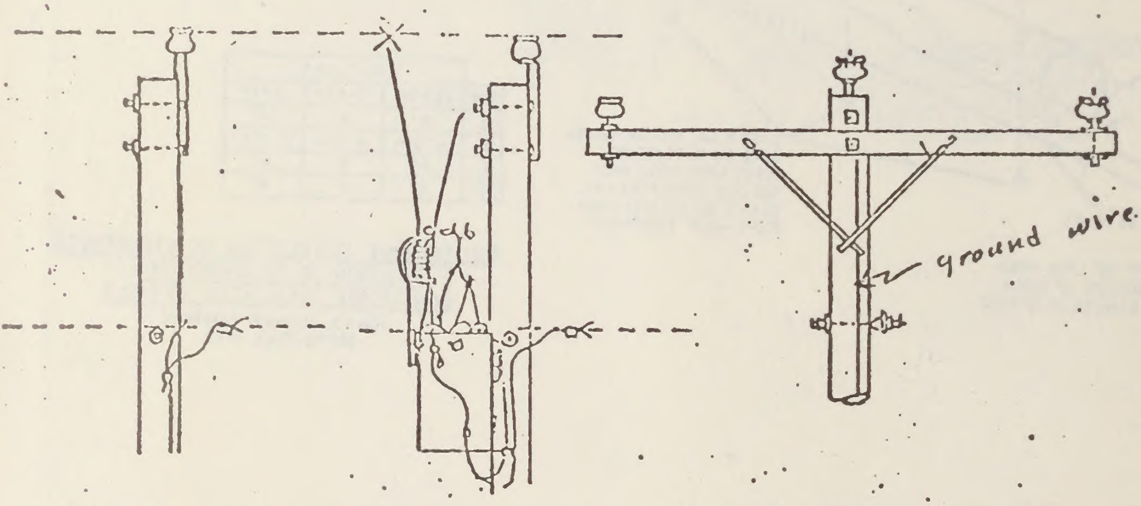
3. Location (county, nearest post office, township, name of electric utility and pole number)

4. Species, age, sex (if known) of each bird found

5. Probable cause of mortality (electrocution, gunshot, etc.)

6. Vegetation (forest, grassland, etc.) and terrain (hilly, flat, etc.)

7. Check pole type from those below



____No crossarm

____No crossarm, but transformer present

____Crossarm(s)

____Other (describe on back)

8. Disposition of carcass (left, picked up, etc.)

9. Name, address, phone number, and agency of person making report

Send Report to State Supervisor
Division of Wildlife Services
Bureau of Sport Fisheries and Wildlife