DELINEATION AND ENVIRONMENTAL GEOLOGIC EVALUATION OF ABANDONED COAL MINES IN NORTH-CENTRAL TEXAS

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TABLE OF CONTENTS

Abstract 1
Introduction 2
Scope of Project 2
Project Goals 3
Geologic Setting 4
Stratigraphy 4
Structural Geology 7
Physiography 7
Land Resources 7
Mining Techniques 11
History of Coal Production 11
Prospecting 12
Underground Mining 12
Shaft mines 12
Slope mines 14
Drift mines 14
Longwall advancing extraction 14
Modified longwall advancing extraction 16
Surface Mining 16
Contour mines 16
Open pit mines 18
Other systems of mining 18
Environmental Effects 19
Loss of Vegetation 19
Progressive devegetation 21
Revegetation 21
Erosion 23
Runoff and Deposition 27
Effects on streams 27
Effects on impoundments 27
Effects downslope 28
Subsidence 29

Refuse 31
Structural and Equipment Remains 33
Methodology 34
Photography 34
Selecting and Recording Photographic Data and Information 36
Interpretation Key 40
Fieldwork Preparation 40
Fieldwork 40
Accessible sites 40
Inaccessible sites 42
Recording Data 43
Mine Site Characterization 48
Site Descriptions 57
Archer, Clay and Throckmorton Counties 60
Brown County 64
Coleman County 75
Eastland County 97
Thurber Mines Area (Erath County and part of Palo Pinto County) . . . 111
Jack County 124
McCulloch County 137
Montague County 163
Palo Pinto County (other than Thurber Mines Area) 186
Parker County 198
Stephens County 208
Wise County 222
Young County 244
Summary 264
Acknowledgements 267
References 268
Appendices 272

LIST OF FIGURES

1. Schematic illustration of facies changes in coal-bearing units. 5
2. Underground mine types. 13
3. Detail of underground mining methods. 15

4. Surface mine types. 17
5. Illustration of progressive devegetation around mine dumps. 22
6. Typical patterns of erosion and deposition near mine sites. 24
7. Example of use of the system for generating unique mine site identification numbers. 35
8. Form used for requesting and inventorying aerial photographs. 37
9. Grid used for locating mine sites on aerial photographs. 38
10. Grid used for estimating acreage of mine sites delineated on aerial photographs. 39
11. Form used for describing the location and condition of mine sites. 45
12. Form used for summarizing mine site characteristics. 47
13. Map of Archer County, Texas. 61
14. Map of Clay County, Texas. 62
15. Map of Throckmorton County, Texas. 63
16. Map of Brown County, Texas. 65
17. Map of Coleman County, Texas. 76
18. Location of Star and Crescent Mines at site number C/FF-4-14. 82
19. Map of Eastland County, Texas. 98
20. Map of Erath County, Texas. 112
21. Map of Jack County, Texas. 125
22. Map of McCulloch County, Texas. 138
23. Map of Montague County, Texas. 164
24. Map of Palo Pinto County, Texas. 187
25. Map of Parker County, Texas. 199
26. Map of Stephens County, Texas. 209
27. Map of Wise County, Texas. 223
28. Map of Young County, Texas. 245

LIST OF TABLES

1. Major land resource units in North-Central Texas. 8
2. Interpretation key for identifying abandoned mine sites. 41
3. Acquisition of data concerning surface conditions at mine sites. 44
4. List of county and quadrangle name codes. 46

5. Mine site characteristics and terms used in site descriptions. 49
6. Outcrop acreage of coal-bearing formations. 58
7. References used in preparing county maps. 59
8. Summary of site descriptions - Brown County. 66
9. Summary of environmental effects in Brown County. 68
10. Confirmed and probable mine sites smaller than 5 acres - Brown County. 74
11. Summary of site descriptions - Coleman County. 77
12. Summary of environmental effects in Coleman County. 79
13. Summary of site descriptions - Eastland County. 99
14. Summary of environmental effects in Eastland County. 103
15. Confirmed and probable mine sites smaller than 5 acres - Eastland County. 110
16. Summary of site descriptions - Thurber Mines Area (Erath County and part of Palo Pinto County). 113
17. Summary of environmental effects in Erath County. 118
18. Synopsis of all mines in Thurber Mines Area (Erath County and part of Palo Pinto County). 121
19. Confirmed and probable mine sites smaller than 5 acres - Thurber Mines Area (Erath County and part of Palo Pinto County). 123
20. Summary of site descriptions - Jack County. 126
21. Summary of environmental effects in Jack County. 129
22. Confirmed and probable mine sites smaller than 5 acres - Jack County. 136
23. Summary of site descriptions - McCulloch County. 139
24. Summary of environmental effects in McCulloch County. 141
25. Summary of sites descriptions - Montague County. 165
26. Summary of environmental effects in Montague County. 167
27. Confirmed and probable mine sites smaller than 5 acres - Montague County. 185
28. Summary of site descriptions - Palo Pinto County (other than Thurber Mines Area). 188
29. Summary of environmental effects in Palo Pinto County. 192
30. Confirmed and probable mine sites smaller than 5 acres - Palo Pinto County (other than Thurber Mines Area). 197

31. Summary of site descriptions - Parker County. 200
32. Summary of environmental effects in Parker County. 203
33. Confirmed and probable mine sites smaller than 5 acres - Parker County. 207
34. Summary of site descriptions - Stephens County. 210
35. Summary of environmental effects in Stephens County. 213
36. Confirmed and probable mine sites - Stephens County. 221
37. Summary of site descriptions - Wise County. 224
38. Summary of environmental effects in Wise County. 231
39. Confirmed and probable mine sites - Wise County. 243
40. Summary of site descriptions - Young County. 246
41. Summary of environmental effects - Young County. 251
42. Confirmed and probable mine sites - Young County. 263
43. Summary distribution of confirmed and probable coal mine sites. . . . 265
44. Summary of environmental effects at mine sites. 266

APPENDICES

A. Summary of photography used to evaluate North-Central Texas abandoned coal mines. 272
B. Personal contacts in coal-mining areas. 275

ABSTRACT

An environmental geologic survey of abandoned bituminous coal mines in North-Central Texas located 140 confirmed and probable mines in 12 counties. Previously, 67 mines were known, although some locations were found to be inaccurate. Present surface conditions at the mine sites have been evaluated relative to the need for possible reclamation. Based on the oldest available, and more recent, 1:20,000-to 1:40,000-scale aerial photography, low-altitude aerial observation, and ground confirmation, mining and subsequent mine abandonment have resulted in five major effects. These are: (1) devegetation, in part due to leachates from mine spoil; (2) erosion by gullying, sheetwash and mass wasting; (3) increased sedimentation in tanks and streams; (4) ground surface subsidence, and (5) accumulation of mine spoil, deteriorated equipment, and other refuse.

The coals, mined from the 1850's to the 1940's are in the middle and late Pennsylvanian Strawn, Canyon and Cisco Groups. Mining was primarily underground by a modified longwall advancing method. A total of 585 acres has been affected by mining, with 142 acres in Young County (13 confirmed mines), 94 acres in Palo Pinto County (16 confirmed mines) and 45 acres in Wise County (15 confirmed mines). The greatest surface effects are evident near Thurber in Erath County and at Strawn in Palo Pinto County, where extensive spoil piles are present. Near Bridgeport in Wise County, shale in the spoil piles has been used in brick-making. Presently there is renewed interest in these bituminous coal resources and exploration is active.

INTRODUCTION

Bituminous coal in the Pennsylvania Strawn, Canyon and Cisco Groups of North-Central Texas was mined primarily from the mid-1880's to 1943. Peak production occurred in the period 1905 to 1920, but declined with the increased use of oil and gas early in this century (Evans, 1974). Coal was mined from outcrop, from relatively shallow surface pits, and from shaft and slope mines. Many of these facilities were abandoned, along with associated spoil piles and areas of disturbed land, and remain as such today.

Presently there is concern for the environmental impact which mining operations have on the land, air and water in mining districts. This applies to present, as well as past, mining operations. Abandoned mines may still have impact due to burning coal refuse, due to chemical leachates from waste piles affecting vegetation, or due to subsidence of mined areas and the presence of open pits or shafts. The Surface Mining Control and Reclamation Act of 1977 provides a mechanism for states to establish reclamation programs for coal-mined lands abandoned prior to August 3, 1977. Funding for this program is to come from fees levied against coal produced from present underground and surface operations (Johnson and Miller, 1979). The first step in establishing a reclamation program, however, is to identify and characterize the abandoned mines and the potential need for reclamation.

Scope of Project

The Railroad Commission of Texas, Surface Mining and Reclamation Division, contracted with the Bureau of Economic Geology, The University of Texas at Austin, for the delineation and environmental geologic evaluation of abandoned coal mines in North-Central Texas. Results of the project are presented in this report, which covers a region of bituminous coal-bearing formations extending across 15 counties and covering an area of 2950 km^2 (1139 mi^2). Possible mines were identified on multiple dates of aerial photographs and confirmation made using historical records, field checking on the ground and via low-altitude aerial observation, and through local landowners, county agricultural agents, and county historical commissions.

A previous feasibility study, encompassing only Young County, Texas (Finley and Hupp, 1979), indicated that 1:20,000-scale black-and-white aerial photographs were adequate to locate possible mines, determine the extent of the disturbed area, and

begin an environmental characterization. Photographs of 1:40,000-scale probably represent the smallest scale data usable for these purposes. Other available scales of data (1:60,000 or 1:120,000), even though on color or color-infrared film types, were not useful, due to lower resolution.

Project Goals

The primary objective of this study was to provide the Texas Railroad Commission with data on the location, size and present condition of abandoned coal mines in North-Central Texas. These data are succinctly summarized on a data sheet for each mine along with a brief summary of the past mining activity and unique characteristics of mines in each county. During the study, information was obtained from former miners, land owners, and local residents regarding mine locations, mining practices and uses of coal from particular mines. Also, some historical records were found during field checking to be incorrect regarding mine locations or extent of mining. The compilation of information from local sources gathered during field checking and notations on improving historical records have been included in this report as a secondary objective. These data are potentially valuable to the coal explorationist in view of the current (1979) level of test drilling and leasing which indicates renewed interest in the bituminous coal resources of North-Central Texas.

GEOLOGIC SETTING

Stratigraphy

Coals in North-Central Texas occur within the Strawn, Canyon and Cisco Groups in deltaic deposits of the middle and late Pennsylvanian (Brown and others, 1973). Evans (1974) reports that mines were opened in Cisco Group rocks in McCulloch, Coleman, Eastland, Young, Jack and Montague Counties; in Canyon Group strata in Wise County; and in Strawn Group rocks in Erath, Palo Pinto, and Parker Counties (fig. 1). Complex stratigraphic relationships exist among these rocks because of extensive facies changes from north to south parallel to the strike of the units. Numerous stratigraphic studies applicable to the region are cited by Evans (1974).

Generally, middle and late Pennsylvanian rocks were deposited in dip-oriented fluvial-deltaic systems, bank systems parallel to shelf-edge, and slope depositional systems in an environment resembling modern continental shelves and slopes but on a smaller scale (Galloway and Brown, 1972; Brown and others, 1973; Galloway and Brown, 1973). Coal deposits originated on delta plains in swamps and marshes, where organic matter accumulated and was preserved, as well as in interdeltaic embayments such as bays and lagoons (Evans 1974).

The Strawn Group (fig. 1) includes the Thurber coal which was deposited in an interdeltaic embayment south of major deltaic depositional sites in northern Palo Pinto and Jack Counties (Brown and others, 1973). The Thurber coal was extensively mined in northern Erath and southern Palo Pinto Counties from the late 1880's to the 1920's. Evans (1974) summarized the depositional environments of coals in the Strawn Group:

> Coal seams are restricted to upper Strawn (Desmoines Series) units which crop out from northwestern Erath County across southeast Palo Pinto County into western Parker County. These units, as well as younger Canyon and Cisco Group units, dip gently (less than 1 degree) northwest. Upper Strawn strata comprise fluvial and deltaic depositional systems which extend westward from Ouachita foldbelt source areas (Brown and others, 1973). Coal associated with these deposits formed during several periods of delta progradation.

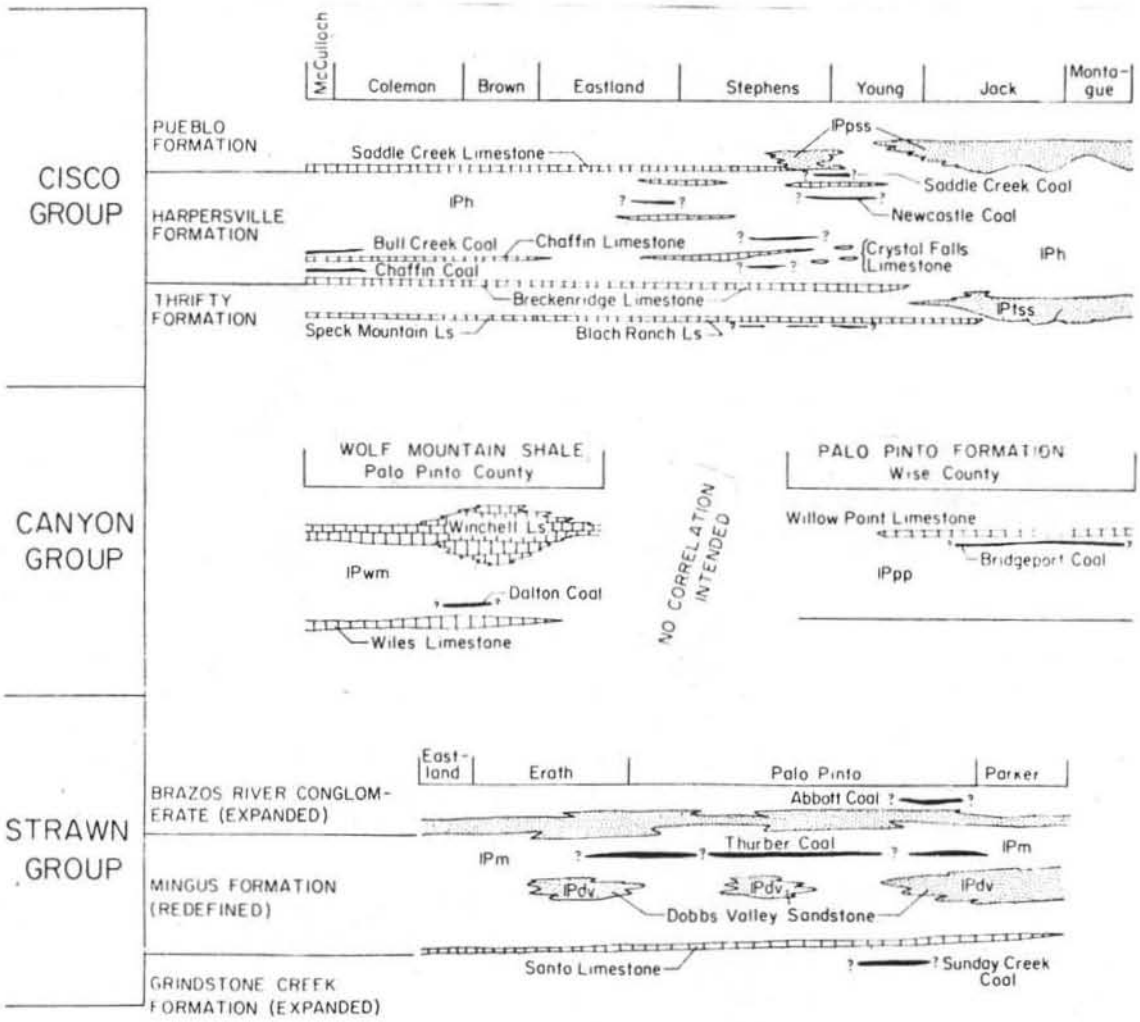


Figure 1. Schematic illustration of south to north facies changes in major coal-bearing lithologic units of North-Central Texas (from Evans, 1974, Plate 1.).

Of the three coals in the Strawn Group, Sunday Creek coal, Thurber coal, and Abbott coal, only the Thurber coal was mined to any great extent; the other two are relatively impure.

The Canyon Group (fig.1) includes the Bridgeport coal that was mined extensively around Bridgeport in Wise County and was the last bituminous coal actively mined in the state--until 1943--during the historic period of mining ending at that time (Stenzel and others, 1948). The Dalton coal is found within the Wolf Mountain Shale in this Group, but apparently was not mined. The depositional environments of coal in the Canyon Group are summarized by Evans (1974):

> Canyon Group (Missouri Series) strata record several periods of northwestward delta progradation. Contemporaneous with this terrigenous clastic system were various carbonate systems (including bank, shelf, and shelf-edge reef), some of which extended eastward during times of reduced clastic influx (Brown and others, 1973). Associated delta-plain sediments were thin and only rarely preserved because marine processes easily reworked these units following delta abandonment. Two coal deposits are recognized in Canyon Group strata; however, the depositional framework of the two seams is poorly understood.

The Cisco Group (fig. 1) includes the Harpersville Formation, which contains 4 laterally persistent coal seams--Chaffin coal, Bull Creek coal, Newcastle coal and Saddle Creek coal. Evans (1974) summarized the depositional environments of the Cisco Group:

> Numerous fluvial-deltaic progradations fed by eastern source areas in the Ouachita foldbelt mark Cisco Group strata (Virgil and Wolfcamp Series). Sites of organic accumulation were mainly interdeltaic embayments lateral to main delta trends. During periods of progradation, delta-flank embayments moved basinward due to strike-fed mudflat and strand-plain accretion. Brackish-bay mudstones and limestones and thin coal beds accumulated shoreward of these mudstones and sandstones. Organic accumulation took place both as in situ marsh or swamp deposition in shallow portions of delta-flank embayments and as detrital accumulations in deeper portions of lagoons or lakes behind the strike-fed barriers. Upon delta abandonment, marine processes reworked portions of the interdeltaic embayment sediments with eventual marine limestone deposition onlapping former sites of delta-flank deposition (Brown and others, 1973).

The Chaffin and Bull Creek coals are restricted in extent and were mined only in parts of McCulloch and Coleman Counties. Newcastle coal is the primary coal in the Harpersville Formation and was mined at 5 or more locations by the Belknap Coal Company near Newcastle in Young County. One persistent, impure coal seam in the Graham and Thrifty Formations (undivided) is noted which is not a part of the Harpersville Formation (Evans, 1974).

Structural Geology

Structurally, rocks in the Strawn, Canyon and Cisco Groups are generally undeformed with regional dips to the west and northwest that average ½ degrees. Some minor faulting occurs in the northern part of the Cisco Group outcrop belt (Evans, 1974; Galloway and Brown, 1972).

Physiography

The North-Central Texas bituminous coal region lies within the North Central Prairies of the Middle Texas Province (Johnson, 1931). Other than northwestern Young County and western Coleman County, the area is known as the Dissected Plateau, developed on eroded exposures of Pennsylvanian rocks. North-northeast to south-southwest trending ridges form the topography of the region; intervening lowlands are generally erosional in origin (Johnson, 1931). Northwestern Young County and western Coleman County fall in the Rolling Limestone Plains, characterized by ridges composed of resistant limestone. The area of eastern Coleman County, designated as Constructional Plains (Johnson, 1931), corresponds to a Limestone, Sand, and Gravel land resource unit (Kier and others, 1977) consisting of limestone gravel with quartz sand, commonly cemented with calcite. These materials are alluvial fan deposits derived from Cretaceous rocks (Kier and others, 1976).

Land Resources

Land resource units within the outcrop area delimit areas of similar characteristics which determine the suitability of the land for various uses. Land resource units are "mappable entities, either natural or man-made, that are defined by the physical, chemical, and biological characteristics or processes that govern the type or degree of use that is consistent with both their natural quality and productive utilization" (St. Clair and others, 1975). Within the outcrop area of coal-bearing strata in North-Central Texas, units of Hard Sandstone, Mud and Mudstone (Undifferentiated), and Ceramic Clay and Lignite/Coal have been delineated (Kier and others, 1977). A Clay Mud and Sandstone unit is widespread elsewhere through North-Central Texas. The latter unit includes local coal beds and thin limestones. Physical properties and other characteristics of these units are summarized in table 1, and their distribution has been mapped by Kier and others (1977).

Table I. Major land resource units in North-Central Texas (from Kier and others, 1977).

Unit	HARD SANDSTONE, MUD, AND MUDSTONE (UNDIFFERENTIATED)	CERAMIC CLAY AND COAL	CLAY MUD AND SANDSTONE
COMPOSITION OF SUBSTRATE	Quartz sand and clay mud; predominantly cemented by calcite, locally cemented by silica	Kaolinitic clay and coal; local quartz sand	Illitic clay mud and quartz sandstone with local coal beds; local thin limestone beds
RESOURCES AND ECONOMIC POTENTIAL	Road base material	Ceramic clay, coal, local ground water	Coal, sand, clay, crushed stone (in limestone beds)
INFILTRATION CAPACITY	Low	Low	Low to moderate
AQUIFER POTENTIAL	Poor to moderate, surface exposures tight	Poor	Poor
TOPOGRAPHY, SLOPE	Steeply to moderately sloping hills	Rolling prairie	Rolling hills

Table 1. Major land resource units in North-Central Texas (from Kier and others, 1977). (continued)

Unit	HARD SANDSTONE, MUD, AND MUDSTONE (UNDIFFERENTIATED)	CERAMIC CLAY AND COAL	CLAY MUD AND SANDSTONE
PHYSICAL PROPERTIES			
SHRINK-SWELL POTENTIAL	Low to moderate on mud and mudstone	Low to moderate	Low to moderate
FOUNDATION STRENGTH	Moderate to high	Low to moderate	Moderate
COMPRES-SIBILITY	Low	Moderate	Moderate
CORROSION POTENTIAL	High to moderate	Moderate	High
SLOPE STABILITY	Moderate to high	Low to moderate	Moderate
EXCAVATION POTENTIAL	Moderate to difficult in sandstones; easy to moderate in mud and mudstones	Easy	Easy to difficult
PLASTICITY	Low	Moderate	Moderate

Table 1. Major land resource units in North-Central Texas (from Kier and others, 1977). (continued)

Unit	HARD SANDSTONE, MUD, AND MUDSTONE (UNDIFFERENTIATED)	CERAMIC CLAY AND COAL	CLAY MUD AND SANDSTONE
SOIL CHARACTERISTICS	Thin, stony clay and sandy loams	Clay loams	Clay and sandy loams
PLANTS	Oak, mesquite, and grasses	Mesquite and grasses	Scrub brush, mesquite, cacti, and grasses; live oak and juniper on limestone
GEOLOGIC STRUCTURE	Fractures common, locally faulted	Locally faulted	Locally faulted
NATURAL PROCESSES	Erosion	Erosion	Erosion
CURRENT LAND USE	Rangeland	Rangeland, cropland, small urban, local mineral production	Rangeland, cropland, small urban, local mineral production
COMMENTS			Central and North-Central Texas units contain thin limestone beds

MINING TECHNIQUES

A variety of mining techniques were available to late 19th- and early 20th-century coal miners, despite a general lack of reliance on mechanization. The most important techniquest are discussed here, and emphasis has been placed on aspects of mining which have caused identifiable environmental effects. Differences in the effects of surface and underground mining procedures are the most obvious, but each of the techniques produces a characteristic combination of effects, due to either the initial mining procedure or subsequent mine abandonment.

Personal interviews with each of several retired miners or other mine company employees form the basis for much of this discussion. This oral history is essentially the only link to the historic mining techniques in use in the region, which have not been systematically described elsewhere. An effort was made to check these oral accounts against the limited available literature pertaining directly to Texas' bituminous coal mining industry, and to more complete descriptions of coal mining techniques in use in other states during the same period. In general, these references provided background information only.

The following individuals, all of whom were interviewed during the summer of 1979, materially contributed to this chapter: Rupert Green, Bridgeport, Texas (Bridgeport area mines, including small mines); Ebertt W. Pitts, Bridgeport, Texas (larger Bridgeport area mines); Allard Smith, Jacksboro, Texas (Jack and Young County mines); and P. D. "Pink" Wylie, Mingus, Texas (Thurber area mines).

History of Coal Production

The earliest record of coal extraction and use in North-Central Texas is that of Shumard (1853, p. 182) who mentioned the discovery of bituminous coal seams which were mined by soldiers from Fort Belknap in Young County, near the present community of Newcastle. During the 1850's the soldiers dug bedded coal, by hand, from the banks of a ravine near the Brazos River. Slumping of the stream bank at this point had already obscured the excavation when the site was visited by Buckley (1866, pp. 22-23).

Coal mining continued, although somewhat sporadically, at a number of locations in the region until approximately 1943 (Stenzel and others, 1948, pp. 35, 42), and mines at Newcastle in Young County may have been operated on a limited basis until 1947 (Daniels, personal communication, 1979). Oral accounts describe other instances of

coal extraction from previously existing mines during the 1930's and '40's for limited local use (Jackson, personal communication, 1979).

Prospecting

The earliest form of coal prospecting practiced in the region was simple observation. Coal was noticed in the banks and beds of streams by the earliest settlers and was probably known to the Indians of the area even earlier (Henderson, 1964, p. 208), although Betancourt (1977, p. 67) states that there is no known record of use of coal by Indians in the state. Shallow pit and contour excavations helped to expose the full thickness of the seams and allowed the prospector to trace the seam laterally.

In addition to surface and shallow subsurface observations made along the outcrop, coal was accidently encountered during the construction of water wells (Buckley, 1866, p. 23). The first wells were dug by hand. Later water wells were drilled and soon after, coal prospecting with diamond drills came into use (Hunter, 1976, p. 36). Cummins (1891, p. 512) recommended the use of a diamond drill for prospecting. Drilling is still the preferred prospecting technique and has been used extensively throughout the region in recent years (1974-1979) as interest in coal mining has resumed.

Underground Mining

Almost all of the mining which took place during the era of historic coal production in the North-Central Texas region was underground mining. Movement of large volumes of overburden, as in modern surface mining practices, was not practical when little mechanization was available. For most purposes, surface and near-surface deposits of coal have limited utility, since oxidation and water damage reduce the fuel value and hardness of the coal leaving only weathered coal dust, or slack. For these reasons, underground mining, although costly, was utilized.

Shaft mines - The most direct access to deeper coal seams was afforded by sinking vertical entrance shafts, usually at a distance (in the dip direction) from an outcrop (fig. 2). At the depth of the coal, mining spread horizontally along a system of entries (passageways). Larger mines utilized entrance shafts which were generally reinforced by setting timbers around the shaft walls (P. D. Wylie, personal communication, 1979) or by surfacing the walls with concrete. Yet there were disadvantages as well. The vertical entrance demanded mechanization for hoists to remove the coal and mine wastes and provide access for the miners. Ventilation was frequently a

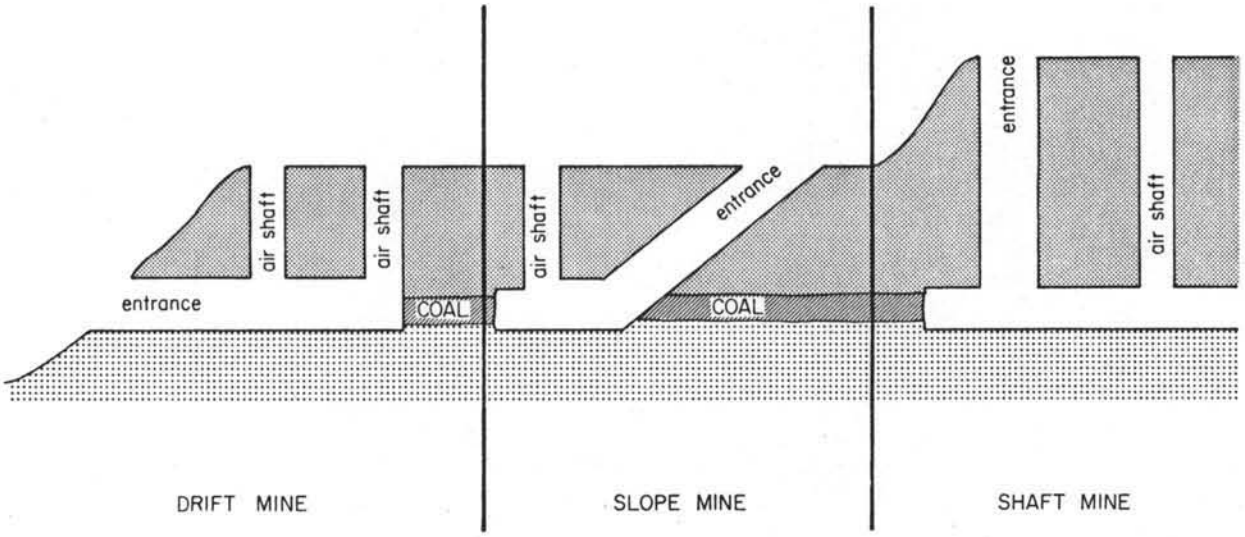


Figure 2. Underground mine types utilized in North-Central Texas coal fields.

problem. Most small operators could not afford the capitalization required to develop and operate a shaft mine. However, the largest shaft mines proved to be the most financially successful, longest operated, and most productive, accounting for the vast majority of bituminous coal production in the state (Taylor, 1911, p. 5). Many mines eventually developed double shaft entrances (pair of adjacent entrance shafts providing greater production capacity and improved ventilation).

Slope mines - Smaller operators most often employed slope entrances. An inclined tunnel was sunk to the depth of the coal seam from the surface (fig. 2). At the seam depth, mining extended laterally, along one or more main entries. The slope entrance permitted use of draft animals to remove the coal and waste. Mine cars with flanged wheels were loaded with coal by the miners and then pulled along tracks through the mines by horses or mules. The animals were able to pull the cars up the slope entrance and out of the mine without disconnecting the cars. Animal haulage along main entries was used in the shaft mines, as well, but a hoisting engine was used to remove the loaded cars from the mine.

Drift mines -The third type of underground mine is the drift entrance mine. A drift entrance is simply a tunnel extending essentially horizontally (following the nearly horizontal seams) into a hillside from an outcrop (fig. 2). Although a few of the very old larger mines employed this system, it was less efficient than the slope mine, in that the entrance generally had to be dug farther into the hill to obtain unweathered coal initially. Drainage problems were also created in some mines because ground water seeping in would tend to pond in work areas.

Longwall advancing extraction - Almost all of the smaller mines and many of the older large mines in the North-Central Texas coal fields utilized this system for obtaining coal. Once an entrance and system of main entries had been laid out, the actual mining of coal could begin.

The longwall system involved continual mining along the entire length of a wall of coal (longwall or working face) extending between two parallel or (more often) diverging entries. A shallow trench was dug, usually with a pick, into the face (parallel to the floor) in the shale or underclay beneath the coal (fig.3). Wedges were then driven between the mine roof and the top of the coal seam to break the coal free from the face. Later, explosives, particularly black powder, were used to the same effect. When the coal was broken down at one point, the miner loaded the coal, piece by piece, into a waiting mine car in the main entry, and then moved farther along the longwall.

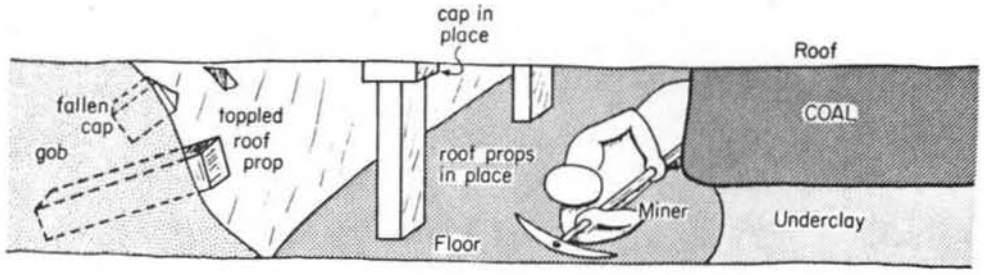


Figure 3. Detail of longwall and modified longwall advancing extraction methods at the working face of underground mines.

As the mining advanced in the direction of the working face, the miner removed all of the coal before him along the entire length of the wall, leaving no unmined coal pillars to support the roof. The thin seams of the North-Central Texas coal field were unsuited for pillaring because the pillars would have had to have been much too large. Elsewhere, as in Pennsylvania, where coal seams are thicker, room and pillar extraction (known there as pillar and breast extraction) is often practiced, leaving carefully spaced pillars of coal to support the roof above mined-out rooms (Chance, 1883, pp. 117-118).

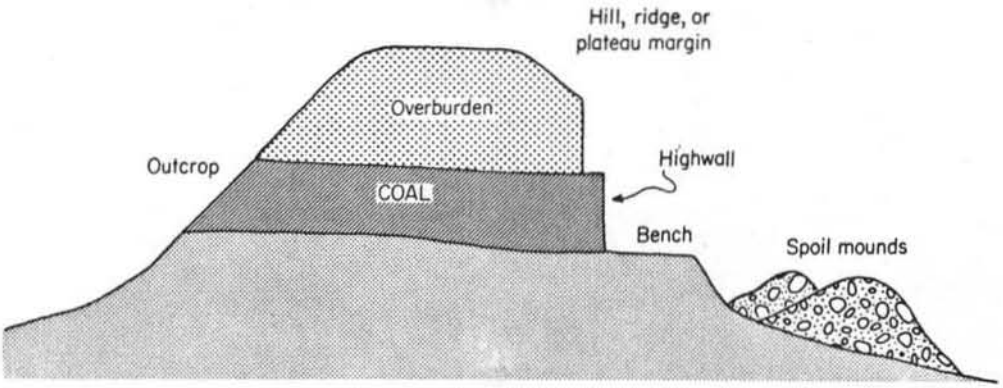
Instead of leaving pillars, the coal miners in North-Central Texas used light wooden posts, or props, cut from small diameter oak trees to support the roof over the mine workings. Main entries in Texas mines (as elsewhere) were heavily timbered across their 2 m (6 ft) widths to create maintained passageways, but only light props were used in the actively mined areas. The miners' objective was to support the roof only temporarily. The entire mined-out area could not have been supported by any system of supports then available; instead, pressure of the overburden was released gradually by allowing the roof to settle behind the miners as they advanced away from previously mined-out areas. The temporary props supported only a narrow roof span. Once the mined-out area reached a certain width, the roof collapsed. Mine wastes including shale and coal dust were thrown behind the miners, forcing gob piles which partly filled the area that would be closed as the roof settled.

Modified longwall advancing extraction - A slightly modified longwall mining technique was developed for use in large mines. Instead of a single longwall (the length of which had to be kept relatively short to allow ready access to entries from all parts of the working face), a continuous series of shorter working faces were created by extending secondary or work entries off the main passages. Several miners were thus able to work simultaneously, along a composite longwall whose length was much more flexible.

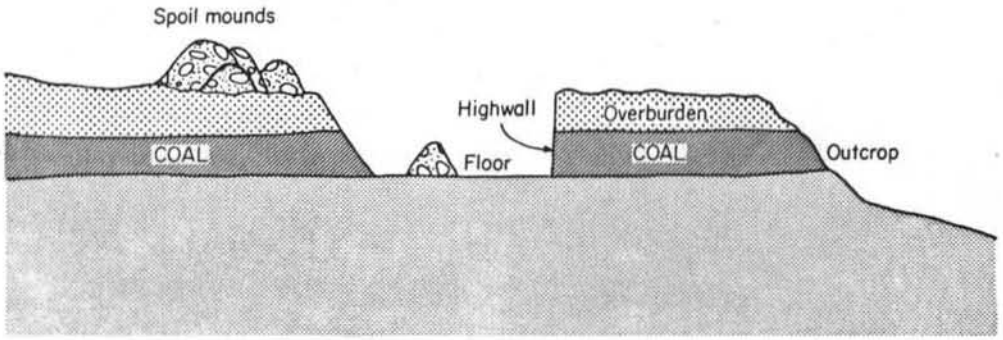
Surface Mining

A few small surface mines were operated in the North-Central Texas coal fields. Two similar types of surface mines were seen.

Contour mines - A contour mine is simply a shallow excavation, from the surface to a near surface coal seam or directly into an outcropping seam, which follows the topographic contour (fig. 4). By following the contour, very little surface material was removed other than the coal. This system, in addition to causing a comparatively



CONTOUR MINE



OPEN PIT MINE

Figure 4. Surface mine types utilized in North-Central Texas coal fields.

large amount of surface disturbance in relation to the mass of coal produced, was also of limited commercial value because all of the coal produced was weathered and therefore less useful as a fuel. Only three mines of this type throughout the entire region appear to have had any appreciable production, and in each case, the coal was probably mined and utilized on a local basis over a number of years. This method of locating and tracing coal seams does, however, appear to have been widely utilized as a prospecting technique.

Open pit mines - This type of surface mine is rare in the region and each of the few examples known was probably the site of a prospecting effort rather than a serious mining attempt. In open pit mining, the shallow seam is simply exposed by stripping the overburden and mounding this material nearby (fig. 4). The coal is removed without subsequent replacement of the overburden. This system of mining is disproportionately destructive of the environment in relation to the value of the coal produced. As in the contour mining procedure, only oxidized coal was mined in these extremely shallow pits. Current coal strip mining methods, in use at two sites in the region today, carefully segregate for replacement the soil, subsoil, and rock overburden, while mining deep enough to yield a higher quality coal, as well. While the modern practice may potentially pose other problems, it is much less destructive than were historic surface mining methods practiced in the North-Central Texas region.

Other systems of mining - A few examples of unusual mining techniques were observed during this study. The majority of these were simple combinations of more conventional techniques such as an underground mine with one slope and one shaft entrance. However, one method, observed at only one site (site number S/CF-1-1), combined a surface and a subsurface mining procedure. This mine followed a coal seam horizontally, from the outcrop, into the hillside like a drift entrance, but the roof was cut away along its entire length, forming an open trench. Little production is evident at this small site which is of interest primarily because of the unusual mining technique.

ENVIRONMENTAL EFFECTS

Bituminous coal mining in North-Central Texas has produced a variety of potentially serious environmental effects. More than 130 confirmed and suspected mine sites in 12 counties may have been affected by coal mining and related activities to some degree. At least 2.3 km^2 (0.9 mi^2; 585 ac) of rural and urban lands throughout the region exhibit characteristics of mining damage.

Environmental effects observed at these sites include (1) loss of vegetation, (2) erosion, (3) effects of increased runoff and sediment deposition (on streams, impoundments, and hillslopes), (4) subsidence, (5) accumulation of refuse, and (6) deterioration of abandoned mining-relating structures and equipment. Potentially hazardous conditions which could affect public health and safety, property holdings, and environmental integrity were emphasized. Effects of mining on surface and ground water quality generally could not be determined in detail by methods used in the present study; however, some qualitative observations were made and a few possibly severe water quality conditions were noted. No attempt was made to recommend individual sites for possible reclamation efforts.

Loss of Vegetation

A wide variety of plants and plant communities are represented in the North-Central Texas region. Much of the outcrop area of important coal-bearing units in this region lies within the Cross Timbers and Prairies vegetational area of Gould (1969). The balance of the outcrop area comprises the southeasternmost portion of the Rolling Plains vegetational area. These two large biological provinces have been subdivided by some authors on the basis of physiographic and comparatively minor vegetative variations within the areas. For additional discussion see Correll and Johnston (1970; pp. 7, 10-11).

In general, ridges and steep slopes throughout the region are wooded with blackjack oaks and post oaks predominating. Plains and rolling hills are dominated by prairie grasses, particularly little bluestem, although many of the prairies have been invaded (reoccupied following disturbance of the original flora through overgrazing, etc.) by brush species, especially honey mesquite. Honey mesquite and other xerophytic (plants which are aridity-tolerant) brush species also occupy dry alluvial valleys, particularly in the Rolling Plains portion of the outcrop area. Minor intermittent tributaries are lined with cedar elm and major intermittent and perennial

streams and rivers maintain dense riparian (streamside) woodlands dominated by pecan.

Each of these broad community types has been affected by coal mining activities in the region. The degree to which vegetation may be influenced by a surface disturbance at a given site is controlled by (1) the type of disturbance, (2) the type and condition of the plant population, (3) characteristics of the site (topography, soils, etc.), and (4) seasonal conditions and other variables. Although many factors dictate how a particular plant population will respond to a given environmental stress, a few generalizations can be made.

Historic coal mining practices in use in the North-Central Texas region have affected vegetation directly, during active mining, and indirectly, primarily after abandonment of the mines. Examples of the direct impact of mining on vegetation include (1) complete elimination of plants (caused by surface excavation or burial beneath shale dumps), (2) land clearing and tree cutting (to permit site access and/or provide timber for mine props, etc.), and (3) turf damage (caused by foot traffic, draft animals, and motorized or animal-drawn vehicle use). Mining activities which result in the complete elimination of plants are indiscriminate with regard to the type of vegetation destroyed. Land clearing and timber cutting practices are preferential, removing only the larger woody plants (trees and shrubs). Turf damage primarily affects the low groundcover species, such as grasses, herbs, and trailing vines. Each of these impacts, whether selective or generalized, is a direct and immediate effect. These effects may be temporary or, in a few cases, essentially permanent.

Examples of indirect impact of coal mining on vegetation include (1) progressive devegetation (the continuing loss of vegetation around a shale dump as toxic leachate and sediment spread farther downslope), (2) inundation (as subsidence occurs, the tendency for runoff to pond at the site increases, thereby inundating upland species at least seasonally while providing new habitat for wetland species), and (3) landslide devegetation (mine wastes piled on a steep slope may fail, causing earth slides or earth flows which can uproot or bury vegetation downslope). In many ways, indirect impacts signify more widespread and persistent disturbances of the plant population than direct impacts.

Indirect impacts of mining result from changes in the environment at the site. Coal was mined in the region, at least on a small scale, perhaps as early as the 1850's (Shumard, 1853, p. 182) and as late as the 1940's (Stenzel, 1943, p. 203), with major production during the interval from the late 1890's to early 1920's (Evans, 1974, p. 7). Thus, all of the region's coal mines are less than 140 years old and more than 30 years

old, while major producing mines were active from 1900 to 1925. The fact that almost all of the mine sites observed during this study exhibit some degree of devegetation (many sites, including those of older mines, being completely barren) is certainly of interest.

Progressive devegetation- In few if any cases is it possible to attribute existing conditions of relative devegetation to direct effects of mining alone. The more significant long-term cause has been the indirect effect or residual influence of an altered site environment. For example, the acidic leachate that emerges from mine dumps is a major contributor to devegetation (fig. 5). Pyrite contained in coal and shale in these dumps is exposed to the atmosphere, permitting oxidation. One of the reaction products in the oxidation of pyrite is sulfuric acid, which significantly alters the chemistry of the dump's surface. Toxic effects of the acid prevent establishment of plants on the dump even when seeds are transported there by wind and animals. The barren dump is particularly erosion-prone, and sediment removed from the steep slopes of the mound forms a wide, spreading apron around the dump. This sediment and that which is freshly exposed on the dump surface by erosion also yield sulfuric acid, which kills the vegetation around the dump and prevents the reestablishment of seedlings. As the sediment apron grows larger so does the devegetated area, thus the term "progressive devegetation." This is an example of an adverse environmental condition which actually worsens through time. Even when the original contour of the site is restored, as in the case of site number MC/FF-3-1, which is a small site releveled almost fifty years ago, there may be no revegetation.

Revegetation - When the plant community of a site is disturbed, either directly or indirectly, by coal mining, area vegetation may respond in any of three ways: (1) the original flora begins to recover through natural revegetation, eventually becoming completely or partially reestablished, (2) the original flora continues to be affected by the disturbance and subsequent condition of the site which is also unsuitable for the natural introduction of other species, and (3) the new site conditions favor the complete or partial establishment of a replacement flora better adapted to these particular conditions. In the latter case, the original flora may not be entirely displaced, so that newly and formerly established species may comprise a mixed population. In fact, variations among each of these cases is possible because of successional changes, whereby a series of somewhat discrete community types succeed one another as a site gradually recovers from a disturbance. Examples of these cases and variations were noted throughout the study area.

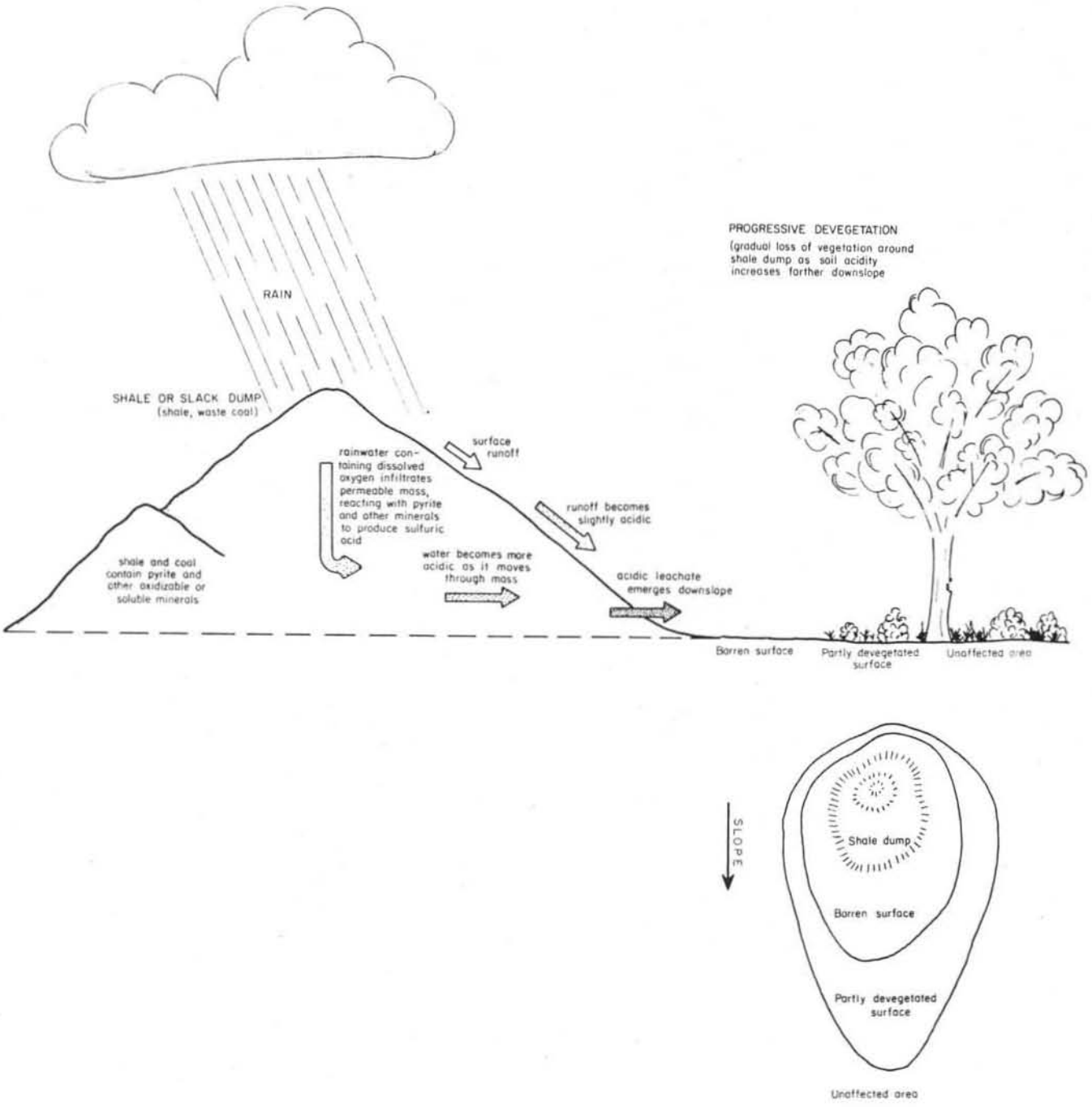


Figure 5. Illustration of progressive devegetation around coal mine dumps, depicting flow patterns through waste mass to ground surface. Leachate may also infiltrate porous substrates beneath the dumps.

Erosion

Erosion is "the wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep" (Soil Conservation Service, 1976, p. 8-9). Erosion is accomplished by both active and passive agents. In North-Central Texas, the most important active agent of erosion is flowing water, including channeled and unchanneled runoff (fig. 6). Runoff flowing through rills, gullies, streams, or other sloping linear depressions is said to be channeled, while water flowing as a uniform film over a relatively smooth landform, with no apparent confinement in an identifiable channel, is termed unchanneled.

The most obvious channel form at disturbed sites such as mine dumps and entrances are gullies. The process of gullying includes initial incision and subsequent widening, deepening, and headward lengthening of a gully. Single or multiple gullies may develop at a given site. Multiple gullies may converge, or anastomose, downslope, or they may remain essentially parallel. When gullies enter a stream they are said to integrate with the surface drainage system of the area. Runoff in gullies may also discharge onto a broad, flat surface lacking defined surface-drainage features (channels), or into a depression with no obvious drainage outlet. Under these circumstances, the gullies fail to integrate with the major drainage network.

Active erosion is also accomplished by unchanneled flowing water which spreads evenly over a slope in a thin sheet. For this reason, unchanneled overland flow is called sheetflow. Like channeled flow, sheetflow is an important erosive agent. Erosion caused by sheetflow is called sheetwash erosion.

In both channeled flow and sheetflow, soil and rock particles, organic matter, and other surface debris are transported downslope by moving water. The removal of these materials from their point of origin constitutes erosion. The severity of erosion at any point is determined by the amount of material moved within a finite time period. However, erosion is often judged to be significant only when the rate of material removal from a given site is greater than the erosion rate on nearby slopes, causing differential erosion. A local reduction in elevation, injury to plant life, or loss of a particular surface material is also normally required in order for active erosion to be recognized.

Erosion is a passive process, as well. Weathering contributes passively to the erosion process by altering rock and soil materials and buried organic matter, making them more susceptible to the influence of surface water flow. Mechanical, chemical, and biogenic weathering occur constantly at the Earth's surface and to a shallow

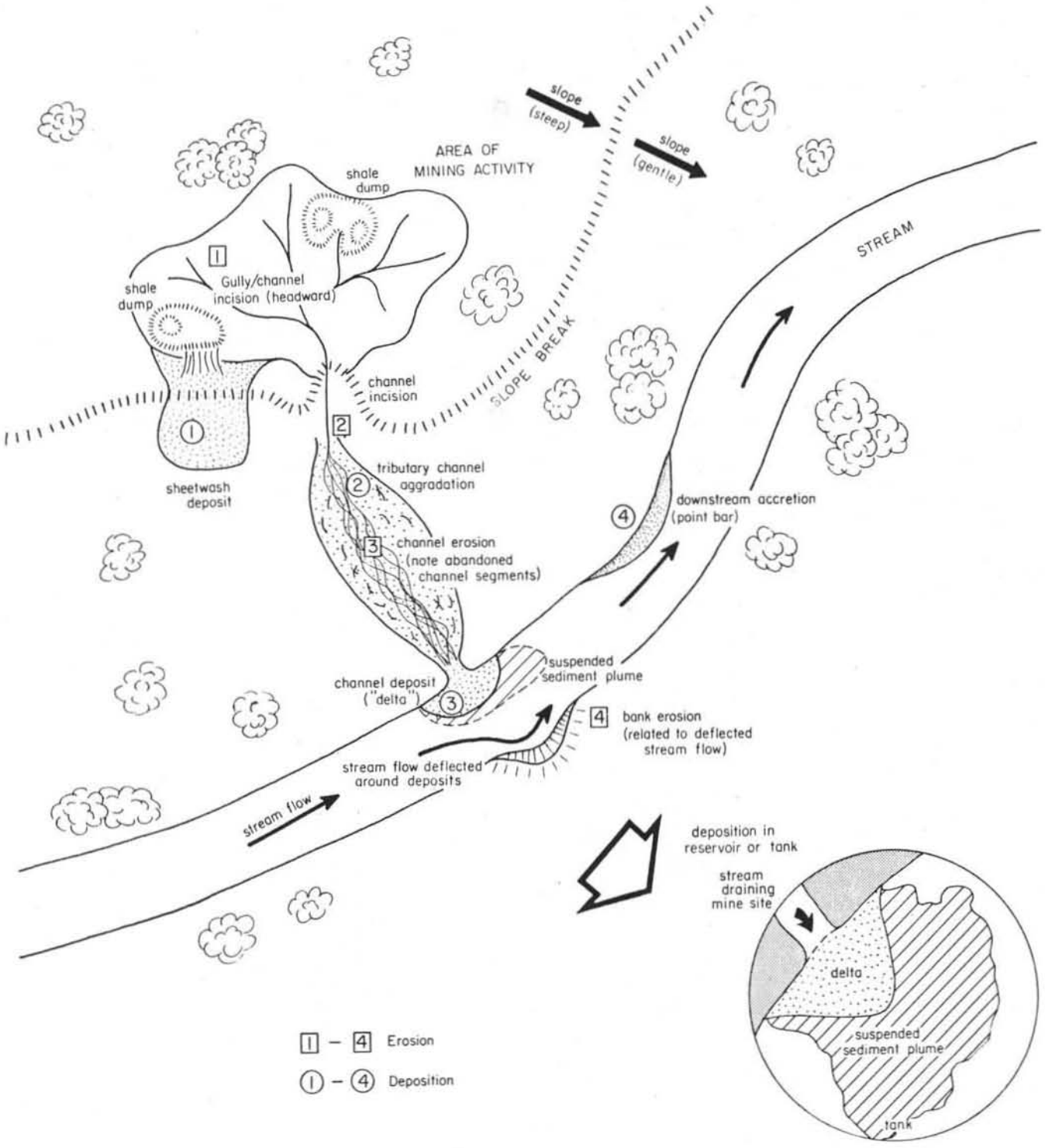


Figure 6. Typical patterns of erosion and deposition near abandoned surface mines and surface disturbance areas around underground mine entrances.

depth. However, one type of weathering is uniquely characteristic of coal mine sites. Coal, shale, and other rock materials which are transported to the surface from underground mines or are exposed in surface excavations are suddenly subjected to weathering conditions from which they had previously been protected by overburden. Oxygen and water, in particular, have a marked effect on these mined materials, releasing among other substances sulfuric acid which contributes to the devegetation evident at most mine sites, thereby enhancing the effects of active erosional processes.

Gravity is also a passive agent of erosion. Gravity acts uniformly on all surface materials; however, these materials differ in their capacity to remain in place. Competent surface materials can resist gravity, supporting not only their own weight but the weight of overlying masses, as well. Incompetent surface materials are unable to support their weight and that of their overburden. A normally competent surface material can become incompetent, even under a constant load, in certain situations. Most often, the competence of a material at a given site may be reduced by (1) weathering phenomena, which decrease the material's internal strength, and (2) undercutting (usually by a stream or surface excavation), which effectively increases the dynamic force acting on the material.

Surface materials such as soils or rock strata which exhibit incompetence under a particular stress are said to fail. Failure, particularly when it occurs on a moderate to steep slope, may initiate mass wasting of the material and its overburden. Mass wasting is the gradual to rapid movement of solid surface materials (with or without entrained fluids) down an inclined surface under the direct influence of gravity; the materials are not transported by a moving fluid such as running water, wind, or ice, but instead move as a mass by sliding, bouncing, falling, or flowing.

At mine sites observed in the current study, two types of mass wasting were observed: (1) earth slides or earth flows, the unconfined movement of loose materials downslope; and (2) rock topples or downslope tilting (forward rotation) of rock masses of boulder size (Varnes, 1975). Evidence for both types of mass wasting was observed at scattered sites throughout the study area. At one site (site number M/SL-4-1), mine wastes deposited on a slope with roughly 20 percent gradient apparently failed, perhaps suddenly. The resulting earth slide or earth flow toppled and buried several trees, one of which survived and is now aproximately 0.22m (0.75 ft) in diameter and highly contorted in the downslope direction.

Erosion may occur wherever the movement of surface materials is not otherwise retarded. However, many rock types, including hard limestones and sandstones, are

resistant to erosion. These rock types are eroded more slowly than are nonresistant materials such as most soils, loosely piled mine wastes (shale and undersize coal particles), and soft, bedded shale. Resistant strata may thus become prominent features of local relief. At an outcrop or excavation, otherwise competent, resistant beds forming relief features may be subject to mass wasting because of excavation or mine collapse at the toe of the slope, or by erosion of underlying nonresistant strata. Steep, devegetated slopes are especially vulnerable to erosion of all types which may strip away soils and promote mass wasting and headward gully extension. Most of the abandoned coal mine sites of North-Central Texas share some combination of (1) alternating resistant and nonresistant strata exposed within or around the excavation area, (2) moderate to steep slopes over at least part of the site, (3) progressive devegetation or incomplete revegetation, (4) excavation or mine collapse at the slope toe, and (5) active gullying and/or stream incision.

Abandoned coal mine sites in North-Central Texas are thus characterized by a distinctive combination of erosional features. The presence or absence of these features is, generally, a diagnostic criterion for recognition of mine sites through aerial photointerpretation and field observation. Among the characteristic erosional features of abandoned coal mines are (1) radiating gully patterns, which may develop on small, conical to rounded mine waste dumps and around collapsed entrance shafts on level slopes, (2) deep, parallel gullies on large, ridge-like mine waste dumps, (3) a broad apron of freshly-deposited sediment on level to moderate slopes below excavations and around mine dumps, which indicates erosion by closely-spaced gullies or sheetflow, (4) rectilinear gully and stream patterns in areas of subsidence, often tracing the plan of the mine workings, (5) deflection of stream and gully channels around mine dumps extending into the channel, and (6) development of a dense gully network across most excavations, with possible stream channel extension into the excavated or disturbed area. The degree to which gullies are internally integrated at the mine site, rather than the absolute size of the gullies, was observed to qualitatively correlate with the time of site abandonment, the oldest sites generally having the most well-organized shallow drainage networks.

Erosion is among the more obvious environmental hazards associated with coal mining and mine abandonment. Vegetation, water quality, land use, and the water storage capacity of downstream reservoirs may all be affected by eroison. Potential mechanisms of erosion must be carefully evaluated before reclamation procedures are prescribed. These same erosional processes could adversely affect poorly conceived reclamation measures.

Effects of Increased Runoff and Sediment Deposition

The nature of runoff and deposition in the immediate vicinity of abandoned coal mines are components of the process of erosion described in an earlier section of this chapter. Runoff and deposition around mine sites are discussed here in relation to their impact on adjacent streams and natural impoundment and their effects downslope from mine sites.

Effects on streams - As used in this report, stream denotes a minor tributary of the surface drainage system, which has developed a relatively stable and well-defined channel. Streams are the smallest tributary features normally depicted on 1:24,000-or 1:62,500-scale topographic maps. A stream which receives runoff and/or sediment input from a mine site is here referred to as the receiving stream for that site. Input may be direct (from a site immediately adjacent to the stream) or via sheetflow or gullies and rills not shown on topographic maps covering the site (fig. 6).

Runoff normally influences the receiving stream either by accelerating erosion, or by transporting large volumes of sediment, resulting in deposition. Combinations of these effects may also be noted. In general, devegetation and the removal of soils by excavation or erosion tend to increase surface runoff, thereby altering streamflow characteristics, as well. However, few examples were found in which mining activities could be shown to have definitely caused unusual increases in stream discharge as a result of increased runoff; nor were clear examples of resulting channel scour or bank erosion found. Some stream channels have extended into sites of mining activity by headward erosion, but few other changes attributable solely to increased runoff were noted, even in these streams.

More significant changes have taken place in receiving streams accepting large volumes of sediment from mine sites. Channel aggradation or in-filling was observed in a few cases, and several streams accumulate sediment, probably on a seasonal basis, at the confluence of gullies originating at mines. Aggradation reduces stream channel capacity, encouraging local flooding. In addition, potentially significant reductions in stream water quality may be caused by increased concentrations of suspended sediment and other substances. Such effects are generally not proven by the present study as evidenced by only qualitative observations in individual site descriptions.

Effects on impoundments - Impoundments have been impacted as a result of mine abandonment at some North-Central Texas sites. Livestock watering tanks and conservation impoundments were constructed at or below many mines. These

impoundments receive large contributions of sediment from the mine sites, reducing storage capacity and water quality (fig. 6). Several small earthen dams near mines, including one masonry-reinforced dam, have been destroyed because of the indirect effects of sedimentation in the impoundments. As sedimentation increases, storage capacity generally decreases. A constant volume of water in storage will lap ever higher on the dam as the impoundment is in-filled. In the case of the masonry-reinforced dam, the capacity of the impoundment at site number Ea/CN-2-3 was apparently exceeded following one recent storm, allowing the water to spill over the dam, forming a "nick point" or initial incision in spite of the masonry lining (unmortared), and despite apparent emergency sand-bagging efforts (remains of bags still in place). Once the nick point was formed, the dam failed very quickly. The sudden outrush of water carved a deep gully below the dam and transported sediment 1 km (0.6 mi) downstream.

The quality of water retained in some impoundments is also affected by runoff and sediment from mines. The water of a conservation pond at site number B/BU-1-20, is extremely discolored, suggesting unusual water chemistry. Interestingly, no vegetation was present around the margin of this earth-walled tank.

Other types of impoundments may be affected in the same way. Subsidence at some mine sites has created closed depressions which fill with water, at least on a seasonal basis, forming shallow ponds. Most of these are small rain-fed ponds with small catchments (drainage areas) but one subsidence bowl covering 5 acres has formed beneath the bed of an intermittent stream (at site number W/BW-4-7), allowing water to collect during much of the year. These ponds receive runoff and sediment from the mine sites, as well, and are experiencing the same influx of chemical leachate and sediment which was observed at stock tanks and conservation ponds.

Small ponds also form on the surfaces of large shale dumps. Following a rainstorm, ephemeral ponds can be seen on the dump surface wherever the normally porous material permits the retention of water. The waters held in such ponds are probably affected by leachate contamination. The presence of contaminated water bodies on the unstable surfaces of mine dumps poses a particular hazard; failure of the slope could suddenly discharge a large volume of probably acidic water onto the area below.

Effects downslope - Gullying and sheetwash erosion commonly extends from mine sites onto adjacent areas downslope (fig. 6). The slope below a mine site may be incised by parallel or intersecting gullies, or may be relatively smooth as the result of

sheetwash erosion. Both channeled and unchanneled runoff from a site may cross slopes below a mine site, possibly reaching a stream and thereby integrating with the surface drainage network. Often, channels fail to integrate, reaching instead (1) an impoundment or other closed depression, (2) a flat (broad, level area lacking defined surface drainage), or (3) a slope break (point on a slope, usually at the toe, where there is an abrupt reduction in slope). Upon reaching one of these areas, the water is either retained, absorbed, or spread laterally. Sediment which was transported downslope is quickly deposited. These deposits are normally in the form of one of three depositional features (1) a small delta (subaqueous sedimentary deposit formed at the point where running water enters a body of standing water), building outward from the waterline of the impoundment; (2) a small alluvial fan (radiating subaerial accumulation of sediment below a steeper slope), constructed along the edge of the flat; or (3) a slopewash deposit (thin, accretionary mass of sediment deposited irregularly across a low-angle slope or level surface), spreading as a veneer over the gently inclined surface below the slope break.

Examples of each of these features were observed during the present study. Most alluvial fans and slopewash deposits seen in the vicinity of mines were small features, only occasionally covering more than one acre. The significance of these features is that they indicate an eroding surface at the mine and poorly developed surface drainage below.

Subsidence

In general, subsidence is the progressive sinking or settling of part of the landscape resulting in an essentially permanent local loss of elevation. Displacement of the surface is almost exclusively vertical, with little or no horizontal movement. A wide variety of surface and, in particular, subsurface conditions may cause subsidence. The amount of displacement and the size of the affected area are extremely variable.

At coal mine sites in North-Central Texas, subsidence most often occurred when underground passageways (tunnels and entries) and mined-out areas (workings) collapsed under the weight of overburden. The movement underground was eventually translated to the surface, causing subsidence. Collapse occurred because the removal of material to create the mine left part of the overburden or overlying strata unsupported. Artificial supports were installed in order to maintain open passageways by actually holding up the mine roof. In the longwall advancing system of mining, and in a modified version of this system, only temporary roof supports were used in the area of the mine where coal was actually being extracted. After removal of the coal

in one small area, temporary roof supports or props were installed in the area just mined. As the area of active mining advanced, the roof very soon began to collapse into the previously mined-out void beneath. But by working steadily and quickly, the miners could keep an open space in front of them along the retreating wall of coal, while the roof was constantly settling behind them. Thus, this system and its variant were called advancing systems. The modified longwall advancing system differed only in having a slightly different arrangement of passageways and mining areas. These systems of mining were practiced to the near exclusion of other systems throughout the mining region.

The mined areas collapsed while mining was continuing only a few meters away. Subsidence occurred almost simultaneously, as long as the mine was being actively worked. Only the heavily timbered, maintained passageways could withstand the overburden pressure for an extended period. At some mines, there may yet be open mine passages, and additional subsidence might be possible.

Most of the mines at which subsidence was observed during the present study had experienced subsidence many years before. Only a few sites gave any indication of relatively recent surface movements. One example of possible recent subsidence is also discussed in the section of this report entitled "Runoff and Deposition--Effects on impoundments." At this site (site number W/BW-4-7), a mined-out area collapsed beneath an intermittent stream, thereby forming a closed surface depression, 5 acres in size, which in most seasons is water-filled. The margins of this depression follow precisely the outlines of underground mine workings. Similar observations were made by Earth Satellite Corporation (1975, p. 3) at mines in Pennsylvania. The sharpness of the outlines at site number W/BW-4-7, and the uniform depth of the depression may indicate that the feature was formed relatively recently since little evidence of erosion or deposition was noted on the aerial photographs.

One of the most unusual examples of recent surface displacement above historic mine workings involves two mines at Lake Cisco in Eastland County. When the lake is near capacity storage, the small shaft mines are completely inundated. During the summer of 1979, the lake level was elevated for a brief period and then dropped to its normal position. The weight of lake water above these mines (which are exposed at lower lake levels), combined with a pumping action caused by the rapid rise and fall in the local water table, apparently caused or contributed to the sudden collapse of a mine tunnel beneath an infrequently traveled trail. The resulting collapse structure is a sharply-defined, bell-shaped depression approximately 1.6 m (5 ft) deep which expands downward from a circular opening 0.5 m (1.5 ft) in diameter. Although this

depression is not a true subsidence feature, the event serves to demonstrate that voids are present in at least some mines in the study area, making additional subsidence possible.

Mines with drift and slope entrances were very often affected by subsidence. An inclined linear depression at one site (site number C/FF-4-14) was traced for more than 36 m (120 ft) between the collapsed mine entrance and a partially collapsed vertical air shaft. Linear gullies followed this subsidence trough, as well. Several small, closed depressions as much as 3 m (10 ft) in diameter were noticed at intervals along a steep slope above another collapsed mine (site number J/LC-4-41). These depressions formed stair steps in the slope profile above the mine tunnel. A small underground room near the entrance of a third mine (site number MC/FF-4-4) collapsed leaving a poorly defined subsidence "bowl" (closed depression) at the surface.

These examples are intended to convey an impression of the variety of subsidence features observed at North-Central Texas coal mines. But the most serious potential subsidence hazard is felt in built-up areas overlying abandoned mine workings. A large part of the city of Bridgeport in Wise County may be undermined. Operations in one mine (prior to 1902) had to be redirected because of "settling of the ground under the town" (Phillips, 1902, p. 34). There may be a risk of additional subsidence at some sites, particularly in the vicinity of larger mines. The example previously given of a possible recent subsidence event involving 5 surface acres occurred at a site (site number W/BW-4-7) within the city limits of Bridgeport. While such evidence is circumstantial it does suggest a need for care in the development of areas which could be affected by additional subsidence and should be considered when devising possible reclamation measures.

Refuse

Refuse may be defined as either (1) the unutilized and generally unwanted residuum that remains after a more desirable commodity is obtained or utilized, or (2) material that has been collected for the purpose of disposal. Refuse found at abandoned bituminous coal mines in North-Central Texas includes: (1) waste materials (materials other than marketable coal) generated by coal mining, (2) structural debris and equipment left at the mine sites and now deteriorated due to exposure and age, and (3) waste products produced elsewhere, or generated at the mine site by activities other than mining, which have been discarded at the mine site.

The most frequently noticed form of refuse in the North-Central Texas coal fields is the shale dump, or slack dump. This feature was formed by mounding, near

the mine entrance, those waste materials (primarily shale) mined to allow access to coal beds, as well as undersized, unmarketable coal particles and coal dust (pea coal and slack). The shale or slack dumps (these terms are used interchangeably) may have covered a few tens of square meters or as much as 13 acres at a single mine site, and reached a maximum height of 20 to 30 m (65 to 100 ft). Spontaneous combustion within the dumps, and their typically acidic and sediment-laden runoff, are characteristic of these features. The hazard was controlled to a degree at a few mine sites, however, because some of the shale dumps were removed, the shale being used in tile- and brick-making. Use of shale from the dumps of historic mine sites, numbers PP/G-2-9 and W/BW-4-5, for example, has continued to the present.

Other types of refuse commonly seen at the abandoned mines include (1) collapsed and partly collapsed masonry on concrete structures (retaining walls, loading ramps and platforms, foundations for machinery, and buildings); (2) mining and miscellaneous equipment (wooden props and beams, iron rails, mine cars, and unidentified metal debris); and (3) domestic, agricultural, and industrial wastes (household garbage, dead farm animals, abandoned farm equipment, scrap building materials, and brickyard cullings). Of these, the latter category of miscellaneous domestic and other wastes poses the most potentially serious hazard and problem for reclamation.

The suitability of North-Central Texas coal mines as landfill sites is highly questionable. In many cases, surface water and shallow ground-water sources utilized by livestock and humans lie adjacent or in close proximity to abandoned mines. The geochemistry of surface and ground waters at mine sites in the study area is almost entirely unknown, although preliminary indications suggest acid waters are present. Superimposed on the complex water chemistry of some mine sites is the composition of leachate derived from a wide assortment of refuse brought to these sites for disposal. The resulting water chemistry may pose a potential hazard. However, no record of injurious effects of these waters has been obtained.

Refuse materials at mine sites are also of interest because they represent a unique stratified cultural record of one hundred years or more in the history of the region, from the 1880's, or earlier, until the present. Shaft entrances at two mines (site numbers MC/FF-3-1 and MC/FF-4-3) in northern McCulloch County, for example, are filled with cultural debris, and dumping continues at one of these sites. These sites preserve a continous record of occupation, from the frontier period to the present.

Structural and Equipment Remains

The presence of structures and equipment at mine sites throughout the North-Central Texas region was one of the possible keys to recognizing these sites through photointerpretation and field observations. However, these features, with notable exceptions, could not be readily detected in aerial photographs. The comparatively small size, usually deteriorated condition, and frequent vegetative overgrowth of mine structures (such as tipples, loading ramps, and machinery housings), made recognition very difficult. Only when the outline or some other aspect of the structure was accentuated by selective revegetation, erosion patterns, or other site features were structures identified. Similarly, because of the small size, deterioration, and overgrown condition of equipment remains, these were almost never noted in aerial photographs. The only structural features consistently noted at mine sites were roadways and paths, and active and abandoned railways. These features could usually be detected with comparative ease, although they did not uniquely identify sites of mining activity, nor were they obligatory features of mine sites. They were, however, useful guides for locating suspected mines and, in some cases, connected two or more mine sites.

METHODOLOGY

The detection of abandoned coal mine sites utilizing photointerpretation techniques involved the use of both historical and recent aerial photography. Identified sites recorded as confirmed, or probable, abandoned mines were field-located by use of maps, photography, and historical references. Locating inaccessible sites required observation from low-flying aircraft. Disturbance at each mine site was evaluated by on-site examination or by analysis of aircraft reconnaissance information, and the level of surface disturbance was recorded for each mine site in terms of specific criteria.

Upon recording the conditions of specific surface features on descriptive forms (for each mine site) all mine locations were plotted on U.S. Geological Survey 7.5-minute quadrangle maps (a few 15-minute maps were used because 7.5 minute maps had not been prepared for certain areas). A unique identification number (fig. 7) was assigned to each mine site.

Photography

Aerial photographs used during photo interpretation included historical and recent 9x9 inch, black-and-white paper prints at scales of 1:20,000 (1 mi=3.17 in) and 1:40,000 (1 mi=6.34 in) (Appendix A). Black-and-white aerial photography has been found to provide more interpretive information on mining activities than other types of photography (Wilson, 1969, p. 19). Supplemental photography consisted of (1) aerial low-oblique 35 mm color slides, (2) 35 mm color slides of features photographed on the ground, and (3) 9x9 inch aerial color infrared paper prints at scales of 1:5,000 and 1:12,000 (limited coverage of Newcastle, Texas-flown by the Texas General Land Office).

All historical and recent county aerial photography was obtained from the Texas Natural Resources Information System (TNRIS). In addition to receiving historical aerial photography for most counties, generated by the Soil Conservation Service for the Texas Department of Highways and Public Transportation (TDHPT), reformatted indices developed by TDHPT for departmental purposes were also provided. The index numbers recorded for historical photography in the mine site descriptions refer to this reformatted index system. Recent aerial photography was referenced according to the

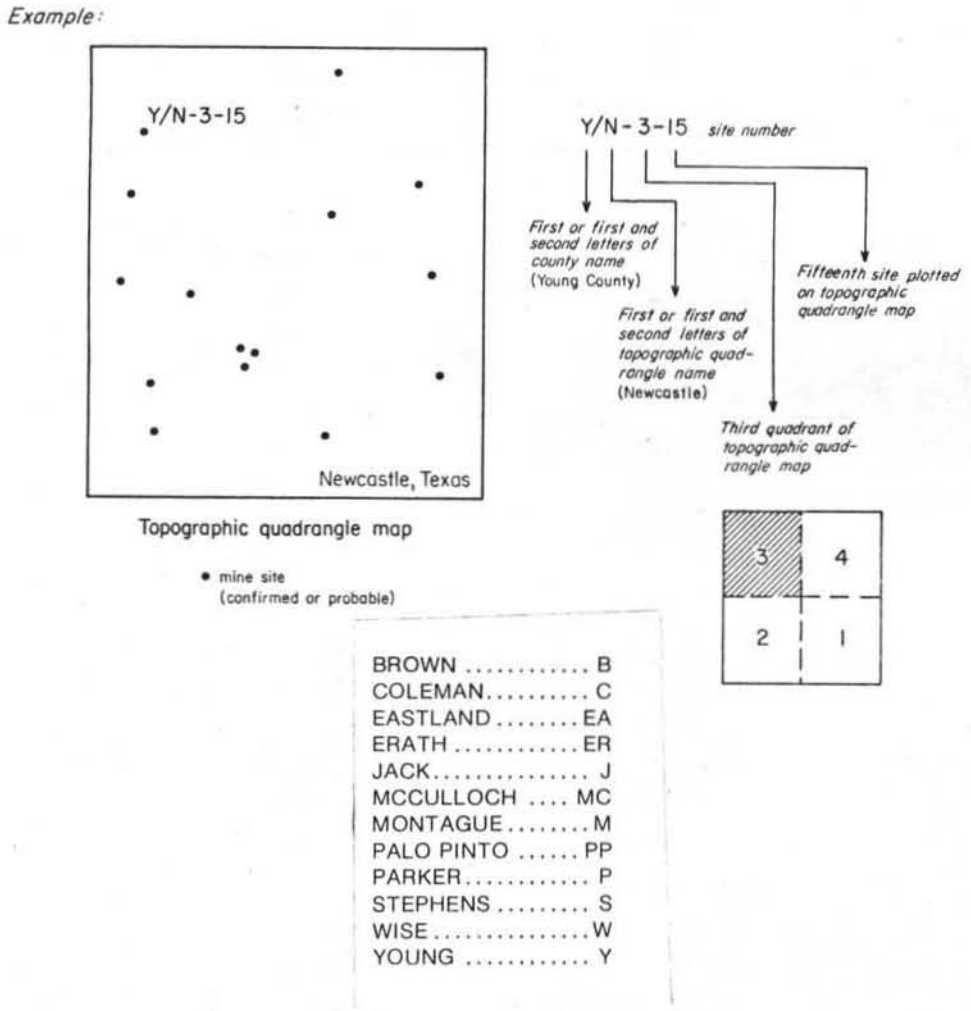


Figure 7. Example of use of the system for generating unique mine site identification numbers.

group of index numbers on the upper right of each photograph, or the standard system. Photo mosaic indices, derived from photo-enlarged microfiche, provided a means for rapidly locating specific photographs within a county. The status of photographic data on order and on hand was recorded on forms (fig. 8) developed and maintained by project personnel.

Historical aerial photographs were used primarily for detecting abandoned mine sites because (1) fewer surface changes had occurred since mine abandonment, (2) disturbed areas were more apparent (often less vegetated) than on recent aerial photography, and (3) the historical aerial photography was usually at a larger scale than the more recent data. Recent photographs were used for (1) mine site delineation when historical coverage was not available, and (2) as an aid in evaluating current surface conditions of inaccessible mine sites.

Selecting and Recording Photographic Data and Information

The outcrop areas of the Harpersville, Palo Pinto and Mingus Formations were transferred from a map by Evans (1974) to appropriate county highway maps (scale: 1 inch=2 mi) as an aid in selecting flightlines (historical aerial photography) to be examined. Stereo pairs of photographs were examined using an Abrams Model CG-1 pocket stereoscope with two- and four-power magnification. Individual frames of photography could be examined monoscopically, but at greater magnification, using a Baush and Lomb Zoom Transfer Scope.

When disturbed areas, possibly corresponding to abandoned mine sites in appearance, were found the location of each site was noted on the photographs using a china marker. The photo numbers for the stereo pair, the index number of a single photo on which the possible mine site was located, and a grid location number were noted for each site identified. A location grid of 9x5 one-inch squares was placed on the north edge of each photograph and the site located within one of 45 grid squares (fig. 9). The site of each square corresponds to a distance of 508 meters (1,666 ft) at a scale of 1:20,000. A size estimate of each site was also recorded. Size estimates of potential sites were initially made using a template with 1, 2.5, 5, 10 and 40 acre units denoted at the scale of the photography. This template was later replaced by a more accurate template (modified acreage grid) based on 64 small dots per square inch and each dot representing given acreage at a given scale of photography (fig. 10).

ABANDONED COAL MINE PROJECT

ORDERED PHOTOGRAPHY

COUNTY _____

Date R.R.C. Request Submitted _____

Submitted By _____

Photo Scale/s _____

Photo Date/s _____

Source/s _____

Remarks _____

_____

_____

_____

_____

TNRIS Order Date _____

Ordered By _____

ETA _____

Remarks _____

_____

_____

_____

_____

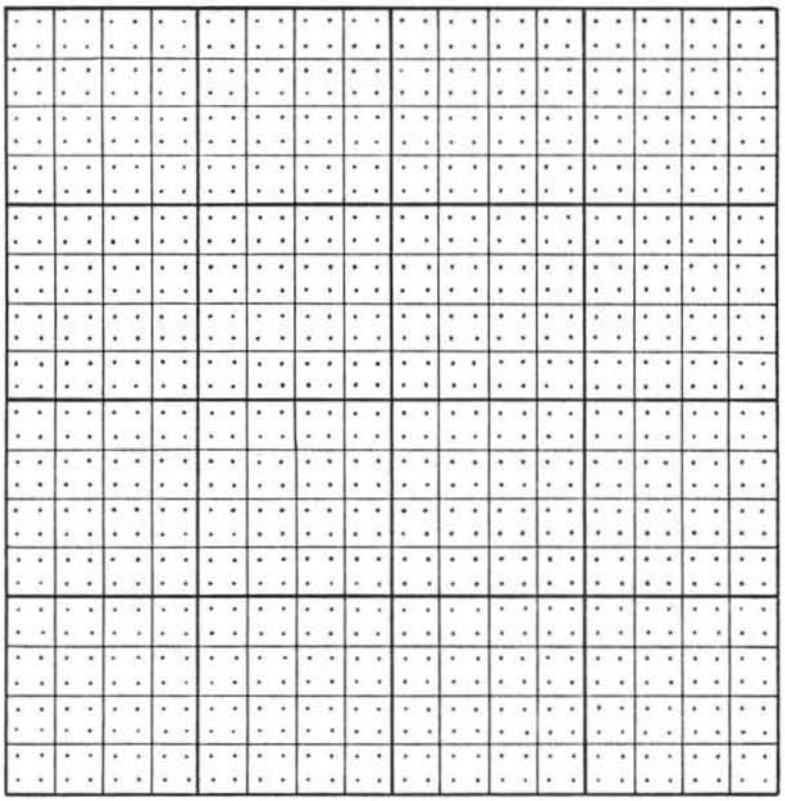
_____

_____

Figure 8. Form used for requesting and inventorying aerial photographs.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35
36	37	38	39	40
41	42	43	44	45

Figure 9. Grid used for locating mine sites on aerial photographs.



MAP SCALES AND EQUIVALENTS

Fractional Scale	Inches Per Mile	Acres Per Square Inch	Converting Factor Each dot equals:
1" = 7,920"	8.00	10.000	0.156 Acres
1" = 9,600"	6.60	14.692	0.230 Acres
1" = 15,840"	4.00	40.000	0.625 Acres
1" = 20,000"	3.168	63.769	0.996 Acres
1" = 31,680"	2.00	160.000	2.500 Acres
1" = 63,360"	1.00	640.000	10.000 Acres
1" = 125,000"	0.507	2,490.980	38.922 Acres
1" = 250,000"	0.253	9,963.906	155.686 Acres
1" = 500,000"	0.127	39,855.627	622.744 Acres

Figure 10. Grid used for estimating acreage of mine sites delineated on aerial photographs.

Interpretation Key

The most obvious characteristic of abandoned mine sites in North-Central Texas is a barren area or area of sparse vegetative cover. Physical modification of mine sites includes leveled and excavated areas, piles of waste material, small pits or depressions, notched hill slopes, or complete removal of narrow ridge crests. Based on these and other known characteristics, an interpretation key (table 2) was developed and used as an aid in identifying potential mine sites on aerial photography.

Fieldwork Preparation

Prior to undertaking fieldwork, a review was conducted of all available literature related to past coal mining activities within each county to be visited. Indicated mine sites were located on the appropriate aerial photography of each county, when possible.

Potential and confirmed mines (from historical literature) noted on aerial photographs were also plotted on U.S. Geological Survey 7.5-minute and 15-minute quadrangle maps for use during fieldwork. A few additional mines were occasionally found during fieldwork and subsequently noted.

Fieldwork

Project fieldwork was conducted using two distinct methods, a ground or on-site approach and an aerial reconnaissance approach. Both methods were utilized to locate abandoned mine sites and to assess specific surface conditions. The choice of methods was dictated by the accessibility of the site to be examined.

An important aspect of fieldwork was gathering and checking information provided by local citizens within each county (Appendix B). Information such as the location, accessibility, historical data, and current surface conditions of mines were provided by residents of the North-Central Texas area.

Accessible sites -- Readily accessible probable and confirmed mine sites, excluding those incidentally found during fieldwork, were located by using one or several of the following information sources:

Table 2. Interpretation key for identifiying abandoned mine sites on black-and-white aerial photographs.

Characteristic	Appearance
Barren or poorly vegetated areas	White to light gray tones.
Disturbed areas	Light gray tone, rough surface, slightly vegetated. Found on hill slopes, base of hills and bluffs, ridge tops, and level areas.
Access routes	Subtle/apparent path, trail, or road leading to or adjacent to a disturbed area.
Activity tracks or ruts	Wagon, railroad, animal, motor vehicle, man. Light tones, slightly vegetated.
Structural or equipment debris	Railroad or push cart rails, concrete blocks, building foundations, loading platforms (adjacent to railroad grade), and vertical structures.
Depressions	Pits, holes, low areas which may exhibit slightly more vegetation than the surrounding area.
Mine Spoil	Mounds or linear deposits with no apparent pits or excavated areas nearby. Usually dark gray tone and no vegetation.

1. Aerial photography
2. U.S. Geological Survey topographic maps
3. Geologic maps
4. Stratigraphic interpretations
5. Unpublished records (county survey maps and deed records)
6. Local information

Accessible sites were visited and the amount of surface disturbance, in terms of specific criteria and modifiers derived from the interpretation guide, was determined and recorded. Only probable and confirmed mine sites five acres or larger and smaller mines exhibiting unique or unusual characteristics were evaluated. Supposed mine sites which were found to be something other than abandoned mines were not studied further. These sites were often found to be "salt kill" areas (oil well brine-flow over a level area), excavated or natural depressions, overgrazed areas along the base of hills and bluffs, sand and gravel pits and abandoned oil well sites. These sites appeared similar to abandoned mine sites on aerial photography because of similar lack of vegetative cover and characteristic erosion.

Inaccessible sites -- Locating inaccessible sites, for mine confirmation purposes and obtaining surface condition information, required the charter of a small aircraft and pilot. Pre-flight requirements included the (1) preparation of county highway maps for the pilot (half-scale format, 1 in = 2 mi) with sites plotted, and (2) a check on weather and visibility conditions to insure that good quality low level oblique photographs could be taken. Each designated site was observed at an altitude between 300 and 500 feet. Low level 35 mm color slides were taken of each abandoned mine site and the following information was recorded:

1. Approximate size
2. Vegetative condition
3. Runoff into stream or impoundment
4. Erosion severity and type
5. Refuse
6. Miscellaneous information

The degree of surface disturbance reported for each mine site was determined by (1) a review of aerial reconnaissance notes, and (2) the analysis of recent 9x9 inch aerial photography and 35 mm low-oblique photography. Inaccessible sites not confirmed as mines or observed from aircraft were recorded as possible mines. Surface disturbance information was obtained primarily from the analysis of recent 9x9 inch photography. Occasionally, information derived by observing the site from a

distance, and from conversations with local citizens, was utilized. Table 3 lists ways in which information was obtained in order to determine the amount of surface disturbance for accessible and inaccessible mine sites.

Recording Data

All information related to the extent and types of surface disturbance at each abandoned mine and probable mine was recorded on descriptive forms (fig. 11). The location of each site was plotted on U.S. Geological Survey 7.5-minute and 15-minute quadrangle maps (table 4) along with assigned identifiers. Mines less than five acres in size were usually indicated with a circled dot. Mine sites larger than five acres, including probable mines, were indicated by drawing the outline of the site (from photographs) on the appropriate map. The description forms provided a means by which specific surface conditions and features could be individually addressed and the degree of disturbance recorded. In addition, aerial photographs used for mine identification, the type of mine (slope, shaft, etc.), local contacts, and other related information were recorded. Information such as the number of confirmed and unconfirmed mines, acreage represented, period of operation and other pertinent information was summarized and recorded on a site description summary form (fig. 12) for each county.

Table 3. Acquisition of surface condition information.

Accessible mine sites	Inaccessible mine sites
On-site observations.	Aerial reconnaissance notes.
Local citizen input.	Aerial oblique 35mm photography.
	9x9 inch recent photography.
	Distant ground observation.
	Local citizen input (limited).

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

_____County

Size:

Site Number:

Aerial Photography: Date Index # Grid # Scale

Historical -

Most Recent -

Status:

Confirmed Mine -

Unconfirmed Mine -

Method of Verification:

Local Contact:

Accessibility:

Mining Method:

Conditions

Vegetation:

Erosion:

Runoff/Deposition:

Receiving stream -

Impoundment -

Downslope -

Subsidence:

Refuse:

Structural/Equipment Remains:

Hazard Potential:

Surrounding Land Use:

Remarks:

Figure 11. Form used for describing the location and characteristics of mine sites which are 5 or more acres in size, and smaller sites exhibiting unusual features.

Table 4. Counties and associated USGS 7.5-minute and 15-minute topographic maps containing mine sites.

County	County abbreviation code
7.5/15 minute quadrangle	Map abbreviation code
Brown	B
Burkett	BU
Byrds	BY
Coleman	C
Fife	FF
Thrifty	TH
Eastland	Ea
Cisco North	CN
Bernie Lake	BL
Erath	Er
Reddy Mountain	RM
Gordon (15-minute map)	G
Jack	J
Lynn Creek	LC
Antelope	AN
Postoak	PO
McCulloch	MC
Fife	FF
Montague	M
Brushy Mound	BM
Selma	SL
Parker	P
Mineral Wells (15-minute map)	MW
Palo Pinto	PP
Gordon (15 minute map)	G
Stephens	S
Crystal Falls	CF
Breckenridge	B
Wise	W
Bridgeport East	BE
Bridgeport West	BW
Young	Y
Lake Eddleman	LE
Markley	M
Proffitt	P
Newcastle	N

TABLE __. SUMMARY OF SITE DESCRIPTIONS - _____ County

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation

Figure 12. Form used for summarizing mine site characteristics.

MINE SITE CHARACTERIZATION

Objectives of this study of abandoned bituminous coal mines in North-Central Texas are (1) to develop an inventory of accurately located confirmed and suspected mine sites, and (2) to characterize these sites in order to evaluate the need for possible reclamation. The latter objective required the description and comparison of mine site conditions at a large number of sites, through use of a standardized set of descriptors. Terms chosen for this purpose appear on the site description form (fig. 5) and in table 5. A more complete definition of these terms, along with a discussion and examples of conditions at the mine sites, is found in the section entitled ENVIRONMENTAL EFFECTS.

Table 5. Mine site characteristics and terms used in site descriptions.

Size:

Area of disturbance (in acres) at confirmed and unconfirmed mine sites, generally as seen and measured on aerial photographs. Where revegetation has occurred, site (as designated) may be smaller than area originally affected by mining. Where erosion, deposition, and acid runoff have occurred, site may be larger than area originally affected. Texas Railroad Commission guidelines established 5 acres as the normal minimum acreage of a site to be described in detail (using site description form, fig. 11) unless some unusual condition was represented at a smaller site.

Status:

Confirmed Mine - Site at which one or more mines can be demonstrably shown to be located (see "Method of Verification").

Unconfirmed Mine - Site which has many of the characteristics of a mine locale but at which no mine can be confirmed (see "Method of Verification"). Failure to confirm a mine site may result from an inconclusive ground or air inspection (ambiguous site characteristics) or, more often, from inability to inspect site during this study.

Method of Verification:

Historic record (published, unpublished) - Documentation establishing the location and/or identity of a mine.

Local contact - Information establishing the location and/or identity of a mine provided by area resident. See also "Local Contact," below.

Ground inspection - Location and condition of a mine site established through on-site observations.

Air inspection - Location and condition of a mine site established through low-altitude aerial observations. A hand-held camera was used to take oblique aerial photographs.

Aerial photointerpretation - Location and condition of a mine site established through stereoscopic examination of historic (generally, pre-1950) and recent vertical aerial photographs (Appendix A), utilizing recognition criteria established during this study.

Local contact - Knowledgeable individual, often a landowner and/or long-term area resident, familiar with: (1) the location and/or history of confirmed or unconfirmed mine sites in the county, and/or (2) mining techniques utilized in the development of area mines. Complete address and description of the contribution of each local contact provided in Appendix B.

Accessibility:

Descriptions not in all cases standardized, but normally include: (1) statement concerning ease of access (e.g., direct, meaning site is within or adjacent to public right-of-way, or limited, meaning site can be reached only by private road or on foot), (2) statement concerning land ownership (private or public), and (3) statement describing location of site with respect to that of nearby community (e.g., "3.2 km NW of...").

Mining Method:

Shaft entrance (underground mine) - Vertical access shaft excavated to depth of coal seam; lateral mining at depth.

Slope entrance (underground mine) - Inclined access tunnel excavated to depth of coal seam; lateral mining at depth.

Drift entrance (underground mine) - Horizontal or slightly inclined tunnel excavated from outcrop of coal seam; lateral mining once tunnel has penetrated beyond the zone of surface weathering.

Contour (surface mine) - Shallow horizontal excavation along topographic contour following outcrop of coal seam; also employed as a prospecting technique.

Open pit (surface mine) - Broad vertical excavation to depth of coal seam, pit not refilled; also employed as a prospecting technique.

Other mining methods - Rare. Variations on methods described above.

Longwall advancing extraction (underground mines) - Procedure for removing all coal in the mine (complete extraction), i.e., without leaving roof-supporting, unmined pillars of coal as in other extraction procedures. Mining occurred along a uniformly retreating wall of coal (longwall) which in small mines extended across the entire mined area (workings). Mined-out areas were filled with waste coal and other mined materials (gob) and the collapsed or settled mine roof.

Modified longwall advancing extraction (underground mines) - Very similar to the longwall advancing extraction procedure except that two or more longwall surfaces could be mined simultaneously. A more complex arrangement of main and secondary passageways (entries) divided the longwall into discrete work areas. In major underground mining operations, modified longwall extraction was practiced because it provided a more efficient means of working large areas. There were also practical limits to the size of a mine in which simple longwall extraction could be employed.

Other mining data - Other information concerning historic coal mining methods was recorded when available and pertinent to the discussion of environmental effects at the site. Additional information is provided under Remarks, and in the county site description summaries when data were available concerning the period of active mining, the use and user of the coal produced, and the relative production rate at each mine.

Vegetation (vascular plants only):

Barren - Living plants very widely scattered or entirely absent; bare ground, with isolated plants only.

Sparsely vegetated - Isolated plants or small clusters interspersed over essentially bare ground; normally, only low groundcover species (grasses, herbs, etc.) represented.

Moderately vegetated - Incomplete but general vegetative cover, some bare ground, low ground cover species and woody plants common.

Completely vegetated - Vegetative cover complete, to the extent of coverage that likely existed at the site prior to disturbance, and consistent with coverage of adjacent areas not affected by mining; in portions of the region, natural vegetative cover is sparse. Both low groundcover and larger woody species may be represented.

Site condition - In many cases, an attempt was made to determine whether a site was reestablishing its vegetative cover or continuing to experience loss of vegetation long after mining had been discontinued because of continuing erosion, acid runoff (progressive devegetation), or other factors. The terms devegetation, revegetation, and stable vegetation were used to describe the apparent trend of vegetative conditions.

Plant types - A general indication of the type of plants found at a site was usually provided. Information concerning (1) the morphology or growth habit (tree, shrub, grass, herb, herbaceous, woody), (2) persistence (annual, perennial), and (3) habitat preference or ecology (aquatic, xerophytic) of the plants was noted when available. Names of plants (common names used, with a few exceptions), when known, were also included in the description of vegetation.

Other data concerning vegetation - When the distribution and/or condition of vegetation at the site was affected by environmental processes such as subsidence, mass wasting, sediment deposition, or acid runoff, that process was often mentioned in the description of vegetative conditions.

Erosion:

Severe - Evidence of advanced denudation (loss of surface materials through the action of erosive agents), usually affecting an area of several acres.

Moderate - Evidence of substantial denudation over several acres or advanced denudation over a small area.

Slight - Evidence of minimal denudation or more extensive denudation over an extremely small area.

Negligible - Very little active erosion.

Undetermined - Extent of erosion could not be evaluated using available photo-interpretive techniques (when site was not observed in the field), usually indicating that site was overgrown with trees that masked the ground surface. There was some indication of erosion in areas not covered by the canopy.

Active - Continuing denudation. Rate of erosion likely to be constant or possibly accelerating.

Stabilized - Processes of erosion at a site now apparently curtailed; surface no longer eroding and may be experiencing deposition.

Sheetwash - The transport of soil and other surface materials which have been stripped from inclined slopes (generally smooth) by unchanneled runoff. Sheetwash deposits are often broad, smooth, and lobate in plan.

Gully - Generally shallow, unstable, poorly-defined surface drainage channel often developed on disturbed, devegetated, moderate to steep slopes.

Stream - Relatively stable, well-defined surface drainage channel normally connecting (integrating) with larger channels throughout the drainage basin of a river.

Mass wasting - Movement of surface materials on inclined slopes under the direct influence of gravity. Slope movements which result from this process are classified by type of movement and type of material. At mine sites (confirmed, unconfirmed) observed during the present study, slope movements which were observed

included: (1) rock topple (downslope rotation of boulders), and (2) earth slide or earth flow (downslope movement of loose, predominantly fine-grained surface materials such as soil or mine waste). Although earth slide and earth flow are two separate classes of slope movement, they could not be readily distinguished at most field sites during the present study. Mass wasting may involve movement of large volumes of solid material and can cause marked local changes in topography, such as scarp retreat or the upslope migration of a steep, naturally eroded or excavated slope.

Runoff and Deposition:

Receiving Stream - A tributary of the surface drainage system which, in most cases, is depicted on 1:24,000-scale maps covering a mine site, and which receives runoff and sediment from a mine site either directly or via gullies or sheetflow. Changes in channel configuration, bed characteristics, and stream-mouth deposits may be attributable to variations in runoff and sediment load derived from the mine site.

Impoundment - Denotes a small, water-filled depression. Most impoundments of interest in the study area were surface water storage facilities intended to provide water for livestock on open rangeland (tank) and/or to reduce erosion hazards (conservation ponds). Subsidence has also created small impoundments, and very small, ephemeral ponds were observed on the irregular surfaces of some large mine waste dumps. Impoundments are subject to a variety of effects related to coal mining including gradual in-filling with sediment, water quality degradation (suspended sediment and chemical leachate derived from oxidation of mine wastes), and breaching of the retaining structure due to excessive inflow. Limited effects on larger impoundments were also noted.

Downslope - Movement of runoff and sediment from a mine site to a downslope area may result from (1) channelized flow (primarily through gullies), (2) unchannelized

flow (sheetflow and sheetwash), and (3) mass wasting (earth slides/flows and rock topples). Erosion and increased discharge may be observed downslope from the mine site and sediment may accumulate in gullies, in stream channels, and on smooth slopes lacking channels.

Subsidence:

Net loss of elevation over an area, attributable (normally) to vertical displacement of the land surface with no or very little accompanying horizontal movement. Subsidence may induce water ponding and/or gullying. In some cases an effort was made to determine the recency of subsidence at the affected site.

Refuse:

Discarded or surplus material (mine waste such as shale, unmarketable coal, and miscellaneous mining debris; and domestic, agricultural, or industrial waste brought to site for disposal) or deteriorated mining structures and equipment. Type of material and its significance at site usually described. Mounded mine wastes or dumps were the most frequently seen form of refuse at mine sites.

Structural and Equipment Remains:

Relict structures (walls, foundations for heavy machinery, building foundations); roads and railroads; and equipment present at site, usually in some condition of deterioration or disrepair.

Hazard Potential:

Evaluation of possible risk, represented by site conditions, to (1) public health and safety, (2) property, and (3) environmental integrity. Risk was evaluated relative to

the absolute hazard and the proximity to communities, structures, etc. In some cases, comments relating to possible reclamation procedures were included.

Surrounding Land Use:

Type of land use, intensity of use, and relative proximity to site (in some cases) were noted. Typical land use descriptors include: (1) grazing (improved or unimproved rangeland or pastures), (2) cultivation (hay, wheat, etc.), (3) industrial (brick plant, oil/gas production or pipelining, etc.), (4) transportation (railways, roads), (5) commercial (urban, rural), (6) residential (urban, rural), (7) recreation, (8) water storage or irrigation withdrawal, and (9) other (historic land use described in some cases).

Remarks:

Limited review of site/mine history, problems affecting identification of mine sites, special environmental problems, etc.

SITE DESCRIPTIONS

Bituminous coal-bearing formations crop out over 2950 km^2 (1139 mi^2) across 15 North-Central Texas counties (table 6). Confirmed or probable mine sites were found in 12 of these counties. A total of 131 mine sites were mapped and described following procedures established for this study.

Mine sites (confirmed or probable) were found in Brown, Coleman, Eastland, Erath, Jack, Montague, McCulloch, Palo Pinto, Parker, Stephens, Wise, and Young Counties. Coal resources may potentially be located in 3 additional counties in the region, Archer, Clay, and Throckmorton, although no mine sites were found in these counties.

Mine site descriptions are organized by the county in which the sites are located, with one exception. All of the mines in the vicinity of Thurber on the border of Erath and Palo Pinto Counties are described as the Thurber area mines, regardless of the county in which each mine is located (coded site numbers distinguish the county location of each mine). All of the known mine sites in Erath County are located in the Thurber mines area, and no separate listing of Erath County mines is included in this report. Some of the Palo Pinto County mines are in the Thurber vicinity, but mine sites near the communities of Strawn and Gordon are discussed under a separate heading for Palo Pinto County mines other than those in the Thurber Mines Area.

For each county and for the Thurber Mines Area, a narrative description of the distribution of mines, the size and location of each coal-bearing formation's outcrop, and the general environmental setting, as well as other information relevant to the particular county, are provided. A county map is included which depicts the outcrop area, major streams, lakes, communities, and roadways, and lesser features mentioned in the site description (table 7). Individual mine site descriptions are, however, the primary products of this study. Sites which are 5 acres and larger in size, or which are smaller but particularly noteworthy are described individually. Other sites are listed in a table which gives the site number, size, status (confirmed or probable mine site), mine type, and location referenced to historic and recent aerial photographs. From the individual and tabular site descriptions, summary tables were derived which review all of the sites in the county or area, and the environmental effects of mining and mine abandonment at sites which were described individually. A narrative description and county maps of Archer, Clay, and Throckmorton Counties are included, as well.

Table 6. Outcrop acreage of bituminous coal-bearing formations in North-Central Texas.

County	Approximate outcrop area[1] km²	mi²	acres	Total area of county[2] km²	mi²	acres	Percent outcrop area
Archer	101.16	39.06	2,500	2,438.66	941.57	602,608	0.41
Brown	182.10	70.31	45,000	2,413.75	931.95	596,448	7.5
Clay	48.56[3]	18.75	12,000	2,799.56	1,080.91	691,783	1.7
Coleman	230.66	89.06	57,000	3,204.84	1,237.39	791,932	7.2
Eastland	149.73	57.81	37,000	2,307.97	891.11	570,309	6.5
Erath	202.33	78.12	50,000	2,625.30	1,013.63	648,725	7.7
Jack	578.71[3]	223.44	143,000	2,374.30	916.72	586,700	24.4
McCulloch	20.23	7.81	5,000	2,750.04	1,061.79	679,549	0.73
Montague	68.79[4]	26.56	17,000	2,390.34	922.91	590,662	2.9
Palo Pinto	149.73[5]	57.81	37,000	2,462.96	950.95	608,610	6.1
Parker	48.56	18.75	12,000	2,428.28	937.56	600,039	2.0
Stephens	554.26	214.06	137,000	2,325.64	897.93	574,676	23.8
Throckmorton	2.02	0.78	500	2,400.59	926.87	593,200	0.08
Wise	40.40	15.62	10,000	2,348.53	906.77	580,332	1.7
Young	663.69	256.25	164,000	2,364.05	912.76	584,167	28.1
Total	2,950.16	1,139.06	729,000	37,634.88	14,530.84	9,299,740	7.8

[1] Outcrop of coal-bearing formations as delineated by Evans (1974, pl. 1) except as noted.
[2] General Land Office of Texas (undated), "Acreage in Texas Counties" (map).
[3] Outcrop of the Harpersville Formation as delineated by Evans (1974, pl. 1) except in southeastern Clay and northeastern Jack Counties. Outcrop of the Harpersville in these areas inferred from Barnes (project director, 1967).
[4] Outcrop of the Harpersville Formation as delineated by Bullard and Cuyler (1930, pl. 3).
[5] Outcrop of the Dalton Coal (within Wolf Mountain Shale unit) after Mapel (1967, fig. 9 and table 2) and Plummer and Hornberger (1935, p. 192-193 and pl. 2). Outcrop of Mingus Formation (redefined) as delineated by Evans (1974, pl. 1).

Table 7. References used in preparation of county maps.

Feature	Reference
County outline, all major and some minor communities, roads, lakes, and streams.	Texas Department of Highways and Public Transportation (individual county highway maps, 4 miles per 1 inch).
Harpersville Formation (Cisco Group) outcrop areas, all counties where exposed except Montague, southeastern Clay, and northeastern Jack Counties.	Evans (1974, Plate 1).
Harpersville Formation outcrop area, Montague County	Bullard and Cuyler (1930, Plate 3.).
Harpersville Formation outcrop area, southeastern Clay and northeastern Jack Counties	Inferred from Barnes (project director, 1967).
Wolf Mountain Shale (Canyon Group) outcrop area, Palo Pinto County.	Evans (1974, Plate 1.)
"Dalton Coal" (within Wolf Mountain Shale unit) outcrop area (solid outline) and approximate subsurface extent (dashed outline), Palo Pinto County.	After Mapel (1967, Figure 9. and Table 12.) and Plummer and Hornberger (1935, pp. 192-193 and Plate 2.).
Palo Pinto Formation (Canyon Group) outcrop area, Wise County.	Evans (1974, Plate 1.)
Mingus Formation, redefined (Strawn Group) outcrop area, all counties where exposed.	Evans (1974, Plate 1.)

Archer, Clay, and Throckmorton Counties

Archer, Clay, and Throckmorton Counties are among the 15 North-Central Texas counties in which important coal-bearing formations are exposed (figures 13, 14, and 15). The Harpersville Formation, a sequence of Pennsylvanian age marine and fluvial-deltaic deposits has been mapped at the surface in Archer, Clay, and Throckmorton Counties. As illustrated by Evans (1974, Plate 1), the Harpersville crops out over an area of approximately 152 km^2 (59 mi^2; 15,000 ac) in these counties (table 6).

There are, however, no known records of coal mining in the counties, nor were any confirmed or suspected mine sites identified by other means during the present study. There is little evidence to suggest the presence of coal. Cummins (1891, Plate 28) indicated the approximate location of a "coal prospect" in southeastern Archer County, and coal was observed in a roadside bar ditch in southern Clay County during field investigations for the current study. No sites of coal prospecting or of unsuccessful mining were located, however. Thus, there are no environmental effects in any of the three counties which are attributable to coal mining.

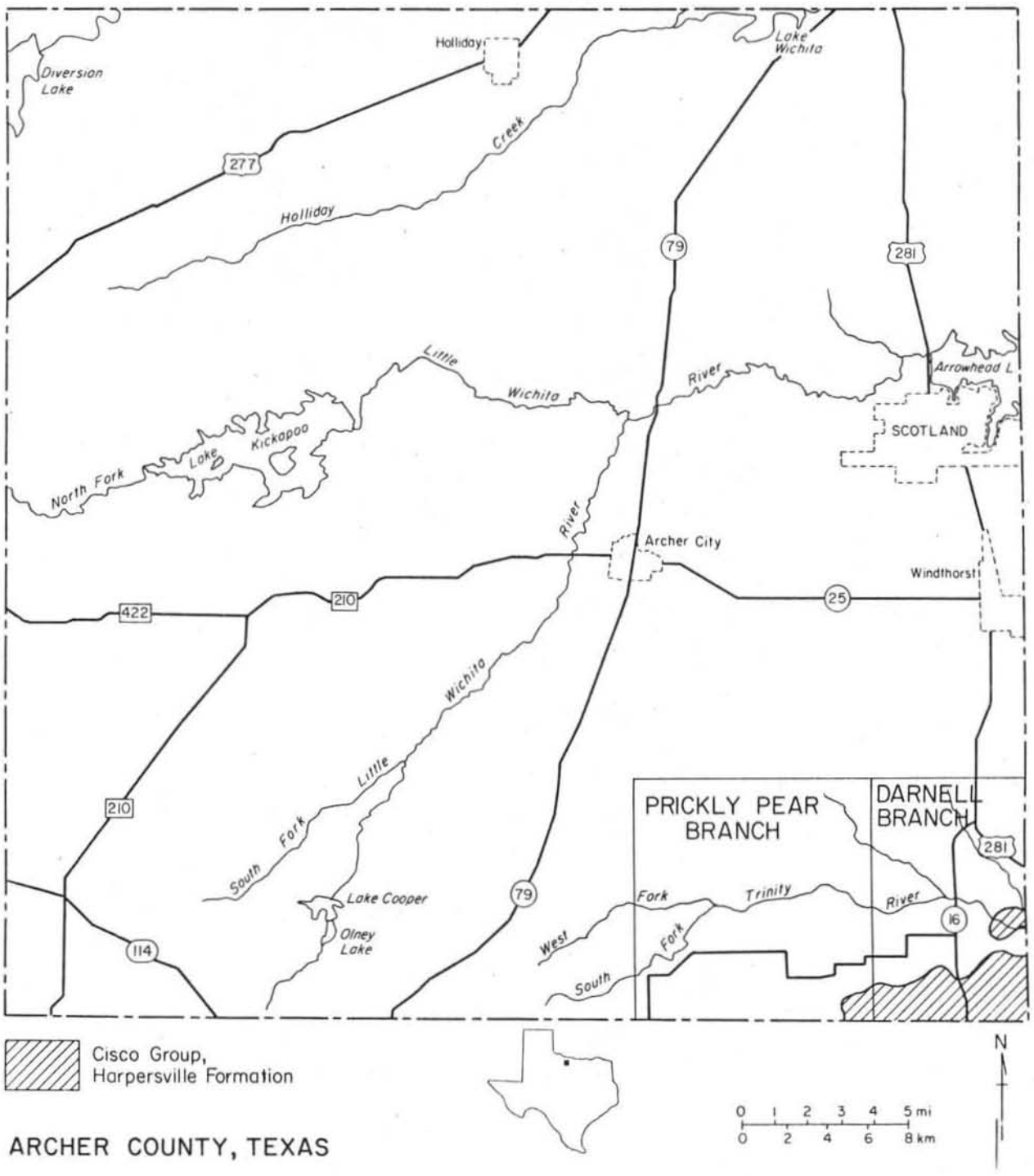


Figure 13. Map of Archer County, Texas, illustrating the outcrop area of the coal-bearing Harpersville Formation, and selected cultural and surface drainage features.

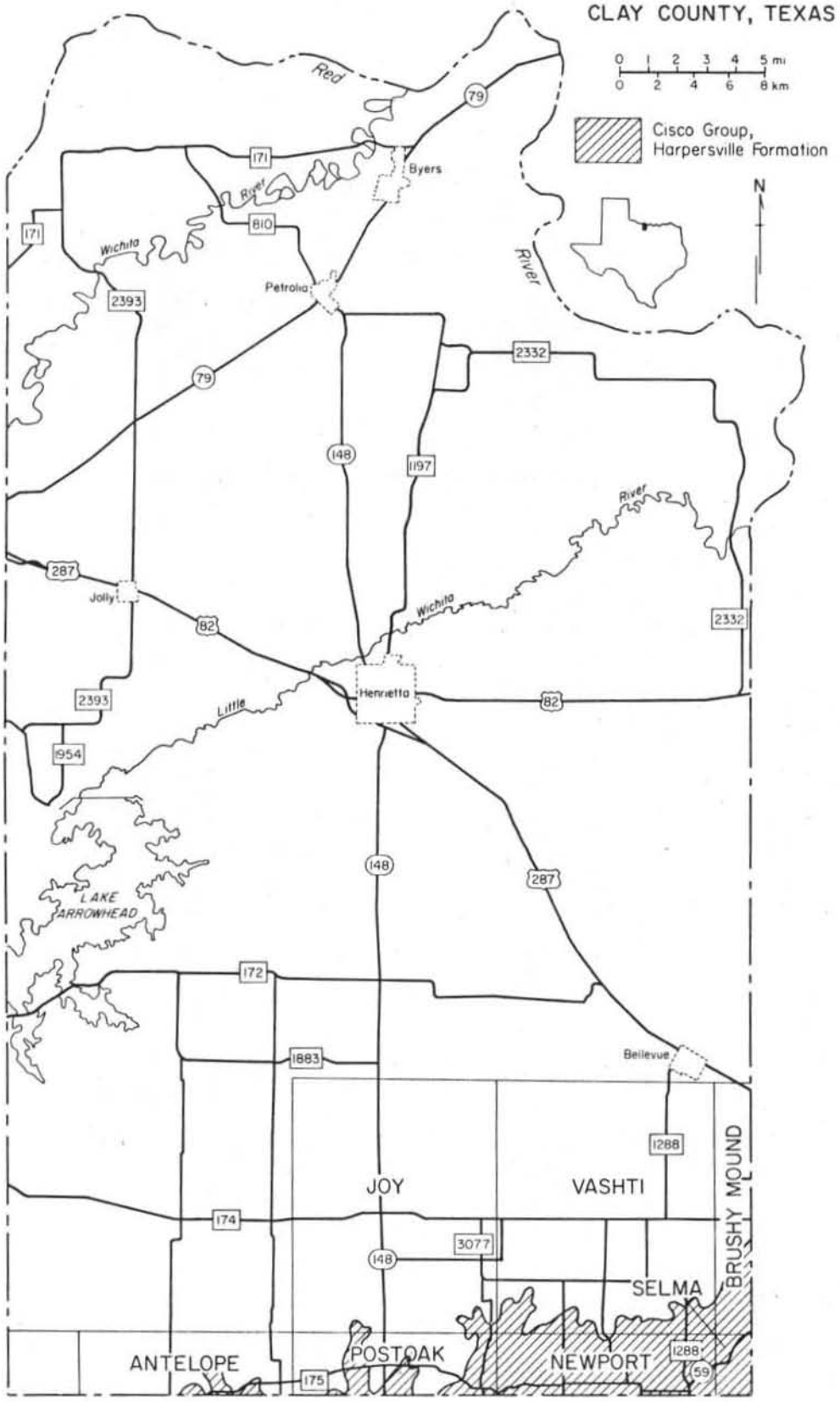


Figure 14. Map of Clay County, Texas, illustrating the outcrop area of the coal-bearing Harpersville Formation, and selected cultural and surface drainage features.

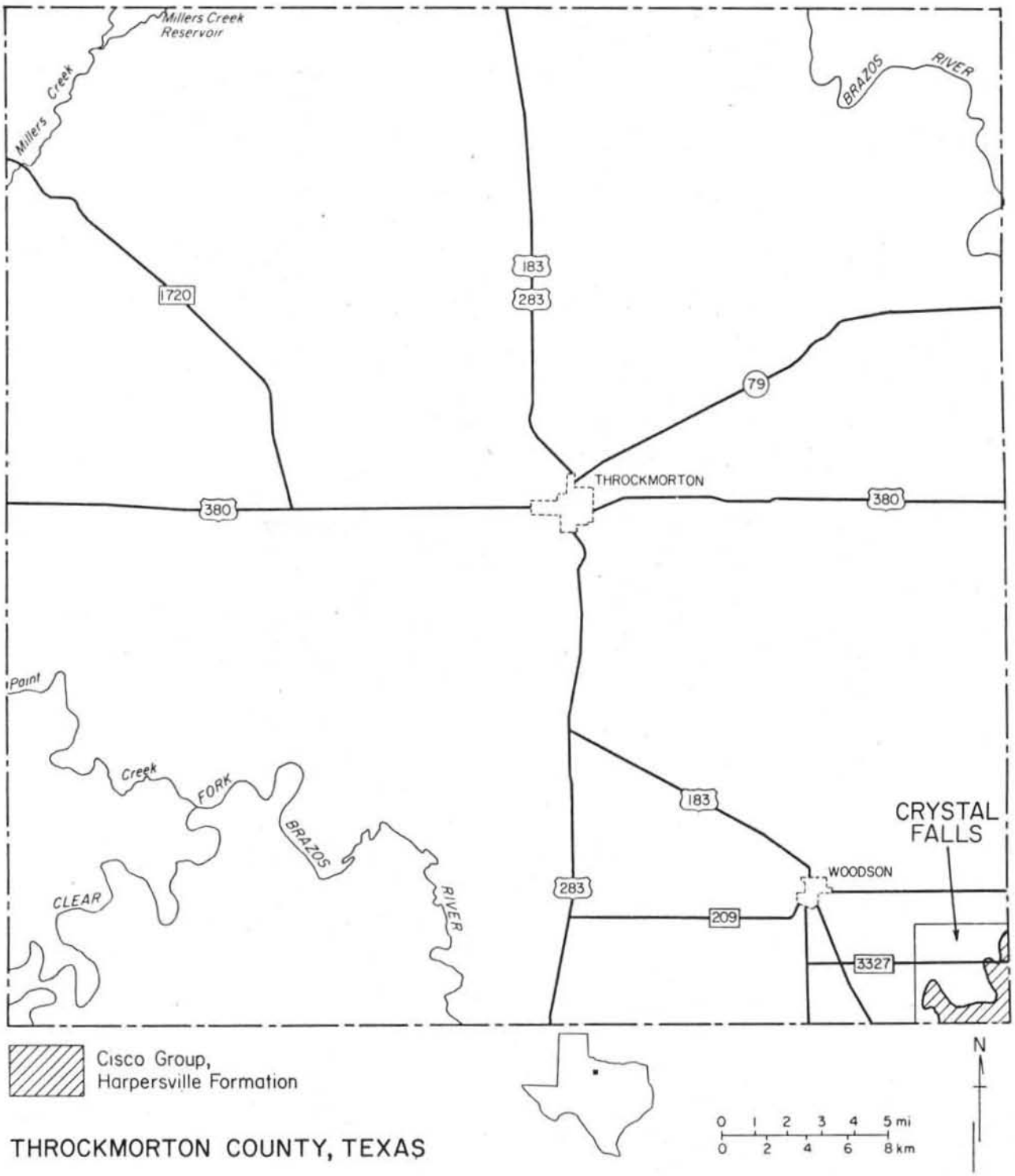


Figure 15. Map of Throckmorton County, Texas, illustrating the outcrop area of the coal-bearing Harpersville Formation, and selected cultural and surface drainage features.

Brown County

Brown County in Central Texas is within the westernmost belt of Pennsylvanian-age bituminous coal resources in the state. The coal-producing Harpersville Formation (Cisco Group) crops out over approximately 182 km^2 (70 mi^2; 45,000 ac) of northwestern Brown County, the outcrop area comprising almost 8 % of the county's total area of 2414 km^2 (932 mi^2) (fig. 16; table 6). The Harpersville Formation, as mapped and described by Kier and others (1976) and Evans (1974), may contain coal reserves over much of its extent, although little coal has been found in Brown County.

The coal beds lie within a complex sequence of terrigenous clastics and limestones originally deposited in a coastal environment characterized by fluvial-deltaic progradation alternating with marine destructional-transgressive conditions (Brown and others, 1973, pp. 57-58 and Figure 42). The resulting strata are laterally discontinuous with only a few persistent beds. The apparent absence of important coal resources from the Harpersville section in Brown County may be attributable to the discontinuity of individual coal beds.

Although there is no known record of successful mining of bituminous coal in Brown County, some prospecting was done. Coal was, in fact, mined within one mile of the Brown County line, at the Silver Moon Mine in Coleman County (Cummins, 1891, p. 544; Tarr, 1890, p. 213). The Harpersville Formation, which is a reliable source of bituminous coal elsewhere in the region, is widely exposed in northwestern Brown County, but Cummins (1891, p. 544) reported that "Very little coal has been found... and there is not much prospect that workable beds will be found." The only reported outcrop of coal in the county is along Pecan Bayou near "Bird's (Byrds) Old Store" (Cummins, 1891, p. 544). Cheney and Eargle (1951) gave the location of this landmark which was called "Old Byrds Store" by these investigators. The area is well within the outcrop area of the Thrifty and Graham Formations (undivided) as mapped by Kier and others (1976). This stratigraphic unit underlies the Harpersville and does not contain producible coal resources (Kier and others, 1976, text accompanying geologic map).

An extensive survey of northwestern Brown County (Harpersville outcrop area) failed to locate even a single confirmed coal mine site (table 8). Ground and aerial reconnaissance and an extensive review of both vintage (1948) and recent (1972) aerial photographs produced little evidence to suggest either prospecting or mining. Only two sites, numbers B/BU/1-20 and -21 represent historic excavations into strata in roughly the correct stratigraphic position to permit possible access to marketable coal. However, the identification of these adjacent sites as possible prospecting areas

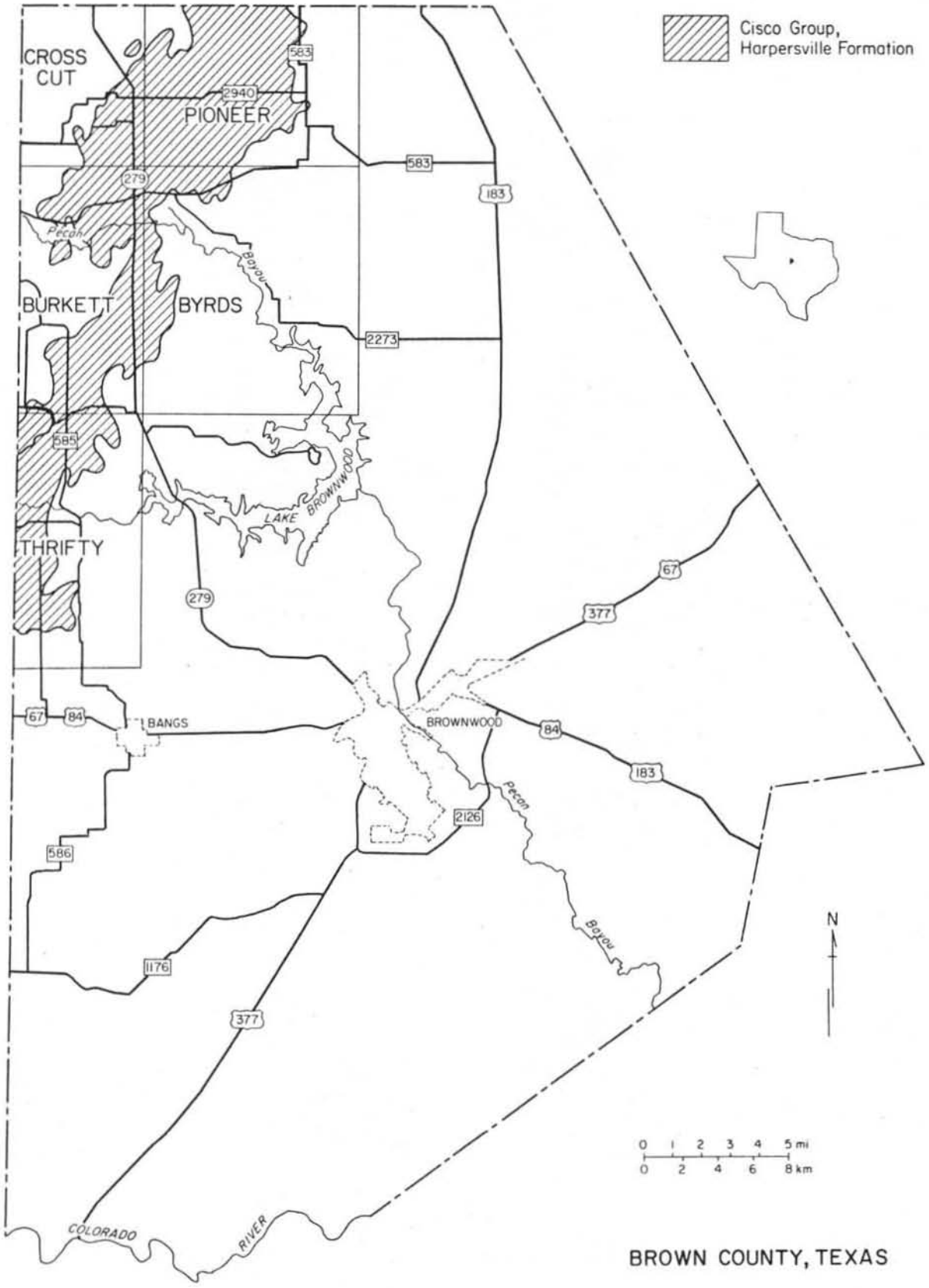


Figure 16. Map of Brown County, Texas, illustrating the outcrop area of the coal-bearing Harpersville Formation, and selected cultural and surface drainage features.

Table 8. Summary of site descriptions--Brown County

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
B/BU-1-20	7	----	1 (possible prospecting site)	Unknown (before 1938)	No known production	Severe (impoundment), possible, undetermined effect on groundwater	Severe
B/BU-1-21	2	----	1 (possible prospecting site)	Unknown (before 1938)	No known production	Negligible	Slight
B/BY-3-1	2	----	1 (possible prospecting site)	Coal discovered before 1890	No known production	Slight	Negligible
Summary: 3 sites	11	----	3 (possible prospecting sites)	Before 1890 (?)	No known production	Slight to severe (impoundment)	Negligible to severe

remains tentative. A third site, number B/BY-3-1, is the most likely point at which a thin coal seam referred to by Cummins (1891, p. 544) crops out. This outcrop was probably known to area residents before 1890, the presumed date of Cummins' visit. Some prospecting and even minor production for limited local use may have taken place but this coal could not have sustained a significant production effort. There is thus little evidence of environmental impact attributable to coal mining in Brown County (table 9).

Effects of other activities in the county often resemble impacts typically associated with coal mining. Land uses such as oil and gas production, open pit mining of industrial clays, construction of water storage impoundments, and overgrazing, particularly on steep slopes, have affected large areas of the county. The task of aerial photointerpretation for the present mine inventory was complicated by the ease with which sites of these activties were mistaken for coal mine sites.

The oak woodlands and sandy and sandy loam soils of northwestern Brown County are characteristic of the Western Cross Timbers region (Templin and others, 1948, pp. 3, 4, and 76). Resistant limestones and sandstones of the Harpersville Formation and, farther west, the Pueblo Formation, form a series of steep, east-facing ridges. These ridges are deeply dissected by larger streams, particularly Pecan Bayou and Jim Ned Creek. Drainage from most of the county ultimately enters the Colorado River. Cretaceous deposits overlie the Pennsylvanian age strata along the Colorado-Brazos drainage divide (in extreme northeastern Brown County and southern Eastland County), marking the northern end of the southern Harpersville outcrop belt delineated by Evans (1974, Plate 1).

Table 9 . Summary of environmental effects in Brown County.

Site Number	C - Confirmed U - Unconfirmed	Acres	Effects on Vegetation	Erosion	Runoff/Deposition			Subsidence	Refuse	Structural Equipment Remains
					Receiving Stream	Impound-ment	Downslope			
B/BU-1-20	U	7	X	X		X	X		X	
B/BY-3-1	U	2		X	X				X	X
Totals: 2 sites	2 U	9	1	2	1	1	1	0	2	1

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

BROWN County

Size: 2 acres.

Site Number: B/BY-3-1 (possible prospecting site, unnamed).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	10/27/48	153	30	1:20,000
Most Recent -	3/30/72	7MM:11	40	1:20,000

Status:

Confirmed Mine -

Unconfirmed Mine - Yes. Possible prospecting site.

Method of Verification: Historical record (published); photointerpretation.

Local Contact: None.

Accessibility: Limited. Private land. Site is approximately 10.5 km (6.5 mi) southeast of Cross Cut.

Mining Method: Possible prospecting involving removal of coal by hand from outcrop (possible shallow excavations?). No evidence of coal extraction in marketable quantities.

Conditions

Vegetation: Revegetation almost complete. Woody riperian species (possibly pecan, others.)

Erosion: Possible slight channel bed and bank erosion at site and short distance below site.

Runoff/Deposition:

Receiving stream - Pecan Bayou (perennial). Possible slight increase in concentration of suspended solids, etc. after bottom or bank disturbance. Coal crops out naturally along stream.

Impoundment - None present.

Downslope - Effects confined to stream channel. Channel appears to be actively downcutting both above and below site, suggesting negligible sediment accumulation.

Subsidence: None evident.

Refuse: Possible foundation of structure and linear pile of earth material(?).

Structural/Equipment Remains: Possible foundation of structure on bank adjacent to stream channel.

Hazard Potential: Possible minimal reduction of water quality for short distance downstream from site.

Surrounding Land Use: Possible withdrawal of water from stream for irrigation, livestock watering, and domestic use; grazing (unimproved range); rural residential.

Remarks:

(see attached page)

Site Number B/BY-3-1 (cont.)

Remarks: Cummins (1891, p. 544) stated, "Very little coal has been found in this county (Brown), and there is not much prospect that workable beds will be found." Cummins did, however, observe that a coal seam "crosses Pecan Bayou in the vicinity of Bird's (Byrds) old store." The present community of Byrds is approximately 5.0 km (3.1 mi) south-southeast of "Old Byrd's Store" as mapped by Cheney and Eargle (1951). Kier and others (1976, text accompanying geologic map) reported the presence of "some coal smut" within the stratigraphic interval between the Speck Mountain Limestone and the Ivan Limestone. As mapped by Cheney and Eargle (1951), these units cross Pecan Bayou approximately 4.6 km (2.8 mi) and 2.0 km (1.25 mi) northwest of "Old Byrd's Store (site)," respectively. Vintage (1948) and recent (1972) aerial photographs covering the 4.4 km (2.75 mi) of stream channel between the Speck Mountain Limestone and Ivan Limestone outcrops in the channel reveal few signs of disturbance characteristic of coal mining in the region. However, site number B/BY-3-1 is the most likely point at which the coal seam may be exposed. There is no historic record or obvious site condition (as seen on aerial photographs) that suggests active mining at this site, or elsewhere is the stream reach examined, but the coal was certainly known to area residents before 1890. Some prospecting or extraction for local use may have occurred.

The coal in question is an extremely thin and apparently discontinuous bed in the Thrifty Formation (Thrifty and Graham Formation, undivided of Kier and others, 1976). Old Byrd's Store is located 5.6 km (3.5 mi) southeast of the outcrop of the northwest-dipping Harpersville Formation, the major coal-bearing unit in the region. The coal bed cropping out near Old Byrd's Store does not constitute a significant marketable resource, and there is no evidence to suggest production of coal at or in the vicinity of site number B/BY-3-1.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

BROWN County

Size: 7 acres

Site Number: B/BU-1-20 (possible prospecting site, unnamed).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	10/27/38	107	22, 23	1:20,000
Most Recent -	3/30/72	7MM:68	7, 8	1:20,000

Status:

Confirmed Mine -

Unconfirmed Mine - Yes. Possible prospecting site.

Method of Verification: Ground, air inspection; photointerpretation.

Local Contact: None.

Accessibility: Direct. Private land. Site is approximately 12.2 km (7.6 mi) south-southwest of Cross Cut.

Mining Method: Unknown. Direct evidence of possible coal prospecting has been obscured. No evidence of coal extraction in marketable quantities.

Conditions

Vegetation: Partial (discontinuous) revegetation -- gentle slopes covered in blackjack oak and cedar elm; steep slopes essentially barren.

Erosion: Severe gullying and sheetwash erosion. Barren slopes are deeply gullied or mantled in coarse colluvium. Gullies in steep slopes anastomose at slope break, forming deep channel.

Runoff/Deposition:

Receiving stream - Unnamed third-order tributary (intermittent) of Pecan Bayou (perennial). Drainage from site poorly integrated with tributary system (no direct input).

Impoundment - Artificial impoundment (livestock watering tank or conservation pond) checks part of the runoff from upper slopes, receiving a rapid influx of sediment (mostly clay). Strongly discolored water may indicate presence of mineral pollutants.

Downslope - Gullies in steep slopes integrate downslope, forming deep channel which discharges onto a flat 0.2 km (0.1 mi) below excavation and becomes undefined. Sediment transported across flat as slopewash. Poorly-marked channels leave flat and merge with defined drainage before reaching Pecan Bayou.

Subsidence: None evident.

Refuse: Small spoil mounds containing carbonaceous shale.

Structural/Equipment Remains: None evident.

Hazard Potential: Source of possible water pollutants, primarily sediment. Hazard is somewhat reduced because impoundment at foot of slope traps part of the runoff-transported pollutants and the balance is deposited on the flat below the excavation.

Surrounding Land Use: Grazing (unimproved rangeland); surface water storage (presumably for livestock watering and/or soil/water conservation purposes); roadway transportation.

Remarks:

See attached page.

Site Number B/BU-1-20 (cont.)

Remarks: Very little direct evidence to suggest that site was prospected or mined for coal. However, surface disturbance, related to excavation for some purpose, is clearly evident and may be seen in 1938 aerial photographs, as well. A carbonaceous shale crops out at the site and this could have been prospected, probably through shallow excavations along the contour. Interpretation of the stratigraphy of the site indicates that these strata are higher in the section than the reported position of the major coal seams in the Harpersville Formation; shallow shafts, or drilled test holes such as those sunk by G.W. Gibson (Hunter, 1976, p. 36) and others (Drake, 1893, p. 433) in Coleman County could have been utilized at this site for subsurface prospecting. The small quantity of mounded shale and other rock debris and the absence of coal suggests that there was very little if any mining effort at the site. Construction of an impoundment, before 1938, may have obscured evidence of mining or prospecting, but could, conversely, have been reponsible for part or all of the excavation noted. Removal of fill material or road metal may have contributed, as well, to disturbance at the site. Thus, other explanations are available to account for the apparent excavation, but the possibility remains that the site was prospected before 1938, presumably unsuccessfully.

Table 10 . Confirmed (C) and Probable(P) mines less than five acres - Brown County.

Site Id	Size (acres)	Status	Mine Type	Photo Date	Number	Grid
B/BU-1-21	2	P	contour (prospecting site?)	10/27/48 3/30/72	107 7MM:68	23 8

Coleman County

Coleman County is near the southern end of the westernmost bituminous coal belt in North-Central Texas (St. Clair and others, 1976). Coal is found in the Harpersville Formation, a Pennsylvanian age stratigraphic sequence consisting of interbedded marine and fluvial-deltaic deposits, including thin coal seams. The outcrop area of the Harpersville extends from the Colorado River, which forms the southern boundary of the county, northeastward to the Brown County line near Pecan Bayou (fig. 17), a distance of approximately 75 km (29 mi). As mapped by Evans (1974, Plate 1) and Kier and others (1976), the Harpersville Formation crops out over an area of more than 230 km^2 (89 mi^2; 57,000 ac) or roughly 7% of Coleman County's total area of 3,200 km^2 (1240 mi^2) (table 6). Drake (1893) stated that coal was widely distributed across the outcrop area, citing observations from outcrops, mines, and shallow prospecting holes.

Coal mining began in the county at least as early as 1889 (Cummins, 1890, p. 152) and may have continued until about 1920 (Box, personal communication, 1979) (table 11). Lack of rail transportation, an inadequate local market, and the difficulty and expense of mining thin coal seams reduced the economic viability of mining ventures. However, persistent attempts to maintain mines were made at several sites and there was a great deal of subsurface prospecting throughout the area (Tarr, 1890, pp. 213-214).

Environmental effects of mining in the county (table 12) are variable, reflecting differences in physiography, climate, soils, and vegetation between the southern and eastern portions of the county where mining occurred. The mine sites of southern Coleman County have been only sparsely revegetated and the thin soils have been severely gullied. In the eastern area with different soils and a slightly greater total annual rainfall, mine sites may be more densely overgrown with erosion-retarding groundcover species. Mine dumps in both areas are barren although progressive devegetation is more obvious around dumps to the south. Subsidence is also more apparent in the southern area, probably because of the difference in vegetative cover.

Three confirmed and two probable mine sites were defined in Coleman County. However, three other possible mines were reported: (1) Viking (actually Vining) Coal Mine, described by Griggs and Minor (1977, site number 58359) and Taff (1902, pp. 407-409); (2) unnamed mine north of Bull Creek west of the Little Bull Creek confluence, depicted on a map by Drake (1893) but not described; and (3) unnamed mine west of

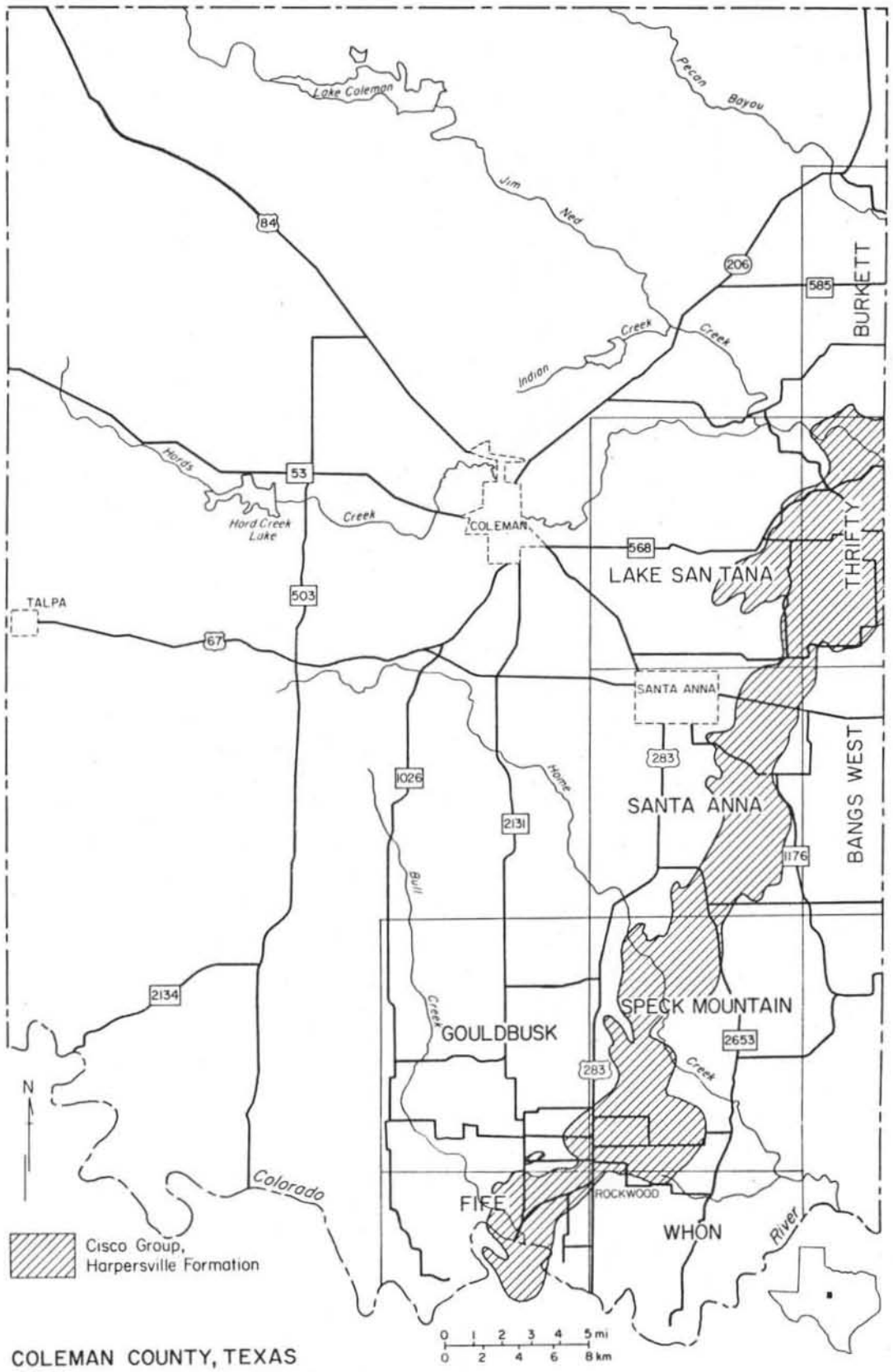


Figure 17. Map of Coleman County, Texas, illustrating the outcrop area of the coal-bearing Harpersville Formation, and selected cultural and surface drainage features.

Table 11. Summary of site descriptions-- Coleman County

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
C/FF-4-14	14	3	1 (mine or possible prospecting site)	1892? - c. 1920	Domestic, industrial, possibly railroads	Moderate	Moderate (erosion, subsidence)
C/FF-4-15	10	2? (2 or more entrances)	----	1889?--1892? (possibly until c. 1901 or later)	Limited (?): domestic, possibly railroads	Moderate	Severe (erosion)
C/FF-4-23	6	----	1 (possible prospecting site)	c. 1920?	No known production	Negligible	Slight
C/TH-3-5	1	2 or more	----	1889? - 1892?	Domestic, possibly other	Undetermined	Slight

Table 11. Summary of site descriptions--Coleman County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
C/TH-3-6	25	----	1 (possible prospecting site)	Opened, abandoned several years before 1938	No known production	Severe (impoundment)	Severe (erosion, sedimentation)
Summary: 5 sites	56	7? or more (7 or more entrances)	3 (possible prospecting sites)	1889? - c. 1920	Domestic, railroads	Negligible to severe	Slight to severe

Table 12. Summary of environmental effects in COLEMAN County.

Site Number	C - Confirmed U - Unconfirmed	Acres	Effects on Vegetation	Erosion	Runoff/Deposition			Subsidence	Refuse	Structural Equipment Remains
					Receiving Stream	Impound-ment	Downslope			
C/FF-4-14	C	14	X	X	X		X	X	X	X
C/FF-4-15	C	10	X	X	X		X	X	X	
C/FF-4-23	U	6	X	X			X	X	X	
C/TH-3-5	C	1		X	X	X		X	X	
C/TH-3-6	U	25	X	X	X	X	X		X	
TOTALS: 5 sites	3 C 2 U	50	4	5	4	2	4	4	5	1

Home Creek, mapped but not described by Drake (1893). An extensive review of historical literature and aerial photographs, combined with ground and air observations, have lead to the conclusion that (1) the Vining Mines were located at the site of either the Gibson or Star and Crescent Mines (sites number C/FF-4-15 and -14), or in their vicinity; and (2) the two mines, near Bull Creek and Home Creek, which were depicted by Drake (1893) were prospecting sites (probably drilling sites) of unknown location.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

COLEMAN County

Size: 14 acres.

Site Number: C/FF-4-14 (Star and Crescent Mines, possibly Vining Mines, as well; see description of site C/FF-4-15 and "Remarks," below).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/19/38	578	4, 9	1:20,000
Most Recent -	2/20/75	475:63	18, 19, 23	1:40,000

Status:

Confirmed Mine - Yes. Three adjacent slope mines (fig. 18).

Unconfirmed Mine - Open pit "mine" (possible prospecting pit, excavated before 1938) adjacent to slope mines.

Method of Verification: Historical records (published, unpublished); local contact; ground, air inspection; photointerpretation.

Local Contact: Joe Williams, Sr.--San Saba, Texas.

Accessibility: Limited. Private land. Site is approximately 3.2 km (2 mi) southwest of Rockwood.

Mining Method: Underground mines--slope mine entrances with vertical air shafts; long-wall advancing extraction. Surface mine (possible)--open pit mine or prospecting pit.

Conditions

Vegetation: Sparsely revegetated. Woody xerophytes (honey mesquite, beebrush, Spanish dagger, others) and herbaceous groundcover (little grass) around mines A and D; blackjack oaks and cedar elms around entrances to mines B (sparse revegetation) and C (moderate revegetation). Shale dumps barren.

Erosion: Moderate sheetwash erosion and gullying, most active on unvegetated shale dumps. Gullies have developed in linear subsidence areas over collapsed tunnels, as well.

Runoff/Deposition:

Receiving stream - Little Bull Creek (intermittent). Direct sediment input from site, causing channel aggradation. Minor channel deflection around shale dump at mine C, Fig. 18. Leachate flushed into stream from shale dumps.

Impoundment - None present.

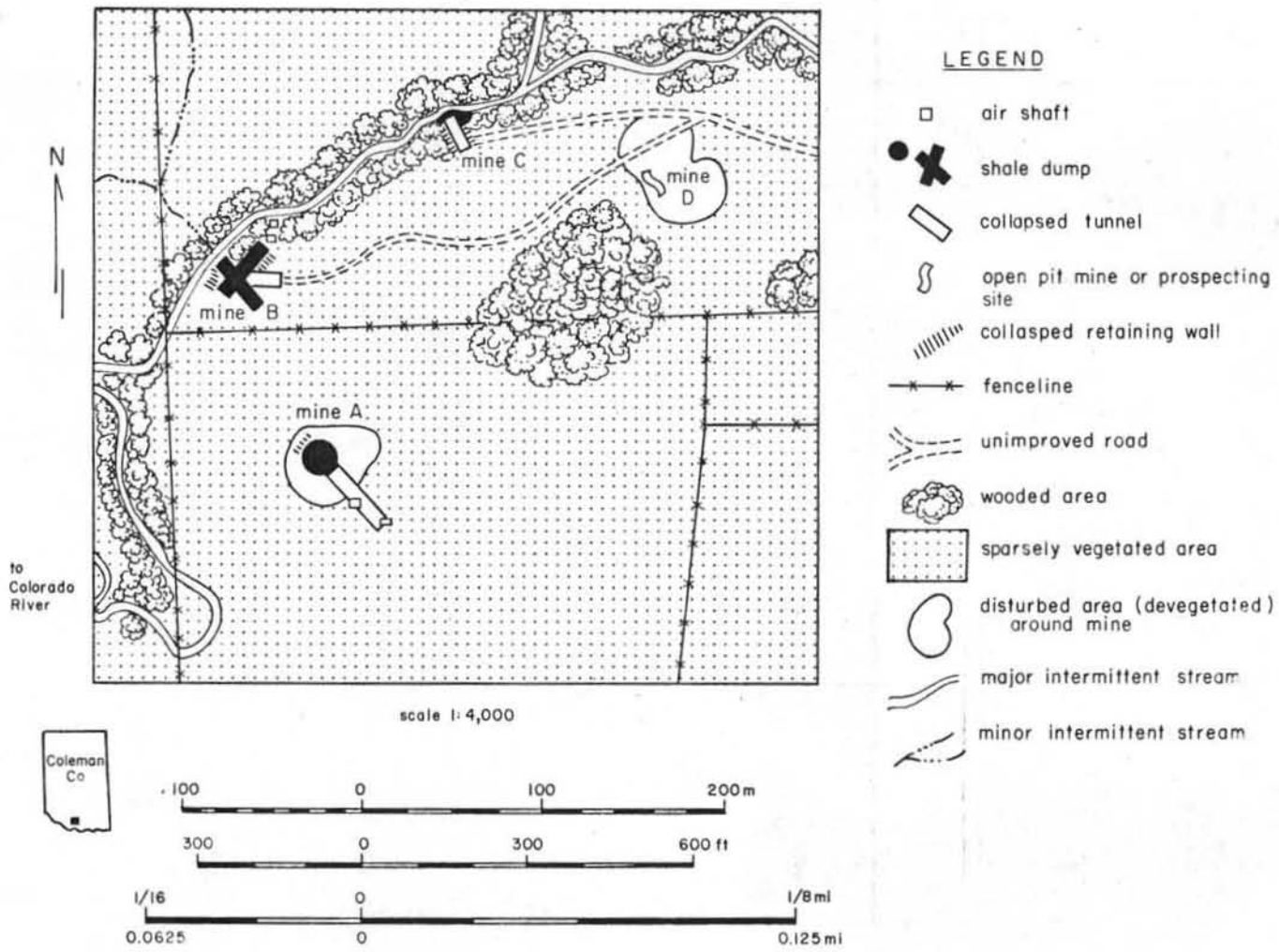


Figure 18. Location of Star and Crescent Mines at site number C/FF-4-14. Map redrawn from a pace and compass field sketch, using 1:20,000-scale aerial photographs.

Downslope - Slopewash deposits; acid runoff-affected, gullied surfaces lacking vegetation around shale dumps. Leachate infiltration to water table possible.

Subsidence: Collapsed mine entrances; collapsed and partly collapsed air shafts; linear subsidence areas over former (collapsed) tunnels. Maximum vertical displacement of approximately 1 m (3 ft) over 37 m (120 ft) long, 3 m (10 ft) wide collapsed tunnel.

Refuse: Shale dumps (maximum 27 m, 90 ft diameter; 3.5 m, 12 ft height); structural debris (collapsed, unmortared masonry structures, see below).

Structural/Equipment Remains: Partly collapsed loading ramps and retaining walls. Loading ramps originally equipped with wooden-railed track for mine cars.

Hazard Potential: Partly open air shafts (to 2 x 1.3 m, 7 x 4 ft; 3 m, 10 ft deep); source of possible water pollutants (sediment, sulfuric acid, other sulfur compounds), primarily derived from leachate, erosion of shale dumps.

Surrounding Land Use: Formerly, grazing (unimproved rangeland), cultivation, and livestock water storage. Presently, area leased for strip mining and coal processing (stripping began in area during summer, 1979).

Remarks: See attached page.

Site Number C/FF-4-14 (cont.)

Remarks: Mines were opened before 1893 (Drake, 1893, p. 434), probably in 1892 (1892 Deed Records of Coleman County). Cummins (1890, p. 152) and Tarr (1890, p. 214) implied that mines were not open at the time of their visits, in 1889. The mines may have been operated on a limited basis until about 1920 (Box, personal communication, 1979), possibly as the Vining Mines from 1895 until at least 1901 (Griggs and Minor, 1977, site number 58359; Taff, 1902, p. 407). Site location is incorrectly given as "1¼ miles south of Rockwood" by Evans (1974, p. 51) who cited Drake (1893, p. 434). Drake actually gave the location as "one and a quarter miles southwest of Rockwood." The mines are approximately 3 km (2 mi) southwest of the present Rockwood townsite. At the time of Drake's visit to the mines, presumably in September, 1892, the Star and Crescent mines were the only coal mines "being operated" in the area (p. 434). The tunnel (main entry) of one of the mines was then "forty to fifty feet long." Total thickness of the two exploited, overlying coal seams (parted by 7.6 cm or 3 inch-thick shale bed) was 62 cm (24.5 in) (p. 434). One air shaft at mine B has recently been reexcavated and subsequently filled using earth-moving equipment. Prospecting samples were collected while excavation was open, probably in 1976 (Williams, personal communication, 1979). Mine name erroneously recorded as "Starr and Crescent" by Griggs and Minor (1977, site number 58366). The mines may have been operated as the Vining Coal Mines, as well (see also description of site number C/FF-4-15). The Vining mine had a shaft entrance 29.5 m (97 ft) deep and longwall advancing extraction was practiced (Taff, 1902, p. 409).

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

COLEMAN County

Size: 10 acres

Site Number: C/FF-4-15 (Gibson Mine, possibly Vining Mine, as well; see description of site C/FF-4-14 and "Remarks," below.)

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/19/38	579	2, 7	1:20,000
Most Recent -	2/20/75	475:63	19, 24	1:40,000

Status:

Confirmed Mine - Yes. Possibly two or more entrances.

Unconfirmed Mine -

Method of Verification: Historic records (published); local contact; ground, air inspection; photointerpretation.

Local Contact: Joe Williams, Sr.--San Saba, Texas.

Accessibility: Limited. Private land.

Mining Method: Cummins (1891, p. 549) indicates that mine had a shaft entrance, but a combination of slope and shaft entrances may have been used. Longwall advancing extraction method probably utilized.

Conditions

Vegetation: Barren to slightly revegetated--low herbaceous ground cover, little grass, few honey mesquite on adjacent moderate slopes. Shale dumps barren.

Erosion: Severe-gullying, sheetwash, mass wasting of steep adjacent slope-margin. Prospecting at site, since 1975, produced small, steep-walled, open pit at presumed shaft entrance. Depression left at reexcavation point traps part of the sediment eroded from steep adjacent slope.

Runoff/Deposition:

Receiving stream - Little Bull Creek (intermittent). Runoff and sediment transported to stream from slopes via gullies which integrate downslope with anastomosing channels. Direct input of sediment into stream, causing channel aggradation, with rapid local build-up evident. Leachate probably flushed into stream from shale dumps.

Impoundment - None present.

Downslope - Sheetwash deposits; gullied and possibly acid runoff-affected surface lacking vegetation below mine site. Leachate may enter water table.

Subsidence: Collapsed entrance, partly reexcavated since 1975 for prospecting purposes. Open, collapsed, and partly collapsed air shafts.

Refuse: Small shale and coal dumps, including those left by recent reexcavation.

Structural/Equipment Remains: None evident.

Hazard Potential: Open (recent) excavation (2.4 x 4.5 m, 3 m deep; 8 x 15 ft, 10 ft deep); source of possible water pollutants (sediment, sulfur compounds), primarily derived from leachate and erosion from shale dumps.

Surrounding Land Use: Formerly, grazing (unimproved rangeland) and water storage for livestock. Presently, area leased for strip mining and coal processing (stripping began in area during summer, 1979).

Remarks:

See attached page.

Site Number C/FF-4-15 (cont.)

Remarks: Mine was open at the time of Cummins' investigation, in 1889 (Cummins, 1890, p. 152), and apparently had been excavated since Tarr's visit, also in 1889 (Tarr, 1890, p. 214). Drake (1893, p. 434) implied that mine was closed during his study, probably in 1892. Location of mine given as "about one mile east of the road crossing on Bull Creek (Cummins, 1891, p. 549)," which is approximately correct. (Road crossing probably referred to has been essentially abandoned since 1913 and is located approximately 0.6 km (0.4 mi) northwest of FM Rd 2635 bridge over Bull Creek.) The shaft was 14.6 m (48 ft) deep during Cummins' visit. Two coal seams, separated by a 5 cm (2 in) thick shale parting, and having a combined thickness of 86 cm (34 in), were being worked at the time (p. 549). Little historic or on-site evidence to suggest prolonged or extensive production. The mine may have been reopened in, or operated on a limited basis until 1895 when it may have become the Vining Mine (Griggs and Minor, 1977, site number 58359; Taff, 1902, p. 407). See also description of site MC/FF-4-14. The Vining Mine operated until at least 1901; the shaft entrance was 29.5 m (97 ft) deep and longwall advancing extraction was employed (Taff, 1902, pp 407-409).

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

COLEMAN County

Size: 6 acres

Site Number: C/FF-4-23 (possible prospecting site, unnamed).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/19/38	578	17, 18	1:20,000
Most Recent -	2/20/75	475:63	27, 28	1:40,000

Status:

Confirmed Mine -

Unconfirmed Mine - Yes. Possible prospecting site.

Method of Verification: Local contact; ground, air inspection; photointerpretation. See "Remarks."

Local Contact: Linnie Box--Rockwood, Texas.

Accessibility: Direct. County road right-of-way and private land. Site is approximately 4 km (2.5 mi) west-southwest of Rockwood.

Mining Method: Surface excavation along contour, possibly shallow shafts or drifts (now obscured, if ever present). No evidence of coal extraction in marketable quantities.

Conditions

Vegetation: Barren to sparsely revegetated. Xerophytic woody shrubs (primarily small honey mesquite) and sparse herbaceous groundcover over part of the site.

Erosion: Moderate. Barren slope is deeply gullied but gullies do not integrate with defined tributary channels evident in aerial photographs. Minor sheetwash erosion at the base of presumably excavated slopes.

Runoff/Deposition:

Receiving stream - Drainage from site enters brush-covered flat lacking defined channel system. No transport to integrated channel evident.

Impoundment - None present.

Downslope - Minor sheetwash deposits. Runoff and sediment transported via shallow gullies onto brushy flat below site.

Subsidence: Shallow shafts or drifts, if ever excavated, have collapsed or been filled-in completely. Some mass wasting of slope margin between gullies.

Refuse: Small amount of domestic refuse present.

Structural/Equipment Remains: None evident.

Hazard Potential: Negligible. Primary hazard at site is presented by domestic refuse.

Surrounding Land Use: Grazing (unimproved rangeland). Possible excavation of fill material at site for road metal or other use.

Remarks:

See attached page.

Site Number C/FF-4-23

Remarks: Local residents, particularly Box (personal communication, 1979), described a coal mine the location of which was vaguely recalled by Box to be this site. Aerial photographs (1938) revealed some surface disturbance and a possible shallow excavation west of a now abandoned, curved road segment at this location. The present paved road passes approximately 48 m (150 ft) east of the bend. Careful inspection along the abandoned road and in the vicinity during the present study indicated no definitive evidence of coal mining activity, although shallow excavations were present. A thin bed of carbonaceous shale containing ferruginous concretions crops out at this site, and it may have encouraged some prospecting. Williams (personal communication, 1979), who had also been told of the mine, conducted exploratory drilling at the site, finding coal but at 27 m (90 ft) depth. There is no evidence to suggest historic mining at that depth at site number C/FF-4-23; this conviction was shared by Williams who has prospected at all of the mines in the area.

The description of a mine by Box closely matches that of mine B in the Star and Crescent Mines area (site number C/FF-4-14). In addition, Box's account of recent (since 1975) exploration for coal at the abandoned mine by Williams corresponds to Williams' description of his prospecting efforts at mine B. These circumstances suggest that the mine recalled by Box was not located at site number C/FF-4-23, but was instead one of the Star and Crescent Mines. However, site number C/FF-4-23 may have been the scene of some shallow prospecting before 1938, although apparent excavations could be related to the removal of fill material.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

COLEMAN County

Size: 1 acre

Site Number: C/TH-3-5 (probably Silver Moon Mine)

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/19/38	956	18	1:20,000
Most Recent -	11/20/74	275:45	28, 29	1:40,000

Status:

Confirmed Mine - Yes. At least two shafts may have been sunk at and near mine site.

Unconfirmed Mine -

Method of Verification: Historic records (published, unpublished); local contact; ground, air inspection; photointerpretation.

Local Contact: Mrs. S.D. Wilson -- Santa Anna, Texas (rural area).

Accessibility: Limited. Private land. Site is approximately 15 km (9.5 mi) northeast of Santa Anna (see "Remarks," below).

Mining Method: Shaft entrance. No air shafts found. Longwall advancing extraction method probably practiced.

Conditions

Vegetation: Near complete revegetation (blackjack oaks and grasses) except on small shale dumps and in areas currently mined for clay or recently reexcavated (presumably for coal prospecting purposes); see "Remarks," below.

Erosion: Slight. Surface essentially stabilized except where collapsed mine entrance has been recently reexcavated (see "Remarks," below). Excavation left partly open, trapping some sediment eroded from shale dump and excavation walls.

Runoff/Deposition:

Receiving stream - Runoff from mine site impounded in adjacent clay pits. Effects on receiving stream of runoff leaving clay pits reflect the condition of these pits to a greater degree than that of the coal mine.

Impoundment - None present.

Downslope - Runoff transported immediately into clay pits. Effects further downslope indistinguishable from those of clay mining.

Subsidence: Collapsed mine entrance (shaft), possible slight subsidence over mined-out area.

Refuse: Small shale dump and coal "slack" pile. Additional coal added to pile
" by recent reexcavation of collapsed entrance, presumably for prospecting purposes.

Structural/Equipment Remains: None evident.

Hazard Potential: Hazard negligible compared to that presented by adjacent clay pits.

Surrounding Land Use: Clay mining (open-pit, no reclamation) and grazing (unimproved rangeland).

Remarks:

See attached page.

Remarks: Mine had "just opened" when Tarr (1890, p. 214) visited it, in 1889. The mine was not mentioned by Cummins (1890; 1891), and Drake (1893), who provided a brief description (pp 430-433), suggested that the Silver Moon Mine was not in operation at the time of his visit, probably in 1892 (p 434). Location of site incorrectly given as "about 1 mile northwest of Santa Anna" by Evans (1974, p 51 and Plate I) who cited Tarr (1890, p 210). Tarr actually stated that the mine was about 16 km (10 mi) from Santa Anna, near the Brown County line, on Jim Ned Creek (pp213, 214), which indicates a point northeast of Santa Anna. This description of the mine location is supported in part by Phillips and Worrell (1911, p 33; 1913, p 24) although at one place in the text of their 1913 work (p 24), the location was given as "northwest of Santa Anna" because of a typographical error. Unpublished Deed Records of Coleman County, 1889 confirmed both the general location and the date when mining began that were given by Tarr, and the location is in approximate agreement with that of the mine described here. The depth of the shaft at the Silver Moon Mine was almost 27 m (87 ft), and two or three coal seams with a maximum combined thickness of 56 cm (22 in) were worked. One or two tons of coal were produced each working day and hauled to Coleman or Santa Anna (Cummins, 1892, pp 210, 214). The collapsed mine entrance was partly reexcavated, presumably for prospecting purposes, before and during summer, 1979.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

COLEMAN County

Size: 25 acres

Site Number: C/TH-3-6 (possible prospecting site, unnamed).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/19/38	958	32	1:20,000
Most Recent -	11/20/74	275:45	35	1:40,000

Status:

Confirmed Mine -

Unconfirmed Mine - Yes. Possible prospecting site.

Method of Verification: Ground, air inspection; photointerpretation.

Local Contact:

Accessibility: Direct. County road right-of-way and private land. Site is approximately 13.3 km (8.25 mi) northeast of Santa Anna.

Mining Method: Open pit surface mining, probably for commercial removal of clay. Possible coal prespecting, as well, although direct evidence has apparently been obscured. No evidence of coal extraction in marketable quantities.

Conditions

Vegetation: Partial (discontinuous) revegetation--gentle and level slopes, particularly near impoundment, are densely vegetated (grasses, herbs); steeper slopes essentially barren.

Erosion: Severe gullying and sheetwash erosion on steeper, barren slopes. Gullying lessened by presence of conservation impoundment on slope, as shown by comparison of 1938 (pre-impoundment) and 1975 aerial photographs. Below impoundment and on unprotected slopes, however, gullying remains severe.

Runoff/Deposition:

Receiving stream - Little Mud Creek (intermittent). Anastomosing gullies integrate with creek 180 to 550 m (600 to 1200 ft) below excavation. Effects on creek undetermined.

Impoundment - Conservation impoundment checks runoff from upper slopes, receiving a heavy influx of sediment which has filled much of the pond, reducing storage capacity and increasing risk of earthen dam failure.

Downslope - "Apron" of sheetwash deposits at slope break below impoundment and unprotected slopes. Extensive gullying (see above), extending to Little Mud Creek.

Subsidence: None evident.

Refuse: Large spoil mounds, probably related to clay mining but may be associated with coal prospecting; several large, weathered timbers.

Structural/Equipment Remains: None evident (timbers do not appear to have been part of a structure).

Hazard Potential: Possible water pollution hazard related to influx of sediment and other potential pollutants. Reduced impoundment capacity resulting from in-filling increases risk of earthen dam erosion, threatening ranch structures and county road.

Surrounding Land Use: Grazing (unimproved rangeland); water storage (possibly for livestock); active clay mining (open pit, no reclamation) 1.6 km (1 mi) north of site.

Remarks:

See attached page.

Site Number C/TH-3-6 (cont.)

Remarks: No known history of coal mining or prospecting at site. Extensive surface disturbance undoubtedly related to production of a bulk material, probably clay or perhaps fill or road base material. Limited coal production or prospecting could have occurred, however, although no direct, confirmatory evidence could be found. Strata exposed at site are, apparently, in proximity to presumed stratigraphic position of major coal seams in the Harpersville Formation. In addition, a carbonaceous shale containing ferruginous nodules and resembling coal crops out at the site, and may have been prospected. The excavation (but not the impoundment) is depicted in 1938 aerial photographs covering the area, and has the appearance of long abandonment. Such an age is consistent with the history of coal mining in the area, although clay pits located 1.6 km (1 mi) north of the site were also noted in the 1938 photos, and appear to have been in operation. Thus, while tha most likely explanation for the disturbance at site C/TH-3-6 is that clay was mined there prior to 1938, some coal could have been found and even extracted. Site number C/TH-3-5, located approximately 2 km (1.25 mi) north-northeast, experienced a comparable history of development, with early coal mining activities being succeeded by clay mining (which has continued to the present at site C/TH-3-5). Identification of site C/TH-3-6 as a possible coal mining or prospecting site is, however, largely speculative.

Eastland County

Nine mine sites (confirmed and probable) of a total of twelve sites in the county are within the Cisco North 7.5-minute quadrangle (fig. 19). These sites are all slightly north of the Cisco community and appear to have been worked by local citizens to provide a small supply of coal for domestic use. The mines were small (table 13) and did not have a significant impact on the economy of the county. The identification of abandoned mines using aerial photography was hampered by similarities between mines and active and abandoned oil well sites. The difficulty in detecting very small mine sites in view of these similarities resulted in greater emphasis on field work than was originally anticipated.

The outcrop of the Harpersville Formation extends from the northwest part of the county to a point approximately 17 km (10 mi) south of Cisco (fig. 19). Land cover across the outcrop area includes dry cropland, rangeland, and a small area of forest land. The coal-bearing Harpersville Formation crops out over 37,000 acres of the county's total area of 570,309 acres (table 6). Soils are moderately deep with loamy surface layers and clayey subsoils (Godfrey, McKee, and Oakes, 1973). The outcrop area is hilly with woody vegetation while other parts of the county are somewhat flat wth mixed grass types. Environmental effects of coal mining in the county are summarized in Table 14.

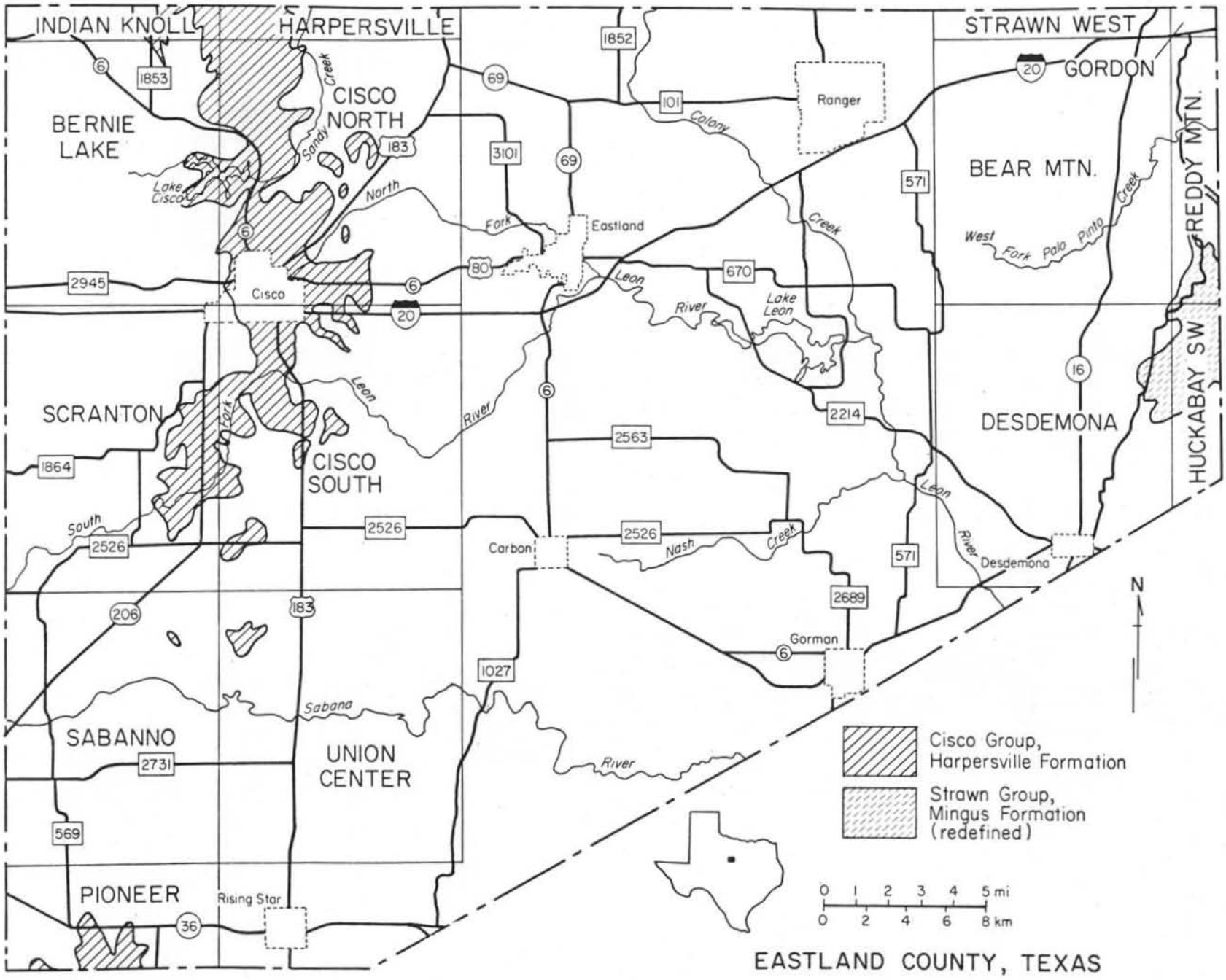


Figure 19. Map of Eastland County, Texas, illustrating the outcrop areas of the coal-bearing Harpersville and Mingus Formations, and selected cultural and surface drainage features.

Table 13. Summary of site descriptions-- Eastland County

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
Ea/CN-2-3	5	1	----	Unknown	Domestic and industrial	Severe (Stocktank)	Severe
Ea/CN-2-5	5	----	1	Unknown	Unknown	Moderate	Moderate
Ea/BL-4-2	Less than ¼ acre	1 (Air shaft)	----	Unknown	Unknown	Negligible	Negligible
Ea/BL-1-3	3	1	----	Unknown	Texas Central Railroad	Negligible	Moderate

Table 13. Summary of site descriptions-- Eastland County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
Ea/BL-1-1	5	1	----	Opened 1900-1901 closed 1904	Domestic	Negligible	Slight
Ea/CN-2-4	Less than 1 acre	1	----	Unknown	Domestic	Negligible	Slight
Ea/CN-2-2	1 acre	1	----	Unknown	Domestic	Negligible	Nebligible
Ea/CN-2-9	1 acre	1	----	Unknown	Domestic	Negligible	Negligible

Table 13. Summary of site descriptions--Eastland County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
Ea/CN-2-1	1 acre	----	1	Unknown	Domestic	Negligible	Negligible
Ea/CN-2-8	1 acre	----	1	Unknown	Domestic	Negligible	Negligible
Ea/CN-2-7	1 acre	----	1	Unknown	Domestic	Negligible	Negligible
Ea/CN-2-6	1 acre	----	1	Unknown	Domestic	Negligible	Negligible

Table 13. Summary of site descriptions--Eastland County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
County Summary: 12 sites	24.5	7	5	Unknown	Domestic	Negligible	Negligible

Table 14. Summary of environmental effects in EASTLAND County.

Site Number	C - Confirmed U - Unconfirmed	Acres	Effects on Vegetation	Erosion	Runoff/Deposition			Subsidence	Refuse	Structural Equipment Remains
					Receiving Stream	Impound-ment	Downslope			
Ea/BL-1-1	C	5						X	X	X
Ea/BL-4-2	C	7¼						X	X	X
Ea/BL-1-3	C	3		X				X	X	X
Ea/CN-2-3	C	5	X	X		X	X		X	
Ea/CN-2-5	U	5	X	X			X	X	X	
TOTALS: 5 sites	4 C 1 U	18	2	3	0	1	2	4	5	3

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

EASTLAND County

Size: 5 acres.

Site Number: Ea/BL-1-1

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	12/22/47	72	7	1:20,000
Most Recent -	3/4/73	173-26	14	1:40,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Photointerpretation, local contact, on-site observation.

Local Contact: Mrs. James Lee - Cisco, Texas.

Accessibility: Limited access.

Mining Method: Shaft mine.

Conditions

Vegetation: Complete revegetation (grass, shrubs, trees, vines).

Erosion: Stabilized.

Runoff/Deposition:

Receiving stream - Not affected.

Impoundment - None present.

Downslope - Not affected.

Subsidence: Several depressions including a recently collapsed feature (see remarks).

Refuse: Mine spoil deposits and rock debris.

Structural/Equipment Remains: Loading platform and an abandoned railroad grade.

Hazard Potential: Remote--no settlement within one mile; no ready access.

Surrounding Land Use: Rangeland (moderately good condition).

Remarks: The collapsed feature was approximately 1.5 m.(5 ft) deep, had the same interior diameter (1.5 meters) and had a surface opening of 0.5 m (2 ft) in diameter. Similar features were known to be in the area but were not found due to the lush vegetative ground cover. It appears that the railroad used this mine as a source of coal. The site is inundated each time Lake Cisco exceeds normal pool level.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

EASTLAND County

Size: < ¼ acre (hazardous feature).

Site Number: Ea/BL-4-2

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	12/22/47	71	22/23	1:20,000
Most Recent -	3/4/73	173-26	17	1:40,000

Status:

Confirmed Mine - Confirmed mine feature.

Unconfirmed Mine -

Method of Verification: Photointerpretation, on-site examination.

Local Contact: Mrs. James Lee - Cisco, Texas.

Accessibility: Limited access.

Mining Method: Shaft.

Conditions

Vegetation: Good cover.

Erosion: None.

Runoff/Deposition:

Receiving stream - None.

Impoundment - None.

Downslope - None.

Subsidence: Very deep, square shaft, approximately 10 m (30 ft) deep. No protective barrier, very dangerous to livestock.

Refuse: Slight excavation debris around opening.

Structural/Equipment Remains: Adjacent abandoned railroad grade.

Hazard Potential: Remote--no settlement within one mile; difficult access.

Surrounding Land Use: Rangeland (moderately good condition).

Remarks: The mine associated with this air shaft was not found.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

EASTLAND County

Size: 3 acres (see remarks).

Site Number: Ea/BL-1-3

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	12/22/47	71	8	1:20,000
Most Recent -	3/4/73	173-60	41	1:40,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Photointerpretation and low level fly-over.

Local Contact: None available.

Accessibility: Limited.

Mining Method: Shaft mine.

Conditions

Vegetation: Moderate cover (grass and woody vegetation).

Erosion: Slight sheetwash.

Runoff/Deposition:

Receiving stream - None.

Impoundment - None.

Downslope - None.

Subsidence: Depression, possible collapsed mine entrance (under low tree canopy).

Refuse: Mine spoil deposits.

Structural/Equipment Remains: Adjacent abandoned railroad grade (common to sites Ea/BL-4-2 and Ea/BL-1-1).

Hazard Potential: Remote--no settlement within one mile; limited access.

Surrounding Land Use: Rangeland (moderately good) and nearby municipal lake.

Remarks: Although only 3 acres in size, the mine site may be dangerous to individuals who visit the area (easy access by boat) when Lake Cisco exceeds normal pool level. Depressions of unknown depths, a possible mine opening and other hazardous features are a risk to individuals stopping for recreational purposes.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

EASTLAND County

Size: 5 acres.

Site Number: Ea/CN-2-3

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	12/22/47	103	8	1:20,000
Most Recent -	3/4/73	173-60	30	1:40,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Photointerpretation, on-site observation.

Local Contact: Carl Kleiner - Cisco, Texas.

Accessibility: Good.

Mining Method: Surface mine (supposedly once used by community residents).

Conditions

Vegetation: Sparsely vegetated (grass) with good fringe vegetation (grass, trees, and shrubs). Several barren areas of exposed, bedded coal.

Erosion: Moderate to severe sheetwash and gullying (very active erosion).

Runoff/Deposition:

Receiving stream - Not affected (considerable distance from the site).

Impoundment - Two impoundments (see remarks).

Downslope - Deep and narrow drainage channel, no downslope deposition.

Subsidence: Undetectable due to recent man-made changes to the area.

Refuse: Small mine spoil deposits and much loose shale and coal debris scattered throughout the site.

Structural/Equipment Remains: None.

Hazard Potential: Settlement within one mile; ready access.

Surrounding Land Use: Rangeland (appears to be overgrazed).

Remarks: See attached page.

All runoff within the mine site immediately enters a small centrally located earthen tank lying within a depression. Runoff, containing leachate from a bank of exposed coal and carbonaceous shale causes "Yellow boy" (Iron Hydroxide) to form at the water and land interface. The impoundment appears to have been placed directly over the mine entrance and possibly other features as well.

An adjacent area exhibits severe erosion and may have also been mined. This is difficult to verify due to the construction of a large earthen tank after 1973. Additionally, the dam is currently breached. Runoff from this location is moved downslope within a deep and narrow channel to a distant stream. No apparent deposition has occurred downslope.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

EASTLAND County

Size: 5 acres.

Site Number: Ea/CN-2-5

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	12/22/47	102	12	1:20,000
Most Recent -	3/4/73	173-60	32	1:40,000

Status:

Confirmed Mine -

Unconfirmed Mine - Probable mine.

Method of Verification: Photointerpretation.

Local Contact: None available.

Accessibility: No visible access route.

Mining Method: Possible slope or shaft mine.

Conditions

Vegetation: Sparsely vegetated (grass and woody vegetation).

Erosion: Severe gullying, sheetwash erosion and scarp retreat.

Runoff/Deposition:

Receiving stream - None.

Impoundment - None.

Downslope - Runoff drains into Lake Cisco by way of a small ravine.

Subsidence: Possible mining related depressions and disturbed areas (from photo interpretation).

Refuse: Possible mining related waste deposits (from photo interpretation).

Structural/Equipment Remains: Undetected.

Hazard Potential: Remote--no settlement within one mile; difficult access.

Surrounding Land Use: Rangeland (appears overgrazed).

Remarks: Significant sediment deposition at confluence of lake and ravine.

Table 15 . Confirmed (C) and Probable(P) mines less than five acres - Eastland County.

Site Id	Size (acres)	Status	Mine Type	Photo Date	Number	Grid
Ea/CN-2-2	1	C	shaft	12/22/47 3/4/73	103 173-60	12/13 29
Ea/CN-2-9	1	C	shaft	12/22/47 3/4/73	103 173-60	7 29
Ea/CN-2-1	1	P	Unknown	12/22/47 3/4/73	103 173-60	6 28
Ea/CN-2-8	1	P	Unknown	12/21/47 3/4/73	135 173-60	28 24
Ea/CN-2-7	1	P	Unknown	12/21/47 3/4/73	135 173-60	28 24
Ea/CN-2-6	1	P	Unknown	12/21/47 3/4/73	135 173-60	26 23
Ea/CN-2-4	<1	C	slope	12/22/47 3/4/73	103 173-60	3 30

Thurber Mines Area (Erath and Palo Pinto Counties)

The Thurber Mines are located within a 26 km^2 (10 mi^2) area including parts of northwestern Erath (fig. 20) and southwestern Palo Pinto Counties (fig. 24). This area has the largest concentration of large, abandoned bituminous coal mines in the state (16 mine sites), all of which (except the Newcastle Mine) were operated by the Texas and Pacific Coal Company (table 16). The depth of the mines ranges from 32 m (106 ft.) to 95 m. (310 ft.). Mining and coal extraction techniques utilized at these mines were identical.

The Thurber Mines were developed in thin coal seams of the Mingus Formation at a point approximately 21 km (13 mi) northeast of the southern end of the Mingus outcrop area in Eastland County. The Mingus Formation crops out over an area of approximately 50,000 acres in Erath County (table 6). The hilly terrain of the Thurber area is primarily used as rangeland. The soil is moderately deep to deep with loamy surface layers and clayey subsoils (Godfrey, McKee and Oakes, 1973). Environmental effects of coal mining in the county are summarized in Table 17.

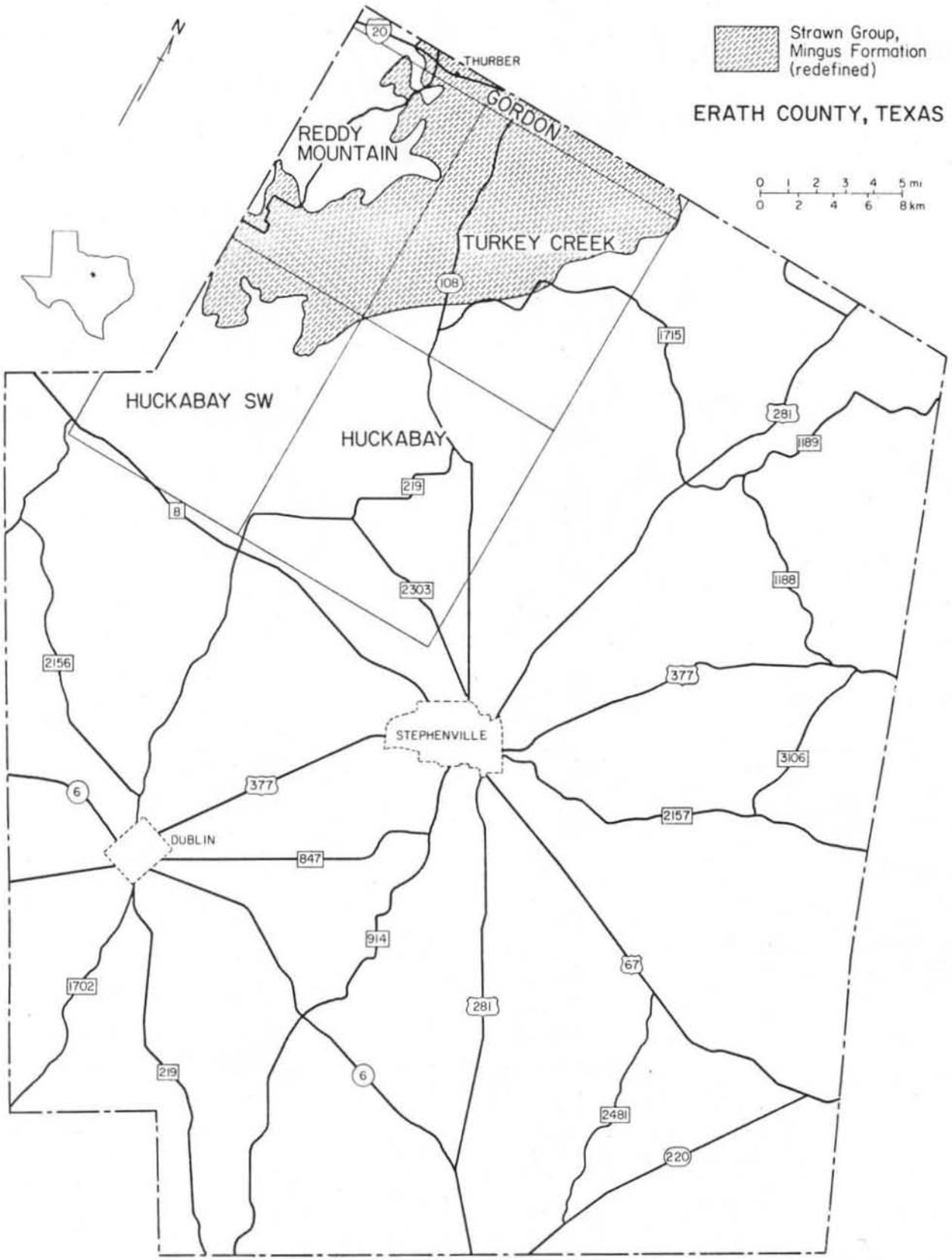


Figure 20. Map of Erath County, Texas, illustrating the outcrop area of the coal-bearing Mingus Formation, and selected cultural and surface drainage features.

Table 16. Summary of site descriptions--Thurber Mines Area--
Erath and Palo Pinto Counties

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
Er/G-2-59 Old Shaft number 1	8	1	----	Open 1886 Closed before 1924	Texas and Pacific Railroad	Negligible	Slight
Er/RM-3-12 New Shaft number 1	6	1	----	Unknown	Texas and Pacific Railroad	Negligible	Moderate
Er/G-2-57 Shaft number 2	4	1	----	Opened 1889 Closed 1902	Texas and Pacific Railroad	Negligible	Moderate
Er/G-2-60 Old Shaft number 3	4	1	----	Unknown	Texas and Pacific Railroad	Negligible	Moderate

Table 16. Summary of site descriptions-- Thurber Mines Area--
Erath and Palo Pinto Counties (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
Er/G-2-56 New Shaft number 3	2	1	----	Opened 1889 Closed before 1902	Texas and Pacific Railroad	Negligible	Moderate
Er/G-2-58 Shaft number 4	2	1	----	Opened 1891 Closed before 1902	Texas and Pacific Railroad	Negligible	Slight
Er/G-2-62 Old Shaft number 5	4	1	----	Unknown	Texas and Pacific Railroad	Negligible	Moderate
Er/G-2-55 New Shaft number 5	5	1	----	Opened 1891. Closed before 1902	Texas and Pacific Railroad	Severe (Intermittent creek)	Severe

Table 16. Summary of site descriptions--Thurber Mines Area--
Erath and Palo Pinto Counties (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
Er/G-2-61 Shaft number 6	4	1	----	Opened 1891 Closed before 1902	Texas and Pacific Railroad	Moderate (small impoundment)	Moderate
PP/G-2-52 Shaft number 7	8	1	----	Opened after 1891 Closed before 1910	Texas and Pacific Railroad	Negligible	Severe
PP/G-2-53 Shaft number 8	12	1	----	Opened between 1891--1902 Closed 1914	Texas and Pacific Railroad	Negligible	Severe
Er/G-2-63 Shaft number 9	10	1	----	Opened between 1891--1902 Closed before 1933	Texas and Pacific Railroad	Negligible	Severe

Table 16. Summary of site descriptions-- Thurber Mines Area-- Erath and Palo Pinto Counties (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
PP/G-2-51 Shaft number 10	13	1	----	Opened between 1891--1902 Closed before 1933	Texas and Pacific Railroad	Negligible	Severe
PP/G-2-54 Shaft number 11	8	1	----	Opened between 1902--1910 Closed between 1914--1919	Texas and Pacific Railroad	Negligible	Severe
Er/RM-3-11 Shaft number 12	8	1	----	Unknown	Texas and Pacific Railroad	Nebligible	Severe
Er/RM-4-13 Newcastle Mine	2	1	----	Unknown	Unknown	Negligible	Slight

Table 16. Summary of site descriptions--Thurber Mines Area--
Erath and Palo Pinto Counties (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
Summary (Includes Newcastle mine): 16 sites	100	16	0	From 1886 to about 1933	Texas and Pacific Railroad	Negligible	Severe

Table 17 . Summary of environmental effects in Erath County. Portion of Thurber Mines Area.

Site Number	C - Confirmed U - Unconfirmed	Acres	Effects on Vegetation	Erosion	Runoff/Deposition			Subsidence	Refuse	Structural Equipment Remains
					Receiving Stream	Impound-ment	Downslope			
Er/RM-3-12	C	6	X	X			X		X	
Er/RM-3-11	C	8	X	X			X		X	
Er/G-2-63	C	10	X	X			X		X	
Er/G-2-61	C	4	X	X		X			X	X
Er/G-2-62	C	4	X	X					X	
Er/G-2-55	C	5	X	X	X		X		X	
Er/G-2-60	C	4	X	X					X	
Er/G-2-56	C	2	X	X					X	X

(continued)

Table 17. Summary of environmental effects in Erath County. Portion of Thurber Mines Area.

Site Number	C - Confirmed U - Unconfirmed	Acres	Effects on Vegetation	Erosion	Runoff/Deposition			Subsidence	Refuse	Structural Equipment Remains
					Receiving Stream	Impound-ment	Downslope			
Er/G-2-57	C	4	X	X					X	
Er/G-2-58	C	2	X						X	
Er/RM-4-13	C	2	X	X					X	
Er/G-2-59	C	8							X	
Totals: 12 sites	12 C	59	11	11	1	1	4	0	12	2

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

Erath and Palo Pinto Counties

Thurber Mines Area

Size: See Table 18.

Site Number: See Table 18.

Aerial Photography: Date Index # Grid # Scale

Historical -

Most Recent - See Table 18.

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: See attached page.

Local Contact: P.D. (Pink) Wylie.

Accessibility: Direct route to each mine site.

Mining Method: Vertical shaft (common to all Thurber mines).

Conditions

Vegetation: All mine sites, excluding old mine number 1 (Er/G-2-59) which is completely revegetated, exhibit barren spoil deposits and sparsely vegetated downslope areas (adjacent to spoil deposits).

Erosion: Apparent sheetwash erosion at all sites excluding Er/RM-2-58 (mine 4) and Er/G-2-59 (old mine number 1). Most sites five acres or larger exhibit severe sheetwash erosion (active).

Runoff/Deposition:

Receiving stream - Turkey Creek (Erath County) receives direct runoff from Er/G-2-55 (new mine number 5) and exhibits a broad sparsely vegetated entry point. This is the only mine with runoff that affects an adjacent stream or creek.

Impoundment - Stock tank at old mine 3 (Er/G-2-10) - Insignificant deposition. Two stock tanks at mine 6 (Er/G-2-61) - slight deposition.

Downslope - Substantial downslope (adjacent to spoil deposits) deposition at all mines five acres or larger (excluding old mine number 1).

Table 18. Synopsis of all mines in Thurber Mines Area (Erath County and part of Palo Pinto County).

Number of mine sites: 15

Aerial photo coverage: Erath County

Photo date: January 16, 1974

Site No.	Mine No.	Size, acres	Photo No.	Grid No.
Er/Rm-4-3	1 (old No. 1)	8	374-48	2
Er/Rm-3-1	1 (new No. 1)	6	374-48	24/29
Er/Rm-3-9	2	4	374-48	6
Er/Rm-3-7	3 old site	4	374-48	11
Er/Rm-3-8	3 new site	2	374-48	11
Er/Rm-3-10	4	2	374-48	1
Er/Rm-3-5	4 old site	4	374-48	22
Er/Rm-3-6	5 new site	5	374-48	16
Er/Rm-3-4	6	3	374-48	17
PP/G-2-2	7	8	374-47	18
PP/G-2-3	8	12	374-47	23/24
Er/Rm-3-3	9	10	374-48	22
PP/G-2-5	10	13	374-47	27
PP/G-2-4	11	8	374-47	33
Er/Rm-3-2	12	8	374-48	33

Subsidence: No visible subsidence. All mine entrances have been filled and sealed with concrete.

Refuse: Mine spoil deposits were observed at all mines. Spoil consists of coal, carbonaceous shale, red fire clay and "Red Dog" (fire clay cinders). Considerable spoil deposits at mine 8 (PP/G-2-53), mine 9 (Er/G-2-63) and mine 10 (PP/G-2-51).

Structural/Equipment Remains: Visible structural remains consisting of rock walls and wooden beams at new mine 3 (Er/G-2-56). A loading ramp and building foundation were found at mine 6 (Er/G-2-61). Other mines may have similar remains but were not seen (masked by vegetation).

Hazard Potential: Settlement within one mile of site; ready access.

Surrounding Land Use: Rangeland (moderately good condition).

Remarks:

The identification of abandoned mines and work aimed at determining current surface conditions resulting from past mining activities were carried out through the use of (1) high and low level aerial photography, (2) limited on-site observations, (3) historical literature, (4) low level aircraft observations, and (5) interview sessions with local citizens familiar with past mining activities.

Mines previously owned by the Texas and Pacific Coal Company, as well as one additional mine in the vicinity (Er/RM-4-13) are referred to as the "Thurber Mines." These mines are treated as a group because of the high concentration of mines (16) within a 26 km^2 (10 mi^2) area, and because each mine exhibits similar surface characteristics and conditions. Conditions unique to a particular mine have been noted when appropriate.

Spoil deposits are the most prominent mining feature found at the Thurber mines. The amount of mine spoil deposited at each site has a bearing on (1) the extent of downslope deposition, (2) sheetwash erosion, and (3) the amount of downslope ground cover. Runoff from a mine site (spoil deposit) contains leachate and sediment materials detrimental to vegetative growth.

A substantial amount of mine spoil was used as a base material for the railroad grade that was laid to every mine site. The mine spoil in these rail beds is now adversely affecting nearby vegetation.

Table 19 . Confirmed (C) and Probable(P) mines less than five acres - in Thurber Mines Area.

Site Id	Size	Status	Mine Type	Photo Date	Number	Grid
Er/G-2-57	4	C	shaft	1/16/74	374-48	2
Er/G-2-60	4	C	shaft	1/16/74	374-48	11
Er/G-2-56	2	C	shaft	1/16/74	374-48	11
Er/G-2-58	2	C	shaft	1/16/74	374-48	1
Er/G-2-62	4	C	shaft	1/16/74	374-48	22
Er/G-2-61	4	C	shaft	1/16/74	374-48	17
Er/RM-4-13	2	C	shaft	1/16/74	374-41	30

Jack County

Jack County is one of the northern tier of counties wherein the outcrop belt of the Pennsylvanian age Harpersville Formation turns eastward after extending northeast-southwest from the Colorado River. The Harpersville is a mixed fluvial-deltaic and marine sequence which contains thin-bedded coal. The Harpersville outcrop area (fig. 21) covers approximately 579 km^2 (223 mi^2; 143,000 ac) or a little less than 25 % of the total area of Jack County (table 6). The subsurface extent of the Harpersville in Jack County is not well known (Mapel, 1967).

Coal mining began in Jack County before 1890 (Cummins, 1891, p. 512) and may have continued on a small scale (for limited personal use) until the 1930's or later (Jackson, personal communication, 1979). One of only three or four confirmed surface mines in the region is located in Jack County. This mine, at site number J/LC-4-1, was probably the last coal mine operated in the county (table 20).

All of the mines (confirmed, unconfirmed) in Jack County are small, the largest being 4 acres. Environmental effects at these mines are somewhat limited as well, although erosion (gullying) may be locally severe. Other important effects include subsidence and devegetation (table 21).

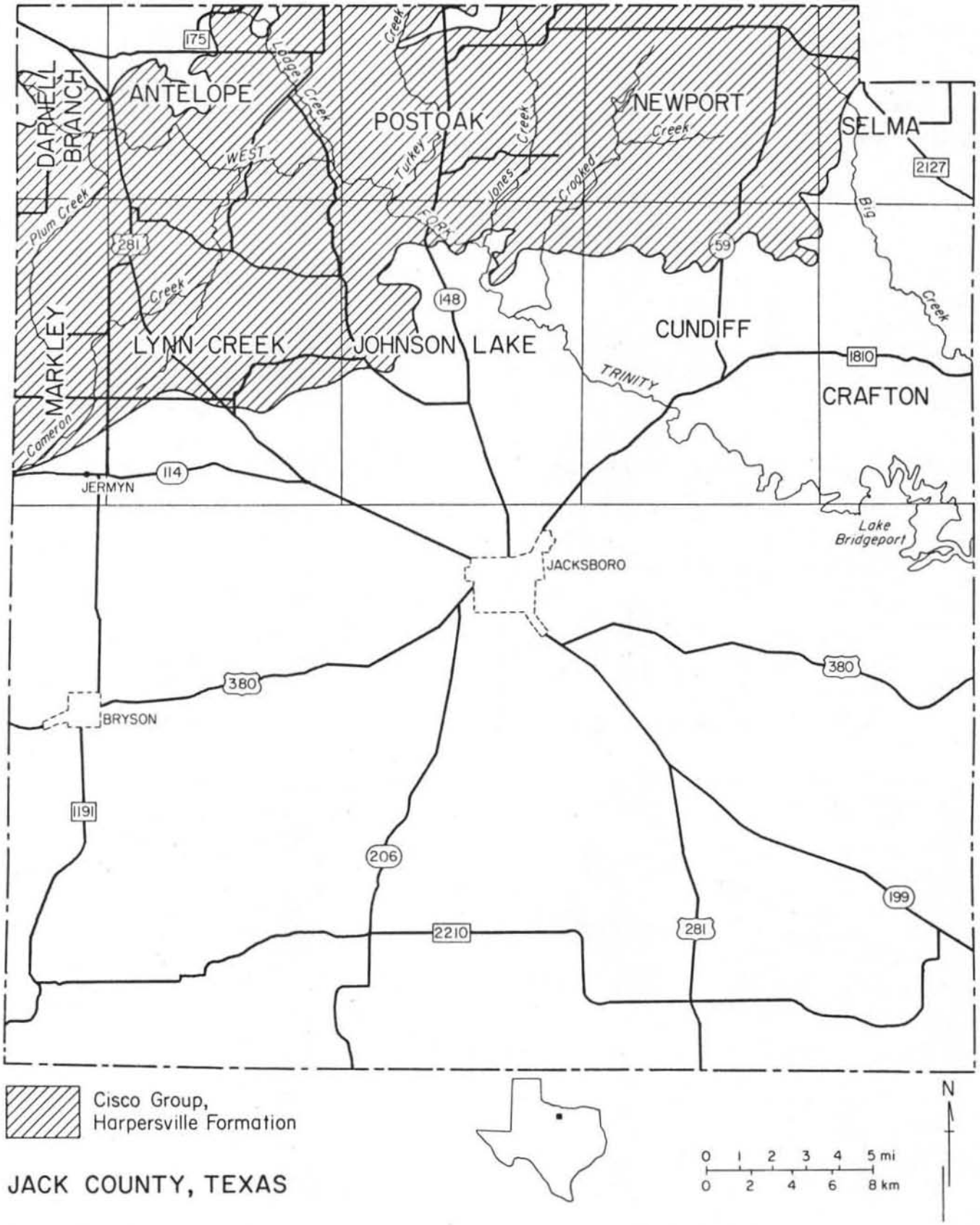


Figure 21. Map of Jack County, Texas, illustrating the outcrop area of the coal-bearing Harpersville Formation, and selected cultural and surface drainage features.

Table 20. Summary of site descriptions--Jack County

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
J/LC-3-10	3	1	----	Opened, abandoned before 1889 (?)	Probably domestic (small production)	Negligible	Slight
J/LC-4-21	4	1	----	Possibly as late as 1930's or '40's	Domestic, industrial (blacksmithing)	Moderate. (impoundment)	Moderate
J/LC-4-39	2	----	1 (possible prospecting site)	Probably not more than a decade before 1951	No known production	Negligible	Slight
J/LC-4-41	2	1	----	Opened, abandoned before 1889, reopened and operated c. 1920	Domestic (small to moderate production)	Slight	Severe

Table 20. Summary of site descriptions--Jack County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
J/AN-1-1	3	1 (prospecting site)	----	Unknown (before 1951)	No known production	Negligible	Slight
J/AN-1-3	3	1	----	Probably not more than a decade before 1951	Probably domestic (small production)	Negligible	Moderate
J/AN-1-4	3	----	1 (possible prospecting site)	Unknown (before 1951)	No known production	Negligible	Slight
J/AN-1-6	4	----	1 (possible prospecting site)	Unknown (before 1951)	No known production	Negligible	Slight

Table 20. Summary of site descriptions--Jack County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
J/PO-2-10	3	----	1	Unknown (before 1951)	No known production	Slight	Moderate
J/PO-2-11	3	----	1	Unknown (before 1951)	No known production	Negligible	Slight
J/PO-2-13	1	----	1	Before 1889	Domestic (possibly no production)	Negligible	Slight
Summary: 11 sites	31	5	6	Before 1889--1940's (?)	Domestic, industrial (blacksmithing)	Negligible to moderate (impoundment)	Slight to moderate

Table 21. Summary of environmental effects in Jack County.

Site Number	C - Confirmed U - Unconfirmed	Acres	Effects on Vegetation	Erosion	Runoff/Deposition			Subsidence	Refuse	Structural Equipment Remains
					Receiving Stream	Impound-ment	Downslope			
J/An-1-3	C	3	X	X			X			
J/LC-4-41	C	2	X	X	X		X	X	X	X
Totals: 2 sites	2 C	5	2	2	1	0	2	1	1	1

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

JACK County

Size: 2 acres.

Site Number: J/LC-4-41 (Brannon Mine).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	2/9/51	4G:96	3	1:20,000
Most Recent -	1/6/72	1MM:64	8	1:20,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Historical record (published); local contact; ground inspection; photointerpretation.

Local Contact: Allard Smith -- Jacksboro, Texas (rural area).

Accessibility: Direct. Private land. Site is approximately 17 km (10.5 mi) northwest of Jacksboro.

Mining Method: Slope/drift entrance, with vertical air shaft. Longwall advancing extraction.

Conditions

Vegetation: Barren to sparsely revegetated. Shale dumps and collapsed mine entrance barren, adjacent moderate slopes sparsely covered in grasses, herbs (annuals).

Erosion: Severe-gullying and sheetwash erosion on shale dumps and at collapsed mine entrance. Gullies, fed by runoff from adjacent steep, unvegetated slopes, are approximately 3 m (10 ft) deep where they cut through the upper shale dump. Lower shale dump/slack pile almost leveled by sheetwash.

Runoff/Deposition:

Receiving stream - Roberts Prairie Branch (intermittent). The runoff and sediment leaving site is distributed across level slope below site before entering stream, significantly reducing effects on stream.

Impoundment - None present.

Downslope - Sediment and runoff from site distributed over level slope below site. Devegetation downslope possibly caused by acid runoff. Effects on groundwater (high local water table) undetermined. Slopewash "apron" around lower shale dump.

Subsidence: Collapsed drift/slope entrance, partly collapsed air shaft. Small depressions on hillslope above presumed mine workings.

Refuse: Shale and shale/coal slack dumps; rock rubble from partly collapsed loading ramp.

Structural/Equipment Remains: Unmortared, hand-hewn stone loading ramp and retaining wall, now partially collapsed.

Hazard Potential: Source of possible water pollutants (principally leachate materials) potentially affecting shallow groundwater (water supplied locally from shallow wells).

Surrounding Land Use: Grazing (pasture and unimproved rangeland); oil and gas production; rural residential; small cemetery.

Remarks: See attached page.

Site Number J/LC-4-41 (cont.)

Remarks: The Brannon Mine was reportedly "...situated about two miles southeast of the mouth of Lodge Creek and on the south side of the West Fork of the Trinity River" (Cummins, 1891, p 513). Site number J/LC-4-41 corresponds almost precisely with this location, but is actually almost due south of the mouth of Lodge Creek. Cummins (1891, p 513) stated, "A tunnel had been driven into the hill on the coal seam at this place, but it had fallen in so badly at the time of my visit (probably in 1889) that I did not venture into it. The tunnel is driven into the hill from the north side." The tunnel, actually on the northwest side of the hill, was, apparently, later reopened because Smith (personal communication, 1979) stated that he had worked in the mine as a young man, around 1920. Cummins (1891, p 513) remarked that "The seam was thicker here than at any place I have seen it in this vicinity." This fact may have stimulated continued interest in the operation of the mine. Coal production during the latter period of operation was primarily for a local market (Smith, personal communication, 1979). The Brannon Mine appears to have been the largest (most productive) and longest-lived coal mine in Jack County.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

JACK County

Size: 3 acres.

Site Number: J/AN-1-3

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	2/9/51	4G:95	8 (southeast)	1:20,000
Most Recent -	1/6/72	1MM:65	9, 14	1:20,000

Status:

Confirmed Mine - Yes. Probable small production.

Unconfirmed Mine -

Method of Verification: Local contact; ground inspection; photointerpretation.

Local Contact: Allard Smith -- Jacksboro, Texas (rural area).

Accessibility: Direct. Private land. Site is approximately 18.5 km (11.5 mi) northwest of Jacksboro.

Mining Method: Contour (surface) mining and possible prospecting. Probable small production.

Conditions

Vegetation: Sparsely revegetated. Grasses and annual herbs sparsely cover most of site. Isolated woody shrubs are becoming established.

Erosion: Moderate. Between 1951 and 1972, a home was constructed on part of site, reducing the area subject to erosion. Steep excavation scarp is eroded by sheetwash and gullying, and appears to have retreated during interval between aerial photographic missions.

Runoff/Deposition:

Receiving stream - Roberts Prairie Branch (intermittent). Excavation is an essentially closed depression; little contribution of sediment or runoff.

Impoundment - None present.

Downslope - Depression at foot of excavation scarp traps most sediment and runoff at site.

Subsidence: None evident. Possible slumping of excavation scarp.

Refuse: None evident.

Structural/Equipment Remains: None evident.

Hazard Potential: Possible minor source of water pollutants (primarily leachate material) potentially affecting groundwater. Shallow water well at site.

Surrounding Land Use: Grazing (pastures and unimproved rangeland); oil and gas production; rural residential (home, other structures at site.).

Remarks: See attached page.

Site Number J/AN-1-3 (cont.)

Remarks: Aerial photographs taken in 1951 reveal excavation along contour, vehicle tracks, and other traces of activity at site, which are largely obscured in 1972 photographs. Home and road construction at the site, in combination with erosion and sparse revegetation, have reduced the visibility of disturbances. Material had apparently been removed rather than simply redistributed at the site, before the 1951 aerial photographs were taken. Limited coal production is, therefore, suggested, although this may have initially been a prospecting site like others nearby. Numerous small excavations, under 5 acres and usually less than 3 acres in size, are seen throughout the area, and many of these were apparently sites of coal prospecting, probably during the early 1920's (Smith, personal communication, 1979). Cummins (1891, p 511) stated that "Prospecting has been done at several places (at the numerous coal outcrops along the West Fork of the Trinity River in the northwestern corner of Jack County), and when there shall be facilities for transportation there will be good coal mines opened in this country." Vehicle tracks and apparent "sharpness" of excavation suggest that coal may have been removed from the site as late as the 1940's.

Table 22. Confirmed (C) and Probable(P) mines less than five acres - Jack County

Site Id	Size (acres)	Status	Mine Type	Photo Date	Number	Grid
J/LC-3-10 (possibly Jackson Mine)	3	C	drift, contour?	2/9/51 1/9/72	4G:177 2MM:104	14 14
J/LC-4-21	4	C	drift?, contour	2/9/51 1/6/72	4G:155 1MM:11	31,32 22
J/LC-4-39	2	P	drift?, contour (prospecting site)	2/9/51 1/6/72	4G:96 1MM:64	4 9
J/AN-1-1	3	C	contour (prospecting site)	2/9/51 1/6/72	4G:95 1MM:65	14,15 19
J/AN-1-4	3	P	contour (prospecting site)	2/9/51 1/6/72	4G:95 1MM:65	8(central) 13,14
J/AN-1-6	4	P	contour (prospecting site)	2/9/51 1/6/72	4G:95 1MM:65	7 12
J/PO-2-10	3	P	contour (prospecting site)	3/4/51 1/6/72	5G:74 1MM:82	29 35
J/PO-2-11	3	P	contour (prospecting site)	3/4/51 1/6/72	5G:74 1MM:82	22 28,33
J/PO-2-13 (possibly "tunnel" of Cummins, 1891, p. 512	1	P	drift/slope?	2/9/51 1/12/72	4G:10 3MM:158	18 17

McCulloch

McCulloch County is situated at the southern end of the North-Central Texas coal field. Pennsylvanian age bituminous coal resources in the county were first described by Cummins (1890, p. 159). The coal beds lie within the Harpersville Formation (Cisco Group), a complicated sequence of alternating marine and fluvial-deltaic deposits. As mapped by Kier and others (1976) and Evans (1974), the Harpersville Formation crops out over an area of approximately 20 km^2 (8 mi^2; 5,000 ac) in northernmost McCulloch County (fig.22). The outcrop area comprises less than 1 percent of the county's total area of 2750 km^2 (1062 mi^2) (table 6). Coal reserves have been mapped over part of the outcrop area and in the subsurface in the immediate vicinity (Mapel, 1967, p. 15, Figure 11., and Table 2.).

The history of coal production in McCulloch County was relatively brief, perhaps spanning less than a decade from the 1880's to the 1890's (Cummins, 1890, pp. 159-160; Tarr, 1902, p. 407). However, a concerted effort was made during this period to locate workable coal seams. At least seven confirmed and unconfirmed mine sites (two of which include two or more mines or mine entrances) were established (table 23). Prospect drilling was also a common practice during the 1880's. Drilling activity in the same area has resumed since 1974 because of renewed interest in coal resources.

Environmental effects of mining and mine abandonment at the McCulloch County sites are variable (table 24). The most significant effects include continuing collapse of the shaft entrance at site number MC/FF-4-3, and possible contamination of domestic and agricultural water supplies at sites numbers MC/FF-4-1 and -3. All of the county's mine sites are small, measuring no more than 4 acres. However, in this area of low mean annual precipitation (59 cm or 23 in), vegetation is sparse and surface disturbances are persistent (Bynum and Coker, 1974).

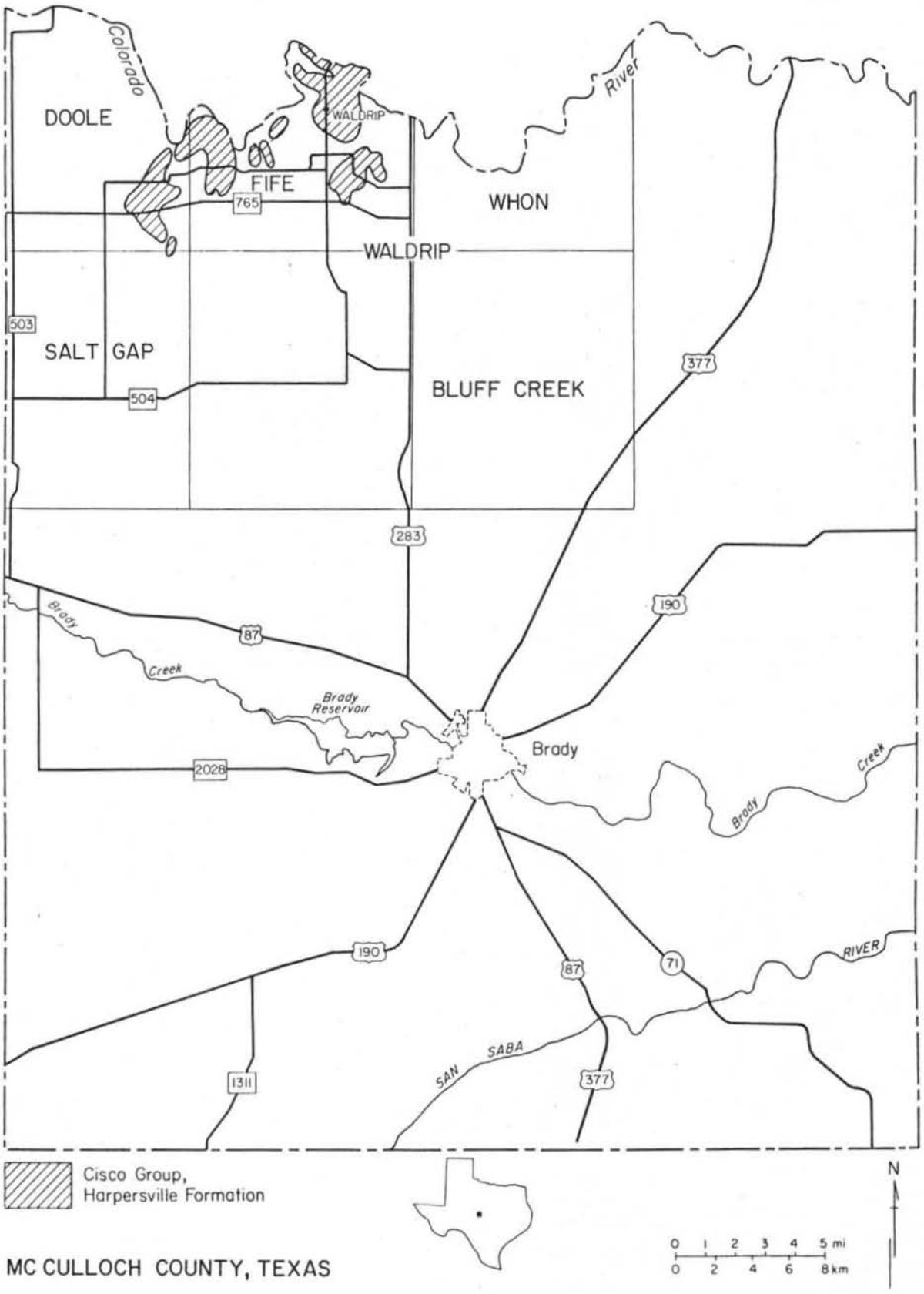


Figure 22. Map of McCulloch County, Texas, illustrating the outcrop area of the coal-bearing Harpersville Formation, and selected cultural and surface drainage features.

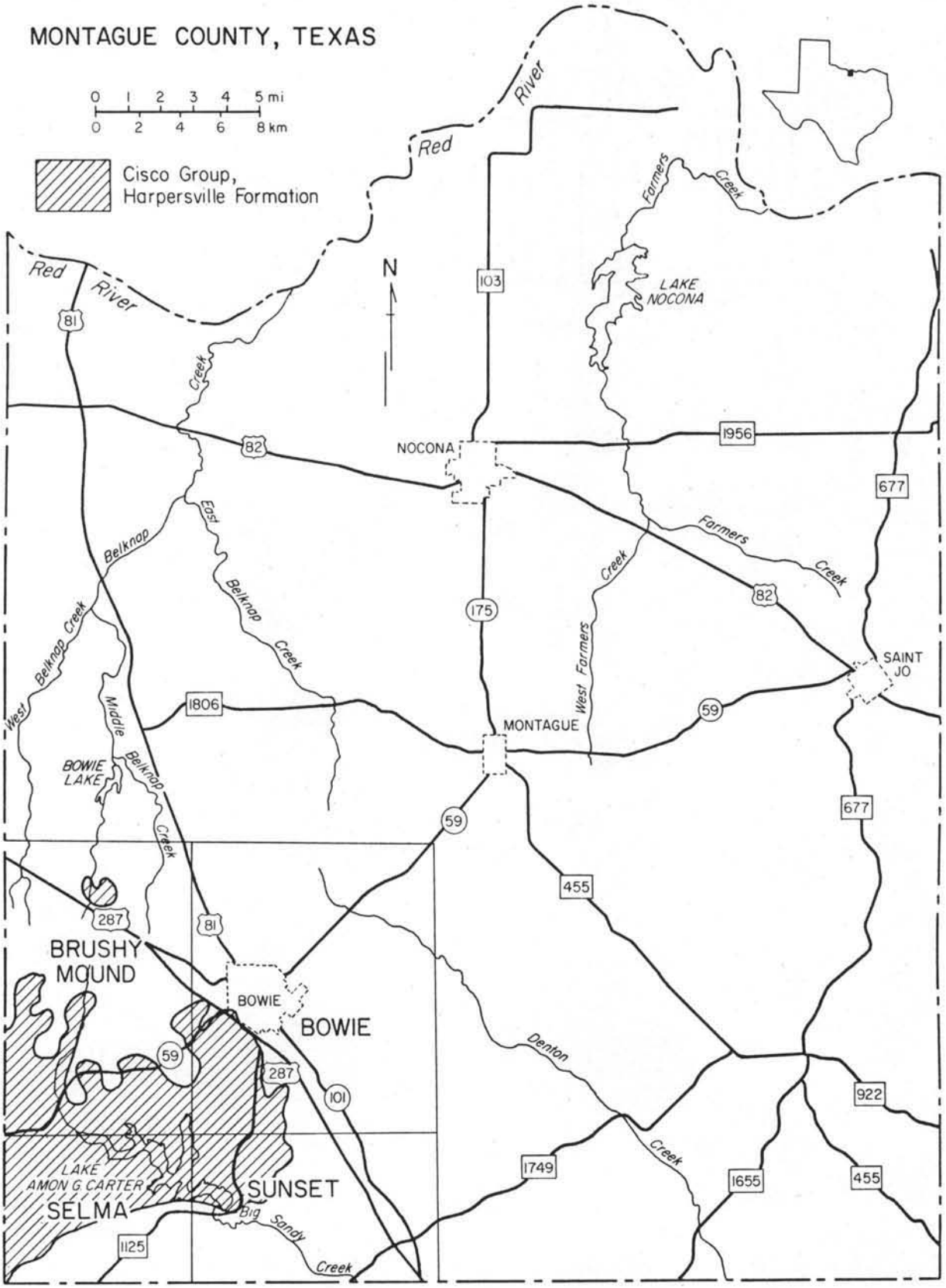


Figure 23. Map of Montague County, Texas, illustrating the outcrop area of the coal-bearing Harpersville Formation, and selected cultural and surface drainage features.

Table 23. Summary of site descriptions-- McCulloch County

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
MC/FF-3-1	1	1	----	Opened, abandoned several years before 1900, probably before 1890	Unknown	Undetermined (impoundment; Colorado River at flood stage)	Slight
MC/FF-3-2	1	1	----	Opened, abandoned a few years before 1889	No known production	Slight to moderate	Moderate
MC/FF-4-3	<1	1	----	Opened, abandoned several years before 1889	Possibly domestic, industrial, railroads	Negligible	Severe (large open shaft)
MC/FF-4-4	4	1	----	Opened, probably abandoned before 1889	Possibly domestic, industrial, railroads	Slight to moderate	Severe

Table 23 . Summary of site descriptions-- McCulloch County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
MC/FF-4-5*	2	1 - 3 (3 entrances)	----	Opened before 1889, abandoned before 1892 (probably before 1889)	Unknown	Slight to moderate	Slight to moderate
MC/FF-4-6*	3	1 - 2 (1 or 2 entrances)	----	Probably opened and abandoned before 1889	Unknown	Negligible	Moderate
MC/FF-1-7	2	----	1	Before 1938 (probably before 1890)	No known production	Negligible	Negligible
Summary: 7 sites	14	6 - 9 (8 or 9 entrances)	1	1880's ?	Possibly domestic, industrial, railroads	Negligible to moderate	Negligible to severe

*Contiguous sites, mines possibly connected.

Table 24. Summary of environmental effects in McCulloch County.

Site Number	C - Confirmed U - Unconfirmed	Acres	Effects on Vegetation	Erosion	Runoff/Deposition			Subsidence	Refuse	Structural Equipment Remains
					Receiving Stream	Impound-ment	Downslope			
Mc/FF-1-7	U	2	X	X			X	X		
Mc/FF-3-1	C	1	X	X		X	X	X	X	
Mc/FF-3-2	C	1	X	X	X		X	X	X	
Mc/FF-4-3	C	< 1		X			X	X	X	X
Mc/FF-4-4	C	4	X	X	X		X	X	X	X
Mc/FF-4-5	C	2	X	X	X			X	X	X
Mc/FF-4-6	C	3	X	X			X	X	X	X
TOTALS: 7 sites	6 C 1 U	13	6	7	3	1	6	7	6	4

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

McCULLOCH County

Size: 1 acre.

Site Number: MC/FF-3-1 (unnamed mine).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/19/38	580	38	1:20,000
Most Recent -	2/20/75	475:20	37	1:40,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Local contact; ground, air inspection; photointerpretation.

Local Contact: Samuel E. Hays -- Lohn, Texas (rural area).

Accessibility: Direct. Private land. Site is approximately 3 km (1.8 mi) northwest of Waldrip.

Mining Method: Shaft entrance. No air shafts found. Longwall advancing extraction probably employed.

Conditions

Vegetation: Barren to partly revegetated -- honey mesquite and black willow trees, herbaceous groundcover, cultivated wheat; shale dump (almost level) barren. Cultivation extends to edge of shale dump.

Erosion: Slight sheetwash erosion on unvegetated, almost level shale dump.

Runoff/Deposition:

Receiving stream - Site is on a high floodplain of the Colorado River, but was, apparently, inundated during flood of September, 1936 (Hunter, 1976, p 37). Drainage from site reaches river only during extreme floods.

Impoundment - Immediate input of sediment from shale dump into depression marking former shaft entrance. Water-filled depression utilized by cattle. See also "Hazard Potential," below.

Downslope - Slopewash deposits encircling now almost level site of shale dump. Effects of acid leachate (restricting revegetation) at surface confined to dump site. Infiltration of leachate to water table possible.

Subsidence: Slight depression at former shaft entrance which was filled and/or collapsed. See also "Remarks," below.

Refuse: Shaft filled with domestic and agricultural refuse (Hays, personal communication, 1979), now covered with sediment. Traces of shale dump, now almost level.

Structural/Equipment Remains: None evident.

Hazard Potential: Possible source of water pollutants potentially affecting cattle drinking from water-filled depression at former shaft shaft entrance.

Surrounding Land Use: Wheat cultivation, grazing (pasture and unimproved rangeland), and water storage for livestock.

Remarks: See attached page.

Remarks: Site is not mentioned in literature reviewed for this study. Mine shaft had been excavated before 1900, roughly at which time the site bacame a camping spot for fishing parties coming to the Colorado River (Hays, personal communication, 1979). Groups would camp at site for extended periods, discarding refuse into the then open shaft. Area residents (including occupants of home seen near site in 1938 aerial photographs but now completely removed) also used shaft for disposal of domestic and agricultural wastes, probably from the time of abandonment (before 1900) until at least the 1930's. Flood event of September, 1936 probably filled shaft with water and sediment and eroded or even leveled adjacent shale dump. Aerial photographs dated August, 1938 reveal no obvious debris mound or open shaft at site. Little is known of the history of mining operations at the site, but the mine may be analogous to the Finks Mine located approximately 2 km (1.25 mi) to the southeast at almost the same elevation. The Finks mine was described as a shaft 27 m (84 ft) in depth by Cummins (1890, p 153; 1891, p 550), and 21 m (69 ft) in depth by Tarr (1890, p 209). (There may have been two or more Finks Mines, as implied by Cummins, 1890, p 153; see also descriptions of sites MC/FF-4-3 and -4.) Thickness of the coal seam in the Finks Mine was approximately 0.7 m (2 ft), and the mine was opened and abandoned before 1889 (Cummins, 1890, p 153; Tarr, 1890, p 209).

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

McCULLOCH County

Size: 1 acre.

Site Number: MC/FF-3-2 (possibly Williamson Shaft).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/19/38	581	38 (western)	1:20,000
Most Recent -	2/20/75	475:62	38 (central)	1:40,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Historical records (published); local contact; ground, air inspection; photointerpretation.

Local Contact: Samuel E. Hays -- Lohn, Texas (rural area).

Accessibility: Direct. Private land. Site is approximately 2 km (1.2 mi) northwest of Waldrip.

Mining Method: Shaft entrance. No air shafts found. Longwall advancing extraction probably employed.

Conditions

Vegetation: Barren to partly revegetated -- herbaceous groundcover (primarily annuals), little grass. Few xerophytic shrubs.

Erosion: Moderate sheetwash erosion and deep gullying of poorly vegetated shale dump on moderate slope. Gullies merge downslope, onto the floodplain of the Colorado River. See also "Runoff/Deposition: Downslope," below.

Runoff/Deposition:

Receiving stream - Colorado River (perennial). Runoff from site reaches alluvial floodplain prior to entering river through gullies or infiltration. Small deposit of sediment in river below mouth of gully is evident in 1938 and 1975 aerial photographs.

Impoundment - None present.

Downslope - Sheetwash deposit immediately below site; poorly-defined gullies extend down slope from site to alluvial floodplain. Deep gullies in floodplain which were evident in 1938 aerial photographs were apparently scoured by flooding prior to 1975 aerial mission date. Reincision had not progressed markedly by 1975.

Subsidence: Possible minor collapse at presumed site of shaft entrance suggested by surface irregularity adjacent to shale dump.

Refuse: Small shale dump, now almost level. Dump contains little coal residue.

Structural/Equipment Remains: None evident.

Hazard Potential: Source of possible water pollutants (sediment, sulfuric acid, other substances). Little coal (major source of pyrite) present in shale dump, suggesting that leachate may not contain significant concentrations of pollutants.

Surrounding Land Use: Grazing (both improved and unimproved rangeland), residential, and water supply (Colorado River).

Remarks: See attached page.

Site Number MC/FF-3-2 (cont.)

Remarks: Site probably corresponds to that of the Williamson Shaft, "located one mile northwest of the town of Waldrip" (Cummins, 1890, p 152). Curiously, Cummins (1891) gave the location of the mine as "about one mile northeast of Waldrip," (p 550), an apparent typographical error. The community of Waldrip has relocated at least three times since 1900 (Hays, personal communication, 1979; United States Geological Survey, "Waldrip, Texas" 15-minute topographic quadrangle map, 1928), moving several tenths of a kilometer in each case. The location of site MC/FF-3-2 is approximately 2 km (1.25 mi) northwest of the present Waldrip townsite, but approximately 1.5 km (1 mi) from the 1928 townsite, which is in agreement with Cummins (1890, p 152). Cummins (1891, p 152) wrote: "A few years ago, a company at heavy expense put down this shaft (the Williamson Shaft), eight by eight feet, and timbered it from top to bottom with pine lumber two inches thick, hauled a long distance, and when they finally reached the coal, at a depth of one hundred and sixty feet, it was only one foot thick, and the work was abandoned at once." Cummins (1890, p 152) had earlier noted that at the time of his visit, in 1889, the shaft had been "abandoned and is nearly full of water." No subsequent production from the mine is reported.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

McCULLOCH County

Size: <1 acre.

Site Number: MC/FF-4-3 (probably Finks Mine--"A"; see description of site number MC/FF-4-4).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/19/38	581	28	1:20,000
Most Recent -	2/20/75	475:62	33	1:40,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Historical record (published); local contact; ground, air inspection; photointerpretation.

Local Contact: Samuel E. Hays -- Lohn, Texas (rural area).

Accessibility: Limited. Private land. Site is approximately 3 km (1.8 mi) northwest of Waldrip.

Mining Method: Shaft entrance. No air shafts found. Longwall advancing extraction probably employed. Wooden tipple utilized (Hays, personal communication, 1979).

Conditions

Vegetation: Complete revegetation -- area south of and immediately surrounding shaft now under cultivation (wheat or hay). Area north of shaft is being invaded by woody plants, primarily blackjack oak (stunted and shrubby, possibly because of heavy livestock browsing).

Erosion: Moderate -- mass wasting (slumping) of shaft margin, producing vertical walls. Progressive slumping preceded by formation of concentric fractures propogating vertically through the soil profile. Slight gullying around edge of open shaft.

Runoff/Deposition:

Receiving stream - No apparent transportation of runoff or sediment to a stream.

Impoundment - None present.

Downslope - Depression at collapsed shaft entrance traps all runoff and sediment eroded from the crater margin.

Subsidence: Severe collapse of shaft entrance, forming unstable, vertically-walled depression 6 m (20 ft) in diameter and 3 to 4.6 m (10-15 ft) deep, circular in shape.

Refuse: Disposal of domestic and agricultural wastes has continued from the date of abandonment of the shaft, probably several years before 1889, until the present.

Structural/Equipment Remains: Abandoned road and foundations (north of site) apparent in 1938 aerial photograph, almost completely obscured in 1975 imagery and at present. No trace of shale dump, tipple at shaft entrance.

Hazard Potential: Open shaft expanding progressively through mass wasting of shaft margin. Potential groundwater pollution related to infiltration of leachate (from domestic and agricultural wastes in shaft) into permeable strata.

Surrounding Land Use: Formerly (historically), area north of site was occupied by a blacksmith shop, school, and other buildings, in addition to those structures (including a tipple) related to operation of the mine (Hays, personal communication, 1979). Presently, cultivation (wheat or hay) and grazing (rangeland heavily invaded by woody species) are principal land uses. Site was apparently cleared of shale dump and other debris between 1938 and 1975.

Remarks: See attached page.

Remarks:

Site probably corresponds to that of the Finks Mine, incorrectly referred to as "Fink Mine" by Cummins (1891, p 550) and as "Fink's Mine" by Evans (1974, p 53) (Cummins, 1890, pp 153, 160; Tarr, 1890, pp 208, 209, 214). Tarr (1890, p 209) simply stated that the Finks Mine is "at Waldrip," but Cummins (1890, p 153) gave the mine location as "one half mile west of the town of Waldrip." Site MC/FF-4-3 is located approximately 0.8 km (0.5 mi) northwest of the present Waldrip townsite. However, the town has relocated at least three times in this century, moving several tenths of a kilometer in eash case (Hays, personal communication, 1979; United States Geological Survey, "Waldrip, Texas" 15-minute topographic quadrangle map, 1928). Furthermore, no evidence of a mine could be found in the areas west of Waldrip's current and 1928 locations, despite careful searching. Presumably, then, the mine at site MC/FF4-3 is the Finks Mine.

It is possible that more than one mine may have been called Finks Mine. Cummins (1890. p 153) and Tarr (1890, p 208), to a lesser extent, implied that the Finks mining operation involved two or more shafts. Also, the measured sections (said to have been made at Finks Mine) which were provided by Cummins (1890, p 153) and Tarr (1890, p 209) do not correspond stratigraphically or in their indication of total mine depth. Cummins (1890, p 153) following his Finks Mine section, stated "(another) shaft fifty-five feet deep was put down near the river," a probable reference to the mine at site MC/FF-4-4. This latter mine may thus have also been called the Finks Mine.

Of one of the Finks Mines (presumably that located at site MC/FF-4-3), Cummins (1891, p 550) stated "the work had been abandoned for some time," but that "the owners of the mine took the trouble at the time of my visit (in 1889) to clean out the shaft" for his inspection. Cummins (1891, p 550) also stated that from the bottom of the shaft, "An entry has been driven into the seam in an easterly direction for a distance of fifty feet ('forty feet': Cummins, 1890, pp 153, 160) and the coal taken out for several feet on each side of the entry." Tarr (1890, p 214) reported that the Fink Mine, "...after taking out one hundred tons (of coal), or thereabouts, suspended operations, not from lack of coal but absence of market." Tarr explained that the mine "is nearly 25 miles from the railway, and is separated from it by the Colorado River, which, with other bad places in the road, effectually prevents the profitable marketing of coal at the railway (p 214)." A tipple may have been present in 1938 (aerial mission date).

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

McCULLOCH County

Size: 4 acres.

Site Number: MC/FF-4-4 (possibly Finks Mine--"B"; see description of site number MC/FF-4-3).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/19/38	581	38 (eastern)	1:20,000
Most Recent -	2/20/75	475:62	38 (southeastern)	1:40,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Historical record (published); local contact; ground, air inspection; photointerpretation.

Local Contact: Samuel E. Hays -- Lohn, Texas (rural area).

Accessibility: Limited. Private land. Site is approximately 1.5 km (1 mi) northwest of Waldrip.

Mining Method: Shaft entrance. Possible air shaft. Longwall advancing extraction probably employed.

Conditions

Vegetation: Barren to sparsely revegetated. Excavation area, shale dump, and area immediately downslope essentially barren, except for few blackjack oaks. Adjacent "upland" under cultivation (hay?). Colorado River floodplain below site heavily vegetated (pecan trees, grasses, herbs).

Erosion: Moderate to severe. Steep slopes deeply gullied, with gullying most active on unvegetated shale dump and steep slope immediately below. Sheetwash erosion has resulted in formation of a small alluvial cone at toe of slope (see "Runoff/Deposition: Downslope," below).

Runoff/Deposition:

Receiving stream - Colorado River (perennial). Site is adjacent to narrow, low level alluvial floodplain of river. Runoff and sediment are transported to river through gullies cut into floodplain. A small sediment deposit in in river channel at mouth of gully is evident in 1975 aerial photographs.

Impoundment - None present.

Downslope - A small alluvial cone has developed at slope break where deep gully below site emerges onto flat, narrow, alluvial floodplain. Floodplain deeply gullied, possibly acid runoff-affected (within gully).

Subsidence: Collapsed shaft entrance and probable collapsed tunnel segment and air shaft.

Refuse: Small shale dump on steep slope, retained by partly collapsed, unmortared, stone masonry wall.

Structural/Equipment Remains: Partly collapsed, unmortared stone masonry retaining wall maintaining shale dump on slope. Wall was vandalized, after 1970 (Hays, personal communication, 1979).

Hazard Potential: Possible risk of sudden failure of partly collapsed retaining wall supporting shale dump on steep slope. Source of possible leachate-derived water pollutants.

Surrounding Land Use: Grazing (improved rangeland, recently invaded by woody shrubs, on plain above site); recreation (on floodplain below site); and water use (irrigation water withdrawn from Colorado River at a point just downstream from entry point of runoff from site).

Remarks: See attached page.

Remarks:

Mine at this site may be one of presumably two Finks Mines. See description of site number MC/FF-4-3 for discussion. Hays (personal communication, 1979) recounted the history of the mine at site MC/FF-4-4 on property that has been owned by members of the Hays family for more than 100 years. The mine was worked before 1890. Throughout the brief period of active mining, Indian attacks on the miners were a constant threat. Coal was hauled from the mine entrance near the top of the slope by animal-drawn wagons. A ramp leading from the entrance to the top of the slope was built on the shale dump. The retaining wall supporting the dump was still intact until the 1970's when it was vandalized by someone searching for legendary Indian treasure. Production rates and total production of coal at the mine may have been significant in comparison with that of other largely unmechanized, labor-intensive mines of the period. Mine was apparently not in operation at the time of Cummins' visit in 1889 (Cummins, 1890).

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

McCULLOCH County

Size: 2 acres.

Site Number: MC/FF-4-5 (probably Chaffin Mine; see description of site number MC/FF-4-6, and Remarks," below.)

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/19/38	581	9	1:20,000
Most Recent -	2/20/75	475:62	24 (central)	1:40,000

Status:

Confirmed Mine - Yes. Three adjacent drift/slope entrances.

Unconfirmed Mine -

Method of Verification: Historical record (published); local contact; ground, air inspection; photointerpretation.

Local Contact: Samuel E. Hays -- Lohn, Texas (rural area).

Accessibility: Limited. Private land. Site is approximately 1.5 km (1 mi) east-northeast of Waldrip.

Mining Method: Drift/slope entrances with vertical air shafts. Longwall advancing extraction probably employed.

Conditions

Vegetation: Moderate revegetation except on shale dumps (barren)--cedar elm, blackjack oak, honey mesquite trees; Texas prickly pear, prairie grasses, and herbaceous groundcover.

Erosion: Moderate sheetflood erosion and gullying. Gullies and rills, developed parallel and perpendicular to roughly rectangular boundaries of presumed subsidence area. Coal seam exposed in bed of unnamed intermittent tributary, downstream from mines.

Runoff/Deposition:

Receiving stream - Unnamed, third-order tributary (intermittent) of Colorado River (perennial). Direct input of sediment and coal (slack), causing tributary channel aggradation. Leachate flushed into stream from shale dumps.

Impoundment - None present.

Downslope - Mines are adjacent to intermittent tributary. All runoff and sediment transported from site by stream (seasonal discharge).

Subsidence: Collapsed mine entrances; linear subsidence area, approximately 15 x 100 m (50 x 330 ft) in size and reflecting a maximum of 1 m (3 ft) of vertical displacement, encompassing all entrances and air shafts and presumably caused by collapse of worked-out area and tunnels connecting entrances and air shafts.

Refuse: Small shale dumps and rock rubble from partly collapsed loading platform (see below).

Structural/Equipment Remains: Unmortared stone masonry loading platform, partly collapsed. Fitted, hand-hewn rock walls supporting platform core composed of shale and other mine waste.

Hazard Potential: Air shafts partially open (circular, 1.5 m or 5 ft in diameter, 3 m or 10 ft in depth); source of possible leachate-derived water pollutants, although coal crops out naturally in stream bed.

Surrounding Land Use: Grazing (unimproved rangeland); gas production and pipelining.

Remarks: See attached page.

Remarks:

Cummins (1890, p 152) implied that the Chaffin Mine had been worked at intervals over a period of several years prior to his visit, in 1889. Drake (1893, p 433) stated that during his study, presumably in 1892, the mine could not be entered because "....it had been neglected and was filled with water and mud." Cummins (1890, p 152) gave the location of the Chaffin Mine as "two miles southeast" of the Williamson Shaft, an accurate description of the locale based on present knowledge of the identity of mines observed during this study. However, Cummins also reported that the Chaffin Mine was located "two miles east of Waldrip (p 159)." Drake (1893, p 493) placed the mine approximately 2 km (1.5 mi) east of Waldrip. The Waldrip townsite has relocated at least three times in this century (Hays, personal communication, 1979; U.S. Geological Survey, "Waldrip, Texas" 15-minute topographic guadrangle map, 1928); its location in 1928 was roughly 0.8 km (0.5 mi) west of the present townsite. Site MC/FF-4-5 is thus approxmiately 2.4 km (1.5 mi) east-northeast of the community's 1928 location, which agrees with the location of the Chaffin Mine given by Drake (1893) and Cummins (1890). Coal was extracted at the Chaffin Mine "by following the seam under the hill from the outcrop" Cummins, 1890, p 159). This description seems to suggest a drift or slope entrance. The seam worked in these mines is 51 cm (20 in) thick (Cummins, 1890, p 159). The commercial failure (and abandonment) of the Chaffin Mine was attributed to distance from rail transportation (Taff, 1892, p 407).

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

McCULLOCH County

Size: 3 acres.

Site Number: MC/FF-4-6 (possibly part of Chaffin Mine; see description of site number MC/FF-4-5 and "Remarks," below).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/19/38	581	8, 9	1:20,000
Most Recent -	2/20/75	475:62	24 (northern)	1:40,000

Status:

Confirmed Mine - Yes. One or two shaft entrances.

Unconfirmed Mine -

Method of Verification: Historical record (published); local contact; ground, air inspection; photointerpretation.

Local Contact: Samuel E. Hays -- Lohn, Texas (rural area).

Accessibility: Limited. Private land. Site is approximately 1.5 km (1 mi) east-northeast of Waldrip.

Mining Method: Shaft entrance(s). Vertical air shafts. Longwall advancing extraction probably employed.

Conditions

Vegetation: Barren to moderately revegetated -- prairie grasses and herbaceous groundcover over most of site; shale dumps, and spoil mounds generated by recent reexcavation of shafts (entrance, air) are barren to sparsely revegetated.

Erosion: Slight sheetwash erosion and shallow gullying, most active on shale dumps and recently mounded spoil.

Runoff/Deposition:

Receiving stream - Unnamed third-order tributary (intermittent) of the Colorado River. Sediment eroded from shale dumps deposited on site. Effects on stream negligible.

Impoundment - None present.

Downslope - Depressions left at shaft entrance(s) and air shafts following recent partial reexcavation (for prospecting purposes); these trap most of the sediment eroded from spoil mounds. Limited slopewash deposits rim the shale dumps and spoil mounds.

Subsidence: Collapsed shaft entrances, air shafts, and tunnels (subsidence area, difficult to trace, over collapsed tunnel). Entrance(s) and air shafts partly reexcavated since 1975 aerial mission.

Refuse: Shale dumps and recently emplaced spoil mounds, all small in size. Rock rubble from partially collapsed loading ramp (see below).

Structural/Equipment Remains: Unmortared stone masonry loading ramp, partly collapsed. Tipple or other structure at shaft entrance possibly evident in 1938 aerial photographs, now gone.

Hazard Potential: Water-filled open pit, 2.5 m (8 ft) x 4.5 m (15 ft), 3 m (10 ft) deep. Pit formed by recent (since 1975) excavation at shaft entrance -- other excavations, at air shafts, possible second entrance now almost filled. Source of possible water pollutants (leachate-derived), primarily affecting shallow groundwater.

Surrounding Land Use: Grazing (improved, recently deteriorated rangeland); oil and gas production; and pipelining.

Remarks: See attached page.

Remarks:

Mine at this site may be part of the Chaffin Mine system. See description of site number MC/FF-4-5 for discussion. The property line separating these sites has, however, been maintained for generations, since the earliest settlement of the area (Hays, personal communication, 1979). Mining at the two sites could thus, conceivably, have never been connected. Differences in the types of mines at the sites tend to support this conclusion, although it would appear that both mines were operated at approximately the same time and the same coal seam was worked in each. Proximity of the sites also implies similarities in the required mining techniques. By analogy, the mine at site MC/FF-4-6 was probably opened several years before 1889 and was abondoned before 1892, probably in the 1880's. Depth of the mine was shallow, corresponding to the depth of the workable seam. The rate of coal production is unknown, as is the market for which the coal was extracted. Little information is available concerning the history of the Chaffin Mine, and even its location is not known with complete certainty. However, both sites MC/FF-4-5 and -6 are very near the presumed location of the Chaffin Mine and site MC/FF-4-5 seems to match the description provided by Cummins (1890, p 159). Site MC/FF-4-6, which is immediately adjacent, may simply represent an extension of site -5.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

McCULLOCH County

Size: 2 acres.

Site Number: MC/FF-1-7 (possible unnamed mine).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/19/38	637	44	1:20,000
Most Recent -	2/20/75	475:62	25	1:40,000

Status:

Confirmed Mine -

Unconfirmed Mine - Yes.

Method of Verification: Local contact; ground, air inspection; photointerpretation.

Local Contact: Samuel E. Hays -- Lohn, Texas (rural area).

Accessibility: Limited. Private land. Site is approximately 1.5 km (1 mi) southeast of Waldrip.

Mining Method: Possible slope entrance. No air shafts found. No known production.

Conditions

Vegetation: Sparsely to almost completely revegetated -- xerophytic shrubs and prairie grasses on moderate, rocky slope (sparsely vegetated); dense groundcover (grasses and sedges) in swale adjacent to stock tank.

Erosion: Slight sheetwash erosion on moderate, rocky slopes.

Runoff/Deposition:

Receiving stream - Unnamed first-order tributary (intermittent) which integrates with third-order drainage entering Colorado River. Effects on stream negligible at present but site may have contributed sediment to stream prior to construction of the impoundment.

Impoundment - Impoundment was, apparently, constructed on former shale dumpsite, possibly utilizing the mine shale in the earthen dam (built between 1938 and 1975, probably in the 1960's or 70's). Effects on impoundment negligible.

Downslope - Minor slopewash deposit below moderate, rocky slope in densely vegetated swale.

Subsidence: Presumed slope entrance partly collapsed and had apparently been filled with rock material long before 1965 (aerial mission date).

Refuse: None evident. Possible small shale dump seen in 1938 aerial photographs, at a point now occupied by small stock tank.

Structural/Equipment Remains: None evident. Possible loading ramp seen in 1938 aerial photographs.

Hazard Potential: Negligible.

Surrounding Land Use: Grazing (unimproved rangeland); water storage for livestock; gas pipelining.

Remarks: See attached page.

Remarks:

Hays (personal communication, 1979) stated that he had seen a mine in the vicinity of this site during his youth. The mine had long been abandoned even then, but the shale dump and certain other features were still evident. However, Hays could not recount the precise location of the mine. Ground and low-altitute aerial observations in the general area of the mine failed to provide definitive confirmation of the mine site, although site number MC/FF-1-7 seemed to represent an excavation of sufficient age. Site features that suggested mining activity were subtle and no shale dump or other diagnostic indicator could be found. Vintage (1938) aerial photographs covering the site were examined and an apparent shale dump and possible loading ramp were seen. However, 1975 aerial photographs revealed that these features had been obscured and that a small livestock tank covered most of the original mine area. The shale dump and ramp had apparently been inundated or removed, probably for incorparation in the earthen dam forming the impoundment. Although the evidence is inconclusive, MC/FF-1-7 may represent a mine site. Coal mining at the Chaffin Mine located 1 km (0.6 mi) north was begun several years before 1889 and was discontinued by 1889 or 1892 at the latest. The mine was shallow and apparently was worked discontinuously (Cummins, 1890, pp 152, 159; Drake, 1893, p 433).

Montague County

Montague County is located at the northernmost end of the bituminous coal field in Texas. Coal is found in the Harpersville Formation (Cisco Group). As mapped by Bullard and Cuyler (1930, Plate 3), the Harpersville crops out over 69 km^2 (27 mi^2; 17,000 ac) or about 3% of Montague County's total area of 2390 km^2 (923 mi^2) (fig. 23; table 6). The Pennsylvanian-age Harpersville Formation is a complex stratigraphic unit consisting of interbedded terrigenous clastics and marine limestones, with thin coal beds.

From the 1880's or '90's until the 1920's several bituminous coal mines were in operation. The largest of these mines, at site number M/BM-1-40, may have been operated by three different owners, reopening for the last time in 1910 to 1920 following a period of abandonment or reduced production around the turn of the century. All of the other mines were small and apparently short-lived, never achieving important production levels (table 25).

Steep slopes in the southern portion of the county are heavily wooded, primarily in blackjack and post oaks. Most of the county, however, consists of rolling plains dominated by prairie grasses and associated herbs. Much of the county is presently used for livestock grazing (generally, on unimproved rangeland).

Environmental effects at the sites are varied both in type and intensity (table 26). The most important effects are related to erosion, but potentially serious (although generally undetermined) effects on surface- and ground-water quality are evident at some of the sites. Site number M/BM-1-40 is also of interest because of the presence of well-preserved structures and mining equipment, including numerous concrete pillars (foundations) and a mine car with flanged wheels. Iron rails are still in place at the entrance to this mine.

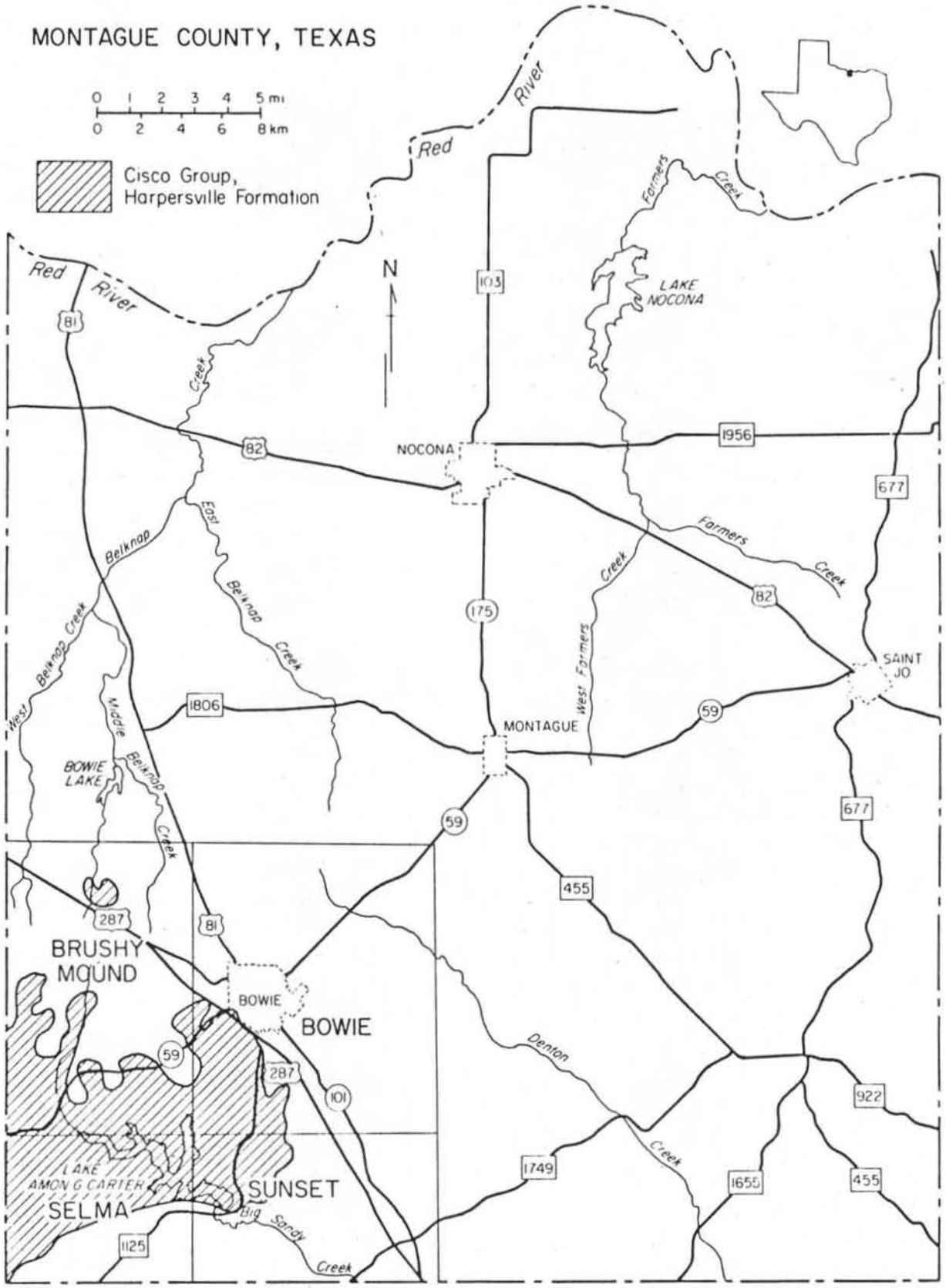


Figure 23. Map of Montague County, Texas, illustrating the outcrop area of the coal-bearing Harpersville Formation, and selected cultural and surface drainage features.

Table 25. Summary of site descriptions--Montague County

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
M/BM-4-1	1	1	----	1889? - early 1890's? (possible operation during the late 1910's, early 1920's)	Unknown (moderate production)	Negligible	Moderate (erosion deposition) to severe (open shaft)
M/BM-1-2	5	1 (surface)	1 (possible subsurface prospecting site)	Unknown (possibly c. 1890 or c. 1920)	Unknown (probably domestic only)	Slight	Moderate
M/BM-1-3	<1	1	----	Opened, abandoned (as mine) before 1888?	No known production	Undetermined	Negligible
M/BM-1-4	40	1 (possibly 2 or more entrances)	----	Opened, possibly abandoned before 1888?; resumed (?) operation about 1914 until about 1919	Unknown (extensive production)	Moderate	Severe

Table 25. Summary of site descriptions--Montague County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
M/BM-3-5	5	1	----	c. 1895 ? (apparently abandoned before 1902)	Railroads, possibly other	Negligible	Moderate
M/BM-3-6	4	----	1 (possible prospecting site)	Unknown (possibly related to operation at site M/BM-3-5)	No known production	Slight	Severe
M/SL-4-1	1	1	----	Unknown (probably 1880's or early 1890's)	Unknown (small production, probably domestic only)	Negligible	Moderate (mass wasting)
Summary: 7 sites	56	6 (possibly 7 or more entrances)	2 (possible prospecting sites)	c. 1895 ? (possibly 1883 or before) - c. 1920 ?	Railroads, probably domestic, possibly other	Negligible to moderate	Negligible to severe

Table 26. Summary of environmental effects in Montague County.

Site Number	C - Confirmed U - Unconfirmed	Acres	Effects on Vegetation	Erosion	Runoff/Deposition			Subsidence	Refuse	Structural Equipment Remains
					Receiving Stream	Impound-ment	Downslope			
M/BM-1-2	C	5	X	X	X		X		X	X
M/BM-1-3	C	<1				X		X		
M/BM-1-4	C	40	X	X		X	X	X	X	X
M/BM-3-5	C	5	X	X		X	X	X	X	X
M/BM-4-1	C	1	X	X		X	X	X	X	X
M/SL-4-1	C	1	X	X			X	X	X	
TOTALS: 6 sites	6 C	52	5	5	1	4	5	5	5	4

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

MONTAGUE County

Size: 1 acre.

Site Number: M/BM/4-1 (possibly part of Stephens Mine complex).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -				
Most Recent -	2/8/72	1MM:26	20	1:20,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Historic record (published); local contact; ground inspection; photointerpretation.

Local Contact: Kent Henry -- Bowie, Texas (rural area).

Accessibility: Limited. Private land. Site is approximately 7.5 km (4.7 mi) southwest of Bowie.

Mining Method: Shaft entrance. Possible vertical air shaft found. Longwall advancing extraction probably employed.

Conditions

Vegetation: Complete revegetation except on shale dump and immediately downslope (barren)--small black willow trees growing in water-filled depression, prairie grasses elsewhere.

Erosion: Moderate sheetwash erosion and gullying on unvegetated shale dump and immediately downslope. Abandonment of meander loops of East Prairie Branch adjacent to and upstream from site was evaluated as a possible effect of mining, but no realistic causal relationship could be found.

Runoff/Deposition:

Receiving stream - East Prairie Branch (intermittent). Effects of sheetwash on stream negligible; effects of leachate undetermined.

Impoundment - Water-filled depression at collapsed mine entrance receives sediment from eroded shale dump. Sediment influx rapid, partly filling depression.

Downslope - Sheetwash deposits distributed discontinuously downslope to stream. Gullies poorly-defined below shale dump. Minor contribution of sediment and runoff to stream.

Subsidence: Shaft entrance partly collapsed, forming steep-walled, unstable depression (slumping of rim apparently continuing). Possible collapsed air shaft.

Refuse: Small shale dump, containing wooden beams and iron rails in addition to shale and coal slack. Small amount of domestic and structural waste in depression at collapsed shaft entrance.

Structural/Equipment Remains: Concrete foundation for machinery adjacent to shaft entrance and shale dump. Iron rails in shale dump (rails not in place).

Hazard Potential: Partly open shaft entrance approximately 15 m (50 ft) in diameter, 6 m (20 ft) deep, and circular in shape. Possible leachate infiltration to water table.

Surrounding Land Use: Grazing (possibly improved prairie rangeland); water storage for livestock; oil and gas production; dairy farming and rural residential (in vicinity).

Remarks: See attached page.

Remarks:

Mine at this site may be part of Stephens Mine complex. The principal Stephens mine was said to be located "....four miles southwest of the town of Bowie, on the Josepha Diaz survey and vicinity...." (Cummins, 1891, p 508). The mine ("tunnel") to which Cummins probably referred is approximately 8 km (5 mi) southwest of the present city limits of Bowie and 3 km (1.9 mi) south of site M/BM-4-1. Cummins (1891, p 508) stated that "Four shafts have been put down to the coal to the north of the tunnel, the farthest about one and a half miles from the tunnel." If by "shaft" Cummins meant a shaft entrance for a mine rather than a drilled prospecting hole (sometimes called a shaft), then the mine at site M/BM-4-1 may be the northernmost of the Stephens mines. If so, then the shaft was at least 45 m (150 ft) deep and had only "recently been put down" at the time of Cummins' visit probably in 1889 (Cummins, 1891, p 508). The shaft was apparently constructed after 1888 since Cummins' (1889, p 50) description of the Stephens mine based on his observations of that year seemingly does not apply to the northernmost shaft of his later report. The tunnel mine was dry and could be worked but "Water was encountered in all the shafts . . . in the sandstone overlying the clay above the coal" and most of these were apparently abandoned soon after completion (Cummins, 1889, p 50; 1891, p 508). The possible exception to this pattern of abandonment was the mine at site M/BM-4-1 which shows evidence of continued operation for at least a brief period, or of renewed activity at a later date. Cummins (1891, p 508) observed that ". . .the quality of the coal was much better (in this shaft). . . than in the others" which could have promoted additional mining efforts. Continued or renewed mining at site M/BM-4-1 is suggested by a shale dump of significant size and a possible (collapsed) air shaft at a distance of 75 m (250 ft) south-southwest from the shaft entrance. Coal mining resumed in the area (at site number M/BM-1-4, possibly elsewhere) in about 1914 and continued until about 1919 (Litteken, unpublished letter, 1970), after an apparent lapse from the early 1890's until 1913 or 1914 (Phillips and Worrell, 1913, p 25; Taff, 1902, p 407).

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

MONTAGUE County

Size: 5 acres.

Site Number: M/BM-1-2

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -				
Most Recent -	2/8/72	1MM:26	15	1:20,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine - Yes. Possible subsurface prospecting site.

Method of Verification: Ground inspection; photointerpretation.

Local Contact: Kent Henry -- Bowie, Texas (rural area). James Brite -- Bowie, Texas.

Accessibility: Limited. Private land. Site is approximately 7.5 km (4.7 mi) southwest of Bowie.

Mining Method: Contour (surface) mine. Shallow excavation into outcrop of thin coal seam exposed around isolated hillock. Possible subsurface prospecting site, as well.

Conditions

Vegetation: Barren to slightly revegetated -- prairie grasses. Eroded slopes barren, sheetwash deposits slightly vegetated.

Erosion: Moderate gullying and sheetwash erosion on steep, excavated slopes particularly on east and west sides of hillock. Deep gullies extend downslope to stream.

Runoff/Deposition:

Receiving stream - Unnamed first-order tributary (intermittent) of East Prairie Branch (intermittent). Slight aggradation in tributary channel.

Impoundment - None present.

Downslope - Gullies extend from excavation to stream, a distance of approximately 215 m (700 ft). Slopewash deposits virtually encircle hill and extend northwest to a fenceline.

Subsidence: None evident.

Refuse: Small spoil mounds within general excavation areas.

Structural/Equipment Remains: Coal miner's grave (crypt) on top of hill (Brite, personal communication, 1979). Crypt and gravestone vandalized (name of deceased, date of burial obscured).

Hazard Potential: Minor contributor of possible water pollutants (sediment, leachate material).

Surrounding Land Use: Grazing (possibly improved prairie rangeland); water storage for livestock; oil and gas production; dairy farming and rural residential (in vicinity).

Remarks: See attached page.

Remarks:

Shallow contour excavations at this site give little indication of a sustained production effort, although a small amount of coal evidently was removed and subsurface prospecting may have occurred. A grave on the hilltop is that of a miner who worked in the mines on this property and others in this vicinity. The miner had requested that upon his death he would be buried at the site; his death was not the result of a mining accident (Brite, personal communication, 1979). Coal seam worked at this site is apparently a thin local lens, higher in the section than the seam worked in underground mines nearby.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

MONTAGUE County

Size: <1 acre.

Site Number: M/BM-1-3 (possibly part of Stephens Mine complex).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -				
Most Recent -	2/8/72	1MM:27	14	1:20,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Historical record (published); local contact; ground inspection; photointerpretation.

Local Contact: Kent Henry -- Bowie, Texas (rural area).

Accessibility: Limited. Private land. Site is approximately 7.7 km (4.8 mi) southwest of Bowie.

Mining Method: Shaft entrance. No air shafts found. Apparently little extraction (shaft filled with water and was converted into well for livestock watering).

Conditions

Vegetation: Revegetation complete -- prairie grasses, few shrubby honey mesquite.

Erosion: Negligible.

Runoff/Deposition:

Receiving stream - Trail Creek (intermittent). No evident transport of sediment to stream.

Impoundment - Adjacent impoundment (livestock watering tank) receives well water from shaft. Water brought to surface by windmill. Water quality unknown, but water is used by cattle.

Downslope - Negligible effects.

Subsidence: Depression (livestock watering tank) adjacent to shaft may represent local subsidence area over possible small mine workings.

Refuse: None evident.

Structural/Equipment Remains: None evident.

Hazard Potential: Source of possibly contaminated water. Water brought to surface by windmill.

Surrounding Land Use: Grazing (possibly improved prairie rangeland in early stage of invasion by honey mesquite); water storage for livestock.

Remarks: See attached page.

Remarks:

Site was possibly one of the Stephens Mines (see description of site number M/BM-4-1). Mine consists of a single shaft entrance and a possible small worked-out area underground. Shaft has been enclosed and a windmill-driven pump installed to provide water for livestock. Cummins (1891, p 508) stated that "Water was encountered in all the (Stephens) shafts . . . in the sandstone overlying the clay above the coal." The quality of water from this well (mine) was undetermined. The water is held at the surface in a small tank, possibly at a point of subsidence.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

MONTAGUE County

Size: 40 acres.

Site Number: M/BM-1-4 (probably Stephens "tunnel" mine).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -				
Most Recent -	2/8/72	1MM:28	14, 15, 19, 20	1:20,000

Status:

Confirmed Mine - Yes. Possibly two or more entrances.

Unconfirmed Mine -

Method of Verification: Historical records (published, unpublished); local contact; ground inspection; photointerpretation.

Local Contact: Dave Rhone -- Bowie, Texas (rural area).

Accessibility: Limited. Private land. Site is approximately 8 km (5 mi) southwest of Bowie.

Mining Method: Slope entrance. Vertical air shafts. Modified longwall advancing extraction (longwall extraction within adjacent "rooms" separated by maintained "entries") probably employed.

Conditions

Vegetation: Barren to partly revegetated--steep slopes, shale dumps, and gullied area downslope essentially barren. Level slope above slope entrance completely revegetated (prairie grasses); moderate slopes adjacent to slope entrance moderately revegetated (blackjack oaks).

Erosion: Severe sheetwash erosion and gullying, particularly on steep slopes and shale dumps. Deep gullies anastomose downslope, forming a well-defined first-order channel. Erosion has exposed the concrete pillar foundations of tipples and other structures (1 m, 3 ft of denudation probable). No evidence of significant mass wasting from steep slope.

Runoff/Deposition:

Receiving stream - Unnamed second-order tributary (intermittent) of Prairie Branch (intermittent). Runoff and sediment influx checked or reduced by conservation impoundments.

Impoundment - Two small artificial impoundments (conservation impoundments) on tributary of Prairie Branch receive rapid runoff/sediment influx, reducing storage capacity.

Downslope - Gullies extend from steep slopes to tributary of Prairie Branch. Earth slides/flows extensive below shale dumps, burying some trees.

Subsidence: Collapsed slope entrance; partly collapsed air shaft. No apparent subsidence over tunnel.

Refuse: Large shale dumps; equipment and structural debris.

Structural/Equipment Remains: Concrete pillar foundations of tipples and other structures. Mine car (damaged) and iron rails (in place).

Hazard Potential: Continued erosion at slope margin above mine entrance could threaten unpaved ranch road. Possible source of surface- and groundwater pollutants.

Surrounding Land Use: Grazing (unimproved prairie rangeland); water storage for livestock; gas and oil production; dairy farming and residential (in vicinity).

Remarks: See attached page.

Remarks:

Site is probably that of the primary Stephens Mine, located ". . .four miles southwest of the town of Bowie, on the Josepha Diaz survey and vicinity" (Cummins, 1891, p 508). Site number M/BM-1-4 is approximately 8 km (5 mi) southwest of the present city limits of Bowie, a distance comparable to that estimated by Cummins. The principal Stephens mine was "A tunnel four hundred feet long. . . driven into the side of a hill on the coal seam. . . " (Cummins, 1891, p 508). Unlike the other Stephens mines, the tunnel was dry and was apparently worked extensively. At least one vertical air shaft was provided at the top of the hill above the mine.

The history of mining in the area is particularly complicated and could not be completely deciphered in the present study. The mine at site number M/BM-1-4 may have been called the McCauley Mine in earlier years (Griggs and Minor, 1977, site number 58266), and was possibly renamed again at a later date. This mine was worked in the 1910's and 20's (Brown, 1978) and achieved major production levels. A variety of well-preserved mining structures and equipment may be seen at the site.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

MONTAGUE County

Size: 5 acres.

Site Number: M/BM-3-5 (possibly Bowie Mine).

Aerial Photography: Date Index # Grid # Scale

Historical -

Most Recent - None available.

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Historical record (published); local contact; ground inspection.

Local Contact: Kent Henry -- Bowie, Texas (rural area).

Accessibility: Direct. County road and railroad rights-of-way and private land. Site is approximately 3.4 km (5.4 mi) northwest of Bowie.

Mining Method: Shaft entrance. No air shafts found. Longwall advancing or modified longwall advancing extraction probably employed. Tipple utilized (Brown, 1978).

Conditions

Vegetation: Barren to sparsely revegetated -- shale dumps and adjacent areas essentially barren; sparse growth of honey mesquite around water-filled depression, and woody xerophytic species along railroad tracks at perimeter of shale dump.

Erosion: Moderate sheetwash erosion on shale dump (almost level), slight gullying at dump perimeter. Railroad track and county road built over part of shale dump; traffic causes coal dust to be blown from road surface. Bar ditch between railroad tracks and highway access road excavated through part of shale dump.

Runoff/Deposition:

Receiving stream - Unnamed third-order tributary (intermittent) of Middle Belknap Creek (intermittent). Negligible runoff/sediment transport into stream.

Impoundment - Water-filled depression at mine site may be collapsed shaft entrance (almost filled) or, more likely, subsidence area over worked-out portion of mine.

Downslope - Moderate slopewash deposits adjacent to shale dump (almost level). Broad, shallow gully transports runoff into bar ditch beside railroad tracks, effects undetermined.

Subsidence: Possible collapsed shaft entrance and/or subsidence over mine workings, forming depression filled with water.

Refuse: Brick and mortar structural debris. Small shale dump (almost level).

Structural/Equipment Remains: Mortared brick structure (probable tipple) adjacent to shale dump. Structure partly collapsed. Former community site (Tiger Town).

Hazard Potential: Source of possible surface- and groundwater pollutants (sediment, leachate); possible adverse effects on cattle watering at site's impoundment.

Surrounding Land Use: Grazing (unimproved range); livestock watering (from impoundment at site); oil and gas production; highway and railway transportation.

Remarks: See attached page.

Remarks:

Site probably corresponds to that of the Bowie Coal Mine, ". . .located near Bowie on the F.W. and C.C. (Fort Worth and Corpus Christi Railroad, now Fort Worth and Denver Railway) (Griggs and Minor, 1977, site number 58360)." Brown (1978) also described a mine (not named) at this site but did not call it the Bowie mine. The apparent function of the mine at site number M/BM-3-5 was to provide coal to the railroad whose tracks ran adjacent.

The mines at this site and at site number M/BM-3-6 are the only confirmed or suspected mines which are located in the Red River drainage basin. All other mine sites are within the Colorado, Brazos, or Trinity River drainage basins.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

MONTAGUE County

Size: 1 acre.

Site Number: M/SL-4-1 (unnamed mine).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -				
Most Recent -	2/8/72	1MM:100	40	1:20,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Local contact; ground inspection; photointerpretation.

Local Contact: Dave Rhone -- Bowie, Texas (rural area).

Accessibility: Limited. Private land. Site is located approximately 9.3 km (5.8 mi) southwest of Bowie.

Mining Method: Drift entrance. Possible (collapsed) air shaft found. Longwall advancing extraction probably practiced.

Conditions

Vegetation: Almost complete revegetation except on shale dump and below (essentially barren). Blackjack oak woodland on steep slope except where damaged by mass wasting of shale dump. Prairie grasses on valley floor below site.

Erosion: Moderate. Local mass wasting has transported mine waste downslope, damaging vegetation and promoting gullying on steep slope. Failure of shale dump occurred because mine waste was mounded more steeply than the 20% gradient of the ridge slope, at an angle probably approaching the angle of repose of the material. Failure thus occurred either as earth slide or earth flow, burying trees below. See "Remarks."

Runoff/Deposition:

Receiving stream - Big Sandy Creek (perennial). Valley floor below site is lower than maximum pool elevation of A.G. Carter Lake and is subject to periodic inundation (shallow water depth in this vicinity). Effects on stream negligible. Sediment from site deposited on slope and on alluvial valley floor adjacent to slope.

Impoundment - Valley floor below site is periodically inundated by A.G. Carter Lake. Effects on lake of sediment, runoff transported from site are undetermined.

Downslope - Evidence of earthslide or earthflow from shale dump at mine entrance. Several blackjack oaks buried, one still living (22 cm or 9 in in diameter) but highly contorted in downslope direction. Orientation of trees suggests possible slight lateral movement of slide/flow rather than simple downslope movement. Living tree partly exhumed by erosion.

Subsidence: Collapsed drift entrance and air shaft.

Refuse: Small shale dump.

Structural/Equipment Remains: None evident.

Hazard Potential: Continued mass wasting including earth slides/flows and rock topples (see "Remarks"). Possible lake water contamination.

Surrounding Land Use: Grazing (unimproved woodland and valley grassland); oil and gas production. Water storage and possible periodic flatwater recreation (A.G. Carter Lake).

Remarks: See attached page.

Remarks:

Site number M/SL-4-1 is not reported in the literature referring to historic coal mining in Montague County. The principal significance of this one acre site in the present study is that it exhibits well-developed mass wasting. Two types of mass wasting occur at this site: (1) either earth slides or earth flows, or a combination of both processes; and (2) rock topples. Use of these terms follows Varnes (1975). Earth slides, earth flows, and rock topples are briefly discussed in the chapter of this report entitled "Environmental Effects." At site number M/SL-4-1, rock topples are a natural event and may be noticed along the entire length of the east-facing slope on which this site is located, including areas not known to have been affected by mining activities. Apparently, however, coal mining at this confirmed mine site has accelerated rock toppling, allowing more large boulders to move farther down the slope in the immediate vicinity of the mine. A thick, competent limestone bed caps the ridge. Underlying this bed are mudstones, thin calcareous sandstones, and coal strata (mostly covered by soil and float material). These underlying beds are less resistant to weathering than is the limestone stratum. The resulting steep slope is unstable, causing the limestone to break into large joint blocks along the edge of the ridge. As these blocks break free they tilt or topple forward. The excavation along this ridge, while affecting only a small surface area approximately midway up the slope, has steepened the slope above the site, accelerating rock toppling even over the geologically brief time interval since active mining (mining occurred elsewhere in the county between the 1880's or 90's and the 1920's). Possible construction of an air shaft (obscured by float blocks but suggested by local topography) at the site may have accelerated this mass wasting even further.

Table 27. Confirmed (C) and Probable(P) mines less than five acres - Montague County.

Site Id	Size (acres)	Status	Mine Type	Photo Date	Number	Grid
M/BM-3-6	4	P	Contour? (possible prospecting site).	(None available.)		

Palo Pinto County

The majority of abandoned mines in Palo Pinto County (excluding the Thurber Mines) are located near the communities of Strawn and Gordon. The mines are within and north of the outcrop area of the coal-bearing Mingus Formation (fig. 24). The formation extends northeastward from the Thurber area and crops out over approximately 146 km^2 (36,000 ac) or almost 6% of Palo Pinto County (table 6).

The Strawn mines (5 mine sites) were considerably more productive and contributed more to the economy of the county than those in the Gordon area (table 28). The combined production of the Gordon Mines (3 mine sites) was 600 tons per day while one Strawn mine (number 4) alone produced 580 tons per day (Cummins, 1891, p. 532-533; Plummer and Hornberger, 1935, p. 198, plate 7).

The Gordon Mines were identified with difficulty on aerial photographs because they were well masked by vegetation, and they resembled small eroded areas along hillsides. Other mines in the county were less difficult to detect because large spoil deposits are present.

Land cover near Strawn and Gordon, and in the area between the two communities, includes dry cropland, forest land and a small amount of rangeland. The soil is dark red to reddish brown in color and is moderately deep with loamy surface layers and clayey subsoils (Godfrey, McKee, and Oakes, 1973). The eastern portion of Palo Pinto county (Gordon area) includes more woody vegetation and has greater relief than the southwestern area (Strawn vicinity) of the county. Environmental effects of coal mining in the county are summarized in Table 29.

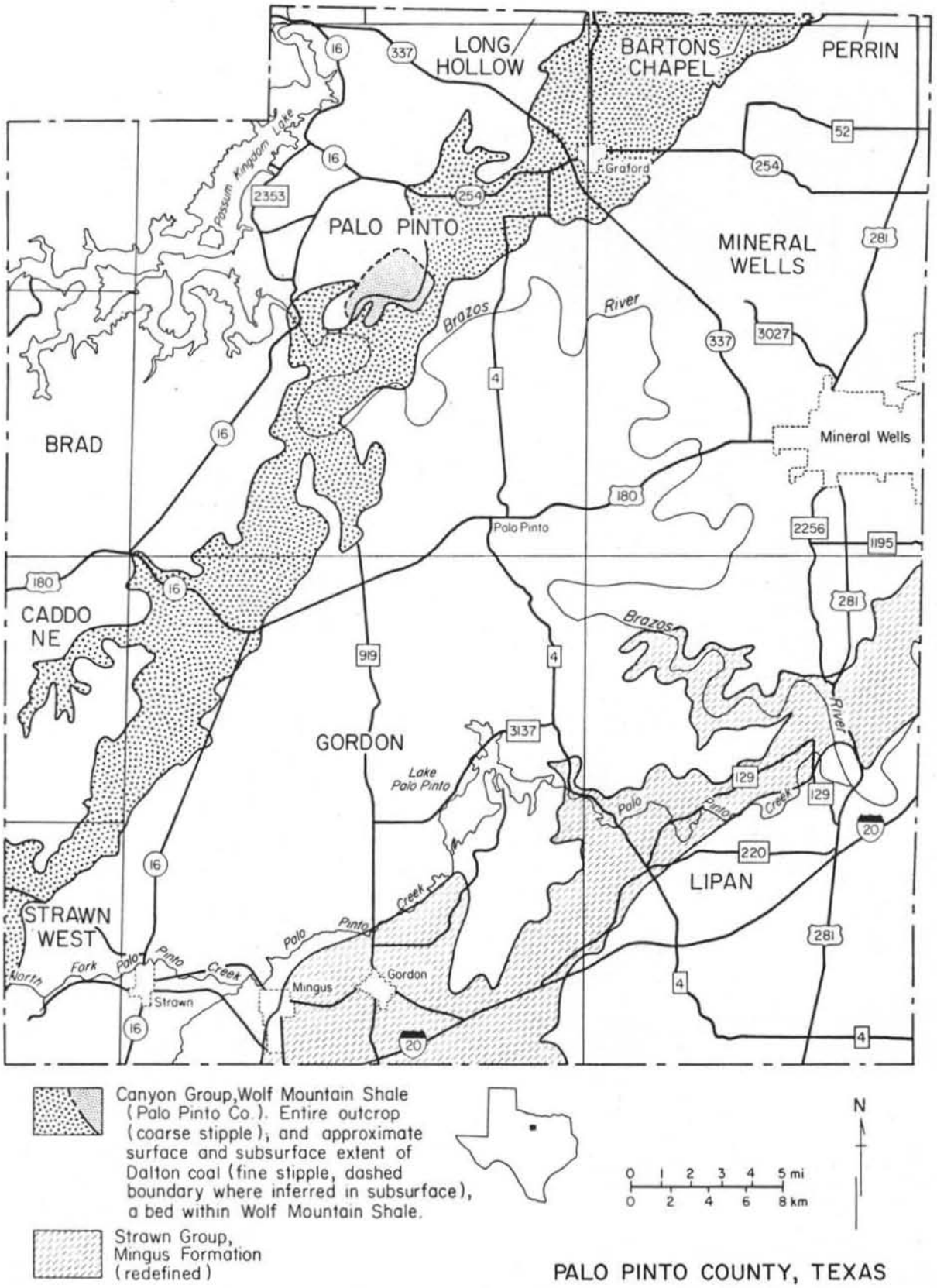


Figure 24. Map of Palo Pinto County, Texas, illustrating the outcrop areas of the Wolf Mountain Shale and coal-bearing Mingus Formation, the outcrop area and known subsurface extent of the Dalton coal (a localized seam within the Wolf Mountain Shale), and selected cultural and surface drainage features.

Table 28. Summary of site descriptions--Palo Pinto County

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
PP/G-2-1 Obel Mine	2	1	----	Operating in 1924	Domestic and Texas and Pacific Railroad	Negligible	Negligible
PP/G-2-7 Mt. Marion mine	10	1	----	Opened 1895 Closed before 1933	Texas and Pacific Railroad	Moderate (small impoundment)	Severe
PP/G-2-9 Lyra Siding mine	8	1	----	Mine worked after 1902 and before 1919	Texas and Pacific Railroad	Negligible	Moderate
PP/G-2-10 Strawn shaft number 2	12	1	----	Unknown	Texas and Pacific Railroad	Slight (small impoundment)	Severe

Table 28. Summary of site descriptions--Palo Pinto County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
PP/G-2-11 Strawn shaft number 4	8	1	----	Opened between 1902 - 1910 Unknown closing date	Texas and Pacific Railroad	Negligible	Severe
PP/G-2-12 Strawn shaft number 3	2	1	----	Opened 1897 Closed between 1910 - 1914	Texas and Pacific Railroad	Negligible	Slight
PP/G-1-2	3	1	----	Opened early 1880's Closed 1891	Unknown	Negligible	Slight
PP/G-1-3	1	1	----	Opened early 1880's Closed 1891	Unknown	Negligible	Slight

Table 28. Summary of site descriptions--Palo Pinto County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
PP/G-1-4	1	1	----	Opened early 1880's Closed 1891	Unknown	Negligible	Slight
PP/G-1-8	2	1	----	Unknown	Unknown	Negligible	Slight
PP/G-1-6	2	1	----	Unknown	Unknown	Negligible	Slight
PP/G-1-5	2	1	----	Unknown	Domestic use	Negligible	Negligible

Table 28. Summary of site descriptions-- Palo Pinto County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
County Summary: 12 sites	53	12	0	From 1880's to before 1933	Texas and Pacific Railroad, domestic use	Negligible	Slight

Table 29. Summary of environmental effects in Palo Pinto County.

Site Number	C - Confirmed U - Unconfirmed	Acres	Effects on Vegetation	Erosion	Runoff/Deposition			Subsidence	Refuse	Structural Equipment Remains
					Receiving Stream	Impound-ment	Downslope			
PP/G-2-52	C	8	X	X			X		X	
PP/G-2-53	C	12	X	X			X		X	
PP/G-2-54	C	8	X	X			X		X	
PP/G-2-51	C	13	X	X			X		X	
PP/G-2-7	C	10	X	X		X	X	X	X	
PP/G-2-9	C	8		X			X		X	
PP/G-2-10	C	12	X	X		X	X	X	X	X
PP/G-2-11	C	8	X	X		X	X	X	X	X
TOTALS: 8 sites	8 C	79	7	8	0	3	8	3	8	2

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

PALO PINTO County

Size: 10 acres

Site Number: PP/G-2-7

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -				
Most Recent -	9/30/77	277-123	42	1:40,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Photointerpretation, historical literature and low-level aircraft observations.

Local Contact: None.

Accessibility: Good.

Mining Method: Shaft mine.

Conditions

Vegetation: Sparsely vegetated.

Erosion: Moderate sheetwash and significant gullying.

Runoff/Deposition:

Receiving stream - None.

Impoundment - Small impoundment appears to be moderately affected by runoff.

Downslope - A broad flat area receives runoff containing leachate and sediment (pulverized coal and carbonaceous shale) from spoil deposits.

Subsidence: A few shallow depressions including a possible collapsed mine entrance.

Refuse: Large clay and shale mound and a widespread deposit of coal and carbonaceous shale.

Structural/Equipment Remains: None.

Hazard Potential: Nearby settlement; ready access.

Surrounding Land Use: Rangeland (moderately good) and improved pasture.

Remarks: This site is southwest of Strawn and slightly outside the city limits. Possibly known as the Mt. Marion mine.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

PALO PINTO County

Size: 8 acres

Site Number: PP/G-2-9

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -				
Most Recent -	9/30/77	277-124	29	1:40,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Photointerpretation, limited on-site observation, low level aircraft observation and historical information.

Local Contact: None.

Accessibility: Good, adjacent to highway.

Mining Method: Vertical shaft mine.

Conditions

Vegetation: Moderate tree cover, sparse groundcover (grasses).

Erosion: Apparent sheetwash adjacent to the mine spoil deposit.

Runoff/Deposition:

Receiving stream - Distant, insignificant deposition.

Impoundment - No impoundment.

Downslope - Broad sheetwash erosion downslope from the spoil deposits.

Subsidence: Difficult to determine because of current use of the site (see remarks).

Refuse: Substantial mine spoil deposits consisting primarily of shale.

Structural/Equipment Remains: Difficult to determine (see remarks).

Hazard Potential: Insignificant.

Surrounding Land Use: Rangeland (appears to be overgrazed).

Remarks: This site is now a cinder block and tile manufacturing plant. The mine spoil deposits serve as a source for raw materials and will eventually be depleted if manufacturing continues. The coal mine is the Lyra Siding Mine.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

PALO PINTO County

Size: 12 acres

Site Number: PP/G-2-10

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -				
Most Recent -	9/30/77	277/124	27	1:40,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Historical information, low level aircraft observation, photointerpretation of recent aerial photography.

Local Contact: None.

Accessibility: Limited, remote location.

Mining Method: Vertical shaft mine.

Conditions

Vegetation: Barren (Mine site is a large spoil deposit).

Erosion: Severe sheetwash.

Runoff/Deposition:

Receiving stream - None.

Impoundment - Small impoundment (unknown water quality) receives a moderate amount of runoff from the site.

Downslope - Areas immediately adjacent to the spoil deposit exhibit significant sheetwash erosion.

Subsidence: Shallow depressions.

Refuse: Large deposit of mine spoil consisting of coal, clay and shale.

Structural/Equipment Remains: Possible structural and equipment debris observed.

Hazard Potential: Remote, no nearby settlement within one mile; limited access.

Surrounding Land Use: Rangeland (appears to be moderately overgrazed).

Remarks: This mine is Strawn shaft number 2. A considerable amount of mining took place at this site as evidenced by the amount of deposited spoil.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

PALO PINTO County

Size: 8 acres

Site Number: PP/G-2-11

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -				
Most Recent -	9/30/77	277-125	29	1:40,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Historical literature, low level aircraft observation, and interpretation of recent aerial photography.

Local Contact: None.

Accessibility: Limited, remote location.

Mining Method: Vertical shaft mine.

Conditions

Vegetation: Barren.

Erosion: Severe sheetwash.

Runoff/Deposition:

Receiving stream - None.

Impoundment - Distant downslope impoundment receives a slight amount of runoff. This will gradually increase as more downslope vegetation is destroyed by leachate (see progressive devegetation) and deposition.

Downslope - Broad area of sheetwash erosion immediately downslope of the spoil deposit.

Subsidence: Shallow depressions.

Refuse: Large towering single deposit (coal, shale and clay).

Structural/Equipment Remains: Structural or equipment debris observed from low level aircraft observation.

Hazard Potential: Remote--no settlement within one mile, difficult access.

Surrounding Land Use: Rangeland (appears to be moderately overgrazed) with no woody vegetation.

Remarks: Possibly Strawn Mine number 4.

Table 30 . Confirmed (C) and Probable(P) mines less than five acres - Palo Pinto County.

Site Id	Size (acres)	Status	Mine Type	Photo Date	Number	Grid
PP/G-1-2	3	C	Slope	9/30/77	277-87	30
PP/G-1-3	1	C	Slope	9/30/77	277-87	24
PP/G-1-4	2	C	Slope	9/30/77	277-87	23
PP/G-1-5	2	C	Slope	9/30/77	277-86	8/13
PP/G-1-6	2	C	Slope	9/30/77	277-87	30
PP/G-1-8	2	C	Slope	9/30/77	277-87	29
PP/G-2-1	2	C	Shaft	9/30/77	277-123	9
PP/G-2-12	2	C	Shaft	9/30/77	277-125	24

Parker County

All abandoned mine sites (confirmed and probable) in Parker County are located between Millsap and Mineral Wells (the latter in Palo Pinto County). These sites are north of the outcrop of the coal-bearing Mingus Formation near the western edge of the county (fig. 25). The Mingus Formation in Parker County crops out over an area of approximately 12,000 acres (table 6), and dips to the northwest.

With the exception of two mines (P/MW-1-3 and P/MW-1-4), the mines in Parker County are very difficult to identify on aerial photographs. Although mining activity was intensive, the mine sites are small (table 31) and now densely vegetated, and are usually located within ravines or on hillsides (slope and drift mines).

Land use in the area in which the abandoned mines are found includes non-irrigated cropland and forest land. The terrain is hilly with steep and densely vegetated slopes. Environmental effects of coal mining in the county are summarized in Table 32.

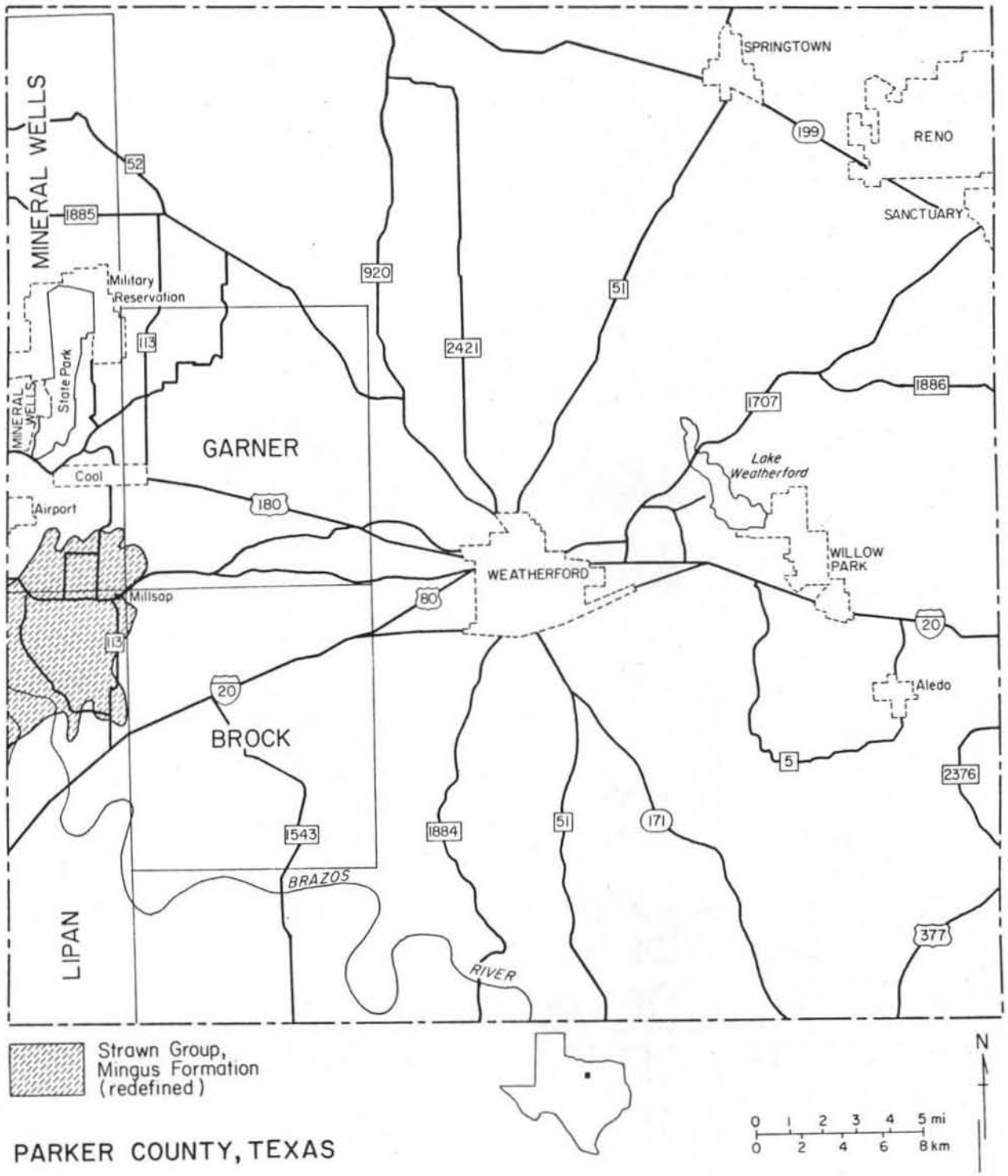


Figure 25. Map of Parker County, Texas, illustrating the outcrop area of the coal-bearing Mingus Formation, and selected cultural and surface drainage features.

Table 31. Summary of site descriptions--Parker County

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
P/MW-1-9	5	----	1	Unknown	Unknown	Negligible	Negligible
P/MW-1-3 Rock Creek shaft number 2	5	1	----	Opened between 1891 - 1902, closed before 1910	Texas Coal and Fuel Company	Severe (creek)	Moderate
P/MW-1-4 Rock Creek shaft number 1	5	1	----	Opened between 1891 and 1902, closed prior to 1910	Texas Coal and Fuel Company	Negligible	Moderate
P/MW-1-10 Brown Mine	1	1	----	Closed before 1891	Unknown	Negligible	Negligible

Table 31. Summary of site descriptions--Parker County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
P/MW-1-13	1	1	----	Unknown	Unknown	Negligible	Negligible
P/MW-1-7 Lake Mine	1	1	----	Closed 1891	Texas and Pacific Railroad	Negligible	Negligible
P/MW-1-8 Helm Shaft	1	1	----	Unknown	Private use	Negligible	Negligible
P/MW-1-5 Johnson Shaft	1	1	----	Unknown	Unknown	Negligible	Negligible

Table 31. Summary of site descriptions--Parker County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
P/MW-1-6 Carson and Lewis mine	2	1	----	Closed 1891	Carson and Lewis flour mill	Negligible	Negligible
P/MW-1-14 Stone Shaft	1	1	----	Unknown	Unknown	Negligible	Negligible
County Summary: 10 sites	23	9	1	From 1891 to before 1910	Mixed usage	Negligible	Negligible

Table 32. Summary of environmental effects in Parker County.

Site Number	C - Confirmed U - Unconfirmed	Acres	Effects on Vegetation	Erosion	Runoff/Deposition			Subsidence	Refuse	Structural Equipment Remains
					Receiving Stream	Impound-ment	Downslope			
P/MW-1-3	C	5	X	X	X		X	X	X	X
P/MW-1-4	C	5	X				X		X	X
P/MW-1-9	U	5	X	X			X	X		
TOTALS: 3 sites	2 C 1 U	15	3	2	1	0	3	2	2	2

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

PARKER County

Size: 5 acres.

Site Number: P/MW-1-3

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	12/27/47	50	27	1:20,000
Most Recent -	Unavailable.			

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Photointerpretation, historical literature and distant observation.

Local Contact: None.

Accessibility: No direct route.

Mining Method: Shaft mine.

Conditions

Vegetation: Barren spoil deposit with moderately vegetated adjacent areas.

Erosion: Spoil deposit exhibits considerable gullying. Insignificant erosion adjacent to the spoil deposit (see remarks).

Runoff/Deposition:

Receiving stream - See remarks.

Impoundment - Small impoundment unaffected by runoff.

Downslope - Rock Creek receives runoff (see remarks).

Subsidence: Linear depression adjacent to an open mine shaft or entrance (identified from photography).

Refuse: Large mine spoil deposit.

Structural/Equipment Remains: Possible loading platform at railroad grade and other structures next to the mine entrance.

Hazard Potential: Settlement within one mile of site; no ready access.

Surrounding Land Use: Mixed land use but primarily rangeland (good condition).

Remarks: Rock Creek (Parker Co.) receives direct runoff (leachate and sediment) from a mine spoil deposit immediately adjacent to the creek. Interpretation of 1947 photography reveals only slight deposition at the stream entry point, but this may be more pronounced at this time. Current erosion, vegetative, and subsidence conditions could not be determined because the site could not be visited (difficult access) and current aerial photography is

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

PARKER County

Size: 5 acres.

Site Number: P/MW-1-4

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	12/27/47	50	23	1:20,000
Most Recent -	Unavailable.			

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Photointerpretation, historical literature and an on-site observation (distant view).

Local Contact: None.

Accessibility: Limited (owner approval required).

Mining Method: Vertical shaft mine.

Conditions

Vegetation: Barren.

Erosion: Insignificant.

Runoff/Deposition:

Receiving stream - None.

Impoundment - None.

Downslope - Slight sheetwash erosion adjacent to the mine spoil deposit.

Subsidence: None.

Refuse: Single large spoil deposit.

Structural/Equipment Remains: Possible loading platform.

Hazard Potential: Remote, no settlement within one mile; ready access.

Surrounding Land Use: Rangeland (good condition).

Remarks: The mine site area does not appear to be disturbed or damaged except for the presence of a large spoil deposit.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

PARKER County

Size: 5 acres.

Site Number: P/MW-1-9

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	12/27/47	51	23	1:20,00
Most Recent -	Unavailable.			

Status:

Confirmed Mine -

Unconfirmed Mine - Probable mine site.

Method of Verification: Photointerpretation.

Local Contact: None available.

Accessibility: No direct route, remote location.

Mining Method: Possible shaft mine.

Conditions

Vegetation: Sparsely vegetated.

Erosion: Slight sheetwash and gullying.

Runoff/Deposition:

Receiving stream - Insignificant.

Impoundment - None.

Downslope - Two channels carry runoff to receiving stream (no deposition).

Subsidence: Slight subsidence as shallow depressions.

Refuse: No refuse visible on photography.

Structural/Equipment Remains: None visible on photography.

Hazard Potential: Remote, no settlements within one mile; no ready access.

Surrounding Land Use: Rangeland (good condition).

Remarks: No additional information concerning current conditions is available and the above information is based on interpretation of 1947 aerial photography.

Table 33 . Confirmed (C) and Probable(P) mines less than five acres - Parker County.

Site Id	Size (acres)	Status	Mine Type	Photo Date	Number	Grid
P/M W-1-10	1	C	slope	12/27/47	51	30
P/M W-1-13	1	C	slope	12/27/47	52	23
P/M W-1-7	1	C	drift	12/27/47	51	13
P/M W-1-8	1	C	shaft	12/27/47	50	30
P/M W-1-5	1	C	slope	12/27/47	50	19
P/M W-1-6	2	C	slope	12/27/47	50	14
P/M W/-1-14	1	C	unknown	12/27/47	50	33

Stephens County

Coal mined in Stephens County was used primarily for domestic and industrial purposes (e.g., fueling cotton gins and brick plants). The majority of abandoned mines are located in the northern part of the county (near Crystal Falls), and are within the Harpersville Formation outcrop area (fig. 26). The outcrop extends north-south across the western half of Stephens County and covers approximately 554 km^2 (214 mi^2; 137,000 ac) or almost 24% of the county (table 6).

The mines were small operations (table 34), either surface or drift types, and are extremely difficult to identify using aerial photographs. Historical literature and personal interviews with citizens of Crystal Falls provided information regarding the locations of abandoned mines.

Most of the area in which the mines are located is utilized for grazing. The terrain is gently rolling with a dense drainage network of perennial and intermittent streams. Soils in Stephens County characteristically develop loamy surface layers and clayey subsoils (Godfrey, McKee and Oakes, 1973). Environmental effects of coal mining in the county are summarized in Table 35.

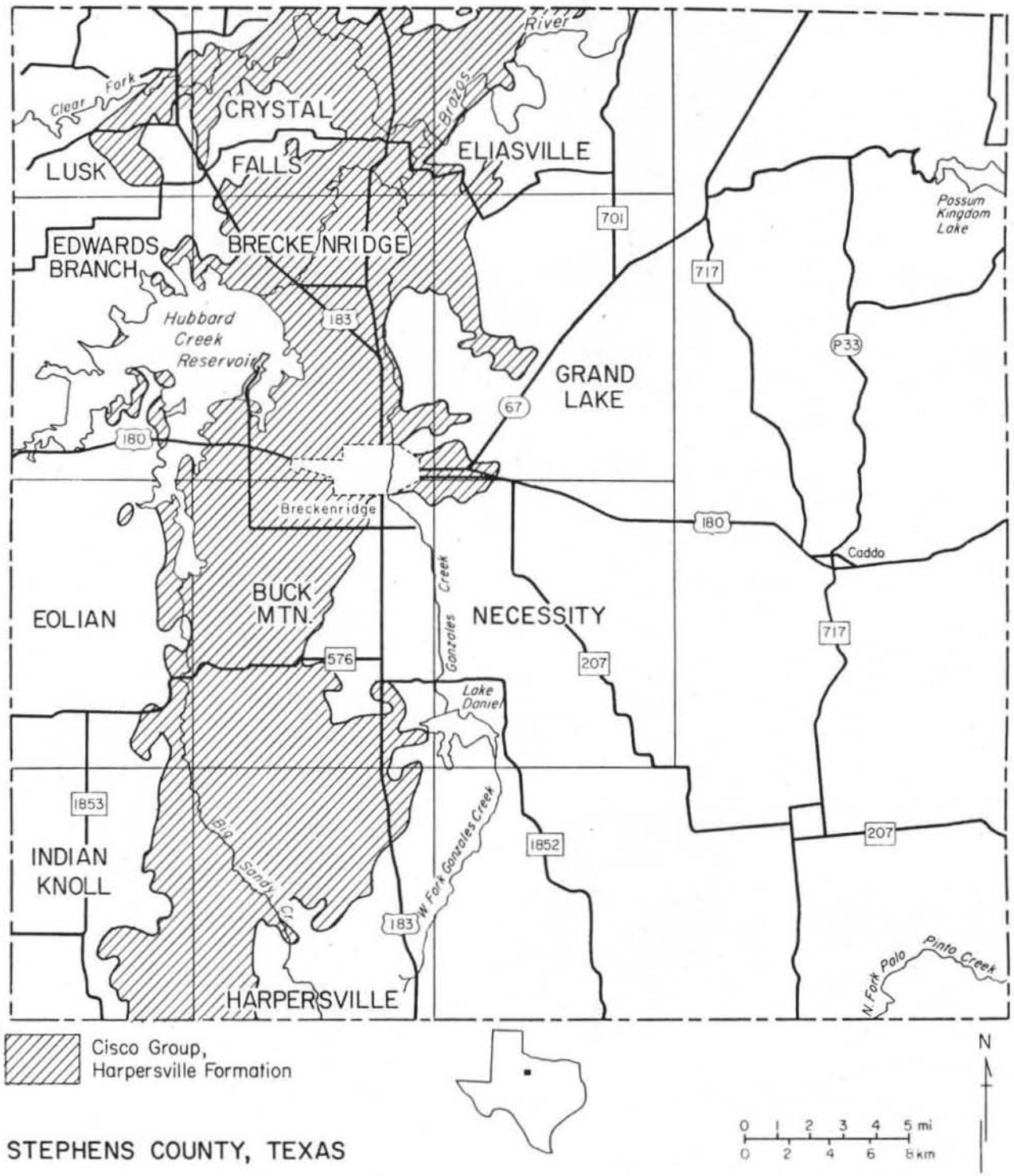


Figure 26. Map of Stephens County, Texas, illustrating the outcrop area of the coal-bearing Harpersville Formation, and selected cultural and surface drainage features.

Table 34. Summary of site descriptions--Stephens County

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
S/CF-1-1 Berry Meadows mine	½ acre	1	----	Unknown	Domestic use	Negligible	Negligible
S/CF-1-2 Jake Wizeart mine	4	1	----	Unknown	Domestic and industrial use	Nebligible	Negligible
S/CF-1-3	Less than ¼ acre.	1	----	Unknown	Domestic use	Negligible	Negligible
S/B-2-1	13	1	----	Unknown	Fort Griffin (abandoned Army post)	Moderate (Impoundment)	Severe

Table 34. Summary of site descriptions--Stephens County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
S/B-2-2	10	----	1	Unknown	Unknown	Slight (Impoundment)	Severe
S/CF-1-4	Less than 1 acre	1	----	Unknown	Unknown	Negligible	Negligible
S/CF-1-5	Less than 1 acre	1	----	Unknown	Unknown	Negligible	Negligible
S/CF-1-6	Less than 1 acre	----	1	Unknown	Unknown	Negligible	Negligible

Table 34. Summary of site descriptions--Stephens County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
County Summary: 8 sites	Approx. 29 acres	6	2	Unknown	Domestic use	Negligible	Negligible

Table 35. Summary of environmental effects in Stephens County.

Site Number	C - Confirmed U - Unconfirmed	Acres	Effects on Vegetation	Erosion	Runoff/Deposition			Subsidence	Refuse	Structural Equipment Remains
					Receiving Stream	Impound-ment	Downslope			
S/CF-1-1	C	<1								
S/CF-1-2	C	4		X			X	X	X	
S/CF-1-3	C	<1								
S/B-2-1	C	13	X	X		X	X		X	
S/B-2-2	C	10	X	X		X		X	X	
TOTALS: 5 sites	5 C	27	2	3	0	2	2	2	3	0

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

STEPHENS County

Size: 13 acres.

Site Number: S/B-2-1

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/16/41	CUU-3B-152	15/20	1:20,000
Most Recent -	1/18/64	CUU-1EE-61	5/10	1:20,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Photointerpretation, historical literature, and observation from a distance.

Local Contact: None.

Accessibility: Direct route (permission to enter property is required).

Mining Method: Surface mine.

Conditions

Vegetation: Moderate vegetation (grass) except on slopes which are sparsely vegetated.

Erosion: Severe sheetwash and gullying (active).

Runoff/Deposition:

Receiving stream - Negligible effect (earthen tank collects runoff).

Impoundment - Two impoundments: one receives direct runoff from the excavated area and is very turbid. The other impoundment receives only a slight amount of runoff and is clear.

Downslope - Considerable gullying adjacent to the excavated hillside.

Subsidence: No visible subsidence.

Refuse: Small spoil deposits and considerable runoff-deposited coal and shale materials.

Structural/Equipment Remains: None (a few unrelated items were observed on photographs).

Hazard Potential: Remote, no settlement within one mile; ready access route.

Surrounding Land Use: Pasture (unimproved).

Remarks: See attached page.

Remarks:

Location known as Coal Mountain. Cummins (1891, p 541) has stated that ". . . considerable prospecting has been done here at one time, and the coal mined was taken to Fort Griffin, but since the removal of the troops from that place the work has been abandoned." A comparison between historical (1941) and recent photographs shows an increase in surface degradation and in the amount of disturbed area.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

STEPHENS County

Size: 10 acres.

Site Number: S/B-2-2

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/16/41	CUU-3B-153	14/19	1:20,000
Most Recent -	1/18/64	CUU-1EE-60	4/9	1:20,000

Status:

Confirmed Mine -

Unconfirmed Mine - Probable mine site.

Method of Verification: Photointerpretation.

Local Contact: None.

Accessibility: Limited access (no direct route).

Mining Method: Surface mine.

Conditions

Vegetation: Sparsely vegetated.

Erosion: Slight sheetwash, and severe gullying. Apparent scarp retreat.

Runoff/Deposition:

Receiving stream - None.

Impoundment - A small earthen tank collects all runoff from this probable mine site and appears to be in good condition.

Downslope - The earthen tank is downslope between the site and the receiving stream.

Subsidence: Several small depressions.

Refuse: Small spoil deposits and runoff-deposited coal and shale materials.

Structural/Equipment Remains: None.

Hazard Potential: Remote, no settlement within one mile; no ready access.

Surrounding Land Use: Rangeland (good condition).

Remarks: The outcrop on the side of a hill appears to have been excavated for coal. This was probably a small site originally, but because of constant erosion, it has increased in size and become more disturbed.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

STEPHENS County

Size: <1 acre (see "Remarks").

Site Number: S/CF-1-1.

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	9/6/41	CUU-5B-73	33	1:20,000
Most Recent -	1/18/64	CUU-1EE-229	28	1:20,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Photointerpretation, historical literature and on-site observation.

Local Contact: Jay Mercer -- Crystal Falls.

Accessibility: Limited access (remote location).

Mining Method: Drift mine with no roof.

Conditions

Vegetation: Partial revegetation except within excavated open tunnel.

Erosion: Negligible.

Runoff/Deposition:

Receiving stream - Negligible effect.

Impoundment - None present.

Downslope - Negligible effect.

Subsidence: None.

Refuse: Negligible.

Structural/Equipment Remains: None.

Hazard Potential: Remote, no settlement within one mile; no ready access.

Surrounding Land Use: Rangeland (good condition).

Remarks: Mine known as the Berry Meadows mine. This mine site has been noted because of its unique mine type. The mine is a long, narrow rectangular tunnel approximately 15 m (50ft) long with no roof. No other mine investigated exhibits this open roof condition.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

STEPHENS County

Size: 4 acres (see "Remarks").

Site Number: S/CF-1-2

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	9/6/41	CUU-5B-73	22	1:20,000
Most Recent -	1/18/64	CUU-1EE-228	20	1:20,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Photointerpretation, historical literature, and on-site examination.

Local Contact: Jay Mercer -- Crystal Falls.

Accessibility: Limited (owner approval, and a guide is recommended).

Mining Method: Drift mine.

Conditions

Vegetation: Moderately vegetated with woody vegetation.

Erosion: Possible scarp retreat above mine entrance (mine is located at the head of a ravine).

Runoff/Deposition:

Receiving stream - Negligible effect.

Impoundment - None present.

Downslope - Shallow, meandering channel transports runoff to the receiving stream.

Subsidence: Limited subsidence in and around the mine entrance. Subsidence is also apparent at a location approximately 120 m (400 ft) from the entrance.

Refuse: Small mine spoil deposits near mine entrance.

Structural/Equipment Remains: None.

Hazard Potential: Remote, no settlement within one mile; no ready access.

Surrounding Land Use: Rangeland (good condition).

Remarks: Mine known as the Jake Wizeart mine. Cummins (1891, p 537) stated that "...more work has been done at this place than at any other opening in this county." Coal from this mine was used by the communities of Crystal Falls and Breckenridge for domestic and industrial purposes.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

STEPHENS County

Size: <1 acre (see "Remarks").

Site Number: S/CF-1-3

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	9/6/41	CUU-5B-73	33	1:20,000
Most Recent -	1/18/64	CUU-1EE-229	28	1:20,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Historical literature, and an on-site examination.

Local Contact: Jay Mercer -- Crystal Falls.

Accessibility: Difficult because of remote location.

Mining Method: Drift mine.

Conditions

Vegetation: Almost complete revegetation except at mine entrance (barren).

Erosion: Negligible.

Runoff/Deposition:

Receiving stream - Negligible effect.

Impoundment - None present.

Downslope - Negligible effect.

Subsidence: None.

Refuse: None.

Structural/Equipment Remains: None.

Hazard Potential: Remote, no settlement within one mile; no ready access.

Surrounding Land Use: Rangeland (good condition).

Remarks: See attached page.

Site Number S/CF-1-3 (cont.)

Remarks:

This mine has been noted because it is still open. The opening is approximately 1.5 m (5 ft) wide and 1 m (3 ft) high. The interior dimensions are the same as the opening and the tunnel extends 10 m (30 ft) into the side of the hill. Shoring posts are still in place on both sides of the entrance. The opening is masked by vegetation. There is no mining debris outside the entrance. Mine was probably abandoned at the same time as were others in the area (1880's).

Table 36. Confirmed (C) and Probable(P) mines less than five acres - Stephens County.

Site Id	Size (acres)	Status	Mine Type	Photo Date	Number	Grid
S/CF-1-4	<1	C	shaft	1/18/64	1EE-229	28
				9/16/41	5B-73	33
S/CF-1-5	<1	C	slope/drift	1/18/64	1EE-229	27
				9/6/41	5B-73	32
S/CF-1-6	<1	P	shaft	1/18/64	1EE-229	27
				9/6/41	5B-73	32

Wise County

Wise County encompasses the easternmost extent of important near-surface bituminous coal reserves in Texas (fig. 27). The coal-bearing strata are within the Palo Pinto Formation (Canyon Group), a complex sequence of terrigenous clastics and limestones, as well as coal. The late Pennsylvanian age Palo Pinto Formation, as mapped by Evans (1974, Plate 1.) and Barnes (1967), crops out over an area of approximately 40 km^2 (16 mi^2; 10,000 ac) in Wise County, or roughly 2 percent of the county's total area of more than 2350 km^2 (907 mi^2; 580,300 ac) (table 6). One coal seam, the Bridgeport Coal, crops out over part of this limited area. At depths of less than 305 m (1000 ft), the Bridgeport Coal is very restricted in the subsurface, as well (Mapel, 1967, Figure 8).

The Bridgeport Coal was mined in Wise County (table 37) before 1888 (Cummins, 1889, p. 49), possibly as early as about 1860 (Griggs and Minor, 1977, site number 58069) although this is a dubious record. Mining continued with few interruptions until about 1943; in fact, Stenzel and others (1948, p. 35) reported that "Mining operations in this bed were the last (bituminous coal mines) to close down in the State," despite the fact that the last officially reported bituminous coal production in Texas was from Palo Pinto County in 1943 (Stenzel, 1943, p. 203; Stenzel and others, 1948, p. 42).

Most of the mines were small, short-lived operations employing slope mining techniques with little mechanization. The largest, longest operating, and most successful mines had deep shaft entrances and were partly mechanized, although both the large and small mines relied on animal haulage and at least some hand mining throughout their production histories (Broman, 1915, table opposite p. 24; Bullock, 1925, p. 4,10). Most of the county's mines are located within the present city limits of Bridgeport; the other known mines are found no more than 4 km (2.5 mi) southwest or northeast of the city.

Coal was produced at these mines primarily for local consumption, and for use by the railroads, with only a fraction of the total production marketed in other cities served by the railroads (Cummins, 1889, p. 49; Scott and Armstrong, 1932, p. 72). The community life of Bridgeport was, to a great extent, dependent upon the coal mines. Cummins (1891, p. 518) implied that railroads were extended to the community in part because of the availability of coal. After the first railroad entered the area, Bridgeport citizens relocated the townsite, preferring to be closer to the tracks than the original location along the West Fork of the Trinity River, 1.4 km (0.9 mi)

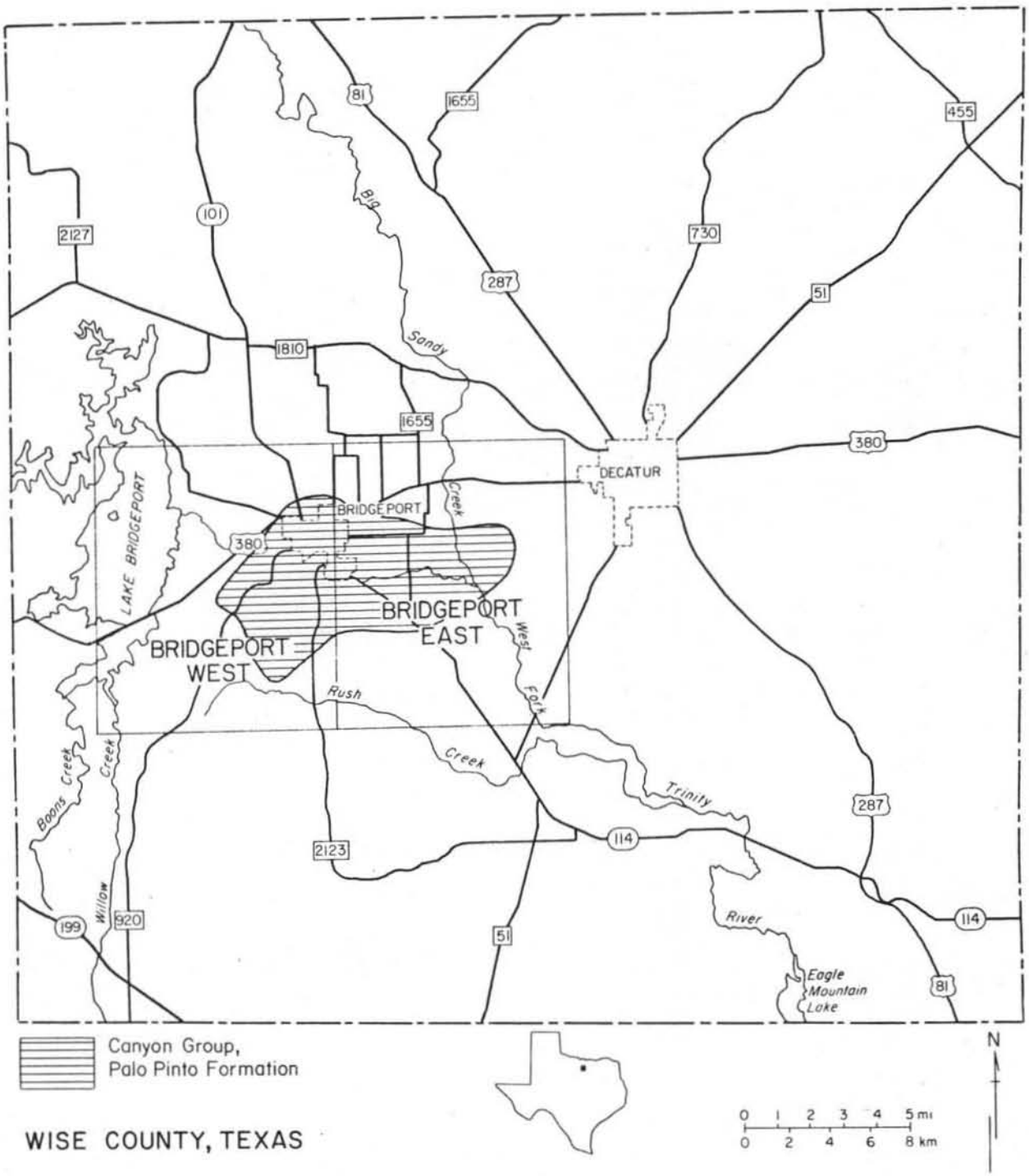


Figure 27. Map of Wise County, Texas, illustrating the outcrop area of the coal-bearing Palo Pinto Formation, and selected cultural and surface drainage features.

Table 37. Summary of site descriptions--Wise County

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
W/BW-1-3 (Grill Mine)	2	1	----	1920's or '30's	Domestic (small production)	Possibly severe (impoundment)	Moderate
W/BW-4-1 (probably Shipley Mine)	<1	----	1	1920's or '30's	Domestic (small production)	Slight	Slight
W/BW-4-5 (possibly Wise County Coal Co. Mine #6)	2	1	----	Possibly opened a few years before 1921?; abandoned c. 1924?	Probably domestic and industrial, possibly railroads	Undetermined	Moderate
W/BW-4-7 (Bridgeport Coal Company Mine #2)	5	1	----	Possibly opened a few years before 1888; abandoned 1932 - 1943?	Industrial, railroads, domestic	Undetermined	Severe (subsidence in urban-industrial area)

Table 37. Summary of site descriptions--Wise County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
W/BW-4-8 (Bridgeport Coal Co. Mine #1)	6	1	----	Opened after 1889, several years before 1902; probably abandoned before 1910	Industrial, railroads, domestic	Negligible	Moderate
W/BW-4-9	1	----	1	Unknown (before 1943)	Probably industrial, domestic (small production)	Negligible	Slight
W/BW-4-10	<1	1	----	Unknown (before 1943)	Probably industrial, domestic (small production)	Undetermined	Moderate
W/BW-4-11 (Wise County Coal Company Mine #1)	2	1	----	Opened several years before 1902; abandoned before 1910?	Industrial, possibly domestic	Undetermined	Severe? (subsidence in urban area)

Table 37. Summary of site descriptions--Wise County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
W/BW-4-19 (Singleton Mine)	1	1	----	Probably opened before 1932?; abandoned after 1940	Domestic, possibly industrial	Slight to moderate (surface water)	Moderate
W/BW-4-20	<1	1	----	Unknown (before 1943)	Probably domestic (small production)	Negligible	Negligible
W/BW-4-21	1	1	----	1920's or '30's	Domestic (small production)	Negligible	Moderate (subsidence in urban area)
W/BW-4-22	3	1	----	1920's or '30's	Domestic (small production)	Negligible	Moderate (subsidence in urban area)

Table 37. Summary of site descriptions--Wise County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
W/BW-4-23	1	----	1	Unknown (before 1943)	No known production	Negligible	Slight
W/BW-4-24 (possibly Bridgeport Coal Co. Mine #3)	5	----	1	Opened between 1902 and 1910; abandoned after 1924, possibly 1932 - 1943	Railroads, industrial, domestic	Negligible(?)	Slight
W/BE-3-2	<1	1	----	Unknown (filled in 1941)	Probably domestic (small production)	Negligible	Slight
W/BE-3-4	2	1	----	Opened early 1930's? abandoned 1932 - 1936	Probably domestic (small production)	Negligible	Slight

Table 37. Summary of site descriptions--Wise County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
W/BE-3-6	1	----	1	Unknown (before 1943)	Probably domestic (small production)	Negligible	Negligible
W/BE-3-7	<1	----	1	Unknown (before 1943)	No known production	Negligible	Negligible
W/BE-3-8 (probably Byrnes and Byrnes Mine)	3	----	1	Opened during 1930's?; abandoned after 1940	Domestic, routine laboratory analyses and testing	Negligible	Slight
W/BE-3-9	<1	----	1	Unknown (before 1943)	No known production	Negligible	Negligible

Table 37. Summary of site descriptions--Wise County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
W/BE-3-14*	2	1	----	1920's and '30's	Domestic (small production)	Slight	Slight
W/BE-3-15*	<1	1	----	1920's and '30's	Domestic (small production)	Negligible	Slight
W/BE-3-16*	<1	1	----	1920's and '30's	Domestic (small production)	Negligible	Slight
Summary: 23 sites	45	15	8	Possibly a few years before 1888 until 1943	Industrial, railroads, domestic, routine laboratory analyses and testing	Possibly severe (impoundment) to negligible	Severe to negligible

*Sites W/BE-3-14, -15, and -16 were probably parts of one mining operation.

southwest of the present city limits (as indicated by historical marker). Later, the thriving coal industry established a brick plant, a company store, and company housing for a work force numbering several hundred (E. C. Pitts, personal communication, 1979). The building which housed the company store is still standing although it has been abandoned for several years. The brick plant, although relocated within the city, is still in operation. Continued production of coal in the county until the 1940's even prompted the establishment of a government-sponsored coal-testing laboratory in Bridgeport (Green, personal communication, 1979). The quality of the Bridgeport Coal was widely conceded to be the best in Texas (Cummins, 1891, p. 518; Scott and Armstrong, 1932, p. 72).

Production of bituminous coal on the rolling prairies of west-central Wise County created certain environmental hazards (table 38). Shale that was necessarily extracted during coal mining operations was mounded near the mine entrances. A significant amount of this material was used in brick-making, but supplies greatly exceeded the needs of the local brick industry and as excess shale accumulated, some adverse environmental effects were experienced. Devegetated, erosion-prone areas around small existing dumps attest to the residual toxicity of acid leachate derived from the shales and coal slack. Surface water and shallow ground-water contamination may result, as well. However, use of shale from old dumps by the brick manufacturer continues and may represent an efficient means of partial site reclamation wherever transportation distances are not prohibitive.

Another important effect of mining is subsidence which may pose a serious hazard particularly in urban areas. Some homes and other structures in Bridgeport overlie old mine workings. Phillips (1902, p. 34) reported that extraction from part of a mine operated by the Wise County Coal Company had to be discontinued "...owing to the settling of the ground under the town." Subsidence of at least 1 m (3 ft) has occurred over an area of 5 acres at a mine site just north of the present brick plant. Greater displacements may occur above major mine passageways. These passageways were reinforced to allow continued use. For this reason, some lag period must pass before the passageway collapses, causing subsidence. There is thus a distinct possibility that additional subsidence may be expected at some larger mine sites in the county. At least one large mine which could experience additional subsidence is now partially filled with water, as well. Draining the mine by pumping could reduce the hydrostatic pressure that is helping to support the mine roof, thereby promoting subsidence. A reclamation effort at this site (number W/BW-4-7) would have to be carefully designed to avoid such an occurrence.

Table 38. Summary of environmental effects in Wise County.

Site Number	C - Confirmed U - Unconfirmed	Acres	Effects on Vegetation	Erosion	Runoff/Deposition			Subsidence	Refuse	Structural Equipment Remains
					Receiving Stream	Impound-ment	Downslope			
W/BW-4-5	C	2	X	X	X		X		X	X
W/BW-4-7	C	5	X		X	X		X	X	X
W/BW-4-8	C	6	X	X	X		X		X	
W/BW-4-24	U	5		X		X	X		X	X
TOTALS: 4 sites	3 C* 1 U	18	3	3	3	2	3	1	4	3

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

WISE County

Size: 2 acres.

Site Number: W/BW-4-5 (possibly one of the Wise County Coal Company mines, perhaps number 6).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -				
Most Recent -	1/12/67	1HH:120	32	1:20,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Local contact; ground inspection; photointerpretation.

Local Contact: Rupert Green -- Bridgeport, Texas.

Accessibility: Limited. Private land. Site is approximately 2.4 km (1.5 mi) northwest of Bridgeport.

Mining Method: Shaft entrance. No air shafts found. Masonry tipple utilized. Modified longwall advancing extraction probably practiced.

Conditions

Vegetation: Almost complete revegetation except on shale dump (barren). Cedar elms and other trees, as well as herbs and grasses, have covered most of site (other than shale dump).

Erosion: Moderate sheetwash erosion and gullying on barren shale dump. Sheetwash distributes sediment over broad area around shale dump, and downslope. Leachate (acid runoff) from dump pile appears to be causing progressive devegetation around the dump, enhancing erosion potential. Recent removal of some material from dump pile for use in brick manufacturing has also increased erosion hazard; see "Remarks," below.

Runoff/Deposition:

Receiving stream - Unnamed third-order tributary (intermittent) of Village Creek (intermittent). Immediate input of sediment and possible acid runoff, effects undetermined.

Impoundment - None present.

Downslope - Slopewash deposits and gullies extend downslope from site to stream. Progressive devegetation evident around shale dump. Active gullying downslope.

Subsidence: None evident.

Refuse: Masonry rubble from partly collapsed structures. Large shale dump, partly removed for brick-making.

Structural/Equipment Remains: Masonry tipple and machinery foundations, partly collapsed.

Hazard Potential: Possible source of water pollutants derived principally from shale dump.

Surrounding Land Use: Grazing (unimproved rangeland); suburban commercial; oil and gas production nearby; suburban residential, within approximately 90 m (300 ft) of site; outdoor movie theater (abandoned) within approximately 150 m (500 ft) of site.

Remarks: See attached page.

Remarks:

The Wise County Coal Company apparently opened and operated at least six mines in the Bridgeport area during the period from several years before 1902 until after 1928 and perhaps as late as 1943 (Gentry, 1922, p 19; Phillips, 1902, pp 33-34; and Stenzel and others, 1948, pp 35, 42). The location of only one (old #1) of these six mines is presently known. The other mines have either been completely obscured or were located at mine sites under 5 acres in size identified during the present study.

The mine at site number W/BW-4-5 was a relatively large-scale operation, even though the disturbed acreage at the site is now small. The remains of a large tipple and other structures and a moderately large, partially removed shale dump at the site suggest that mining activity there was both intensive and comparatively recent. In Wise County, these characteristics apply to mines operated by the major mining companies and of these, only the Wise County Coal Company mines (other than old #1) have not been definitely located. It is possible, then, that the mine at site number W/BW-4-5 was one of the Wise County Coal Company mines, perhaps #6. Mine #6 was apparently opened within a few years after Broman (1915) issued his report on the state's coal and lignite mines active in 1914, because the mine was already in production when Gentry (1922) visited the site in 1921. This mine had a shaft entrance 27 m (90 ft) deep. Rail-mounted, animal-drawn mine cars were used to haul the coal to the cage elevator in the shaft beneath the tipple. Hand mining and blasting were practiced in extracting the coal by longwall or modified longwall advancing methods. Average thickness of the coal seam was 0.4 m (17 in) (Gentry, 1922, p 19). The mine was no longer in operation in 1924 (Bullock, 1925).

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

WISE County

Size: 5 acres.

Site Number: W/BW-4-7 (Bridgeport Coal Company Mine #2).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -				
Most Recent -	1/12/67	1HH:120	18, 23	1:20,000

Status:

Confirmed Mine - Yes. Double shaft entrance.

Unconfirmed Mine -

Method of Verification: Historical records (published); local contact; ground inspection; photointerpretation.

Local Contact: Ebertt W. Pitts -- Bridgeport, Texas (rural area).

Accessibility: Direct. Private land. Site is approximately 0.3 km (0.2 mi) north-northwest of the Acme Brick Plant on the outskirts of northwest Bridgeport.

Mining Method: Double shaft entrances, probably with remote air shafts. Tipple utilized. Modified longwall advancing extraction practiced.

Conditions

Vegetation: Moderate revegetation -- black willow trees and grasses cover most of site around water-filled depression. Brickyard dump adjacent to site is barren.

Erosion: Negligible. Open shaft is concrete-lined. Most of site covered by water during much of the year.

Runoff/Deposition:

Receiving stream - Unnamed third-order tributary (intermittent) of West Fork of the Trinity River (perennial). Effects on stream of sediment input are negligible, of leachate, undetermined. Rectilinear drainage in subsidence area.

Impoundment - Water-filled depression comprises most of site. Effects of leachate on water-quality undetermined but potentially significant. Impoundment formed by subsidence.

Downslope - Entire site lies within an essentially closed depression. Surface effects except potential impact on water-quality are confined to site. Possible effects on groundwater.

Subsidence: Well-defined subsidence area comprises most of site (approximately 5 acres). Subsidence of approximately 1 m (3 ft) is evident, above worked-out areas of mine.

Refuse: Structural debris, small amount of domestic refuse; tremendous brickyard dump adjacent.

Structural/Equipment Remains: Concrete-lined entrance shafts (two, one buried beneath brickyard dump after 1967); concrete foundations for tipple, machinery.

Hazard Potential: Open shaft entrance 33 m (110 ft) deep and partially filled with water; possibly severe surface- and groundwater contamination (no direct evidence); possible continued subsidence in an urban area.

Surrounding Land Use: Active clay pits and brick-yard; highway and railway transportation; urban residential and commercial; grazing (rangeland being invaded by woody species).

Remarks: See attached page.

Remarks:

Bridgeport Coal Company Mine #2 may have been the largest and longest-operating mine in Wise County. Phillips (1902, p 35) remarked that "This mine . . .was formerly worked to a limited extent before the Bridgeport Coal Co. acquired it." Cummins (1889, p 49) described the early mining and prospecting efforts in the area: "Ten miles west of Decatur, in Wise County, near the west fork of the Trinity River (area of present Bridgeport townsite), there is a seam of coal outcropping in the bed of a branch . . .A few years ago a mining company (possibly the Wise County Coal Company) was formed at Decatur for the purpose of prospecting and developing this coal. They did a large amount of prospecting by sinking shafts and did some mining by driving a tunnel into the hill along the seam near the outcrop. The coal taken out was hauled in wagons to Decatur and disposed of to the citizens for domestic and other purposes." Cummins (1891, p 518) also stated that ". . . the shafts had either fallen (in) or were partly filled with water at the time of my visit (presumably in 1889)." Whether any of the Decatur mining company's mines were acquired by the Bridgeport Coal Company and reopened is not now known. However, one of the early shafts may have been the mine to which Phillips (1902, p 35) referred. Bridgeport Coal Company Mine #2 was operated from at least several years before 1889 until about 1932 and possibly until 1943 (Cummins, 1891, p 518; Scott and Armstrong, 1932, p 72; and Stenzel, 1943, p 203.)

Production at Bridgeport Coal Company Mine #2 in 1914 averaged 106 tons per day, with total tonnage (mine run coal) for that year approaching 27,000 tons (Broman, 1915, table opposite p 24). The mine's shaft entrance measured 1.8 x 3.7 m (6 x 12 ft) and was 34 m (112 ft) deep (Phillips, 1902, p 35). Taylor (1911, p 20) and Scott and Armstrong, (1932, Figure 7) indicated that the mine had a double shaft entrance, an observation confirmed by examination of 1967 aerial photographs. Modified longwall advancing extraction was practiced and rail-mounted, animal-drawn mine cars were used in the main entries. Originally, the coal was mined by hand, although black powder blasting was later practiced (E.W. Pitts, personal communication, 1979). Scott and Armstrong (1932, p 68) noted that the ". . .tailings (waste shale) from the #2 shaft . . . .were used in brick-making."

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

WISE County

Size: 6 acres.

Site Number: W/BW-4-8 (Bridgeport Coal Company Mine #1).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -				
Most Recent -	1/12/67	1HH:120	18, 23	1:20,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Historical records (published); local contact; ground inspection; photointerpretation.

Local Contact: Ebertt W. Pitts -- Bridgeport, Texas (rural area).

Accessibility: Direct. Private land and possibly highway right-of-way. Site is approximately 0.3 km (0.2 mi) south of the Acme Brick Plant on the outskirts of northwest Bridgeport.

Mining Method: Shaft entrance. No air shafts found. Longwall advancing or modified longwall advancing extraction probably practiced.

Conditions

Vegetation: Sparsely revegetated--few grasses and annuals and early succession species such as Baccharis sp. distributed sparsely over site.

Erosion: Moderate sheetwash erosion. Part of the site was apparently covered by a large shale dump until most of the shale was removed for use in brick-making. Erosion severity appears to be lessening, at least since 1967, although the aerial photographs (1967 data base) were taken in winter when groundcover was reduced, and the site was visited in summer when groundcover was maximum.

Runoff/Deposition:

Receiving stream - Unnamed second-order tributary (intermittent) of Village Creek (intermittent). No defined channels or gullies extending from site to stream. Effects on stream negligible.

Impoundment - None present.

Downslope - Slopewash deposits immediately downslope from presumed location of shale dump. No evidence of sediment transport to stream.

Subsidence: None evident.

Refuse: Thin residue of shale from dump that formerly occupied site but was removed for use in brick-making.

Structural/Equipment Remains: None evident.

Hazard Potential: Minor source of possible pollutants potentially affecting shallow groundwater. Possible onset of subsidence.

Surrounding Land Use: Active clay pits and brickyard; highway and railway transportation; urban residential and commercial; grazing (rangeland being invaded by woody species).

Remarks: See attached page.

Remarks:

The general location of Bridgeport Coal Company Mine #1 is shown on a sketch map by Scott and Armstrong (1932, p 73). Phillips (1902, pp 34-35) stated the mine was located 457 m (1500 ft) ". . . west of the main line of the C., R.I. and T. Ry. (now the C., R.I. and P. Railroad)." These references define a point corresponding to site number W/BW-4-8. Identification of this site as that of Bridgeport Coal Company Mine #1 was confirmed by E.W. Pitts (personal communication, 1979).

Bridgeport Coal Company Mine #1 was apparently opened after 1889 (Cummins, 1891, p 518), but several years before 1902 (Phillips, 1902, p 35) at which time the mine was well into production. The mine was probably abandoned sometime before 1910 (Taylor, 1911, p 20), although Scott and Armstrong (1932, p 72) implied that the mine might have been in operation until 1932. The entrance shaft was 17 m (56 ft) deep and measured 1.9 m x 3.7 m (6.3 ft x 12 ft). The main entry extended north and south from the bottom of the shaft approximately 275 m (900 ft) in both directions. The distance (east-west) across the workings was about 260 m (850 ft). Average thickness of the worked coal seam was 0.5 m (19 in). A fault crossed the main entry at a point "Only a few feet south of the shaft (which was) the only break of importance in any of the mines in the vicinity of Bridgeport. . ." (Phillips, 1902, p 35). Scott and Armstrong (1932, p 72) reported that, in the Bridgeport Mines, "Keeping the tunnels open was sometimes made difficult by the 'heave' or swell of the underlying shales."

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

WISE County

Size: 5 acres.

Site Number: W/BW-4-24 (possibly Bridgeport Coal Company Mine #3).

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -				
Most Recent -	1/12/67	1HH:120	12, 13, 17, 18	1:20,000

Status:

Confirmed Mine -

Unconfirmed Mine - Yes. Possible double shaft entrance.

Method of Verification: Historical records (published); photointerpretation.

Local Contact: None.

Accessibility: Limited. Private land and possibly railroad right-of-way. Site is approximately 0.6 km (0.4 mi) north-northeast of Acme Brick Plant on the outskirts of northwest Bridgeport.

Mining Method: Double shaft entrance, probably with remote air shafts (none found). Tipple probably utilized. Modified longwall advancing extraction practiced.

Conditions

Vegetation: Almost complete revegetation--trees (probably cedar elm, other) cover site except shale dumps.

Erosion: Apparent moderate sheetwash erosion around presumed low shale dumps. No obvious gullying except possibly on dumps. Limits of site defined by subtle surface irregularities possibly representing traces of mining activity.

Runoff/Deposition:

Receiving stream - Unnamed first-order tributary (intermittent) of Turkey Creek (intermittent). Effects of runoff, sediment on stream probably negligible.

Impoundment - Small impoundment on tributary below site may receive minor contributions of sediment, runoff from site but effects are probably negligible.

Downslope - Minor slopewash deposits around presumed shale dumps. Little evidence of significant gullying apparent in 1967 aerial photographs.

Subsidence: None evident in 1967 aerial photographs.

Refuse: Apparent small shale/slack dumps and possible larger shale dump and structural debris.

Structural/Equipment Remains: Possible structural debris and faint outlines of foundations.

Hazard Potential: Possible minor source of water pollutants potentially affecting shallow groundwater and surface water.

Surrounding Land Use: Cultivation (hay?); highway and railway transportation; urban commercial and residential.

Remarks: See attached page.

Remarks:

The location of Bridgeport Coal Company Mine #3 is known from only one published reference, a sketch map by Scott and Armstrong (1932, p 73). Although few details are shown, the map indicates the most probable location of the mine to be in the area of site number W/BW-4-24. Examination of aerial photographs covering the area revealed features suggesting mining activities although the site could not be inspected to confirm this identification. Indicative features at the site are apparent small shale dumps, a pair of entrance shafts, and building foundations.

Bridgeport Coal Company Mine #3 was evidently opened after 1902 (Phillips, 1902, pp 33-34) and before 1910 (Taylor, 1911, p 20), and was abandoned after 1924 (Bullock, 1925, p 10), probably in 1932 (Scott and Armstrong, 1932, p 72). This mine, or one or more of the other Bridgeport Coal Company Mines, may have reopened for a brief period in the late 1930's or early 1940's. Stenzel (1943, p 203) stated that "The Bridgeport mine was the last bituminous coal mine to cease operations in the State," presumably in 1943, although no coal production was reported for Wise County during that or any subsequent year. Production was reported for Wise County from 1936 to 1937 and 1939 to 1942 (Stenzel and others, 1948, p 42). While it is unclear from these references which coal mines in the Bridgeport vicinity were in operation as recently as 1943, Stenzel's (1943) remark may be taken as an indication of continuing production efforts in the county. Average daily production at Bridgeport Coal Company Mine #3 during 1914 was 106 tons, while 26,647 tons of merchantable coal was produced during the entire year (Broman, 1915, table opposite p 24). The double shaft entrance at this mine was 28 m (92 ft) deep.

Table 39. Confirmed (C) and Probable(P) mines less than five acres - Wise County.

Site Id	Size (acres)	Status	Mine Type	Photo Date	Number	Grid
W/BW-1-3 (Grill Mine)	2	C	slope	1/12/67	1HH:143	14
W/BW-4-1 (probably Shipley Mine)	< 1	P	slope	1/12/67	1HH:121	23
W/BW-4-9	1	P	slope ?	1/12/67	1HH:120	8 (central)
W/BW-4-10	< 1	C	shaft ?	1/12/67	1HH:120	9 (central)
W/BW-4-11 (Wise County Coal Co. Mine #1)	2	C	slope	1/12/67	1HH:120	9 (northeastern)
W/BW-4-19 (Singleton Mine)	1	C	shaft	1/12/67	1HH:120	8 (northern)
W/BW-4-20	< 1	C	slope	1/12/67	1HH:121	17
W/BW-4-21	1	C	slope	1/12/67	1HH:85	33 (northwestern)
W/BW-4-22	3	C	slope	1/12/67	1HH:85	33 (western)
W/BW-4-23	1	P	slope?	1/12/67	1HH:85	28
W/BE-3-2	< 1	C	shaft ?	1/12/67	1HH:86	13
W/BE-3-4	2	C	slope	1/12/67	1HH:86	18,22,23
W/BE-3-6	1	P	slope	1/12/76	1HH:86	16
W/BE-3-7	< 1	P	slope ?	1/12/67	1HH:86	25
W/BE-3-8 (probably Byrnes and Byrnes Mine)	3	P	shaft	1/12/67	1HH:86	29
W/BE-3-9	< 1	P	slope ?	1/12/67	1HH:86	30
W/BE-3-14*	2	C	slope	1/12/67	1HH:86	23, 28
W/BE-3-15*	< 1	C	shale dump	1/12/67	1HH:86	28 (eastern)
W/BE-3-16*	< 1	C	slope?, shale dump	1/12/67	1HH:86	28 (southeastern)

*Note: Sites W/BE-3-14, -15, and -16 were probably parts of one mining operation.

Young County

In Young county (fig. 28), the highest concentration of abandoned mines is within and around the Newcastle community. Eight mines (including one possible mine) are found here, compared to nine other confirmed and possible mines in other parts of the county (table 40). Four mines and one possible mine site are found in the Markley quadrangle. Only the Belknap Mines of Newcastle were of economic importance.

The Harpersville Formation in Young County extends from the northeast to the southwest parts of the county. The area of the county is approximately 584,167 acres of which 164,000 acres are within the outcrop area of the coal-bearing Harpersville Formation (table 6). The predominant land uses within the outcrop area are dry cropland and rangeland.

Young County is in the North-Central Prairie Region which has moderately deep to deep soils with loamy surface layers and clayey subsoils (Godfrey, McKee, Oakes, 1973). Prairie vegetation is predominant in the eastern part of the county while woody vegetation and a more hilly terrain is found west of Graham.

Surface features which complicated the photo-identification of abandoned mines include salt kill areas, brine pits and overgrazed areas. These features were found throughout the county and caused some confusion which was resolved by additional field work. Environmental effects of coal mining in the county are summarized in Table 41.

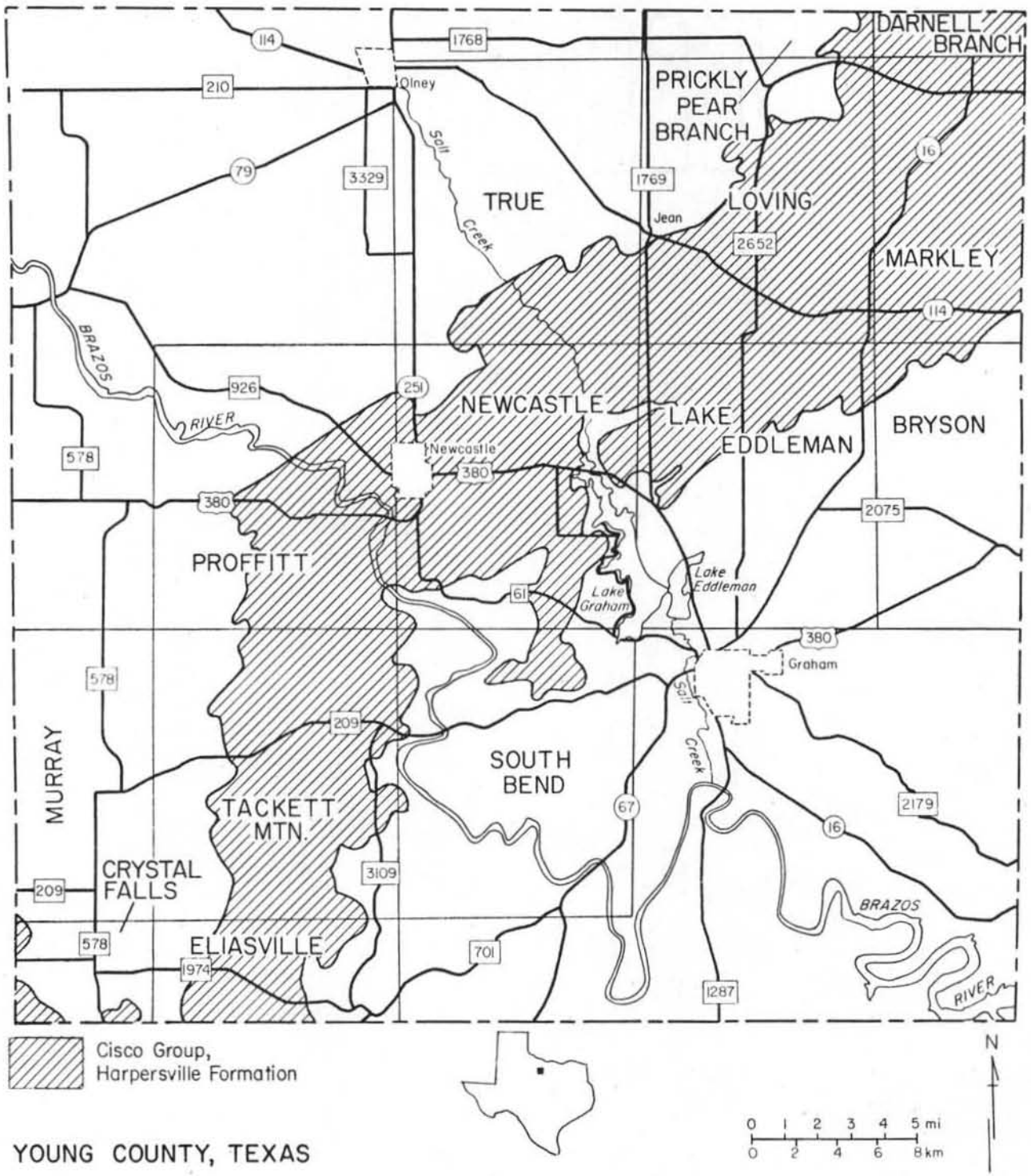


Figure 28. Map of Young County, Texas, illustrating the outcrop area of the coal-bearing Harpersville Formation, and selected cultural and surface drainage features.

Table 40. Summary of site descriptions--Young County

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
Y/N-1-80	1	1	----	--------	Fort Belknap (Historical site)	Negligible	Negligible
Y/N-3-3	40	1	----	Opened 1908 Closed 1914	Railroad	Severe (impoundment)	Severe
Y/N-3-4	1	1	----	---------	Railroad	Negligible	Negligible
Y/N-3-1	3	1	----	Opened 1915 Closed 1923	Railroad	Negligible	Slight

Table 40. Summary of site descriptions--Young County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
Y/N-2-5	3	1	----	Open between 1910--1914 Abandoned 1919	Railroad	Negligible	Negligible
Y/N-2-7	3	1	----	Closed 1947	Domestic	Negligible	Slight
Y/N-2-6	1	1	----	Opened 1908 Closed between 1910--1914	Railroad	Negligible	Slight
Y/LE-4-50	5	1	----	Unknown	Domestic and Industrial	Severe (impoundment)	Severe

Table 40. Summary of site descriptions--Young County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
Y/LE-4-51	3	1	----	Unknown	Domestic and Industrial	Negligible	Slight
Y/M-4-29	10	1	----	Unknown	Domestic	Severe (receiving stream)	Severe
Y/M-1-51	1	1	----	Unknown	Domestic	Negligible	Slight
Y/M-1-33	10	1	----	Unknown	Domestic	Moderate	Severe

Table 40. Summary of site descriptions--Young County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
Y/M-2-50	15	1	----	Unknown	Domestic	Negligible	Severe
Y/M-1-34	6	----	1	Unknown	Unknown	Negligible	Severe
Y/P-1-7	30	----	1	Unknown	Unknown	Negligible	Severe
Y/P-1-51	5	----	1	Unknown	Unknown	Negligible	Moderate

Table 40. Summary of site descriptions--Young County (cont.)

Site Identification No.	Size (acres)	No. of confirmed mines at site	No. of unconfirmed mines at site	Period of operation	Use/user of coal	Effects on surface water	Effects on land surface, vegetation
Y/N-3-50	5	----	1	Unknown	Unknown	Negligible	Severe
County Summary: 17 sites	142	13	4	From 1908 to 1923 (excludes Y/N-2-7)	Railroad and domestic use	Negligible	Severe

Table 41. Summary of environmental effects in Young County.

Site Number	C - Confirmed U - Unconfirmed	Acres	Effects on Vegetation	Erosion	Runoff/Deposition			Subsidence	Refuse	Structural Equipment Remains
					Receiving Stream	Impound-ment	Downslope			
Y/LE-4-50	C	5	X	X		X	X	X	X	X
Y/M-1-33	C	10	X	X		X	X	X	X	
Y/M-1-34	U	6	X	X			X	X	X	
Y/M-2-50	U	15	X	X				X	X	
Y/M-4-29	C	10	X	X	X		X		X	
Y/N-3-3	C	40	X	X		X	X	X	X	X
Y/N-3-50	U	5	X	X				X	X	
Y/P-1-7	U	30	X	X	X	X	X	X	X	

(continued)

Table 41. Summary of environmental effects in Young County.

Site Number	C - Confirmed U - Unconfirmed	Acres	Effects on Vegetation	Erosion	Runoff/Deposition			Subsidence	Refuse	Structural Equipment Remains
					Receiving Stream	Impound-ment	Downslope			
Y/P-1-51	U	5						X		
TOTALS: 9 sites	4 C 5 U	126	8	8	2	4	6	8	2	2

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

YOUNG County

Size: 5 acres.

Site Number: Y/LE-4-50

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	7/5/41	379	13	1:20,000
Most Recent -	1/25/68	2JJ-80	3	1:20,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Photointerpretation and on-site observation.

Local Contact: Arthur Burdick - Loving, Texas.

Accessibility: Good.

Mining Method: Shaft mine.

Conditions

Vegetation: Barren.

Erosion: Severe sheetwash and gullying in addition to scarp retreat (active erosion).

Runoff/Deposition:

Receiving stream - Insignificant effect on stream.

Impoundment - One earthen dam has been breached and another exhibits considerable deposition. Very turbid water was observed.

Downslope - Alluvial deposition caused by that runoff which is not collected by the impoundment.

Subsidence: Collapsed shaft openings (visible interiors) and other features (very hazardous).

Refuse: Runoff deposited coal and mine spoil, small eroded spoil deposits. Considerable rock debris.

Structural/Equipment Remains: Push-cart tracks and shoring timber.

Hazard Potential: Remote--no settlement within one mile; ready access.

Surrounding Land Use: Rangeland and pasture (moderately good condition) and oil production.

Remarks: This site is divided in half by a small unimproved road. The northern portion of the site (described above) is considerably more disturbed than its southern portion. This area has two depressions approximately 20 m (65 ft) apart which are actually collapsed mine entrances. One entrance can be entered by crawling through a small opening. No other features were found.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

YOUNG County

Size: 10 acres.

Site Number: Y/M-4-29

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/1/41	465	13	1:20,000
Most Recent -	2/7/68	3JJ-85	14	1:20,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Photointerpretation and on-site observation.

Local Contact: None.

Accessibility: Very good.

Mining Method: Surface mine.

Conditions

Vegetation: Sparsely vegetated.

Erosion: Severe sheetwash and moderate gullying. Active erosion.

Runoff/Deposition:

Receiving stream - Considerable disturbed confluence of site runoff and stream.

Impoundment - None.

Downslope - Severe gullying.

Subsidence: None.

Refuse: Rock debris.

Structural/Equipment Remains: None.

Hazard Potential: Remote--no settlements within one mile; ready access.

Surrounding Land Use: Pasture (moderately good condition).

Remarks: This site is a large shallow depression with no visible mining (depressions, spoil, etc.) features. A solitary mound approximately 5 m (16 ft) in height and 15 m (50 ft) in diameter and consisting entirely of shale and bedded coal is all that remains of an excavated hill slope. The site is divided by an unimproved road which is on occasion damaged by heavy runoff.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

YOUNG County

Size: 10 acres.

Site Number: Y/M-1-33

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/1/41	468	21	1:20,000
Most Recent -	2/7/68	3JJ-82	19	1:20,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Photointerpretation and on-site observation.

Local Contact: Oliver Loving III - Jermyn, Texas.

Accessibility: Difficult access route and permission to enter land is required.

Mining Method: Slope mine.

Conditions

Vegetation: Sparse cover consisting of short grass and a few scattered bushes. Sheet-washed areas are barren.

Erosion: Considerable sheetwash with moderate gullying associated with steep slopes. Retreating scarp and active erosion.

Runoff/Deposition:

Receiving stream - Insignificant.

Impoundment - Breached earthen dam adjacent to mine site.

Downslope - Slight alluvial deposition.

Subsidence: Partially collapsed mine entrance with visible interior.

Refuse: Mine spoil deposits and considerable shale and other rock debris.

Structural/Equipment Remains: None.

Hazard Potential: Remote--no settlements within one mile; no ready access.

Surrounding Land Use: Rangeland (appears to be heavily grazed).

Remarks: Entrance to the mine is on the slope of a hill rather than at the base.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

YOUNG County

Size: 6 acres.

Site Number: Y/M-1-34

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/1/41	467	30	1:20,000
Most Recent -	2/7/68	3JJ-82	24	1:20,000

Status:

Confirmed Mine -

Unconfirmed Mine - Probable mine (see remarks).

Method of Verification: Photointerpretation.

Local Contact: Oliver Loving III - Jermyn, Texas.

Accessibility: Difficult access route and permission to enter land is required.

Mining Method: Possible slope mine.

Conditions

Vegetation: Barren.

Erosion: Severe sheetwash erosion (very active).

Runoff/Deposition:

Receiving stream - Insignificant effect on stream.

Impoundment - No impoundment.

Downslope - Moderate local deposition of alluvium.

Subsidence: Shallow depressions, possiby collapsed features (slight hazard).

Refuse: Possible spoil deposits (as indicated by aerial photographs).

Structural/Equipment Remains: Nothing visible on photography.

Hazard Potential: Remote, no settlements within one mile; no ready access.

Surrounding Land Use: Rangeland (appears to be heavily grazed).

Remarks: The likelihood of being an abandoned mine is enhanced by (1) the indication of collapse features and spoil deposits, (2) the close proximity to known mines and (3) its similar appearance to these mines.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

YOUNG County

Size: 15 acres.

Site Number: Y/M-2-50

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	8/1/41	468	26	1:20,000
Most Recent -	2/7/68	3JJ-82	19	1:20,000

Status:

Confirmed Mine -

Unconfirmed Mine - Probable mine.

Method of Verification: Photointerpretation.

Local Contact: Oliver Loving III - Jermyn, Texas.

Accessibility: Difficult access route and permission to enter property is required.

Mining Method: Slope mine.

Conditions

Vegetation: Sparsely vegetated.

Erosion: Severe sheetwash and slight gullying on excavated slopes. Considerable scarp retreat and active erosion.

Runoff/Deposition:

Receiving stream - Insignificant.

Impoundment - None.

Downslope - Insignificant downslope erosion.

Subsidence: Possible collapsed mine entrance and other depressions. Slight hazard.

Refuse: Several mine spoil deposits.

Structural/Equipment Remains: Unknown.

Hazard Potential: Very remote--no settlements within one mile; difficult access.

Surrounding Land Use: Rangeland (moderately good condition).

Remarks: The possible mine site is a large shallow depression exhibiting widespread sheetwash erosion.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

YOUNG County

Size: 40 acres.

Site Number: Y/N-3-3 (Belknap mine #2)

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	6/12/41	196	26	1:20,000
Most Recent -	3/23/79	GLO 123-1-4	3/4/8/9	1:5,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Photointerpretation, historical literature and on-site observation.

Local Contact: Charles Bailey (Newcastle, Texas)--mine owner.

Accessibility: Owner permission required to enter property.

Mining Method: Shaft mine.

Conditions

Vegetation: Moderate grass and tree cover in addition to several large barren areas.

Erosion: Mass wasting, severe sheetwash, gullying (see remarks).

Runoff/Deposition:

Receiving stream - None.

Impoundment - Three impoundments affected (unknown water quality) by runoff.

Downslope - Considerable gullying.

Subsidence: Depressions, collapse features and shaft entrances (moderate hazard).

Refuse: Coal waste deposits, rock and shale debris, and spoil gobs (solid large chunks of fused mine spoil).

Structural/Equipment Remains: Small rock structure, concrete foundations, and small pieces of equipment.

Hazard Potential: Nearby settlement, and the mine is easily accessible.

Surrounding Land Use: Rangeland (appears to be heavily grazed).

Remarks: Runoff, consisting of transported sediment, leachate materials (from spoil piles) and brine from past oil production activities, is continuously damaging vegetative cover.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

YOUNG County

Size: 5 acres.

Site Number: Y/N-3-50

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	6/12/41	195	34	1:20,000
Most Recent -	11/30/67	1JJ-228	19	1:20,000

Status:

Confirmed Mine -

Unconfirmed Mine - Yes.

Method of Verification: Photointerpretation.

Local Contact: None.

Accessibility: Good.

Mining Method: Shaft mine.

Conditions

Vegetation: Sparsely vegetated (grass and a few scattered trees).

Erosion: Severe gullying and active erosion throughout the site. Apparent scarp retreat.

Runoff/Deposition:

Receiving stream - Not affected by runoff.

Impoundment - No impoundment.

Downslope - Single channel transports runoff to receiving stream. Insignificant downslope erosion or deposition.

Subsidence: Shallow depressions.

Refuse: Considerable rock debris.

Structural/Equipment Remains: None.

Hazard Potential: Remote but readily accessible (no settlement within one mile).

Surrounding Land Use: Cropland (moderately good condition) and rangeland (appears heavily grazed).

Remarks: This site is particularly unusual in that although there was no direct evidence of previous mining activities, bedded coal was found, the area is considerably disturbed (gullies, depressions, rock debris), and there is an abandoned railroad grade adjacent to the site. This is the same railroad grade that connected most of the Belknap mines. This site is approximately one mile north of Newcastle, Texas.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

YOUNG County

Size: 1 acre (see "Remarks").

Site Number: Y/N-1-80

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	7/23/41	257	34	1:20,000
Most Recent -	1/25/68	2JJ-186	24/25	1:20,000

Status:

Confirmed Mine - Yes.

Unconfirmed Mine -

Method of Verification: Photointerpretation, local information, USGS map notation (mine).

Local Contact: Soil Conservation Service agent, Graham, Texas.

Accessibility: Visible road but not known if entry is possible.

Mining Method: Shaft mine.

Conditions

Vegetation: Good cover (grass and woody vegetation).

Erosion: Insignificant (very small site).

Runoff/Deposition:

Receiving stream - None.

Impoundment - None.

Downslope - None.

Subsidence: None.

Refuse: None.

Structural/Equipment Remains: Nothing visible on photography.

Hazard Potential: None.

Surrounding Land Use: Cropland (good condition) and rangeland (moderately good condition).

Remarks: This mine is supposedly used on occasion by personnel from Fort Belknap to obtain coal for the post blacksmith forge. Fort Belknap is an historical park site at which traditional skills such as blacksmithing are demonstrated. The mined area has also been altered by the construction of a short unimproved road passing through the site.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

YOUNG County

Size: 30 acres .

Site Number: Y/P-1-7

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	7/22/41	168	33/34	1:20,000
Most Recent -	11/30/67	1JJ-194	29/30	1:20,000

Status:

Confirmed Mine -

Unconfirmed Mine - Probable mine.

Method of Verification: Photointerpretation.

Local Contact: None.

Accessibility: Limited to within 1/4 mile (no direct access route).

Mining Method: Possible shaft mine.

Conditions

Vegetation: Sparsely vegetated (primarily grass).

Erosion: Severe gullying, retreating scarp and active erosion.

Runoff/Deposition:

Receiving stream - Natural stream course altered.

Impoundment - Two impoundments (good condition).

Downslope - A small alluvial surface has developed within stream valley.

Subsidence: Visible depressions and/or collapsed features.

Refuse: Possible mine spoil deposits.

Structural/Equipment Remains: Unknown.

Hazard Potential: Remote--no settlements within one mile (no ready access).

Surrounding Land Use: Rangeland (moderately good condition).

Remarks: Considerable surface degradation is visible on recent aerial photography (1967) and from a distant view of the site. Condition statements are based on the interpretation of aerial photos rather than on-site observation.

NORTH CENTRAL TEXAS ABANDONED COAL MINE SURVEY

YOUNG County

Size: 5 acres.

Site Number: Y/P-1-51

Aerial Photography:	Date	Index #	Grid #	Scale
Historical -	7/20/41	168	3	1:20,000
Most Recent -	11/30/67	1JJ-226	30	1:20,000

Status:

Confirmed Mine -

Unconfirmed Mine - See remarks.

Method of Verification: Photointerpretation.

Local Contact: Clarence Daniels - President of Farmers Bank of Newcastle.

Accessibility: Visible road but not known if entry is possible.

Mining Method: Possible shaft mine.

Conditions

Vegetation: Moderate vegetative cover (woody vegetation).

Erosion: Insignificant.

Runoff/Deposition:

Receiving stream - Not affected (see remarks).

Impoundment - No impoundment.

Downslope - Not affected.

Subsidence: Depressions and/or possibly collapse features (various sizes).

Refuse: Nothing visible on photography.

Structural/Equipment Remains: Nothing visible on photography.

Hazard Potential: Remote, no settlement within one mile. Ready access?

Surrounding Land Use: Cropland (good condition), rangeland (good condition).

Remarks: Runoff flows directly into the Brazos River via a very short meandering channel. Depressions within the site may not necessarily be a result of coal mining activities. Due to the location of the site on a river bank, some confusion exists as to whether this is an abandoned mine, sand pit or both. According to the local contact this was a definite mine but was not confirmed by an on-site visit.

Table 42. Confirmed (C) and Probable(P) mines less than five acres - Young County.

Site Id	Size (acres)	Status	Mine Type	Photo Date	Number	Grid
Y/N-3-4	1	C	shaft	6/12/41	196	16/21
				11/30/67	1JJ-277	17
				3/23/79	123-1-2	15
Y/N-3-1	3	C	shaft	6/12/41	196	16
				11/30/67	1JJ-227	2
				3/23/79	123-1-5	8
Y/N-2-5	3	C	shaft	6/12/41	197	16/21
				11/30/67	1JJ-227	10
				3/23/79	123-2-3	7/8
Y/N-2-7	3	C	slope	6/12/41	197	27
				11/30/67	1JJ-226	13
				3/23/79	123-2-4	32/33
Y/N-2-6	1	C	shaft	6/12/41	197	22
				11/30/67	IJJ-226	8
Y/LE-4-51	3	C	slope	7/15/41	379	28
				1/25/68	2JJ-80	18
Y/M-1-51	1	C	drift	8/11/41	469	22
				2/7/68	3JJ-80	22

SUMMARY

A combination of photointerpretation and field studies was utilized to locate a total of 137 to 140 confirmed and probable abandoned coal mines in North-Central Texas (table 43). In addition to mines located through review of available literature, the oldest obtainable, and more recent, aerial photographs were used for locating mines and for environmental geologic evaluation. Much valuable data on mining history, the history of some attempts at reclamation, and information on mines not otherwise known was obtained from residents of the North-Central Texas area.

The environmental impact of past mining activity in the region varies from minimal on small sites of 5 acres or less to significant on a few rapidly eroding 40-acre sites, the largest ones found, in Young and Montague Counties. The most extensive spoil piles noted are at Thurber in Erath County, and at Strawn in Palo Pinto County. Near Bridgeport, in Wise County, some spoil piles are present, but shale in the mine dumps has been used in brick-making. A total of 585 acres of land have been affected by mining, compared to approximately 729,000 acres of outcrop of the coal-bearing formations in the counties studies.

Coal mining and abandonment of the mining area has most notably affected vegetation and caused local erosion (table 44). An accumulation of mine spoil (shale and unusable coal), debris from mining activity and, at some sites, a variety of more recent domestic trash was also commonly found.

A common cause of confusion in locating abandoned mine sites were areas of barren ground caused by the formerly unregulated disposal of oil field brines. Many of the barren sites noted by Finley and Hupp (1979) resulted from brine disposal. Attempts at revegetating some of these areas as well as several confirmed mine sites have been unsuccessful. This points to the need for geochemical data in areas where chemical leachate from mine spoil is affecting the ground surface in that these areas may be difficult to reclaim. While acreage information and potential site distribution can be determined from the 1:20,000 aerial photographs, much crucial environmental geologic data cannot be gained except by ground surveys.

Table 43. Summary distribution of confirmed and probable (but unconfirmed) coal mines (no minimum size criterion)

County	Number of sites	Total acreage	Number of confirmed mines	Number of probable but unconfirmed mines
BROWN	3	11	0	3**
COLEMAN	5	56	7 or more*	3**
EASTLAND	12	24.5	7	5
ERATH	12	59	12	0
JACK	11	31	5	6
McCULLOCH	7	14	6-9*	1
MONTAGUE	7	56	6	2**
PALO PINTO	16	94	16	0
PARKER	10	23	9	1
STEPHENS	8	29	4	4
WISE	23	45	15	8
YOUNG	17	142	13	4
TOTALS	131	584.5	100-103*	37**
12 counties				

*Multiple mine entrances at some sites, possibly indicating separate mines.

**May include possible prospecting areas never worked as mines.

Table 44. Number of mines per county showing specific environmental effects (mines sites which were individually evaluated).

COUNTY	# of sites	Total Acreage	Effects on Vegetation	Locations Impacted by Runoff/Deposition						Structural and Equipment Remains
				Erosion	Receiving Stream	Impound-ment	Downslope	Subsidence	Refuse	
BROWN	2	9	1	2	1	1	1	0	2	1
COLEMAN	5	50	4	5	4	2	4	4	5	1
EASTLAND	5	18	2	3	0	1	2	4	5	3
ERATH	12	59	11	11	1	1	4	0	12	2
JACK	2	5	2	2	1	0	2	1	1	1
McCULLOCH	7	13	6	7	3	1	6	7	6	4
MONTAGUE	6	52	5	5	1	4	5	5	5	4
PALO PINTO	8	79	7	8	0	3	8	3	8	2
PARKER	3	15	3	2	1	0	3	2	2	2
STEPHENS	5	27	2	3	0	2	2	2	3	0
WISE	4	18	3	3	3	2	3	1	4	3
YOUNG	9	126	8	8	2	4	6	8	2	2
TOTALS	68	471	54	59	17	21	46	37	55	25

12 counties

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Appendix A

Summary of Photography Used to Evaluate North-Central Texas Abandoned Coal Mines

County	Date	Photography Historical - H Recent - R	Project Index Number	Scale
Archer	3-17-71	R	CUL - 1MM	1:20,000
	3-31-71	R	CUL - 3MM	1:20,000
Brown	11-8-71	R	BQS - 1MM	1:20,000
	3-30-72	R	BQS - 7MM	1:20,000
	11-26-48	H	BQS - GE	1:20,000
	10-27-48	H	BQS - 1E	1:20,000
	10-27-48	H	BQS - 2E	1:20,000
	10-27-48	H	BQS - 3E	1:20,000
	2-4-49	H	BQS - 7E	1:20,000
	11-1-48	H	BQS - 4E	1:20,000
	11-26-48	H	BQS - 5E	1:20,000
Clay	3-11-73	R	48077	1:20,000
Coleman	11-26-74	R	48083	1:40,000
	11-20-74	R	48083	1:40,000
	2-20-75	R	48083	1:40,000
	5-26-38	H	AWY-18	1:20,000
	10-4-38	H	AWY-22	1:20,000
	5-4-38	H	AWY-16	1:20,000
	5-4-38	H	AWY-17	1:20,000
	5-4-38	H	AWY-15	1:20,000
	3-29-38	H	AWY-3	1:20,000
	5-4-38	H	AWY-15	1:20,000
	3-29-38	H	AWY-4	1:20,000
	4-16-38	H	AWY-11	1:20,000
	4-16-38	H	AWY-9	1:20,000
	4-16-38	H	AWY-10	1:20,000
	8-19-38	H	AWY-19	1:20,000
	8-19-38	H	AWY-20	1:20,000
	5-26-38	H	AWY-18	1:20,000
	4-27-38	H	AWY-13	1:20,000
	4-27-38	H	AWY-14	1:20,000
	4-27-38	H	AWY-12	1:20,000
Eastland	12-22-47	H	BQW-3E	1:20,000
	1-14-48	H	BQW-4E	1:20,000
	12-21-47	H	BQW-2E	1:20,000
	2-7-48	H	BQW-5E	1:20,000
	12-29-47	H	BQW-4E	1:20,000
Erath	12-15-73	R	48143	1:40,000
	1-16-74	R	48143	1:40,000

County	Date	Photography Historical - H Recent - R	Project Index Number	Scale
Jack	1-6-72	R	DJT-1MM	1:20,000
	1-9-72	R	DJT-2MM	1:20,000
	1-12-72	R	DJT-3MM	1:20,000
Palo Pinto	9-26-77	R	48367	1:40,000
	9-30-77	R	48367	1:40,000
	9-30-77	R	48363	1:40,000
Parker	9-26-77	R	48367	1:40,000
	2-16-48	H	BRG-5E	1:20,000
	2-27-47	H	BRG-1E	1:20,000
	2-27-47	H	BRG-2E	1:20,000
	1-17-48	H	BRG-4E	1:20,000
	2-16-48	H	BRG-5E	1:20,000
	2-28-48	H	BRG-5E	1:20,000
	1-14-48	H	BRG-4E	1:20,000
	1-14-48	H	BRG-3E	1:20,000
Stephens	1-18-64	R	CUU-1EE	1:20,000
	1-20-64	R	CUU-2EE	1:20,000
	1-20-64	R	CUU-3EE	1:20,000
	2-7-64	R	CUU-4EE	1:20,000
	8-11-41	H	CUU-3B	1:20,000
	8-16-41	H	CUU-3B	1:20,000
	8-17-41	H	CUU-4B	1:20,000
	9-6-41	H	CUU-5B	1:20,000
	9-7-41	H	CUU-6B	1:20,000
Wise	1-12-67	R	BRM-1HH	1:20,000
	1-4-48	H	BRM-2E	1:20,000
	1-17-48	H	BRM-5E	1:20,000
	12-29-47	H	BRM-1E	1:20,000
Young	11-30-67	R	CUW-1JJ	1:20,000
	1-25-68	R	CUW-2JJ	1:20,000
	2-7-68	R	CUW-3JJ	1:20,000
	7-9-41	H	CUW-5B	1:20,000
	7-23-41	H	CUW-6B	1:20,000
	7-6-41	H	CUW-4B	1:20,000
	7-8-41	H	CUW-4B	1:20,000
	7-22-41	H	CUW-6B	1:20,000
	6-18-41	H	CUW-2B	1:20,000
	7-20-41	H	CUW-6B	1:20,000
	7-31-41	H	CUW-6B	1:20,000
	6-12-41	H	CUW-1B	1:20,000
	7-17-41	H	CUW-5B	1:20,000
	7-5-41	H	CUW-3B	1:20,000
	7-16-41	H	CUW-5B	1:20,000
	8-1-41	H	CUW-6B	1:20,000

Appendix B

Personal Contacts

in Coal-Mining Areas

Brown County

1. Ms. Marie Gramann

   Instructor, Howard Payne University (915) 646-2502

   Has knowledge of area geology.

2. Miss Tessica Martin

   Instructor, Howard Payne University

   Chairperson, Brown Co. Historical Commission

Coleman County

1. Joe Williams, Sr.

   TAA, P. O. Box 608, San Saba, Texas (512) 372-5105

   Familiar with location of abandoned mines in southern Coleman County.

   Participant in Little Bull Creek Coal Mine operation (active strip mine).

2. Ms. Linnie Box

   Rockwood, Texas, postmistress.

   P. O. Box 71, Rockwood, Texas 76873

   Has knowledge, photograph of abandoned mines in Rockwood area; involved in Little Bull Creek strip mine operation.

3. Mrs. S. D. Wilson

   Rt. 1, Box 60, Santa Anna. Texas 76878

   Landowner, knowledgeable person regarding location of Silver Moon Mine.

4. Gladys Nevins Hunter

Hunter Books

P. O. Box 304

Santa Anna, Texas

Historian, has written books on history of Rockwood (formerly Discord), Texas, and of Coleman County. Friend of Linnie Box.

Eastland County

1. Carl Kleiner

402 West 5th, Cisco, Texas

Familiar with mining activities in and around Cisco. Knows several people who also are familiar with mining history of the area.

2. Mrs. James Lee

Cisco telephone exchange (address unknown).

Has mine on her property and knows of other mines on adjacent ranches. Open air shaft at one site on property.

Erath County

1. Thurber Historical Association

725 W. Green Street, Stephenville, Texas 76401

Publishers of book on history of Thurber community. Randy Bennett's father was involved in this effort.

2. Randy Bennett

Rt. 1, Mingus, Texas 76463

Owner of most of the coal mine lands in the Thurber area, which are presently leased to the Texas Industries company (TXI).

3. P. D. ("Pink") Wylie

Rt. 1, Mingus, Texas 76463 (817) 968-8345

Provided detailed account of the history of mining in the Thurber area. Has thorough knowledge, probably more complete than anyone living, of local history concerning mining industry and land use. Familiar with surface conditions of mines.

4. Lee Mitchel

Rt. 1, Mingus, Texas

TXI manager, Thurber; has old photos, maps, can provide access to new mine. Referred to project personnel by Randy Bennett.

5. Vernon Hulme

Coal mine manager for Texas and Pacific Oil Company, Dallas, Texas.

Jack County

1. Oliver Loving III

Star Rt., Jermyn, Texas 76057 (817) 342-2421

Has knowledge of mines (3) on his property in Jack and Young Counties.

2. Tony Dean

Soil scientist, Soil Conservation Service

Jacksboro, Texas (817) 567-5641

Assisted in identifying landowners of suspected mine sites.

3. Ted Jackson

Rt. A, Jacksboro, Texas (817) 567-2768

Knew of location of mine near Robert's Branch cemetery.

4. Allard Smith

Jacksboro, Texas (rural route)

Knowledgeable landowner and former miner in Jack and Young Counties.

McCulloch County

1. Samuel E. Hays

Lohn, Texas 76852 (915)344-5730

Knowledgeable McCulloch County resident familiar with locations and histories of all known McCulloch County mines.

Montague County

1. Kent Henry

Rt. 1, Box 25, Bowie, Texas 76230 (817) 872-1966

Knowledgeable landowner with mines and a miner's grave on his property.

2. Dave Rhone

Rt. 1, Box 98, Bowie, Texas 76230 (817) 872-1654

Knowledgeable Landowner with at least two mines on his property.

3. James K. ("Salty") Brite

Box 1477, Bowie, Texas 76230 (817) 872-2675

Knowledgeable landowner (no mines on land).

4. Tommy Hays

Soil Conservation Service, Montague County

Box 151, Bowie, Texas 76230

Has conducted partial coal mine inventory of Montague County for USDA s RAMP (Reclamation of Abandoned Mines Program).

Parker County

No contacts.

Palo Pinto County

No contacts.

Stephens County

1. Jay Mercer

   Student

   Crystal Falls, Texas

   Familiar with locations of most mines in and around Hubbard Creek area.

2. Dean Wylie

   Ranch hand--Crystal Falls, Texas

   Brother of P. D. Wylie (Mingus, Texas). Very knowledgeable, particularly concerning mining history and industry in Crystal Falls.

Wise County

1. Ebertt W. Pitts

   Rt. 1, Box 195, Bridgeport, Texas (817) 683-4875

   Has detailed knowledge of Bridgeport area mines. mining technology.

2. Charles E. Byrd

   1012 Woodville Drive, Bridgeport, Texas (817) 683-2704

   Son of late miner, has knowledge of mines and mining methods.

3 Rupert Green

   Box 67A, Rt. 1, Bridgeport, Texas

   Former coal hauler, has knowledge of mine locations and histories.

4. Acme Brick Company

P O. Box 368

Bridgeport, Texas 76026

Site of two mines (now owned by Bridgeport Brick and Tile).

Young County

1. Clarence Daniels

President of Farmers Bank of Newcastle.

Newcastle, Texas

Has extensive knowledge of mining operations in Newcastle and the western portion of Young county.

2. Arthur Burdick

Residence between Graham and Loving on highway 16.

Loving telephone exchange.

Provided information on "Flat Top" mountain mines (Y/LE-4-50 and Y/LE-4-51).

3. Oliver Loving III

Star Rt., Jermyn, Texas 76057 (817) 342-2421

Property owner of three mines sites: (Y/M-1-51, Y/M-1-33, and Y/M-2-50)

4. Joe Gray--Newcastle, Texas -Familiar with Newcastle Mines.
5. Charles Bailey--Newcastle, Texas--Owns Belknap Mines 1,2, and 5.
6. Claude Hearne--Loving, Texas--Familiar with Loving Mines.
7. Harold Meyers--Newcastle, Texas--Owns Belknap Mine number 4.
8. Tony Donnell--Eliasville, Texas--Owns several mines.
9. Pat Rice- Soil Conservation Service agent, Graham, Texas.

   P. O. Box 657, Graham, Texas--549-0422

   Has compiled a partial list of mines and currrent land owners.