Raton Basin Coal Mine Feature Inventory

prepared for:

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1. INTRODUCTION

1A. Purpose of Report

Greg Lewicki and Associates (Lewicki) conducted an inventory of coal mines and related features in the Colorado portion of the Raton Basin. The 'Lewicki 2001 Raton Basin Mine Inventory' was created for the Colorado Oil and Gas Conservation Commission (COGCC). The coal seams of this area have been known, since the inception of mining, to contain large amounts of methane gas. Gas explosions occurred frequently in the mines during the most active mining period from 1890 to 1940. The inventory included: underground mine boundaries, coal related drill holes, and portals or other mine-related features that may emit methane gas. This inventory location data can be used to identify potential sources of methane gas at the surface.

It is interesting to note that while underground coal mining has ceased in the area, methane extraction by gas wells from the coal beds has become very active during the late 1990's. Forecasts predict continued development of the coal bed methane resource.

The Colorado portion of the Raton Basin extends from the Colorado/New Mexico border near Trinidad to approximately 8 miles northwest of Walsenburg (See Figure 1). It is bound on the east by a small isolated mine and outcrop approximately 12 miles southeast of Trinidad and on the west by a group of mines 8 to 9 miles west of La Veta, Colorado. The Colorado portion of the Raton Basin is primarily within Huerfano and Las Animas Counties.

1B. Geologic Setting

Many historical publications exist regarding the geology of the Raton Basin coalfield. In addition, several subsequent reports have been published regarding existing and future coal bed methane gas potential of these same coal seams. These reports are referenced in the bibliography.

The Raton Basin is an asymmetrical, elongated structural basin with a north-south trending axis. Along the eastern flank of the basin, the coal strata dip gently toward the west. The gentle dip and relative shallow coal depth made this the best area for mining. On the western flank of the basin, the coals dip very steeply toward the east and few mines were located in this area. One notable exception, the Tercio Mine (south of Stonewall), had numerous openings into the steep outcrop. The workings however, did not extend very deep

underground. Almost all of the deeper portions of the basin were never mined because the coal beds lie below 2000 feet of cover. Mining is difficult and very costly at this depth since rock pressures cause problems with roof stresses, wall stresses and coal bursts in the mine.

The developed coal beds lie within the Raton and Vermejo Formations. The Raton Formation, deposited during the lower Tertiary/Upper Cretaceous age, is comprised of a basal conglomerate, a middle coal bearing zone, and an upper transitional zone. The middle coal-bearing zone is approximately 1,000 feet thick and consists of shales, sandstones and coal beds. This zone also contains coal seams that have been mined extensively such as the Frederick, Ciruela, Delagua #1 and Primero beds. Although the layers of the Raton Formation are regionally conformable, irregularities occur in local areas and gave rise to sudden rolls of the seams mined underground. Above the transitional zone of the Raton Formation is the Poison Canyon Formation, consisting of yellow and grey shales, light grey sandstones and thin coal beds. The Cretaceous age coal bearing Vermejo Formation, immediately below the Raton Formation, consists of interbedded shales, sandstones and coals. The formation ranges from 150 feet thick in the southern part of the basin to 410 feet in the northern part. This formation contains from 3 to 14 coal beds over 14 inches thick over the entire basin. Some coal seams are very close together such as the Lower and Upper Starkville seams near Engleville (less than 15 feet apart).

The Raton and Vermejo Formations have been intruded by igneous rocks of the Spanish Peaks intrusion which caused dikes to radiate outward from the Spanish Peaks area. Another system of parallel eastern-trending dikes affects seams throughout the entire basin (Harbour and Dixon, USGS Bulletin 1072-G). Each system resulted in dikes and sills that had varying effects on the coal seams of the region. The Vermejo and Raton Formation coals are plagued by igneous dikes, sills, faults and rolls. Almost every mine workings map of the region shows that the extent of the mine was limited by one or more of these features.

Almost all the coal beds of the Vermejo and Raton Formations are characterized by high BTU values (11,000 to 13,500 BTU/lb), very low sulfur (<0.6%), very low moisture (1-2%) but relatively high ash, ranging from 10% to 30%. All of the coals of the area have a high volatile content and produce considerable methane when mined in virgin areas. The coals north of Spanish Peaks area is classified as a high volatile C bituminous coal, while the area south of Spanish Peaks is classified as high volatile A and B bituminous coals, according to the ASTM coal classification system.

The swamps that formed the coal seams were often inundated by sediment, which was compressed with the plant matter to form "bony bands" within the coal seam. These bands have a high BTU value per pound (approximately 11,000) but have an ash content over 30% and have a luster like that of dull steel in addition to being very hard. This was a difficult material to separate from the coal and was the economic downfall of many mines in the basin. This problem caused the shutdown of the Sundance Coal Company mine south of Trinidad in the early 1980's.

The Raton and Vermejo Formations lie directly above the Trinidad Sandstone, which is a marker for the entire area since no coals are found below this sandstone. Figure 2 shows the structure elevation contours of the top of the Trinidad Sandstone, which is also indicative of the Vermejo and Raton Formation structures. The thickness of the Trinidad Sandstone ranges between 70 to 150 feet.

Below the Trinidad Sandstone is the very thick and laterally extensive Pierre Shale. This shale was formed by sediment deposition into an inland sea. The inland sea shoreline was at one time located very near the eastern edge of the foothills today. The coal swamps located to the west of the shoreline contained water channels that drained into the sea from the northwest direction. The Pierre Shale consists of over 2,000 feet thickness of marine shale and some limestone.

The Upper Pierre Shale, the Trinidad Sandstone and Vermejo Formations were deposited in a fluvial-deltaic environment. As the sea withdrew from the region, the Pierre shale was deposited on the shelf and the prodelta, the Trinidad Sandstone was deposited on the delta front and the Vermejo Formation accumulated on the delta plain. The Raton Formation, a continental floodplain deposit, was deposited after the shoreline had retreated from the area.

1C. History of Mining

The Raton Basin has had a long history of coal mining. The first mining of coal in the region is said to have been by William Kroenig near Starkville in 1861. The earliest records obtained by Lewicki, show relatively large mines in the Trinidad area between 1872 and 1875. Colorado was declared a state in 1876. It is likely that other smaller mines existed at an earlier date and some of this early mining was later absorbed by large corporation mines such as those of Colorado Fuel and Iron and Victor American Fuel Company, while others were abandoned into obscurity without a trace. Unfortunately, the records of the State of Colorado Division

of Minerals and Geology and the Colorado Geological Survey begin at statehood (1876). Some older maps, obtained by Lewicki from CF&I during investigative work in the 1980's, show some of the mines prior to statehood. These mines have been included in the inventory.

The coal of the Raton Basin made good coking coal, and once the railroads connected the entire Front Range in the 1870's, coal mining in the entire area was booming. The coke was used in foundries in Denver and hauled by wagon train to smelters in Leadville. Many mine site coke ovens are scattered around the Basin, such as those at Cokedale, Hastings, Grey Creek, Sopris, Pictou and others. Over 400 mines existed in the area, and it is estimated that tens of thousands of workers ventured underground on a daily basis during the most active mining period. In 1881, the first steel-making blast furnace was placed in operation in Pueblo by the Colorado Coal and Iron Company. This further increased demand for coal and coke.

Most of the initial mining sprung up along the eastern outcrops of the coal seams, a few miles west of where Interstate 25 is today, from north of Walsenburg to the Colorado/New Mexico border on Raton Pass. Because the coal seams outcrop along the foothills, it was easy to extend narrow gage railroads from the Denver/Pueblo/Trinidad main corridor into these minor canyons and provide rail directly to the main portals of the larger mines. Later, standard gage tracks were laid to the principal mines. Many of these small canyons had their own company towns such as Delagua, Berwind, Pictou, Morley, Brodhead, Pryor and many others. These towns have been abandoned, and many concrete foundations are still visible if one drives through these canyons west of Interstate 25. The maps of many of the mines show that the towns were very basic in nature, with a company store, church, a few saloons, modest houses for married couples and boarding houses for single miners.

Some of the larger mines like Starkville, Engleville, Sopris and Frederick had hundreds of miners working each shift. Working conditions were harsh and in fact, this area became a hotbed of protest because of the tough conditions, which resulted in a confrontation between striking workers and the State militia hired by the mines owned by John D. Rockefeller Jr. This confrontation resulted in gunfire where a number of workers and family members were killed at a makeshift encampment near Ludlow, Colorado in April of 1914. This event is a famous page in Colorado history and is referred to as the Ludlow massacre. After this date, the United Mine Workers Union organized the workers at the mines but conditions underground remained somewhat poor until the 1960's when the only significant mines in the area were CF&I's Allen and Maxwell mines near Stonewall, Colorado. These mines were later operated by Wyoming Fuel Company who changed the names to the New Elk and Golden Eagle mines. The Allen Mine was the first and last mine in

the area to employ underground longwall mining systems, which completely removes large blocks of coal and subsides the surface. Both of these mines were closed by 1982 and were reclaimed according to permits issued by the Colorado Division of Minerals and Geology.

One small mine called the Raton Creek mine near Starkville was operated briefly by Sundance Coal Company and later Energy Fuels, Inc. in the early 1980's but never became a significant operation. Other strip mines operated briefly such as the Trinidad Basin Mine near Delagua, which closed in 1983, the American Fuels operation near Pryor, which closed in the same year and the Rimrock Mine near Engleville, which operated for 4 months in 1994. Since strip mines pose no real potential to emit methane and since all of those known to have been in the basin have been reclaimed, these mines are not included in the mine inventory.

In 2001, the Lorencito Mine complex opened a surface coal mine near Weston. The complex has plans and permits for both surface and underground mining.

2. COAL MINE INVENTORY

2A. General Mining Practices and Types of Mine Openings

Initially, mining was done by pick and shovel along the easiest outcroppings in the tallest coal seams. Most of this mining was based along the foothill outcrops from Starkville to Walsenburg. In the 1880's and 1890's, augering the coal with a mechanical drill, loading charges in the holes, blasting and loading the coal into small wooden railcars was employed. Many of these railcars dot the front lawns of residents in Trinidad and Walsenburg. Each of these railcars held from 1-3 tons. The railcars were initially brought to the surface on a small track through a drift tunnel or slight incline. The coal usually entered a tipple and at times, hand pickers were employed to pick out rock from the coal. Since the coal in the region is well known for making good coke, many sites had brick beehive coke ovens that usually existed along a rail line next to the mine. Most of the medium and small mines loaded their coal or coke on narrow gage trains and at times standard gage railcars for transport to the CF&I steel mill, smelters in Denver, blacksmith shops, etc. Old maps show that these rail lines entered almost every canyon in the area. Some coal was used locally for heating. In the late 1800's and early 1900's people traveled from as far as Kansas to load a wagon with coal from the Trinidad area for winter heating.

As mining became more machine-oriented in the 1920's and 1930's, cutting machines, drills, blasting crews and loading machines were used to blast the coal in designated tunnels underground called rooms, after which the coal was loaded onto a small underground rail system which typically carried the coal to a drift portal for loading to a surface rail system for transport. By far, the vast majority of the mines in the basin where called drift portal mines, that is, the relatively flat coal seam outcropped along the side of a hill and tunnels were simply dug into the hill as shown on Figure 3.

Most mines of an average size, had at least three openings: 1) a drift portal for the main haulage of coal out of the mine, which also served as a passageway for fresh air to enter; 2) a fan portal for pulling air out of the mine, which could have been a short vertical shaft or a drift portal; and 3) a drift portal or short shaft for intake air to supply the mine, keep dust down and carry away methane buildup. All of the drift portals were usually the height of the coal seam itself (2.8 to 6.5 feet high by 8 feet to 20 feet wide). The tunnels of older mines were narrower since they used very little roof support systems. Shafts were usually 10 feet x 10 feet square, more or less, depending upon the size of the mine. Larger mines usually had one main haulage entry, but had as many intake shafts and fans that were needed to keep the mine ventilated. Some of the larger

mines had as many as 15 openings and some mines were in areas where multiple seams were being mined in the same location, therefore, some shafts and inclines were used to connect one mine vertically with another.

It was not unusual for three to four seams to be mined in the same location. In the area near Walsenburg, the following seams were mined from the bottom to top: Cameron, Lennox, Walsen, Pryor, Lower Robinson 2, Lower Robinson 1, and the Upper Robinson seam. It was also not unusual for some mine tunnel heights to be extremely low, on the order of 3 feet or less, which is more commonly associated with mines in Kentucky and West Virginia than the western United States.

Three or more main entries were usually driven to the heart of the coal reserve, where sets of tunnels were extended to the left and right. These were also groups of 2 or 3 tunnels and were normally called 1-Left, 2-Left, 1-Right, 2-Right, etc. From these tunnels, rooms were excavated a short distance and, in many instances, the coal was completely removed from the rooms. This type of mining, referred to as full extraction room and pillar mining, can result in surface subsidence, depending on the depth of the mining, the strength of the overburden rocks, and on the area of extraction. Full extraction mining and subsidence is important since the surface cracks that are produced can be a source of a methane seep even though all portals of a mine may be reclaimed.

Figure 4 shows a small area near the entrance of the Black Diamond Mine, which is a typical example showing main haulage entry, intake shaft, fan shaft, main entries, rooms, fully extracted rooms and the tram used to haul the coal away. The scale is approximately 1 inch = 200 feet. It should be noted that there are countless variations to this layout, but nevertheless, it serves as a good example.

The newer Allen/Maxwell mines were operated by CF&I and Wyoming Fuels until 1982. They utilized longwall techniques that mined larger blocks of coal per day than conventional or continuous mining techniques. This resulted in extensive methane production, which, due to Mine Safety and Health Administration (MSHA) regulations, unfortunately resulted in lower production to stay in compliance. This was overcome by drilling holes from the surface in advance of the longwall panels and bleeding the methane into the air unburned. By the time the longwall mining equipment neared the area, the methane content was sufficiently reduced to allow full scale mining. Ironically, this area has later been successfully drilled for coal bed methane production wells, more than 15 years after the mines have shut down.

Until the first quarter of 2001, it appeared unlikely that any new mines or old ones would ever open in the Raton Basin. Lorencito Coal Company permitted a large underground and strip mining complex west of Frederick in the late 1990's but coal prices were weak and the mines never opened. With the California energy crisis of 2001, and the recognition that the nation has neglected domestic power plant construction, coal prices have more than doubled in the 2nd quarter of 2001. For this reason, the planned surface coal mine at Lorencito began operation in the fall of 2001. It is not known if or when the planned underground mine may open. No other operations are planned for the Colorado portion of the Raton Basin, although a number of coal exploration projects have been undertaken over the past 25 years to evaluate the potential to remove existing coal blocks that were not previously mined.

2B. Methodology of Investigation and Data Availability

Several data sources were investigated to determine locations and extents of mine workings. Once the mine data were reviewed, the mine outlines were digitized using *AutoCad 2000*. All relevant mine information was maintained in a *Microsoft Access* database. The data processing methods and sources are summarized below:

Mine map inventory of the Colorado Geologic Survey (CGS). The CGS keeps on file an inventory of mine maps for the entire state, including the Raton Basin. The mine maps are generally at a scale of 1 inch = 100 feet or 1 inch = 200 feet, and some large mines require 18 sheets to show the entire mine. This source provided the vast majority of mines that comprise the *Microsoft Access* database and *AutoCad* map produced for this investigation.

CGS Mine Database. Prior to this investigation, the CGS had developed a database of mines under the direction of Chris Carroll. This database included Mine ID numbers, locations to quarter-quarter section, seams, mine names, company names, tonnage extracted, coal quality data, location data, depletion, and a wealth of other information. For this reason, it was decided to use this database as the basis for the investigation. All mines from various sources would be digitized on the CAD map and assigned the same number as that shown in the database. If a new mine was encountered from a new source, it was given a new ID number and digitized.

State of Colorado Mine Subsidence Maps. In 1981, the State of Colorado contracted Amuedo and Ivey of Denver, Colorado to develop maps at a scale of 1:24000 which show shaded areas for the extent of all mined

out areas, portal locations, mine names and whatever subsidence areas were known. Another set of maps were produced for the Colorado Inactive Mine Program in 1983 by J. E. Turney and L. Murray-Williams. These maps have a scale of 1:50000 and cover the entire Raton Basin.

Historic Mine Maps. Lewicki's collection includes historic mine maps of the Starkville area before Colorado became a State in 1876. A number of mines in this area are not found in any of the resources listed above and are significant in size.

Mine Maps from Victor American Fuel Company and CF&I. Both of these companies were fairly large and maintained good quality maps. These maps also show the extent of other surrounding mines to a better degree than other companies.

Abandoned Mined Land (AML) branch of the Colorado Division of Minerals and Geology. A few mines were found that were not shown by any other source. In one case, the AML personnel were working on sealing portals in one area when the landowner took them to another site that had a small mine that was not shown on any previous map. The AML ultimately reclaimed this site also.

Open File Report 79-1 titled "Colorado Coal Reserves Depletion Data and Coal Mine Summaries" by Donna Boreck and D. Keith Murray. This study concentrated on identifying mines from each of the coal regions of Colorado, and tabulating production data for these mines.

Colorado Division of Mines and Geology (DMG) Records and Mine Maps. Since the earlier studies terminated in 1983, any new mining after that date had to be obtained from the DMG files. These data were used for the accurate mapping of the Golden Eagle, New Elk and Raton Creek mines.

State Archives. Certain mine maps that were not available in the Colorado Geological Survey files were obtained from the State Archives.

2C. Database and Map Products

Initially, an *AutoCad Map 2000* drawing file was provided to Lewicki by the Oil and Gas Commission to serve as the base map for the study. This drawing file included quarter-quarter section, section, and township-range polygons that were registered to a NAD 27 UTM feet coordinate system. This was chosen

since all old mine locations were based on feet distances from some known point. A large area north of the Colorado-New Mexico border was never surveyed as Public Land Survey System (PLSS) section-township-range since it was part of the original Maxwell Land Grant. Therefore, the COGCC provided Lewicki with a protracted PLSS for the purpose of approximating the locations of mine boundaries and features.

All mine maps were then studied to determine the extent of workings, the portal types and their locations, and if known, the current status of the mine. Using reference points such as section corners and quarter-section corners, the mine extents and portal locations were digitized on the *AutoCad* map. All mines were assigned an ID number based on the original CGS *Microsoft Access* database described earlier. If a mine was encountered that was not in the database, a new mine ID number was assigned to this mine and it was entered in the database and the *AutoCad* map. All portal locations were also entered using UTM X and UTM Y coordinates as well as portal types. No attempt was made by Lewicki to enter information for the coal quality data, seam data, production, etc, for new mines added to the database. The types of portals and the codes used to describe them are listed in the following table:

Table 1 – Mine Portal Codes

DR	Drift opening of horizontal type or mild slope; the vast majority of openings in the Basin.
IS	Intake shaft; vertical opening for intake of fresh air into the mine.
FD	Fan drift; large fan located in drift or mild slope entry to suck air out of the mine.
FS	Fan shaft; large fan located in vertical tunnel to suck air out of the mine.
PD	Power drop; usually a borehole of 8" to 24" diameter that contained a power cable.
SV	Service drop; usually a small borehole for water pumping into or out of the mine or other uses.
RS	Rock slope; usually a slope tunnel placed in rock to slope into a lower coal seam.

Most of the drift tunnels were the height of the coal seam (3 feet to 6.5 feet) and varied in width from 8 feet to 20 feet in the more modern mines. This width was accomplished with roof bolting which creates a beam of the immediate roof by clamping the 5 to 6-foot zone of roof strata together with steel bolts. None of the early mines had this technology, therefore, they kept tunnel widths narrower to avoid roof collapses.

Most average size mines had approximately three openings - one main intake air opening, one haulage opening for the coal and one for the exhaust fan. Larger mines had multiple fans and intake openings. Many

small mines had only one opening which was usually a drift into the coal outcrop. Other mines had workings in three or more seams, this was prevalent in the Walsenburg area, where the Upper Robinson, Lower Robinson, Cameron and Walsen were all mined simultaneously. These mines were very complex and had rock slopes and shafts that went between seams but were separate from the main openings to the surface.

The database also includes a comment column to describe any known facts about the mine such as reclamation status, portal seals, subsidence problems, etc. It should be noted that some portals of the Sopris Mine and other smaller mines were actually covered by Trinidad Lake after it was constructed.

The *AutoCad* map contains a closed polyline for the extent of each mine and an ID number that was attached to the polylines using the XDATA function in *AutoCad 2000*. The ID number was also entered in text along the polyline. A point symbol was also entered for each portal location. The original database provided by the CGS had 374 mines in the Raton Basin. The current database modified for this report has 465 mines listed, of which 328 have mine maps plotted on the *AutoCad* map. The main reasons for these differences are listed below:

A) Many of these mines were so small that no mine map was ever made and reported tonnages in the State Archives at times were less than 100 tons. These mines are still part of the database but the comment column states that the mine was so small that no map was created.
B) Many additional mines were added to the database from other sources such as old investigation maps, maps from CF&I that pre-date statehood, Abandoned Mined Lands reclamation reports, etc.
C) A number of small mines with production over 100 tons but usually less than 5000 tons do not have maps.
D) Some mines started under one owner but the mine was later sold and the mine name was changed. However, only one map may be available for this mine and the map may show the later name, thus an entry may exist in the database for the earlier name but no map is available under this name.

A description of every column in the database follows:

StrID = Mine ID number initially assigned by CGS. This study used those ID numbers and expanded on them.
StrOperator = The operator (company) working the mine.

StrSecondaryMineName(1) = Other mine name if one was ever used. It could be an earlier or later name.

StrSecondaryOperator(1) = Other operator if one was ever used. It could be an earlier or later name.

StrSecondaryMineName(2) = A third name of the mine if one was used.

StrSecondaryOperator(2) = A third operator name if one was used.

StrCoalRegion = This database uses only the Raton Mesa region.

StrCoalField = Either Walsenburg (northern part of the region) or Trinidad (southern part of the region).

StrArea = Left blank for possible future use

StrCounty = Either Huerfano or Las Animas counties.

StrQtr/Qtr = The ¼ ¼ Section that best represents the mine location.

StrSEC = The Section that best represents the mine location.

STRTownship = The Township that best represents the mine location.

IupNorS = The Township designation "N" for north or "S" for south.

StrRge = The Range that best represents the mine location.

IupWorE = The Range designation "E" for East or "W" for west.

StrMineIndexNumber = Mine Index Number from Open File Report 79-1

StrMapIndexNumber = Map Index Number from Open File Report 79-1

StrMineType = This could be underground – drift, slope or shaft or surface-strip mines.

StrPortalElevation = The elevation of the main portal in feet above sea level.

StrCoalBearingRockUnit = Either Vermejo Formation, Raton Formation or Unknown.

StrGeologicAge = The rock age designation such as Upper Cretaceous or Cretaceous-Paleocene.

StrCoalZone = This basically gives the name of the coal zone used in that area. For example the Robinson zone describes a zone around the Robinson Mine. A coal zone may have more than one seam.

StrCoalBedName = Name of the coal seam that was mined in this mine.

StrCoalThickness = The coal thickness of the seam in feet.

StrSrtartigraphicPosition = Any known data regarding the position of this seam in relation to other seams, other coal zones or other formations is placed here.

StrBeddingAttitudeText = This column represents data for the strike and dip of the coal seam.

StrOverburdenThicknessRange1 = Lowest overburden thickness for the mine.

StrOverburdenThicknessRange2 = Highest overburden thickness for the mine.

StrApparentCoalRank = The categorization of coals based on heat value per pound, carbon content and amount of volatile content. Almost all coals in the Raton Basin are of bituminous rank.

StrHeatValue, As-Received = The heat value of the coal in BTU/LB.

StrAsh = The ash content of the coal in percent by weight.

StrAsh2 = The ash content of the coal in percent by weight from another source, if available.

StrVolatileMatter = The amount of volatile matter in percent by weight.

StrVolatileMatter2 = The amount of volatile matter in percent by weight.

StrFixed Carbon = The fixed carbon content of the coal in percent by weight.

StrFixed Carbon2 = The fixed carbon content of the coal in percent by weight.

StrMoisture = The moisture content of the coal in percent by weight.

StrMoisture2 = The moisture content of the coal in percent by weight.

StrSulfur = The sulfur content of the coal in percent by weight.

StrSulfur2 = The sulfur content of the coal in percent by weight.

StrCokingCoalData = reporting of any properties which are relevant to the coal use for making coke.

StrFreeSwellingIndex1 = The free swelling index of the coal.

StrFreeSwellingIndex2 = The free swelling index of the coal. Additional data.

StrMethaneData = Any data related to the amount of methane in the coal seam.

StrDifferentiatedBedAlpha = Mine names& types vs. production amounts for each name/type

StrProduction1 = Any known data on the coal production of the mine in tons for a particular Township/Range.

StrDifferentiated2 = If production from the mine occurred in more than one township/range, the production may have been differentiated. The T/R for that tonnage shown in StrProduction2 is shown here.

StrProduction2 = Any known data on the coal production of the mine in tons for a 2ndTownship/Range.

StrDifferentiated3 = If production from the mine occurred in more than one township/range, the production may have been differentiated. The T/R for that tonnage shown in StrProduction3 is shown here.

StrProduction3 = Any known data on the coal production of the mine in tons for a 3rdTownship/Range.

StrDifferentiated4 = If production from the mine occurred in more than one township/range, the production may have been differentiated. The T/R for that tonnage shown in StrProduction4 is shown here.

StrProduction4 = Any known data on the coal production of the mine in tons for a 4thTownship/Range.

StrTotal = The total known production from the mine in tons.

StrRecoveryFactor = The ratio of 50% was used for all conventional mining in the Raton Basin

StrDepletionTotal = This is the amount of coal reserve made unavailable by the mining already completed. It is 2x the total production based on 50% depletion recovery factor.

StrReferences = These are references used by the CGS in compiling the information for this mine.

StrRemarks = These are remarks by the CGS.

Feature1 = This is the type of mine opening (feature) that has been assigned to number 1.

1utmx = This is the UTM X coordinate of this opening.

1utmy = This is the UTM Y coordinate for this opening.
(This sequence of feature, utmx and utmy is repeated up to feature 15).
Comments = These comments were provided by Lewicki and describe the current reclamation status of the mine (if known), the status of map availability for the mine and other important items.

2D. Potential Sources of Error

Mapping the mines in the Raton Basin is by no means an exact science. Potential sources of error are present with regard to missing mines, slightly incorrect locations, unknown extent of a mine, missing portals and other discrepancies. The fact that many mines were present before Colorado became a state, and the lack of early regulation of the mines indicates that no inventory could possibly represent the exact extent of every mine in the Basin. Lewicki's local experience in the region has made him aware of drilling companies, mining companies and landowners who encountered mine workings in areas that were thought to have no mining. This study contains probably the most complete mine inventory of any that has been done in the Basin to date. The primary sources of error for the inventory are listed below:

1) It is very possible that some early mines are simply not recorded in any way and are not known.

2) Some of the mine maps in the CGS files were made from originals that were folded and the crease is visible on the map and the location of these mines may not be completely accurate.

3) Some early mines were later opened to "rob" coal from easy access portals for local use. This changes the extent of the mine and at times, results in subsidence. Some of these operations were not recorded.

4) Many of the mine maps within the Maxwell Grant area, in the southern part of the basin, could not be tied to section corners since this area was never surveyed. For this reason, locations such as the Tercio Mine, Quinto Mine and others were made by careful assimilation with known portal areas and USGS topographic maps.

5) Some of the larger mines such as Sopris and Robinson Mines had extents that clearly went beyond the maps in the CGS files. This is known since the entries are seen to continue off the existing sheets but

additional sheets are not available. This is further confirmed by the subsidence maps for these two mines showing a much larger extent. The larger extent from these maps was used to delineate the mine boundaries.

6) A few mines had no ties to any known point and were simply located within a quarter section of a particular Township and Range. These mines were placed on a separate layer on the *AutoCad* map.

7) Some of the mine maps in the CGS files do not show the latest extent of the mine. Some mines were closed and then re-opened at a later date under a new name.

2E. Current Status of Mine Openings

It was not possible to field verify the current status of each mine opening in the study. However, personal knowledge of many mines, landowner accounts, and a review of the work of the AML Division of the Colorado Division of Minerals and Geology have provided accurate knowledge of many of the openings in the Basin. Some of the newer mines were reclaimed by the mining companies themselves. Many have been reclaimed either by the landowners, the AML group and the vast majority of the rest have caved in. The sedimentary shale and sandstone which made up the roof strata of the coals are simply too weak to hold up after 50 or more years of neglect. One of the AML priorities is to seal mine openings that pose a threat to public health and safety. For this reason, many old mine portals that are easily accessed by the public are sealed by the AML. Some portals were fixed with iron grates by AML and although they prevent human access, methane can still be emitted from the portal. Wherever this was done, comments in the mine database are so noted. Other portals were plugged with dirt or were blasted shut.

Many MSHA approved and CDMG approved seals include a valve-regulated pipe through the seal that can be opened or closed. If these valves are not fully shut, methane can leak through these pipes. From local accounts, some mine portals are still open. However, it Lewicki's opinion, based on considerable work in the Basin, that the chances of an old portal is still being open is less than 10%.

2F. Mine Subsidence

Since most of the mines in the Basin were entered along drift tunnels near the seam outcrops, the portal entries were usually under shallow cover that is prone to subsidence. In reviewing the AML files for their

work in the Raton Basin, a portion of their work was dedicated to backfilling and re-grading subsidence spots. This was usually done in very accessible locations. It is certain that other subsidence spots from caved portals exist within the Basin that could still emit methane.

Subsidence can also be caused from full seam retreat mining, which was practiced in many mines. In these cases, no coal pillars are left to hold the roof strata and the roof can cave in. Under covers of 300 feet and higher, the surface may experience some subsidence but it would be unlikely that surface cracks would develop that could emit methane. In areas shallower than 100 feet, subsidence can crack the surface. Once main portals were stabilized in many mines, coal was extracted to the edge of naturally burned coal, which varied from the outcrop to 300 feet laterally into the seam. Naturally burned coal is coal which has combusted naturally (and usually slowly) due to the right conditions of water, air, temperature and chemical makeup of the coal. It usually burns into the seam from the outcrop and stops when it can no longer get oxygen to supply the burning. Many seams in the basin have at least some natural burning from the past and many burn boundaries are identified on the old mine maps. In many cases of coal seams with less than 100 feet cover, partially burned coal, shallow roof strata and weak roof strata can contribute to subsidence that may crack the surface and provide a point for methane emission. Identifying these points was beyond the scope of this study.

2G. Known Methane Gas Emission Points

Based on accounts of local residents and DMG inspectors, a few known mine-related methane emission points have been identified. These points are given below:

1) Unsealed shaft of the New Elk (Allen) Mine, ID #10, at UTM coordinates: X = 1651882, Y = 13479489**.** Depending upon the time of year and the temperature difference of the mine air compared to the atmosphere, natural ventilation may cause methane emission.

2) A few other openings of the New Elk Mine in Apache Canyon are sealed to MSHA or CDMG regulations but these regulations do not require 100% containment of methane, and some of these openings are known to seep methane.

The author believes that the highest potential for mine portals to be leaking methane are in the following areas:

- Grey Creek mine area, Sections 34 & 35, T 33 S, R 63 W and Sections 2 & 3, T 34, R 63 W.
- Morley/Wooten mine area, west part of T 35 S, R 63 W, and east part of T 35 S, R 6 4W.
- Golden Eagle/New Elk mine area, T 33 S, R 67 W and T 33 S, R 68 W

2H. Gas Emission Potential from Unsealed Mine Openings

For gas to be emitted from an abandoned mine portal, a system of natural ventilation must be present where slight differences in the weight of the column of air above two portals of a mine induces flow. This can happen when one portal of a mine is at a lower elevation than another and during summer and winter temperature extremes, the air columns above the two points underground have slightly different densities and the air flows from one portal to another. Also, the summer extreme is opposite of the winter extreme and the air flow direction will reverse itself during these extremes. During times when temperatures of the surface air are equal to that of the mine air, flow will not be induced. If flow occurs, methane will accumulate and will be discharged to the surface. As shown on Figure 5, hot summer days will create an air column above Point 2 that is lighter than that over Point 1. The air above Point 1 is cooled by the underground rocks. This will cause air to move from the shaft to the drift portal. In winter, the air above Point 2 is heavier and the flow reverses. Factors that affect this potential for flow are:

1) The difference in elevation between two portals of the same mine. If the difference is significant, flow will be significant. If the difference is slight, flow may not exist at all.

2) The extent to which the surrounding area has been mined. The larger the extent of mining by adjacent mines, the less chance there is for methane emissions.

3) The amount of cover above the mine. The thicker the cover of rock strata, the more pressure on the coal seam and hence the greater likelihood of emissions.

4) The length of time that the mine has been ventilating.

5) The gassy nature of the coal seam. The Morley (ID's 226 and 423), Wooten (ID's 460 and 461) and Turner mine (ID 463) were among the gassiest ever mined in the United States. Also, these mines are isolated near the New Mexico border. If natural ventilation exists in open portals or subsidence cracks in these mines, they are almost sure to contain methane.

Since most of the mines in the Basin have little differences in elevation between portals, and most of the mines have been in place for many decades, and since most portals have been sealed or caved, it is not likely that methane from unsealed portals is prevalent in the Basin, however, given the vast number of sites, it is likely to exist in some areas.

3. DRILL HOLE INVENTORY

3A. History and Types of Coal Drilling in the Basin

The earliest drill holes in the basin for coal mining were completed by the larger companies, such as CF&I and Victor American, around the turn of the 20th Century. Most of the early drilling was diamond core of approximately 4 to 6 inches in diameter. The majority of these holes were placed in conjunction with probing the reserves of existing mines. Many of these drill holes are shown on the old maps and have been registered in this study. It is certain that many early drill holes have no records and are not possible to locate or identify.

In the 1950's and 1960's, coal mining was on a steep decline in the basin and very little drilling activity was undertaken. With the oil embargo of 1973, coal prices increased rapidly and companies began to explore the basin again. It was also at this time that rotary drilling using 6 to 8-inch hole diameters was used in exploration. Companies like Mobil Oil, CF&I, Peabody and Prairie Canyon drilled extensively in the 1970's but no mines other than the Allen and Maxwell of CF&I remained active. No new mines were opened as a result of this drilling, although a huge amount of money was spent in the process. The Colorado Mined Land Reclamation Division was just getting underway in 1978 and all companies that desired to drill after this date were required to permit their operations with the Division, show how the holes would be reclaimed and post a bond for this reclamation. All holes drilled before this time (of which there are hundreds) had no regulation and the reclamation status of these holes is uncertain. Almost all holes drilled subsequent to 1978 were reclaimed. A few have been left for monitoring or have been converted to methane gas wells.

During longwall operations at CF&I's Allen and Maxwell mines in the 1970's, the company began drilling holes from the surface in advance of the longwall panels to release methane so that it would be less of a hazard to the mining operation. Many holes were drilled specifically for this purpose. These holes were simply drilled into the coal seam and the methane was allowed to vent into the atmosphere. The idea of capturing the gas and pressurizing it for sale was never considered at that time, especially since no pipelines existed in the basin.

In the 1980's there was a minor flutter of drill activity with Perma Resources, Sundance Coal near Starkville Anaconda Minerals and others looking for areas that had been left by the old mining companies. Anaconda Minerals drilled a series of holes in the Long Canyon area in 1984 and 1985 using rotary air hammer methods and air-mist for coring. In the 1990's the only major drilling was the Lorencito Coal Project located west of

Trinidad near the Purgatoire River. Most of these holes were rotary drilled with some coring of the coal seams. The recent coal price increase of 2001 has increased the possibility of additional drilling and potential opening of the Lorencito mine complex.

3B. Methodology of Investigation and Data Availability

A number of data sources were reviewed to obtain drill hole data and location information. The following list of data sources were utilized to complete the inventory:

CGS Mine Maps. Many old mine maps from the CGS files show drill holes from the turn of the Century to the 1960's. In some cases, drill depths are included on the map but generally, no information as to the depth or current status of the holes is known.

Historical Mine Maps. Old mine maps in the possession of Lewicki, which show additional holes.

Exploration Maps. Exploration maps in the possession of Lewicki from the 1970's show extensive drilling by Mobil Oil, Peabody, CF&I, Prairie Canyon, Bear Canyon, Consolidated Coal, and McDonough. Many of the depths for these holes are known. Since these holes were drilled before the reclamation regulations, the Division of Minerals and Geology has no record of these holes and their current status is unknown. It is likely that many of them are not reclaimed and could be leaking methane. Hundreds of holes fall into this category.

Colorado Division of Minerals and Geology. CDMG files for exploration permits (including Notice of Intent files and Drill Hole Abandonment Reports) cover all drilling after 1978, and show the hole locations, depths as well as reclamation methods employed. In the first decade of the Division's existence, exploration permit files were not maintained to the same level as the mine files, and it is possible that some holes have been misfiled or lost. However, the vast majority of the holes drilled after 1978 were reclaimed by plugging with cement or some type of gel/bentonite slurry.

Other Drill Hole Programs. From 1982 to the present, Lewicki was involved various drill hole programs in the Hastings area, Delagua, Starkville and Pryor.

3C. Database and Map Products

Each drill hole location was digitized on the *AutoCad* map using section corners, quarter-section corners and other registering points. Overall, there are 1141 drill holes on the *AutoCad* map and the database. Once a hole was digitized, its UTM X and UTMY coordinates were determined from the *AutoCad* map and were entered into the *Microsoft Access* database.

The following information makes up the drill hole database:

- Hole ID Number (assigned by Lewicki);
- Drill Hole Type (rotary, core, air-hammer or other);
- Hole Name (usually given by the driller);
- Mine Association (indicates the mine that the holes were drilled for, if any);
- Depth of Hole in Feet;
- UTM X Coordinate;
- UTM Y Coordinate; and
- Comments (usually the reclamation status of the hole).

If the mine association was not known, the company that drilled the hole was substituted into the mine association field. All drill holes located placed on the *AutoCad* map and were labeled with the Drill Hole ID number. From this *Access* database, GIS programs can generate a map for all the holes from the UTM X and UTM Y coordinates.

3D. Potential Sources of Error

The various sources of error for the drill hole inventory include the following:

1) It is certain that many of the old mine maps (1890-1960) do not show the full extent of the drill holes that were actually placed in the ground. Some mine maps may show Hole 11, 12 and 13 but do not show the earlier numbers. It is safe to say that these holes were drilled, we simply do not know where they are.

2) It is possible that some drilling programs were lost or misfiled.

3) Some drill holes were placed in areas that were eventually mined and, at times, the maps are too poor quality to determine if some holes exist within the mined out areas that could not be seen. A significant effort

was made to study each map to look for these type of holes and many were found, however, it is likely that at least a few were not visible.

4) It is certain that many old companies drilled holes for exploration purposes that were not associated with any mine and would therefore not show up on a mine map. These holes would be very difficult to research today.

5) The Raton Basin is a unique, independent place and it is possible that some later drill holes were never recorded or permitted.

6) Full drill hole data for all holes after 1978 were not always available since the companies have the right to declare this information proprietary.

3E. Current Status of Drill Holes

Although there are many variables and exceptions, it is safe to say that most of the drill holes prior to 1978 were poorly reclaimed if they were reclaimed at all. These do have some potential for methane emissions although most of these holes would have been drilled along the main outcrop corridor from Walsenburg to Trinidad along the west side of Interstate 25. This area has been heavily mined and the area has had a long time to dissipate its methane. Furthermore, the shallow cover of this area does not lend itself to the kind of methane production that the current gas drilling has further west of the outcrops.

Drill holes installed after 1978 were regulated under the Division of Minerals and Geology reclamation rules and it is safe to say that the vast majority of these holes were safely reclaimed. A company cannot get their posted bond released for an exploration permit unless the DMG does a visual inspection verifying that the holes were properly reclaimed. A few holes were converted to water wells, monitoring wells and some were converted to methane production wells west of Trinidad. Approximately half of the 1,141 drill holes, listed in the database, were drilled before 1978 and the other half were drilled after 1978.

3F. Known Methane Gas Emitting Holes

One coal mine-related drill hole is a known methane emission point. This hole is located on the Chavez property in Section 12 of Township 33 South and Range 68 West. This hole is being investigated by the CDMG. The drill hole is ID 414 in the database.

Two other water-monitoring holes, in the Lorencito area, MW-4 and MW-6, are showing bubbling methane once a water sample is brought to the surface. Under normal water pressure conditions, there is no evidence that these holes are leaking methane to the surface.

3G. Methane Gas Emission Potential from Sealed and Unsealed Drill Holes in the Basin

The modern drill holes (after 1978) that were reclaimed with cement or bentonite slurry are not likely to leak methane. Many of the earlier holes, especially those installed west of the mining extent along Interstate 25, are potential candidates for methane emission. It is probable that these holes were never reclaimed. In the area north and west of Aguilar, more water is present in the Vermejo coals and it is possible that any old holes could have filled with water to the point that the water pressure resists the gas pressure and there is no methane emission. The areas of the Morley/Wooten mines, Grey Creek mines and the Golden Eagle/New Elk Mines are also possible candidates for emission of methane through unsealed or improperly sealed drill holes. Mine ID numbers for these mines are the following: The Morley (ID's 226 and 423), Wooten (ID's 460 and 461), Turner mine (ID 463), Grey Creek Mines (ID's 414 through 419) and Golden Eagle/New Elk (ID's 10 and 380)

4. CONCLUSIONS

Given the number of old mines present, the complexity of the mines and the status of the records, it is likely that the mine inventory is not completely accurate. However, it is definitely the most accurate inventory of the mines in the Basin. The *Microsoft Access* Database and *AutoCad* map work products are designed to be imported to GIS mapping software for detailed analysis of any area in the Colorado portion of the Raton Basin.

The author believes that no previous inventories of mine-related drill holes in the Raton Basin have been done. As stated in the "sources of error section," it is certain that some drill holes were made for which no records are currently available. However, many hundreds of drill holes are present in this inventory for which the State Division of Minerals and Geology has no records since these holes were drilled prior to the reclamation laws. Some of these could be emission points for methane.

In using these products to evaluate whether an emission point of methane on the ground is related to coal mining, a good understanding of the inventory is very helpful. For example, if a point exists on the ground that is emitting methane approximately 16 miles west of Aguilar, one look at the *AutoCad* map shows that no mining or drill hole activity occurred within 13 miles of this area. The coal seams are very deep in this area and it is nearly impossible that any emission point here could be related to coal mine activity or exploration. One the other hand, if an emission point were to be located somewhere near the New Elk Mine west of Trinidad or the Morley Mine on Raton Pass, it should be regarded as a possible mine-related emission point.

It is possible that additional information could be made available from drill hole records or other data such as the CF&I archive files in Pueblo. At the time of this inventory, the CF&I files were unavailable for public review although a strong effort was made to see them. These files may have records of old mines that are unknown to anyone else since this was the case in the Starkville area. CF&I kept excellent records and maps for their early mines and their properties were widespread throughout the Raton Basin. The maps are also known to show adjacent mines in good detail.

5. BIBLIOGRAPHY

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14. All Abandoned Mined Land Reports of the Colorado Division of Minerals and Geology for the entire Raton Basin, Colorado 1980 to present.

15. Danilchik, Schultz, and Tremain, Content of Adsorbed Methane in Coal From Four Core Holes in the Raton and Vermejo Formation, Las Animas County, Colorado. USGS Open File Report, pp 79-762.

APPENDIX A
FIGURES

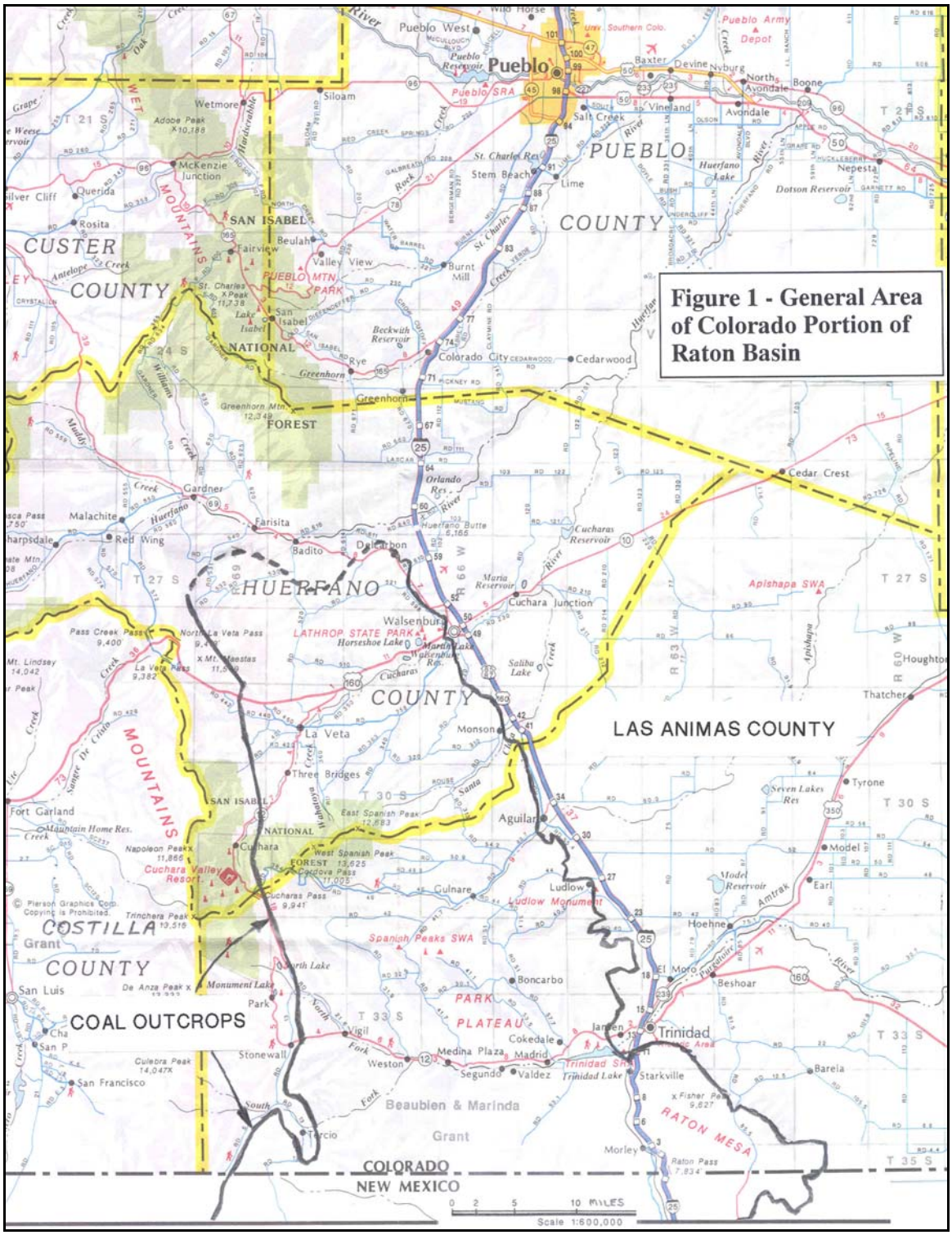
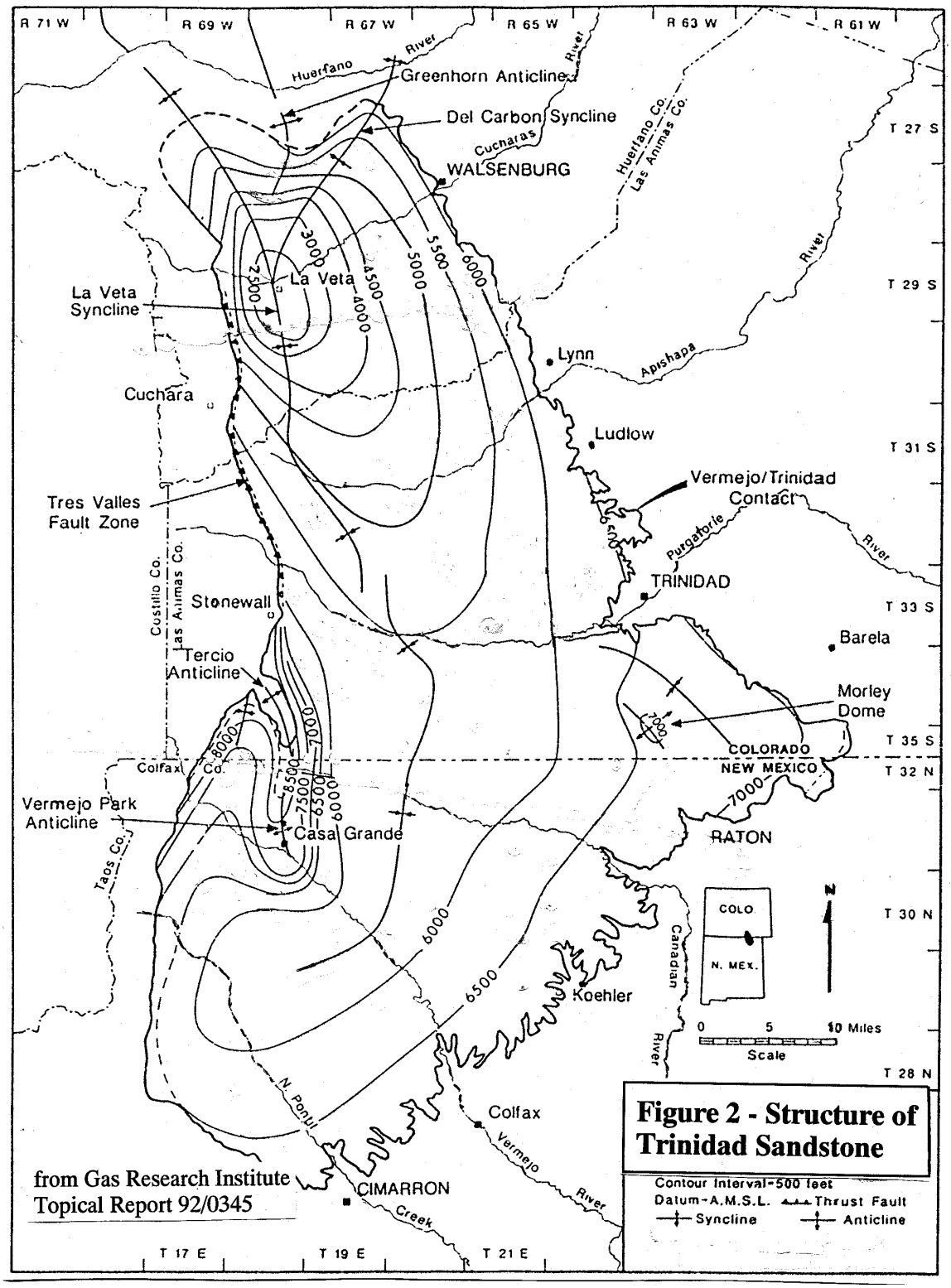


Figure 1 - General Area of Colorado Portion of Raton Basin


R 71 W
R 69 W
R 67 W
R 65 W
R 63 W
R 61 W
Huerfano River
Greenhorn Anticline
Del Carbon Syncline
Cucharas River
WALSENBURG
Huerfano Co.
Las Animas Co.
T 27 S
La Veta
La Veta Syncline
T 29 S
Lynn
Apishapa River
Cuchara
Ludlow
T 31 S
Vermejo/Trinidad Contact
Tres Valles Fault Zone
Purgatoire River
TRINIDAD
Costilla Co.
Las Animas Co.
Stonewall
T 33 S
Barela
Tercio Anticline
Morley Dome
COLORADO
NEW MEXICO
T 35 S
Colfax Co.
T 32 N
Vermejo Park Anticline
Casa Grande
RATON
Taos Co.
COLO.
N. MEX.
T 30 N
Canadian River
Koehler
0 5 10 Miles
Scale
T 28 N
N. Ponil Creek
Colfax
Vermejo River
CIMARRON
Figure 2 - Structure of Trinidad Sandstone
Contour Interval-500 feet
Datum-A.M.S.L.
Thrust Fault
Syncline
Anticline
from Gas Research Institute
Topical Report 92/0345
T 17 E
T 19 E
T 21 E

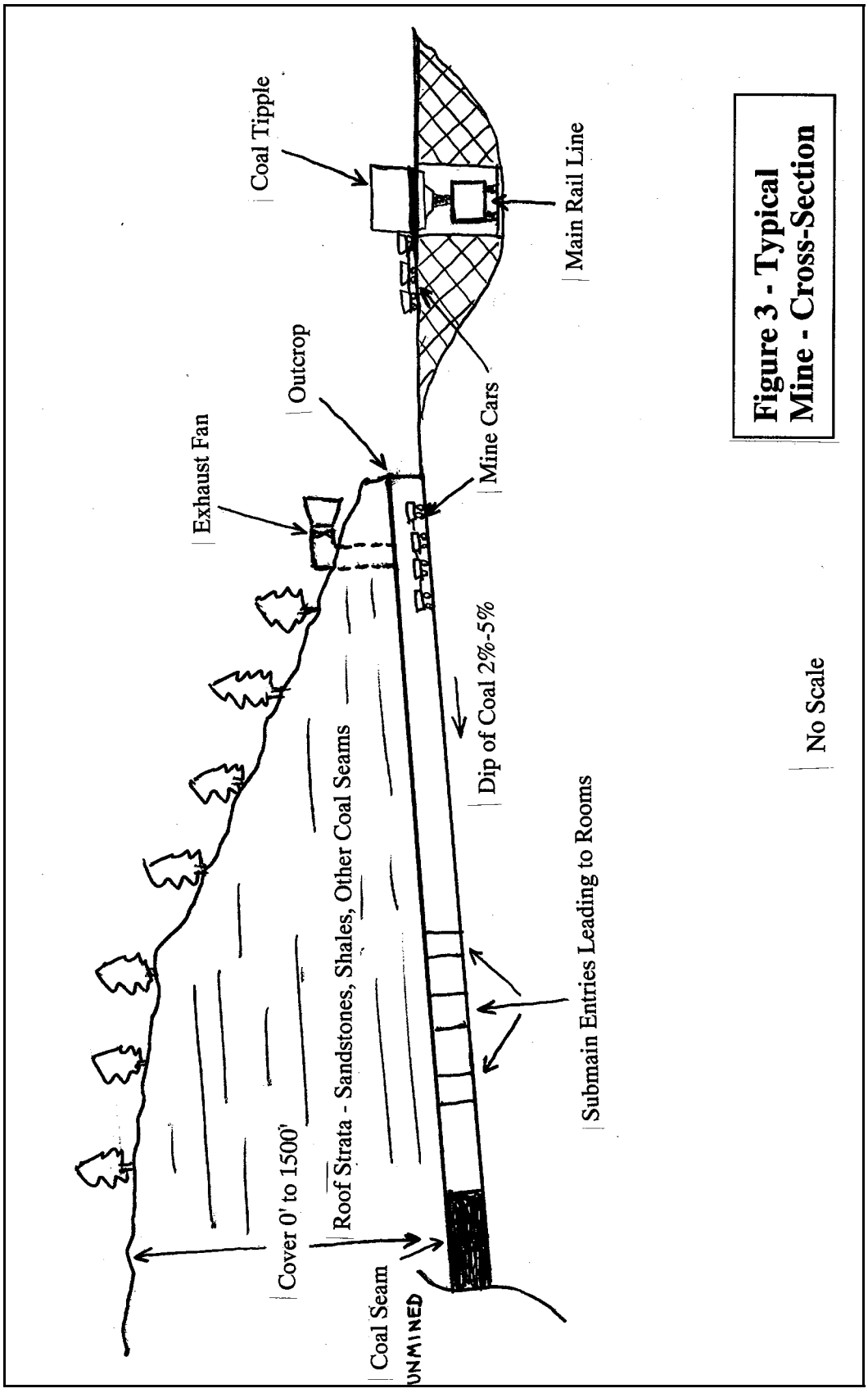


Figure 3 - Typical Mine - Cross-Section

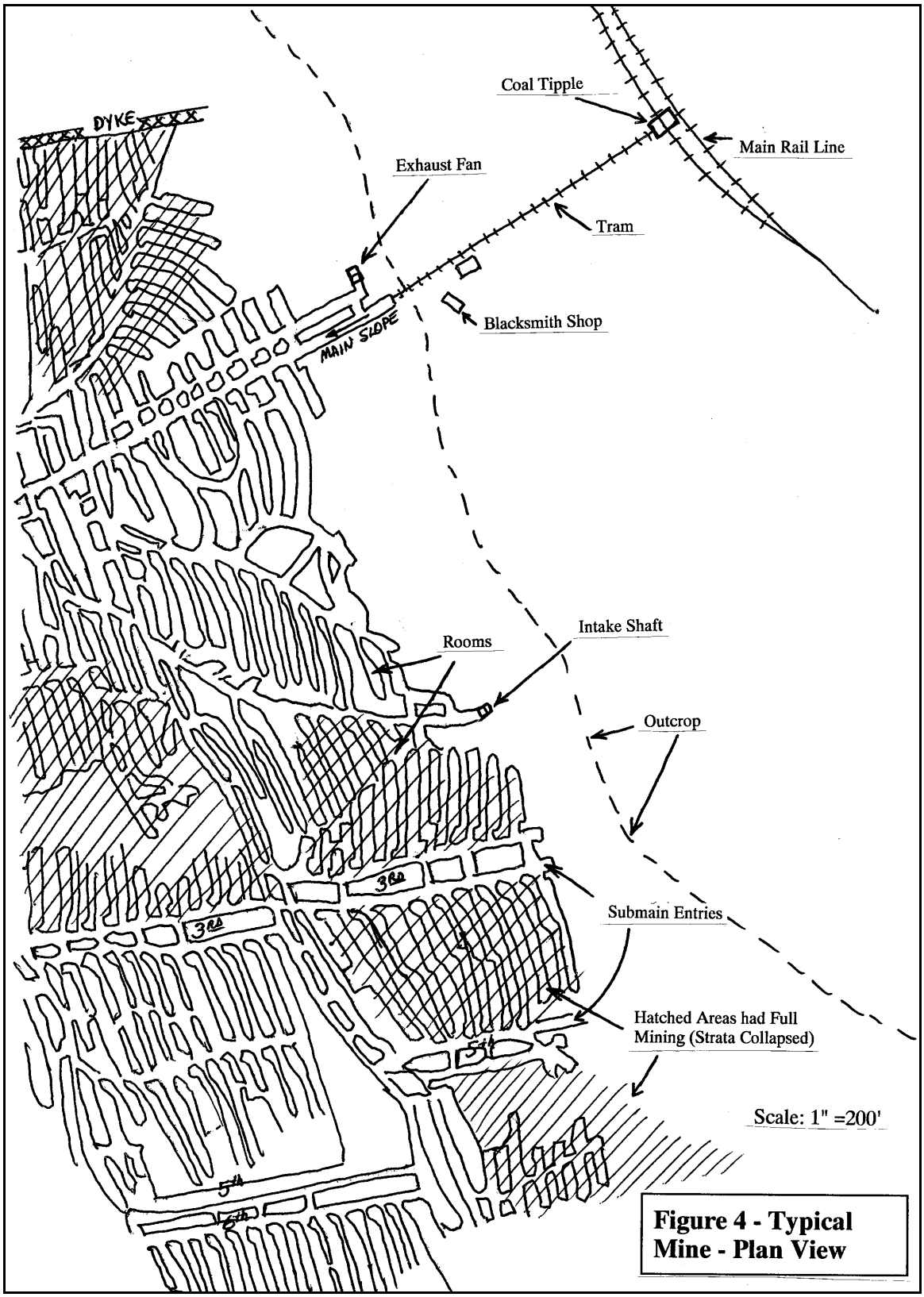


Figure 4 - Typical Mine - Plan View

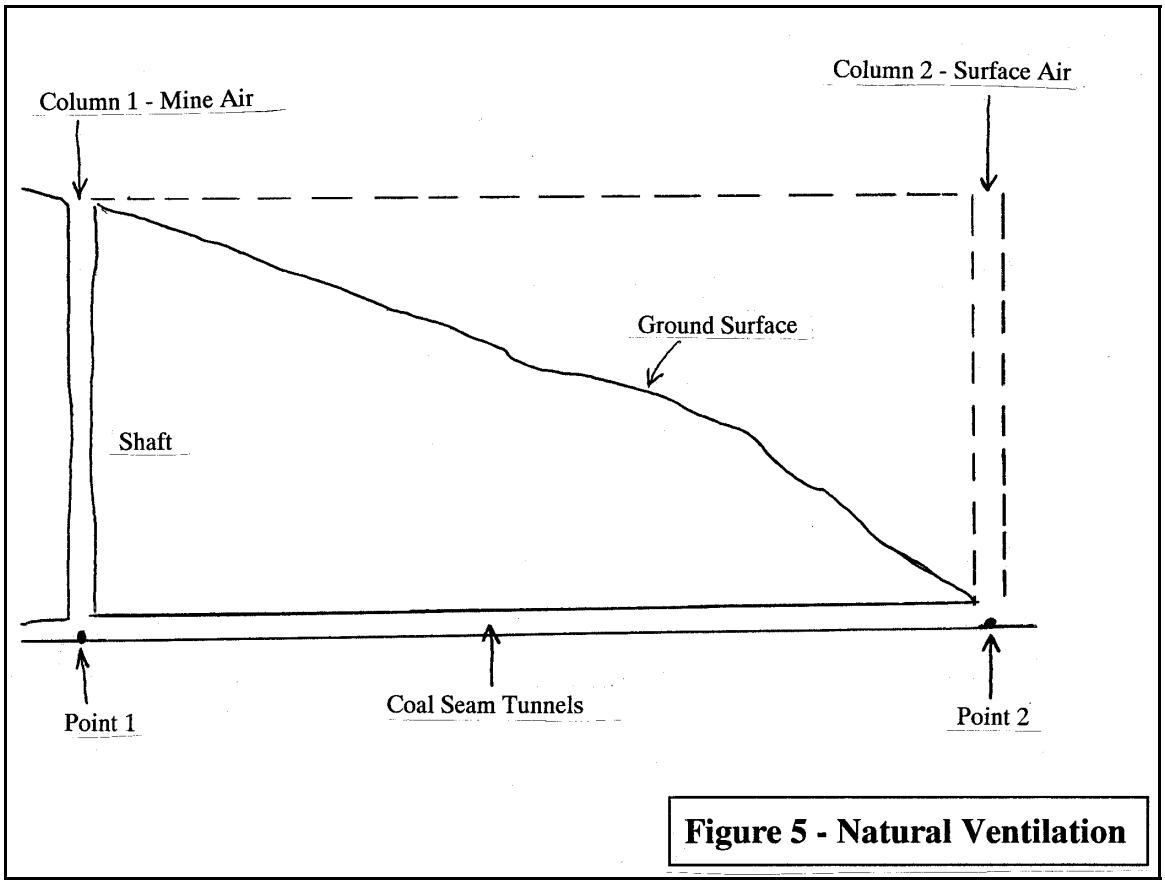


Figure 5 - Natural Ventilation

APPENDIX B
MINE INVENTORY

LEWICKI MINE INVENTORY

Mine ID	Mine Name	Operator
1	Aaron	Redwood Coal Co. 1939-1942
5	Aguilar	Mike Blahut, 1939-1943
6	Aguilar-Imperial	Montoya Coal Co., 1952-1966
7	Aguilar Black Diamond No.1 and No.2	Southern Black Diamond Coal & Oil Co., 1936-1948
10	Allen-East and West Portals	C.F. and I Steel Corp., 1951-1979?
11	Alta	Temple Fuel Co, 1911-1912
12	Amador	July Coal Co., 1912-1923
17	Baldy #1, #2	Baldy Coal Co. (Victor American-owner), 1907-1965
19	Barbour	Butte Valley Coal Co. 1926-1927
21	Beacon	Colorado Coal Selling Co., 1909-1911
23	Bear Canon #' 3 (seams)	Bear Canon Coal Co., 1917-1926
25	Berwind	C.F. and I. 1892-1928
26	Berwind Canyon	Berwind Coal Co., 1939-1966
26	Berwind Canyon	Berwind Coal Co., 1939-1966
28	Berwind #4	Lorenzo De La Rosa, 1959-1962
29	Berwind # 5(New)	Smith Coal Co., 1960-1962
30	Beshoar	William G. Wilton, 1917-1937
32	Black Beauty	Black Beauty Coal Co., 1942-1964
33	Black Canon	New Maitland Coal Co., 1905-1916
34	Black Diamond	Cedar Hill Coal and Coke Co., 1901-1914, 1916-1922
36	Black Hawk #1, Black Hawk #2	Blue Blaze Coal Co., 1958-1962
38	Black Hills	Pelligrino Bassi 1921-1937
39	Bloom	Joseph C. Trujillo 1890-1949
40	Blue Bird	Taylor Coal Co., 1934-1936
42	Blue Blaze	Blue Blaze Coal Co., 1940-1958
44	Boncarbo	American Smelting and Refining Co., 1917-1947
45	Bowen #3 Mine	Home Fuel and Supply Co., 1899-1943
47	Breen	Breen Coal Mining Co., 1911-1920
48	Brennan	Brennan Coal Mining Co., 1918-1923
52	Brodhead #9	Temple Fuel Co., 1911-1939
53	Brown's	Brown Brothers 1935-1936
59	Bunker Hill #1	Steve Mattivi and Sons, 1878-1901
63	Burro Canyon and #@	Manuel Acuri, 1934-1947
65	C.O.D. #1, #2	Klikus Coal Co., 1933-1941
66	Caddell (old)	Black Canon Coal and Fuel Co., 1909-1930
68	Caddell #3	Caddell Coal Co., 1931-1941
69	Calumet #2	Delcarbon Coal Co., Inc. 1924-1971
71	Caprock	F. J. Sweet, 1917-1922

Mine ID	Mine Name	Operator
73	Carbonado	Carbonado Coal Mining Co., 1912-1914
75	Cass	Victor-American Fuel Co., 1911-1924
77	Champion	Union Coal and Coke Co., 1899-1910
80	Chicosa #'s 1,2,3	Trinidad Fuel Co., 1888-1892
81	Cokedale #1, #2	American Smelting and Refining Co., 1907-1919
83	Congo	Andy Collier, 1911-1926
89	Crystal	Guillermo Bowman, 1932-1951
90	Cuatro	C. F. and I., 1903-1907
91	Cucharra Canon	Vesta Coal and Co., 1917-1925
92	Daisy #1, #2	Daisy Coal Co., 1931-1943
93	Dalby #6, #7	No operator given, do date given
94	Davich	Mike Davich 1928-1931
95	Deep Vein	Deep Vein Coal co, 1917-1920
97	Delagua	Victor American Fuel Co, 1903-1952
100	Delauga #5	Victor American Fuel Co., 1946-1952
103	Dix	Dick Coal Co., 1921-1947
105	Dutch	Dutch Coal Co., 1947-1953
106	El Moro #'s 1,2,3	Colorado Coal and Iron Co, 1884-1892
107	Empire	Empire Coal Co., 1907-1935
110	Farr and Thompson	Farr and Thompson, 1921
111	Fawcett	Aguiler Coal Co., 1923-1929
113	Ferrell	John Hollingsworth 1914-1932
114	Fisher's Peak	Fisher's Peak Coal Co., 1913-1935
115	Flag	Antonia Franza 1928-1936
116	Forbes #'s 10 and 11	W. E. Riggs, 1935-1947
117	Forbes #9	Paradise Brothers, 1913-1951
118	Francisco	Rocky Mtn. Fuel Co., 1905-1909
119	Franklin	South Black Diamond Coal and Oil, 1947-1956
120	Frederick	C. F. and I. Corp., 1907-1960
121	Frisco #1 and #2	No operator given, 1931-1954
123	Garcia #1	Benito Garcia 1933-1941
124	Garcia #2	Jas h. Calhoun 1940-1941
125	Garfield	Gus Garcia and Sons, 1939-1941
126	Gem	Guiliano Coal 1932-1956
128	George #1,	Garms and Baione, 1930-1942
130	Globe	National Fuel Co., 1911
132	Gordon	Skinner Coal Co., 1907-1965
133	Green Canon #1	Green Canon Coal Co., 1939-1945
134	Greenville	Cedar Hill Coal and Coke Co., 1903-1927
135	Grey Creek #'s 1, 2, 3	Victor American Fuel Co., 1888-1921
138	Harnish #1 and 2	Mike and Juan Tafoya, 1944-1951
139	Hastings #4	Victor American Fuel Co., 1907-1923
140	Hastings #5	Victor American Fuel, 1920-1922
143	Henderson	J. E. McLaughlin, Lessee, 1917-1921
145	Hezron	Caddell and Son, 1901-1925
148	Hines	Hines Coal Co., 1916-1921
151	Hubbard and Williams	No operator given, no date given
152	Huerfano	Huerfano Coal Co., 1905-1912
154	Ideal	C. F. and I. Corp., 1909-1929
158	Jeffryes (new)	R. and G. Fuel Co., 1937-1946

Mine ID	Mine Name	Operator
159	Jeffryes #1, 2, 3	Jeffryes Fuel Co., 1915-1936
161	Jewel	Jewell Collieries Corp., 1901-1926
163	Jobal # 1 and 2	C. F. and I., 1918-1924
165	Kebler #1	C. F. and I., 1919-1923
166	Kenneth	Hall Coal Co., 1909-1949
167	Keystone #1 and 2	Lunny and Granger, 1915-1918
168	Klay	Pete Klay, 1940-1944
169	Klikus	C. and C. Coal 1932-1958
171	Klondike (Pryor 1, 2, 3 old) (?)	No operator given, no date given
172	Korte	Alliance Coal Co., 1905-1906
173	LaBelle #1, 2 and 3	
175	Lake View	Nick Riggio 1929-1938
176	Lakeview #2	Glorioso and Iuppa 1939-1941
178	Leader #1	Fruth and Stone, 1920-1933
179	Leader #1, 2 and 3	Leader Coal co., no date given
180	Leone	L. Leone 1917-1922
182	Lester	C.F. and I. Corp. 1911-1929
183	Liberty	Liberty Coal Co., 1917-1923
184	Liberty (new)	Liberty Coal co., 1933-1937
185	Linscott	Rufus B. Linscott, 1936
186	Little Mary	Trinidad Brick and Tile Co., 1931-1944
187	Loma #1, 2 and 3	Loma Fuel Co, 1888-1918
189	Lovato	John C. Lovato, 1942-1950
192	Ludlow #1, 2 and 3	Huerfano Coal Co., 1903-1952
193	Lunny	No operator given, no date given
194	Madrid	Bueno y Griego
195	Maitland #1	Red Ash Coal Co., 1897-1962
196	Maitland #2	Red Ash Coal Co., 1952-1972
197	Majestic	Majestic Fuel Co., 1900-1920
198	Major #1	Major Coal co., 1933-1941
199	Major #2	Major Coal Co., 1940-1959
200	Major #3	Major Coal Co., Inc., 1961-1962
202	Martarano	Martarano Bros., 1932-1951
203	Martinez #1 and 2	Albert Martinez, 1924-1971
208	Mc Intosh	Enrietta and Co., 1922-1924
210	McLaughlin #4, 5 and 6	No operator given, 1912-1916
211	McNally	C. F. and I., 1913-1914
212	McPhail	T. P. McPhail, 1938
213	McPherson	Tom McPherson 1914-1915
215	Melonas	Melonas Coal Co., 1947-1954
216	Middle Creek	John Smalley 1940-1942
217	Midnight	Midnight Coal Co., 1934-1936
219	Midway	Union Coal and Coke Co., 1899-1910
221	Monarch	South Monarch Fuel and Gas, 1939-1940
222	Monteleone	Aleck J. Monteleone, 1940-1941
223	Montoya	Montoya Coal Co., 1943-1952
224	Moore	Azar Coal Co., 1917-1919
225	Morasky	Joe Morasky, 1935-1947
226	Morley	C. F. and I., Corp. 1907-1956
228	Murrell	James Murrell, 193301943
229	Mutual	Mutual Coal Co., 1913-1932

Mine ID	Mine Name	Operator
231	New Congo	Cash and Carry Coal Co., 1928-1931
232	New Ideal	Ideal Coal Co., 1939-1941
233	New Primrose #2 and #11	Alex Bisulco, 1940-1954
234	New Slope	Guadagnoli Bros., 1940-1950
237	Niggerhead #1 and #2	Niggerhead Mining Co., 1914-1935
238	Niggerhead #2	Niggerhead Coal Co., 1953-1954
239	No Ash	No Ash Coal co., 1924-1925
240	Nugget	Joe Maloney, 1935-1938
241	Oakdale	Oakdale and Peachy Coal co., 1907-1940
243	Occidental	U.M. and C. Co., 1905-1908
247	Pacific	Pacific Coal Co., 1927-1930
248	Peacock	Peacock Coal Co., 1930-1968
249	Peaks	Peaks and Coal Co., 1939-1957
251	Peerless	Globe Fuel Co., 1892-1913
252	Pete's	Pete's Coal Co., 1962-1967
253	Philips	Philips Coal Co., 1918
254	Pickford	Boaglio Coal Co., 1935
255	Pictou	C.F and I., 1889-1953
258	Pinion #1 and 2	Rocky Mtn. Fuel Co, 1904-1912
259	Pinon #3	Rocky Mtn. Fuel Co., no date given
261	Pinon Canon #2	Pacheco, Secundino, Vallejos, no date given
262	Pioneer (new)	Major Coal Co. Inc., 1959-1962
263	Prairie Canon	Prairie Canon Coal co., 1919-1929
264	Premium (Star)	Premium Coal Mining Co., 1913-1916
265	Primero	C.F. and I., 1907-1927
266	Primrose	Black Hawk Coal Co., 1900-1923
268	Prospect	Prospect Coal Co., 1913-1930
269	Prospect #'s 1, 2, 3 and 4	No operator given 1935-1944
271	Pryor #2 (New)	Alex Shields, 1949-1951
272	Quinto	C.F. and I., 1906-1908
273	Rainbow	Rainbow Coal co., 1934-1941
274	Rainbow #1	Rainbow Coal Co., 1947-1959
276	Rapson #1 and 2	Rapson Coal co., 1900-1961
277	Ravenwood	Caliente Coal Co., 1909-1948
279	Redwood	Redwood Coal Mining Co., 1935-1939
281	Prosperity #1 and 2	George Pantazes 1950-1971
284	Robinson #1	C.F and I. Corp., 1926-1930
285	Robinson #2	C.F. and I., 1927-1929
286	Robinson (Old)	C.F. and I. 1888-1918
287	Rockland	Walsenburg Fuel Co., 1910-1914
291	Royal	Royal Fuel co., 1911-1930
293	Rugby (old)	Teachers' Mining and Milling Co., 1898-1924
294	Rugby #'s 2, 3, 4, 5 and 5 1/2	Rugby Coal Co., 1935-1966
295	Rouse #3	Taylor Coal co., 1905-1948
296	Rouse (old)	C.F and I Corp 1888-1899
297	Rouse (new) or #4	CF and I 1899-1904
302	Sanchez	Joe Sanchez 1933-1940
304	Santa Clara	Union Coal Co 1889-1898
305	Santa Fe	Santa Fe Coal Co., 1913-1946

Mine ID	Mine Name	Operator
310	Sherman	Home Coal and Coke Co, no date given
312	Skyline	Thomas McPhail, 1939-1941
313	Sopris #1	Deldosso Coal Co 1888-1940
314	Southwestern	Rocky Mtn Fuel co 1903-1927
318	Spring Canon	Spring Canon coal Co 1933-1937
320	Starkville (new)	Starkville Coal co., 1935-1943
321	Starkville (old)	CF and I 1884-1921
323	Starkville #3	Nick Cimino, 1942-1952
324	Starkville #4	A Iuppa and Son Coal Co., 1946-1968
325	Starkville #5	Sam Gonzales, 1946-1952
326	Starkville #6	Sam Gonzales, 1950-1951
327	Starkville #7	Dimarco, L and Alverado, L, 1951-1963
328	Stanley	CA Stanley 1921-1926
329	Stella Mae	Stella Mae Coal Co., 1922
330	Stevens	JJ Abercrombie, 1904-1910
333	Stonewall Valley	Gus J Martin 1933-1943
334	Storz	Storz Gus L, 1932-1935
335	Strawberry #1 and 2	Strawberry Coal co 1933-1943
336	Suffield	Green Canyon Coal Co 1904-1909
337	Sun #1, 2 and 3	George and Ray Sneddon 1936-1941
338	Sunlight	Sunlight Coal Co, 1905-1928
339	Sunnyside	Elk Hart Coal Co, 1904-1932
340	Sunrise	Robert Fabec 1935-1951
341	Sunshine (old)	Sunshine Fuel Co, 1896-1903
343	Sweet	Silver State Coal co, 1904-1909
344	Tabasco	CF and I, 1901-1930
345	Tercio	CF and I, 1902-1915
346	Thomas	Star Coal Co 1907-1932
347	Thompson	Fairview Coal Co, 1921-1924
348	Thompson Valley	Maitland Coal and Coke Co 1910
349	Thor	Thor Fuel Co., 1910-1948
353	Toller	CF and I, 1908-1932
354	Toltec (Aztec)	Aztec Coal Mining Co 1894-1944
355	Torrid and Torrid #4	Torrid Coal Co, 1925-1938
358	Turner (Calumet #1)	Turner Coal Co, 1911-1921
360	Valley	Ben C Lucia, 1888-1933
361	Vega	No operator given, no date given
362	Verdun	John Kezele and Sons, 1917-1936
363	Victor #1 and 2	Victor C and C Co, 1889-1895
364	Victor #3	Victor C and C Co, 1890-1893
365	Vigil	Vigil Fuel Co, 1924-1958
366	Viola (old)	Johnson Coal and Coke Co, 1911-1915
367	Walsen	CF and I, 1884-1925
369	Wellington	Wellington Coal Co, 1924-1928
370	Wiley	Dan Fedizzi, 1913-1934
371	Williams	Miners Coal and Coke Co, 1918-1922
373	Wood	Franklin P. Wood 1917-1918
374	Young-Caddell	Young and Caddell Coal Co, 1922-1923
375	Raton Creek #1	Energy Fuels
376	Raton Creek #2	Energy Fuels
377	Carbon Mine	CFI?
378	Trinidad Mine	CFI?

Mine ID	Mine Name	Operator
379	Scandinavian	CFI?
380	Golden Eagle	CFI
381	Bear Canyon #6	
382	Bear Canyon #1,#2,#4,#5	Bear Canyon Coal Company
383	Banner Mine #1	
384	Aguilar Black Diamond Mine #1	
385	New Alta Mine	New Alta Fuel Co. 1913-1920
386	Apache Mine	
387	Baca Mine	Baca-Vigil Coal Co.
388	Brodhead #10 Mine	Temple Fuel
389	New Alta Mine	Temple Fuel
390	Brodhead #11 Mine	Temple Fuel
391	Brodhead #1 Mine	Brodhead Coal Co.
392	Brodhead #2 Mine	Brodhead Coal Co.
393	Brodhead 4a Mine	Brodhead Coal Co.
394	Bowan #1 Mine	Victor Am. Fuel Co.
395	Bowmans Mine	
396	Bon Carbo #5 Mine	Am Smelting $ Refining Co
397	Bunker Hill Mine	
398	C.O.D. #2	John Klickus Mine
399	Cokedale #2	
400	Forbes #5	
401	Forbes #6	
402	Forbes #7 Mine	
403	Forbes #8 Mine	
404	Forbes Mine 6 1/2	
405	Daisy Mine #2	Adam Galli
406	Leader #3 Mine	Leader Coal Company
407	Oak Creek Mine	C&C Coal Co.
408	Jeffrey's Mine #3	Jeffrey's Fuel Co.
409	Creston Mine	
410	Green Canyon #5,#6 & #7	Green Canyon Coal Co.
411	Glen George #2	
412	Glen George #3	
413	Glen George #4	
414	Grey Creek #4	Grey Creek Coal Co.
415	Grey Creek #2	Victor Am. Fuel Co
416	Grey Creek #3	Victor Am. Fuel Co.
417	Grey Creek #7&8	Victor Am. Fuel Co.
418	Grey Creek #6	Victor American Fuel Co.
419	Grey Creek #5	Victor Am. Fuel Co.
420	Ludlow #1 Mine	Huerfano Fuel co.
421	Maitland Mine Upper Vein	Victor Fuel Co.
422	OJO Canyon Mine	
423	Morely East Mine	
424	Rapson #2 Mine	
425	Red Glow Mine	Red Glow Coal Co.
426	Rogers Mine	
427	Cameron Mine	Colorado Fuel and Iron Corp.
428	Pryor #2 Mine	Pryor Coal Mining Co.
429	Pryor #3 Mine	Union Coal & Coke Co.

Mine ID	Mine Name	Operator
430	Jeffries Mine #2	Jeffrey's Fuel Co.
431	Ravenwood #3 Mine	
432	Pictou Upper Robinson Mine	Colorado Fuel and Iron Co.
433	Rugby #4 Mine	Clyde Dawn
434	Pictou Vein 3	
435	Rugby 1 (new)	
436	Rugby #6 Mine	
437	Leader #4 Mine	
438	Rugby 2 (new)	
439	Rugby 5 Mine	
440	Walton/Eli Jeffries Mine	
441	Santa Fe- Starkville West	
442	Southwestern Mine Upper Seam	Rocky Mountain Fuel Co.
443	CFI Tabasco Mine	
444	Three Pines #1 Mine	Three Pines Coal Co.
445	Three Pines #2 Mine	Three Pines Coal Co.
446	Burro Canyon #2	Tony Stancato
447	Burro Canyon #1	Leo Franklyn
448	Sante Fe Section 36	
449	Torrid #3 Mine	Torrid Mining Co.
450	Tweeddale Mine	
451	Torrid #2 Mine	Torrid Mining Co.
452	Rouse #2 Mine	
453	Valley Mine (Small)	Valley Coal Company
454	Black Diamond New	Cedar Hill Coal & Coke Co.
455	Rouse #4 (New) Mine	CF&I Coal Company
456	Abidar Mine	
457	Carbonado (Real) Mine	Carbonado Coal Mining Co.
458	Alamo Mine	Gordon Coal Co.
459	Sunnyside 2	
460	Wooten Mine #1	Wooten Land and Fuel Company
461	Wooten #2 Mine	Wooten Land and Fuel Company
462	Premium Mine	Sudar Coal Company
463	Turner Mine	Wooten Land and Fuel Co.
464	Niggerhead Mine	
465	Unnamed Mine	