EXHIBIT IV-B

COAL SEAM ANALYSIS

Tower Resources, Inc.

ABERDEEN SEAM:

A. HEATING RANGE (BTU'S/LB.):

AS RECEIVED	DRY BASIS
10,967 - 13,434	11,058 - 13,914

B. AVERAGE HEAT (BTU'S/LB.):

AS RECEIVED	DRY BASIS
12,517	13,138

C. MINERAL ANALYSIS OF ASH:

	IGNITED BASIS % WEIGHT
PHOS, PENTOXIDE, P_2O_5	0.17
SILICA, SiO_2	53.92
FERRIC OXIDE, Fe_2O_3	5.0
ALUMINA, Al_2O_3	13.53
TITANIA, TiO_2	0.91
LIME, CaO	11.13
MAGNESIA, MgO	3.30
SULFUR TRIOXIDE, SO_3	9.26
POTASSIUM OXIDE, K_2O	0.35
SODIUM OXIDE, Na_2O	0.99
UNDETERMINED	1.44
	100.00

D. PROXIMATE ANALYSIS:

	AS RECEIVED		DRY BASIS	
	$\bar{X}$	σ	$\bar{X}$	σ
% MOISTURE	4.65	1.57	-----	-----
% ASH	7.63	5.73	7.93	5.80
% VOLATILE MATTER	38.63	2.21	40.54	2.55
% FIXED CARBON	49.09	3.46	51.53	3.71
% SULFUR	0.60	0.29	0.62	0.30
BTU/LB.	12,517	805.34	13,138	875.35

E. ULTIMATE ANALYSIS ($\bar{X}$):

	AS RECEIVED	DRY BASIS
% MOISTURE	5.16	-----
% CARBON	70.03	73.85
% HYDROGEN	4.82	5.09
% NITROGEN	1.44	1.49
% CHLORINE	0.03	.03
% SULFUR	0.64	0.68
% ASH	7.07	7.46
% OXYGEN (DIFF.)	10.81	11.40
	100.00	100.00

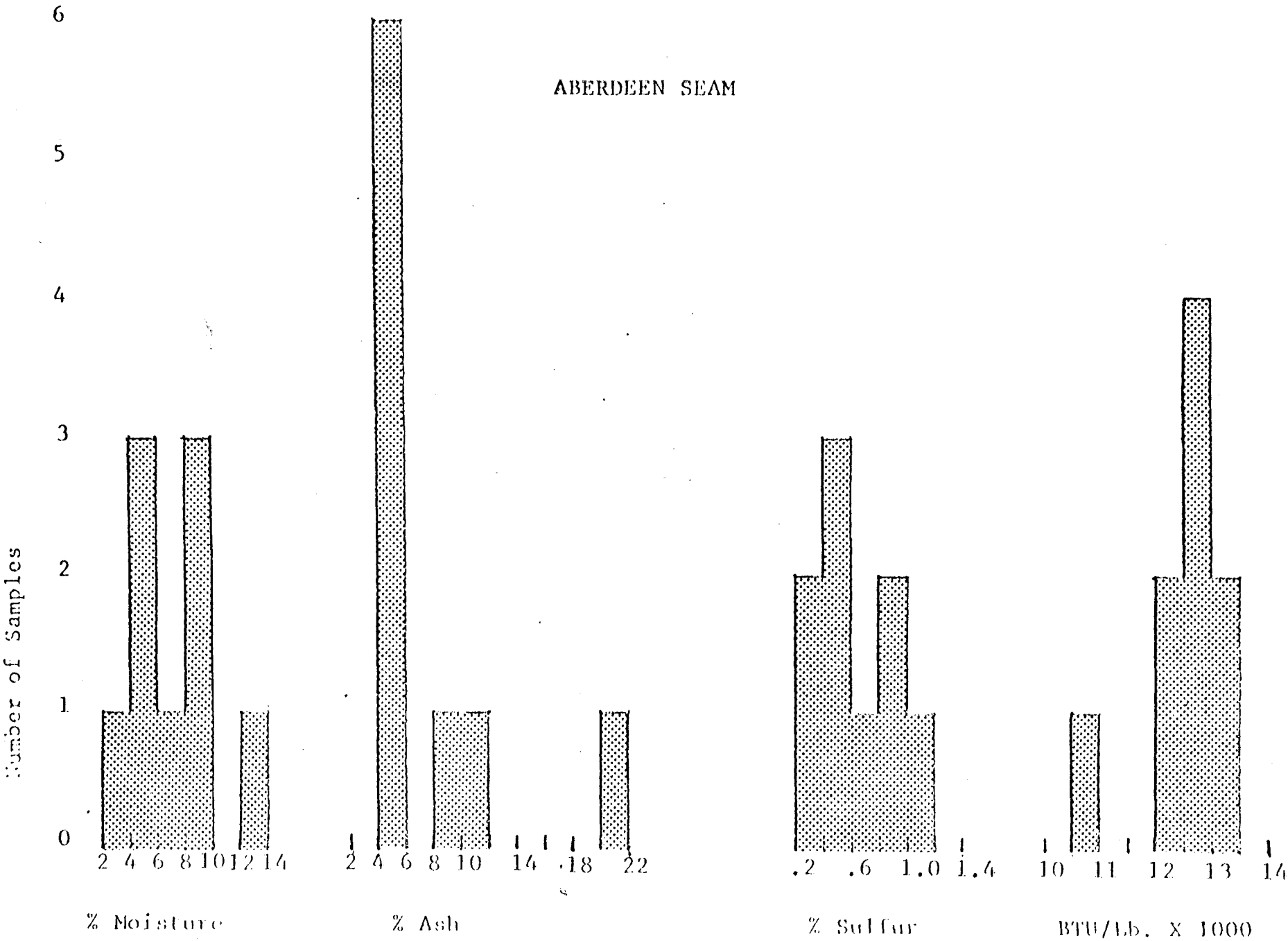
F. WATER SOLUBLE ALKALIES:
$Na_2O = 6.0 \times 10^{-5}\%$

G. ALKALI AS Na_2O OF THE ASH = 0.99%

H. FUSION TEMPERATURE OF ASH (^{o}F):

	REDUCING	OXIDIZING
INITIAL DEFORMATION	2150	2185
SOFTENING (H=W)	2210	2220
SOFTENING (H=½W)	2280	2305
FLUID	2370	2435

I. GRINDABILITY (HARDGROVE INDEX) = 45.2


ABERDEEN SEAM
Number of Samples
0
1
2
3
4
5
6
2 4 6 8 10 12 14
% Moisture
2 4 6 8 10 14 18 22
% Ash
.2 .6 1.0 1.4
% Sulfur
10 11 12 13 14
BTU/Lb. X 1000

GILSON SEAM:

A. HEATING RANGE (BTU'S/LB.):

AS RECEIVED	DRY BASIS
11,944 - 12,542	12,419 - 13,085

B. AVERAGE HEAT (BTU'S/LB.):

AS RECEIVED	DRY BASIS
12,124	12,777

C. MINERAL ANALYSIS OF ASH:

	IGNITED BASIS % WEIGHT
PHOS, PENTOXIDE, P_2O_5	0.09
SILICA, SiO_2	51.56
FERRIC OXIDE, Fe_2O_3	3.98
ALUMINA, Al_2O_3	25.70
TITANIA, TiO_2	0.74
LIME, CaO	7.41
MAGNESIA, MgO	1.50
SULFUR TRIOXIDE, SO_3	6.94
POTASSIUM OXIDE, K_2O	0.50
SODIUM OXIDE, Na_2O	0.51
UNDETERMINED	1.07
	100.00

D. PROXIMATE ANALYSIS:

	AS RECEIVED		DRY BASIS	
	$\bar{X}$	σ	$\bar{X}$	σ
% MOISTURE	5.07	1.32	-----	-----
% ASH	8.54	2.60	8.95	2.66
% VOLATILE MATTER	36.92	1.88	38.99	2.22
% FIXED CARBON	50.00	1.95	52.79	1.76
% SULFUR	0.60	0.11	0.63	0.13
BTU/LB.	12,124	263.76	12,777	309.01

E. ULTIMATE ANALYSIS ($\bar{X}$):

	AS RECEIVED	DRY BASIS
% MOISTURE	5.76	-----
% CARBON	68.88	73.09
% HYDROGEN	4.72	5.01
% NITROGEN	1.39	1.47
% CHLORINE	0.01	0.01
% SULFUR	0.61	0.65
% ASH	7.93	8.42
% OXYGEN (DIFF.)	10.70	11.35
	100.00	100.000

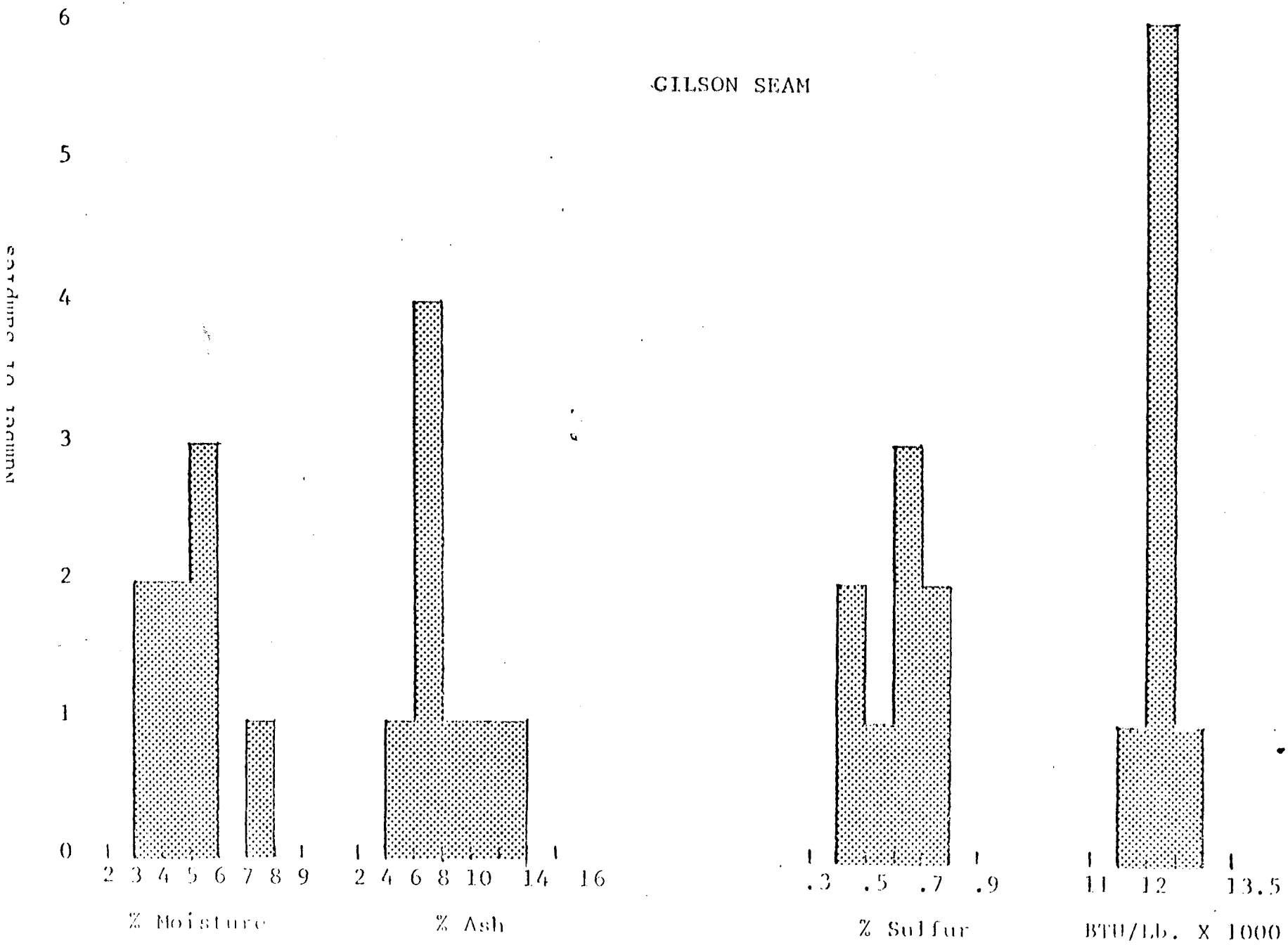
F. WATER SOLUBLE ALKALIES:
$Na_2O = 5.0 \times 10^{-5}\%$

G. ALKALI AS Na_2O OF THE ASH: = 0.51%

H. FUSION TEMPERATURES OF ASH (^{o}F):

	REDUCING	OXIDIZING
INITIAL DEFORMATION	2380	2410
SOFTENING (H=W)	2460	2470
SOFTENING (H=½W)	2550	2560
FLUID	2590	2620

I. GRINDABILITY (HARDGROVE INDEX) = 47.2


GILSON SEAM
Number of samples
0
1
2
3
4
5
6
2 3 4 5 6 7 8 9
% Moisture
2 4 6 8 10 14 16
% Ash
.3 .5 .7 .9
% Sulfur
11 12 13.5
BTU/LB. X 1000

LOWER SUNNYSIDE SEAM:

A. HEATING RANGE (BTU's/LB.):

AS RECEIVED	DRY BASIS
12,025 - 12,549	12,858 - 13,198

B. AVERAGE HEAT (BTU'S/LB.):

AS RECEIVED	DRY BASIS
12,276	12,969

C. MINERAL ANALYSIS OF ASH:

	IGNITED BASIS % WEIGHT
PHOS, PENTOXIDE, P_2O_5	1.11
SILICA, SiO_2	58.05
FERRIC OXIDE, Fe_2O_3	5.08
ALUMINA, Al_2O_3	18.08
TITANIA, TiO_2	0.69
LIME, CaO	6.91
MAGNESIA, MgO	1.90
SULFUR TRIOXIDE, SO_3	5.65
POTASSIUM OXIDE, K_2O	0.58
SODIUM OXIDE, Na_2O	0.66
UNDETERMINED	1.29
	100.00

D. PROXIMATE ANALYSIS:

	AS RECEIVED		DRY BASIS	
	$\bar{X}$	σ	$\bar{X}$	σ
% MOISTURE	5.33	1.15	-----	-----
% ASH	7.64	2.54	8.05	2.60
% VOLATILE MATTER	37.88	1.16	40.02	1.38
% FIXED CARBON	49.15	1.29	51.92	1.52
% SULFUR	0.62	0.11	0.66	0.11
BTU/LB.	12,276	331.82	12,969	347.84

E. ULTIMATE ANALYSIS ($\bar{X}$):

	AS RECEIVED	DRY BASIS
% MOISTURE	6.45	-----
% CARBON	68.37	73.09
% HYDROGEN	4.68	5.00
% NITROGEN	1.43	1.53
% CHLORINE	0.03	0.03
% SULFUR	0.66	0.71
% ASH	7.31	7.81
% OXYGEN (DIFF.)	11.07	11.83
	100.00	100.00

F. WATER SOLUBLE ALKALIES:

$Na_2O = 12.0 \times 10^{-5}\%$

G. ALKALI AS Na_2O OF THE ASH = 0.66%

H. FUSION TEMPERATURES OF ASH (^{o}F):

	REDUCING	OXIDIZING
INITIAL DEFORMATION	2380	2415
SOFTENING (H=W)	2455	2500
SOFTENING (H=½W)	2540	2575
FLUID	2630	2650

I. GRINDABILITY (HARDGROVE INDEX) = 48.0

LOWER SUNNYSIDE SEAM

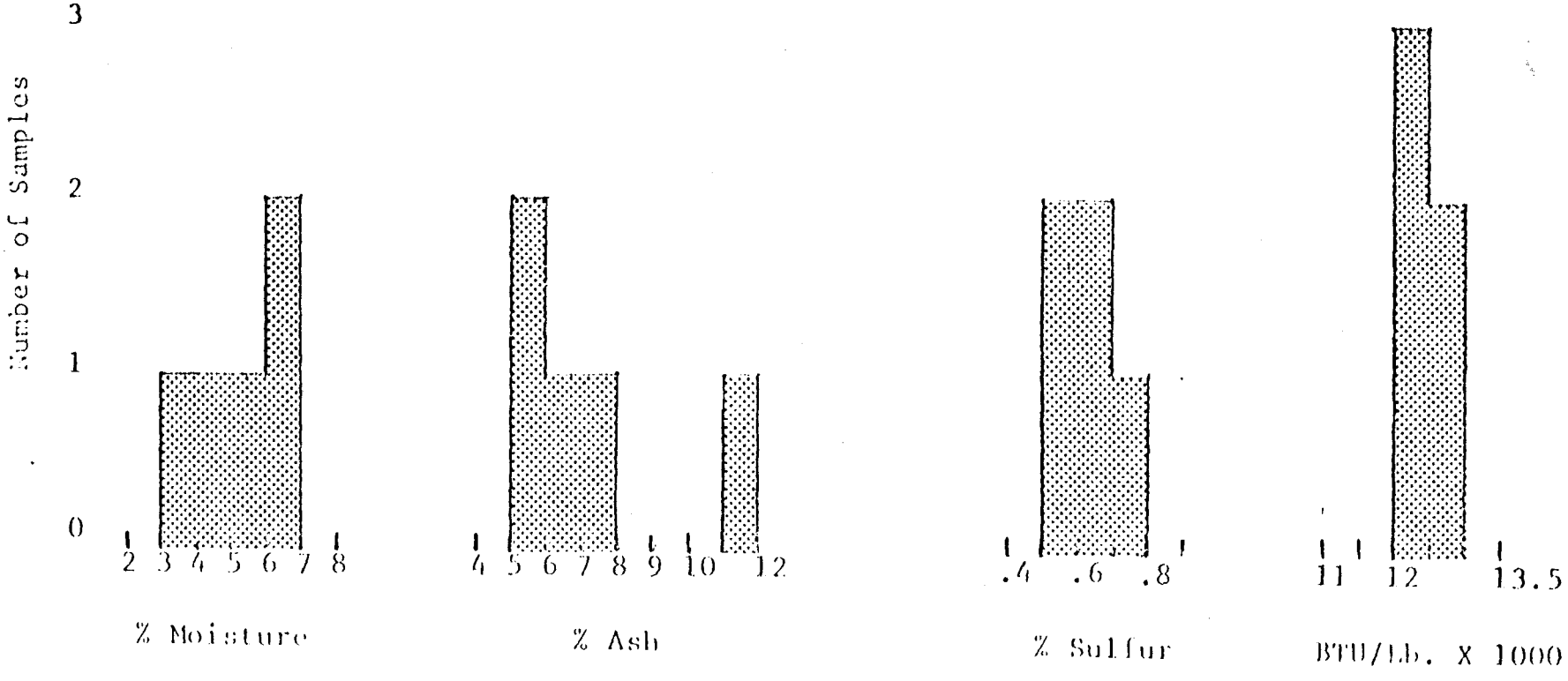


EXHIBIT IV-C

SOIL AND VEGETATION SURVEY

EXHIBIT IV-D

RAPTOR SURVEY

RAPTOR SURVEY OF THE RIGHT FORK

AND THE

STARPOINT FORK

OF

DEADMAN CANYON, AND STRAIGHT CANYON

FOR

TOWER RESOURCES, INC. - PINNACLE MINE, et. al

TO

AMCA COAL LEASING
Walker Bank 2nd Floor, Room 1
82 West Main
Price, Utah 84501

FROM

CLAYTON M. WHITE
Department of Zoology
Brigham Young University
Provo, Utah 84602

INTRODUCTION

Only scant references to birds in Carbon County are available in the literature and these citations contain even less data on raptors.

Although a variety of raptors breed in the Price area (Dalton, et al. 1978) their distribution or abundance is often spotty and poorly known. Frequently, raptors will accumulate in one region to breed because of specific environmental conditions but may be absent from a seemingly identical or at least similar adjacent region. This phenomenon is not completely understood nor is the lack of them from seemingly suitable habitat understood. It is apparently related in some fashion to the productivity of the land (Newton, 1976). Such situations are mentioned because they relate to that seen in Right Fork, Starpoint and Straight Canyons. Outwardly, these three canyons, especially Straight Canyon, appears to have excellent physiographic or floral features that support good raptor populations. However, after spending five days working in these canyons, we found no currently active raptor nests.

METHODS

Right Fork, Starpoint and Straight Canyons were examined on foot on five different occasions in the months of April (2 days) May (1 day) and June (1 day). Each canyon was examined from about a 2 km radius around the proposed mine portals although only a 1 km survey was required.

Each canyon was surveyed of five different ocassions; 29-30 April, 9 May, 23 May and 6 June. All observations were chronicled and recorded.

HABITAT

The major floral types were sage, pinyon-juniper, box elder, riparian forms, Douglas fir and ponderosa pine. The stream side (riparian) vegetation was seemingly the best nesting habitat for such species as sharp-shinned hawk, Cooper's hawk and long-eared owl. The fir and pine habitat was seemingly best for goshawk and buteos while the surrounding cliff structures is that habitat most suitable to eagles, falcons and great-horned owls. All these habitat were specifically searched.

FINDINGS

Only one raptor nest was found. That nest was in a poplar tree along the streamside in Right Fork and appeared to be of a Cooper's hawk though it had not been used recently. The nest was farther than 1 km downstream from the proposed mine portal.

On the following pages are the observations by date and locality of all raptors seen during this study.

SPECIFIC OBSERVATIONS

April 29, 1980

Right Fork

1. two golden eagles soaring above canyon
2. American kestrel hunting
3. adult red-tailed hawk interacting with an adult Cooper's hawk.

Starpoint Canyon

1. one immature red-tailed hawk crusing over canyon.

April 30, 1980

Straight Canyon

1. one golden eagle sitting on rocks in middle of canyon about 2 km up the canyon from the mouth.
2. two adult golden eagles in courtship flight about 2 km down the canyon from the mine.

May 9, 1980

Straight Canyon

1. American kestrel soaring with food near mine area.
2. turkey vulture soaring over the canyon.

May 9, 1980 (cont.)

Starpoint Canyon

1. adult Cooper's hawk flying high over canyon

May 23, 1980

Right Fork

1. adult sharp-shinned hawk along the stream near the construction area.

Starpoint Canyon

1. American kestrel hunting near the mine area

Straight Canyon

1. golden eagle perched on cliffs near mouth of canyon
2. Cooper's hawk hunting near top of mountain about 0.9 km from the mine portal site.

June 6, 1980

Straight Canyon

1. pair of American kestrels 0.5 km from mine portal
2. two other kestrels near head of canyon
3. pair golden eagles soaring near mouth of canyon.
4. regurgitation pellet of owl (size suggests that of a great-horned owl) about 1.0 km from mine site.

June 6, 1980 (cont.)

Starpoint Canyon

1. kestrel in middle portion of canyon.

CONCLUSIONS, ASSESSMENT, AND RECOMMENDATIONS

Based on our findings one can suggest that (1) a pair of golden eagles is using Straight Canyon as a portion of their hunting range and part of that range overlaps the 1 km radius around the mine portal, (2) a pair of American kestrels nest somewhere near the middle portion of Straight Canyon and may occur near the mine portal, (3) an additional pair nests in Straight Canyon, and (4) perhaps the kestrels from Straight Canyon hunt in Starpoint Canyon or another pair occurs in Starpoint.

Clearly, none of the canyons has a modest density of raptors. Their densities may be called poor. We were surprised not to see more buteos than we did. Since one pair of red-tails were interacting with a Cooper's hawk it can be suggested that the territory of the red-tails overlaps part of Starpoint Canyon. We have no conclusive data to show, however, that in fact they were defending a breeding territory.

From the distributions of the observations it can be suggested that no raptors nest within 1 km of any of the proposed mine portal sites. If in subsequent years some nests are found close to the portals they will most likely be that of an American kestrel, Cooper's hawk, or great-horned owl.

It is recommended that additional studies on raptors are <u>not</u> necessary in these three canyons. Further, any species that might be found nesting within 1 km of the mine portal will probably be a common and wide spread species eg. kestrel. It is recommended that <u>no</u> special effort be undertaken to make additional searches for golden eagle nests since they will probably be greater than 1 km from the proposed mine portals.

LITERATURE CITED

Dalton, L. B., et al. 1978. Vertebrate species of southeastern Utah. Publ. 78-16, Utah Division Wildlife Resources, 68 pp.

Newton, I. 1976. Breeding of sparrowhawks in different environments. J. Animal. Ecol. 45:831-49.

EXHIBIT IV-E

ARCHAEOLOGICAL SURVEYS

ARCHAEOLOGICAL RECONNAISSANCE IN DEADMAN CANYON, CARBON COUNTY, UTAH

by

J. Terry Walker

A Special Report
Department of Anthropology and Archaeology
Brigham Young University

Submitted to:
Centennial Development Company
Salt Lake City, Utah

May 1976

INTRODUCTION

On April 10, 1976, the author conducted an archaeological survey in Deadman Canyon north of Price, Utah for Centennial Development Company and Centennial Coal Associates of Salt Lake City, Utah. The survey was requested by Mr. John Peperakis, Jr. of Dr. Ray T. Matheny of the Department of Anthropology and Archaeology, Brigham Young University, who then contacted the author. Authorization to conduct the survey was granted by the Department of Interior Bureau of Land Management permit number 76-UT-036 and by Mr. Bruce Louthan, District Archaeologist, Bureau of Land Management. The purpose of the survey was to identify archaeological sites that would be impacted by the development of coal resources in the canyon.

Setting

The area surveyed was in the upper end of the canyon in Township 13 South, Range 11 East, Section 7, Wellington NW Quadrangle (7.5 minute series). Deadman Canyon is part of the Book Cliffs, and the geology of the area consists mainly of sandstones from the Star Point, Blackhawk, and Price River Formations (Young 1955: 182-186). The Blackhawk strata is coal bearing and the most important.

The vegetation in the canyon varys considerably and includes sagebrush, pinyon pine, juniper, mountain mahogany, oakbrush, maple, rabbitbrush, Ponderosa pine, and assorted forbs and grasses.

Survey procedure

By definition of the Bureau of Land Management, the survey was a reconnaissance survey. Because the proposed development in the canyon

involves impact in the canyon bottom and in the sides of the canyon, the author surveyed both terrains. Because the sides of the canyon are rugged and will be less impacted than the bottom, they were only sampled. This was accomplished by investigating the cliffs and large rocks that potentially could have been used for shelter, habitation, or art. The canyon bottom was intensively surveyed within the lease boundary shown on Map 1.

PREVIOUS ARCHAEOLOGICAL WORK

Prehistoric sites

Recorded archaeological work had never been done in Deadman Canyon prior to this survey. No sites are recorded and no mention of the canyon is made in published literature. The closest recorded sites are just west of Price, and the record of them is found in the State Antiquities Office. In another recent survey near Price, Helper, and Wellington, Patterson (1975) failed to find any prehistoric sites.

Sites are common in other places in the Book Cliffs, however. About thirty miles east of Deadman Canyon is Nine Mile Canyon. This area has been the scene of much archaeological activity since the 1920's and contains many remains of the Fremont Culture which flourished between c. A.D. 1000 to 1200. The most notable work in the Nine Mile area has been done by Morss (1931), the Claflin-Emerson Expedition (Gunnerson 1969), Reagan (1931a, 1931b, 1933), Beckwith (1931, 1932), and Gillin (1938). Petroglyphs (art carved or pecked in stone) and pictographs (painted art) are common in the canyon, and mention of these has been made by Schaafsma (1971), Siegrist (1972), and others. A study of petroglyphs in Nine Mile Canyon was made in 1974 by Louthan, Patterson, and Hurst, and their report is still in progress.

In addition to archaeological studies in Nine Mile Canyon, the many Douglas fir trees there were the basis of dendroclimatological studies by the Laboratory of Tree-ring Research (Schulman 1948, 1956). These studies also provide accurate tree-ring dates from archaeological samples from the area.

East of Nine Mile Canyon near the Green River, Leh (1936), Gunnerson (1957), and the Claflin-Emerson Expedition of 1928-29 (Gunnerson 1969) recorded sites in Range and Desolation Canyons.

In two other areas in the Book Cliffs surveyed by the author, no evidence of occupation or use by prehistoric man was found on Ford Ridge (west of Deadman Canyon) and near Sunnyside (east of Deadman Canyon).

Historical sites

Although no prehistoric sites are recorded in Deadman Canyon, several historical sites are. All of these are coal mines which were in operation between 1925 and 1964 (Doelling 1972: 394). Other canyons along the Book Cliffs contain both active and inactive coal mines dating from 1874 to the present. The most active areas have been in Spring Canyon west of Helper and at Sunnyside. Even though no archaeological work on these historical sites has been done, they are mentioned because of their importance to the coal inductry in Utah.

RESULTS OF THE SURVEY AND POSSIBLE FUTURE IMPACT

Survey results

During the survey, no prehistoric archaeological sites were found. However, the remains of several historical sites (coal mines) were found. These mines from north to south are the Hileman Mine, Zion Mine, Olson Mine (also called Rio Grande Mine), and Blue Flame (also called Sutton) No. 2 and No. 3. Historical information on these mines is rare, but

Doelling (1972: 394) gives their dates of operation, production, and owners.

Impact of development on sites

The plans of Centennial Coal Associates for Deadman Canyon include reopening several of the mines and retrieving the coal. This development would involve the construction of several buildings and shaft ventilator fans (portals), and the removal of the existing evidence of former mines. The main impact in the canyon would be on the canyon floor, and this is why it was intensively surveyed.

SURVEY CONCLUSIONS AND RECOMMENDATIONS

After researching historical records on the canyon and surveying it, the author recommends that the proposed development be permitted, with the exception that when the exact location of the portals is planned, an intensive survey take place to locate possible rock art. Because no Fremont or other prehistoric sites were found during the author's survey, the possibility is slim that such sites will be found during another survey in this part of Deadman Canyon.

The author does not deem any of the historical sites significant, and therefore, sanctions their possible destruction. In an effort to justify this statement, the author made a study of production records and ownership titles to determine the significance of the mines. Only one mine, the Zion Mine, appeared initially to have any significance, but this eventually proved to not be so.

The study of Zion Mine was made because Jesse Knight was the original owner. A study of records at Zion Securities Corporation (the present owner), Jesse Knight records in the B. Y. U. Library and the Utah Historical Society, and published works on coal mining and Jesse Knight indicated

through their lack of mention of the mine that it was not a significant holding of Jesse Knight's, nor a large coal producer, and therefore, not significant in itself.

REFERENCES

Beckwith, F.

1931 Some Interesting Pictographs in Nine Mile Canyon, Utah. El Palacio, Vol. 31, No. 14, pp. 216-222.

1932 Serpent Petroglyphs in Nine Mile Canyon. El Palacio, Vol. 33, Nos. 15-16, pp. 147-149.

Doelling, H.H.

1972 Book Cliffs Coal Field. In Central Utah Coal Fields: Sevier-Sanpete, Wasatch Plateau, Book Cliffs and Emery by H.H. Doelling, Utah Geological and Mineralogical Survey, Salt Lake City, pp. 245-416.

Gillin, J.

1938 Archaeological Investigations in Nine Mile Canyon, Utah. University of Utah Bulletin, Vol. 28, No. 11.

Gunnerson, J.H.

1957 An Archeological Survey of the Fremont Area. University of Utah Anthropological Papers, No. 28.

1969 The Fremont Culture: A Study in Culture Dynamics of the Northern Anasazi Frontier. Papers of the Peabody Museum of Archaeology and Ethnology, Vol. 59, No. 2.

Leh, L.L.

1936 Prehistoric Pueblo Ruins in Range Creek Canyon, Utah. University of Colorado Studies, Vol. 23, No. 2 pp. 159-168.

Morss, N.

1931 The Ancient Culture of the Fremont River in Utah. Papers of the Peabody Museum of Archaeology and Ethnology, Vol. 12, No. 3.

Patterson, G.R.

1975 Archaeological and Paleontological Investigations for the Price River Water Improvement District. Ms. on file Department of Anthropology and Archaeology, Brigham Young University.

Reagan, A.B.

1931a Some Archaeological Notes on Nine Mile Canyon, Utah. El Palacio, Vol. 31, No. 4 pp. 45-71.

1931b Ruins and Pictographs in Nine-Mile Canyon, Utah. Transactions of the Illinois Academy of Science, Vol. 24, No. 2, pp. 369-370.

1932 Some Notes on the Snake Pictograph of Nine Mile Canyon, Utah. American Anthropologist, Vol. 35, No. 3, pp. 550-551.

Schaafsma, P.
1971 The Rock Art of Utah. Papers of the Peabody Museum of Archaeology and Ethnology, Vol. 65.

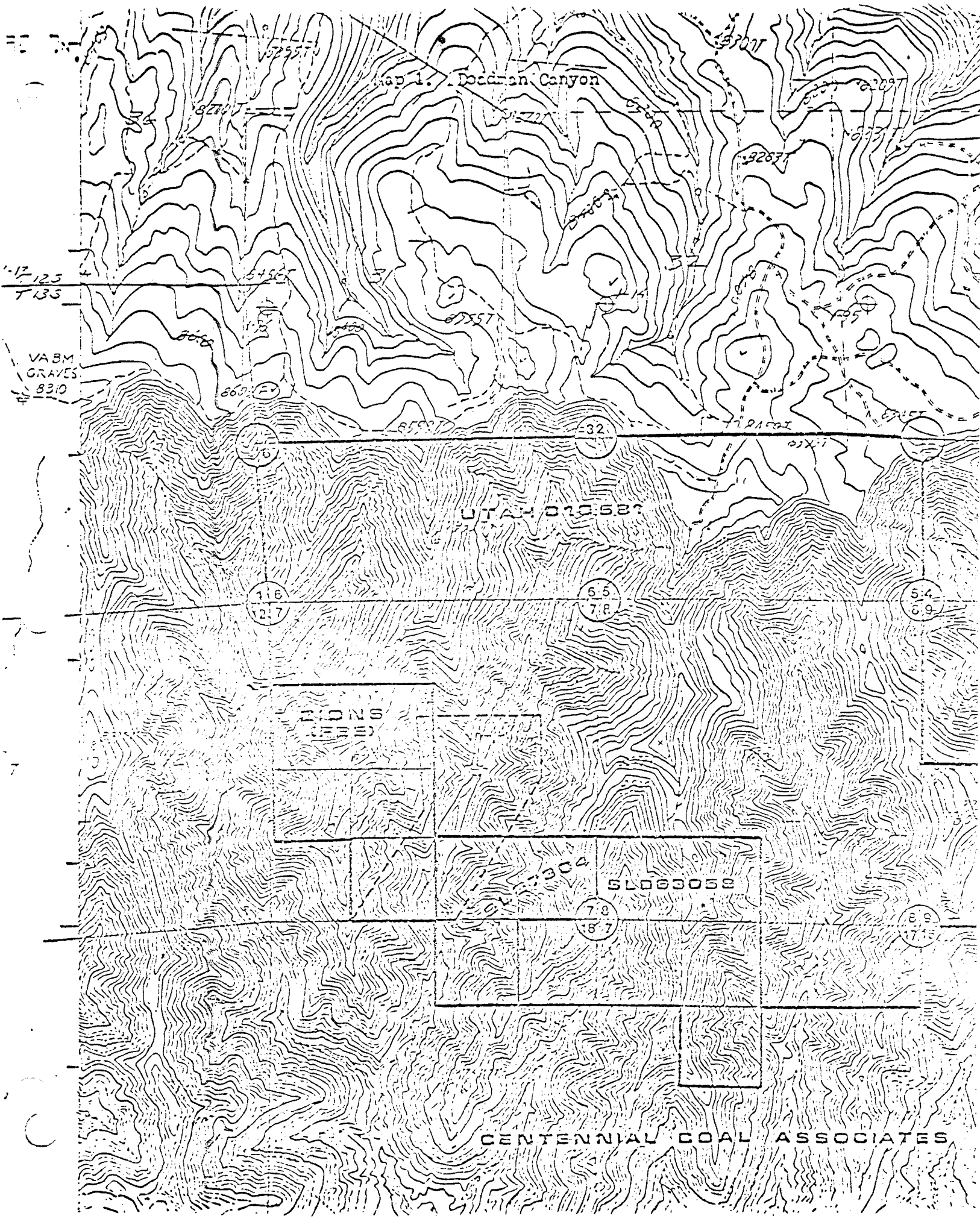
Schulman, E.
1948 Dendrochronology in Northeastern Utah. Tree-Ring Bulletin, Vol. 15, No. 1/2, pp. 2-14.

1956 Dendroclimatic Changes in Semiarid America. University of Arizona Press, Tucson.

Siegrist, R.
1972 Prehistoric Petroglyphs and Pictographs in Utah. Utah State Historical Society, Salt Lake City.

Walker, J.T.
1975 Archaeological Survey Report of Fourteen Proposed Drill Sites Near Ford Ridge, Utah. Ms. on file Department of Anthropology and Archaeology, Brigham Young University.

Young, R.G.
1955 Sedimentary Facies and Intertonguing in the Upper Cretaceous of the Book Cliffs, Utah-Colorado. Bulletin of the Geological Society of America, Vol. 66, pp. 177-202.


Map 1. Deadman Canyon
T 13S
VABM
GRAVES
8310
32
UTAH 013583
ZIONS
(FEE)
SL063058
CENTENNIAL COAL ASSOCIATES

AN ARCHEOLOGICAL SURVEY OF PORTIONS OF FIASCO CANYON, STARPOINT CANYON AND STRAIGHT CANYON NEAR PRICE, UTAH

For the

TOWER RESOURCE-AMCA COAL COMPANY
PRICE, UTAH

Submitted by

Bruce Hawkins
Gregory L. Seward

Under the Direction of

La Mar W. Lindsay
Assistant Utah State Archaeologist
Antiquities Section
Utah Division of State History
Salt Lake City, Utah

June, 1980

TABLE OF CONTENTS

	Page
ABSTRACT	01
INTRODUCTION	01
ENVIRONMENTAL SETTING	03
Location	03
Geology	04
Climate	05
Flora and Fauna	06
CULTURAL HISTORY	07
Archaic	08
Fremont	08
Numic	09
PREVIOUS ARCHAEOLOGICAL WORK	10
HISTORICAL CONTEXT	11
Regional	11
Local	11
HISTORIC SITES	12
42Cb176	12
42Cb177	14
42Cb178	24
42Cb179	32
42Cb180	32
42Cb181	36
RECOMMENDATIONS	36
42Cb180	38
42Cb181	38
BIBLIOGRAPHY	39

LIST OF FIGURES

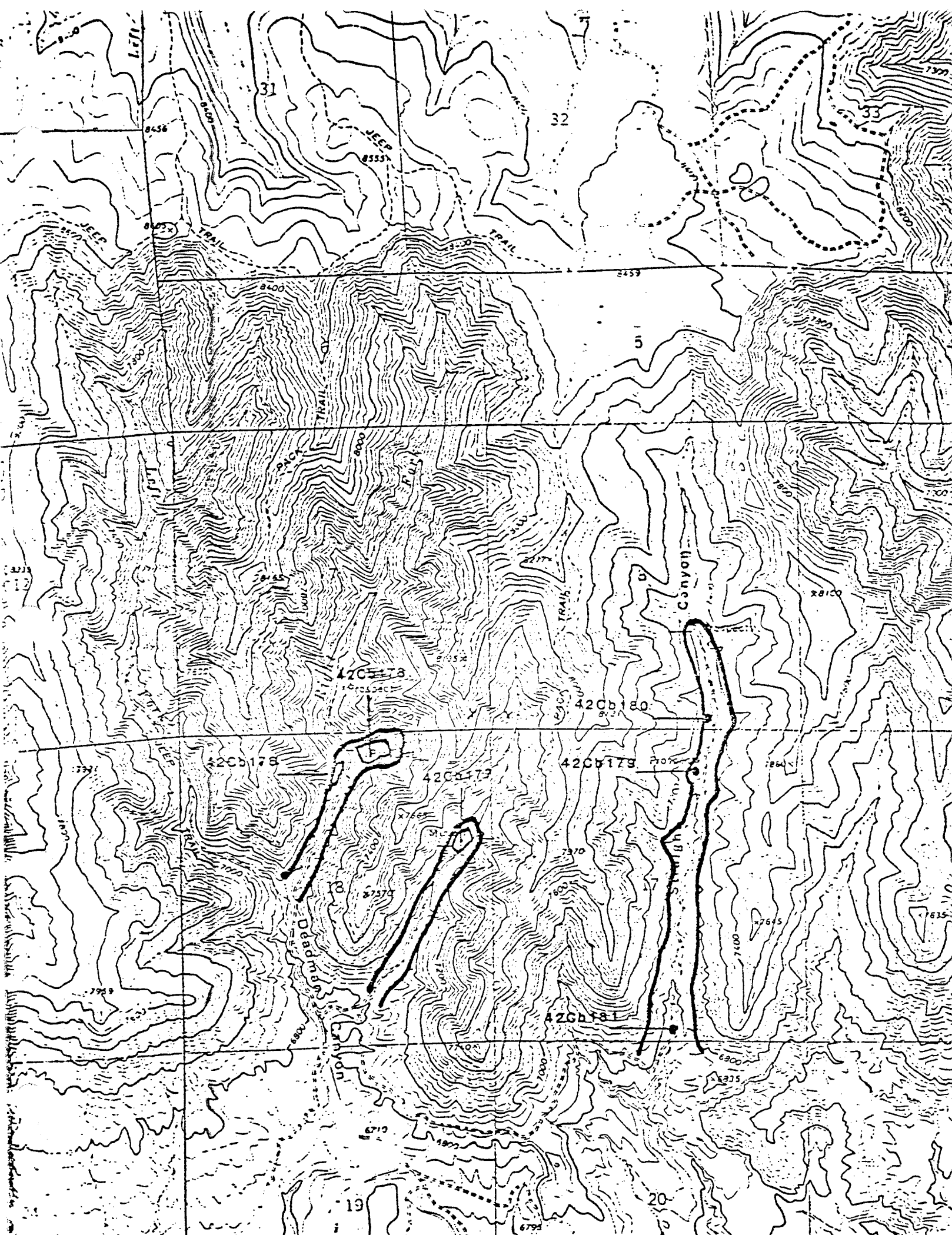
		Page
Figure 1.	Map	02
Figure 2.	42Cb176. Habitation Structure at Zion's Mine. Note inset juniper supports, stone wall and metal roof with stove-hole. Storage to right	13
Figure 3.	42Cb177. Blue Flame/Sutton Mine. View Looking South Down Starlight Canyon	15
Figure 4.	42Cb177. Collapsed Mine Portal	16
Figure 5.	42Cb177. Structure 1. Note stone structure with cement block addition	17
Figure 6.	42Cb177. Structure 2. Wood Frame Concrete Block Construction	19
Figure 7.	42Cb177. Structure 3 on West Slope of Canyon Wall	21
Figure 8.	42Cb177. Coal Loading Bin. Note combined use of wood, cement block and metal sheeting materials .	22
Figure 9.	42Cb177. Outhouse	23
Figure 10.	42Cb177. Coal Piles on North End of Blue Flame/Sutton Mine	25
Figure 11.	42Cb177. Ventilator Foundation Looking Northwest.	26
Figure 12.	42Cb177. Ventilator Fan Looking Northeast . . .	27
Figure 13.	42Cb178. Coal Loading Facility	29
Figure 14.	42Cb178. Structure Pad with Concrete Block Pillars	30
Figure 15.	42Cb178. Concrete Pad	31
Figure 16.	42Cb178. Concrete Footings and Steel Tower . . .	33
Figure 17.	42Cb178. Wooden Debris of a Collapsed Structure.	34
Figure 18.	42Cb180. Cabin	35
Figure 19.	42Cb181	37

ABSTRACT

An archeological survey was conducted in portions of Fiasco, Starpoint, and Straight canyons, in the Book Cliffs area northeast of Price, Utah. The survey portions were small sections of the valley floor that have been selected for development by Tower Resources--AMCA Coal Company of Price, Utah. Although the surrounding canyons were likely heavily utilized by aboriginal groups, no prehistoric sites were located in the project area. There is a high probability that sites occur on the higher terraces atop the canyon walls. The valley floor which will be impacted is devoid of prehistoric sites. Six historic sites were located, all of which are in proximity to early 20th century mining operations. These sites were fully recorded and, lacking National Register qualifications, may be cleared for development.

INTRODUCTION

An archeological survey for Tower Resources--AMCA Coal Company of Price, Utah was comleted during May 19 through May 29. The field crew consisted at various times of Bruce Hawkins, Gregory Seward, and Deborah Truell. Under the supervision of Asa S. Nielson the survey work was carried out by the Consulting Services Branch of the Antiquities Section, Division of State History, Salt Lake City, Utah. The project area included portions of Fiasco Canyon, the Starpoint Fork of Deadman Canyon and Straight Canyon (U.S.G.S. Deadman Canyon Quadrangle 7.5 minute series) (Figure 1). The specific survey


31
32
33
5
7
8
17
18
19
20
JEEP
TRAIL
PACK
42Cb178
42Cb180
42Cb179
42Cb177
42Cb181
Canyon
Dagdad
8400
8000
7600
7400
7200
7000
6800
6710
6795
6835
7645
7910
7959
8100
8456
8555

areas were identified by Mike Glasson of Tower Resources prior to the actual field work.

The survey areas were largely in the canyon bottoms where coal mines operated between 1920 and 1960. Therefore, portions of each survey section had been to some degree impacted prior to 1980.

The terrain of the survey area is extremely rugged as the streams have cut very steeply each canyon exposing irregular profiles in the Book Cliffs stratigraphy. Dense stands of scrub oak (Quercus gambelii) on the valley floor obscurred visibility in many places and hampered orderly transects.

The survey crew walked parallel transects on the mountain floor maintaining intervals of no greater than 20 meters. The lower slopes of the canyon walls were also surveyed to ensure complete coverage of the survey area.

ENVIRONMENTAL SETTING

Location

The survey area included portions of Fiasco Canyon, the Starpoint Fork of Deadman Canyon and Straight Canyon located in Sections 17 and 18, Township 13 South, Range 11 East (U.S.G.S. Deadman Canyon Quadrangle 7.5 minute series) (Figure 1). The canyons are approximately 5.5 miles northeast of Price, Utah and accessible either by a graded dirt road or rough jeep trails. The survey area sets along the western edge of the Colorado Plateau Physiographic Province (Fenneman 1931). The canyons lie parallel to each other draining north to south and

they are perpendicular into the southern face of the Book Cliffs. The Book Cliffs Physiographic Subdivision is bordered on the north by the Uinta Basin, on the south by the Mancos Shale Lowlands, and on the west by the Wasatch Plateau and Mountain Range (Stokes 1977).

Geology

The Book Cliffs are composed of alternating strata of sandstone, shales and coal of Cretaceous and Tertiary age. The cliffs rise to over 8,550 ft. (2,606 meters) asl and descend in giant step-like terraces to southern valleys with elevations between 4,000 feet (1,219 meters) and 5,500 feet (1,676 meters), the survey area stratigraphy is classified as part of the Mesa Verde group. From the lowest stratum to the highest the stratigraphy consists of Mancos shale, Star Point Sandstone, the Blackhawk Formation (these are the coal producing strata), Castlegate Sandstone, and the Price River Formation (Hintze 1979). The easily eroded Mancos Shale and Quaternary gravel deposits dominate the valleys south of the survey area.

With the exception of the Mancos Shale Formation, which surfaces south of the survey area, Fiasco, Deadman and Straight Canyons exhibit similar stratigraphic and topographic characteristics. The canyon sides rise to a height of 1,100 feet above the wash and descend in distinctive step-like terraces to an unusually narrow valley floor.

Mining operations of the past 20-60 years have had a wide range of impacts on the valley floor. However, at the time of

the survey, natural streams and washes maintained a steady water flow. Their volumes have apparently been reduced by impact and many places, the rust of old mining roads have been incorporated into th main channels.

Climate

The climate of the Colorado Plateau is an arid continental/mid-latitude dry area (Burnham 1950). The Wasatch Mountains to the west and the Tavaputs Plateau to the north protect the survey area from storms associated with northerly and westerly winds. This essentially creates a "rain shadow" from late fall to early spring. During the summer and early fall, this mountain/plateau zone aids in the development of rainstorms that originate in the warm air masses above the Pacific and Gulf of Mexico.

The Price area receives between 6 and 20 inches of precipitation annually with increasing amounts 1) from south to north and 2) in canyon areas of higher elevation. Between one-third and one-half of the measured annual precipitation falls during the summer months. The arid nature of this region is due to its tremendous evaporation. Hunt (1974) suggests that up to 95 percent of the precipitation is lost by evaporation, seepage and transpiration.

Average annual temperatures around Price decrease 1) from south to north and 2) at higher elevations. The valley temperatures south of the survey area often exceed 95 degrees F. during the summer and rarely fall below 23 degrees F. in the winter. Temperature averages range from 65-70 degrees F. in

the summer, to 20 degrees F. in the winter in the survey area. The lowest temperatures develop in January and the highest in July. The number of frost-free days range from over 200 in the south to less than 100 in the mountain/plateau to the west and north.

Flora and Fauna

Vegetation within the survey area encompasses several plant communities and three distinct ecozones: the Pinyon-Juniper, the Mountain Brush and the Ponderosa Pine Montane.

The Pinyon-Juniper ecozone ranges from 5,000 to 7,000 feet (1,524 to 2,133 meters) and is classified as the top level of the Upper Sonoran Zone. The species within this zone include: Colorado pinyon (*Pinus edulis*), Utah juniper (*Juniperus osteosperma*), bitterbush (*Opuntia* sp.), cheatgrass (*Bromus tectorum*), and Russian thistle (*Salsola kali*). Species associated with the Big Sage zone were interspersed within the Pinyon-Juniper forest: big sagebrush (*Artemisia tridentata*), rabbitbrush (*Chrysothamnus* sp.), horsebrush (*Tetradymia* sp.), *Ephedra* and silver-leaf buffalo berry (*Schepherdia argentea*).

The Mountain Brush ecozone overlaps the upper Pinyon-Juniper level and includes the following: scrub oak (*Quercus gambelii*), serviceberry (*Amelanchier alnifolia*) and chokecherry ([*rimis vorgomoama*). These species are usually found between 7,000 and 9,000 feet (2,134-2,743 meters).

Two species characteristic of the Ponderosa Pine Montane ecozone were observed in the upper limits of the survey area between 7,500 and 7,000 feet (2,286-2,743 meters): Ponderosa

or Yellow pine (Pinus ponderosa) and mountain muhly (Muhlenbergia montana).

A wide variety of forbs and grass species are common to all three ecozones and in many places form a thick understory.

Fauna

Durrant (1952) and Behle and Perry (1975) give extensive listings for mammals and bird life found within the survey area and Utah in general. Those animals observed within the survey area were: Mule deer (Odocoileus hemionus hemionus), several rat species (Neotoma sp.), rock squirrel (Citellus variegatus utah) and chipmunk (Eutamias quadrivittatus umbrinus). The tracks of Mountain lion (Felis concolor hippolestes) and Black bear (Ursus americanus cinnamomum) were seen in muddy areas near the stream. Avifauna included Red-tailed hawk (Buteo jamaicensis), Great Horned own (Bubo virginianus) and Golden eagle (Aquila chrysaetos canadensis).

CULTURAL HISTORY

Several cultures have inhabited the Price region during the past 10,000 to 12,000 years. Beginning with the nomadic Paleo-Indian, a near occupational continuum of the area has occurred up to the present. A brief description of each of these cultures follows.

Paleo-Indian (12,000 to 9,000 B.P.)

No Paleo-Indian sites were found within the survey area, although several Paleo-Indian kill sites have been recorded in surrounding areas (Sharrock 1966; Miller and Dort 1978).

Isolated finds of the distinctive fluted projectile points used by the Paleo-Indians have been recorded in Utah (Gunnerston 1956; Trip 1964, 1966; Butler 1973; Madsen, Currey and Madsen 1976), but none have been associated with the remains of Pleistocene megafauna.

It was once assumed that the Paleo-Indians subsisted almost exclusively on Pleistocene megafauna. Some archaeologists now theorize that the hunting and gathering of plant and smaller animal species supplimented big game hunting.

Archaic (9,000-8,500 to 2,500 B.P.)

The Archaic period (lacking both pottery and agriculture) is characterized by increasingly selective hunting and gathering. With this came several technological advances in the artifact inventory. The atlatl, or spear thrower, and lanceolate or notched dart points replaced the spear. Milling stones from this period provide evidence of a greater dependence on plant foods. A sophistication in weaving can be illustrated in the manufacture of fine basketry, textiles, fur robes, snares and nets. No Archaic sites have been recorded within the area and none were observed on the survey.

Fremont (1,500 to 500 B.P.)

With the inception of the Fremont culture approximately 1,500 years ago, open-air architecture, villages, coil-made ceramics, one-rod-and-bundle basketry, corner- and side-notched projectile points used in connection with the bow and arrow, corn agriculture and trough metates were added to the Archaic inventory. Noel Morss (1931) was the first to define the

Fremont as "a peripheral culture to the Anasazi" and described them as a mixed group of semi-horticultural hunters and gatherers.

A cultural coninuum between the Archaic and the Fremont has been put for (Jennings 1957, 1978; Aikens 1970; Marwitt 1970). Conversely, others (Madsen and Berry 1975; Lindsay and Lund 1976) have defined a cultural hiatus between the two periods. Few sites containing both Archaic and Fremont components have been found in the Price area. Most excavated sites on which an obvious hiatus was visible within the stratigraphic sequence occur near prehistoric lake shorelines within the Great Basin. A few sites (e.g. Pint-Size Shelter, Clyde's Cavern, Joe's Valley Alcove) on the western Colorado Plateau appear to support the Archaic/Fremont hiatus (Lindsay and Lund 1977). At any rate, Fremont origins remain open to question.

Fremont agricultural groups abandoned Utah by 650 B.P., leaving no clear evidence of their movement. A number of reasons for the demise of the Fremont have been suggested but most archaeologists seem to agree that it was a result of many factors: i.e. competition from Paiute-Shoshoni expansion (Aikens 1970; Madsen 1975) or environmental pressures (Gunnerson 1969).

Numic (650 B.P. to Present) etc.

Fremont occupation was succeeded by the influx Shoshonean groups. These Numic speaking peoples evidently arrived in the area ca. A.D. 1,200 (Madsen 1975), and their migration is fairly well understood. Aikens (1970) dates the first

Shoshonean pottery to ca. A.D. 1300-1400. Steward (1938) describes a subsistence economy based on seasonal hunting and gathering rounds, but recent research has exposed many variations of and exceptions to this model. Euler (1966) and Jennings (1978) feel the Shoshonean subsistence pattern was very similar to the Archaic adaptation. Unfortunately, very little archaeological evidence is available for this period. No Numic sites were observed on the survey.

PREVIOUS ARCHAEOLOGICAL WORK

No archaeological work of any kind has been done in Fiasco Canyon, Starpoint Fork or Straight Canyon prior to this survey. The nearest study was a survey performed by Walker (1976a) in the northern portion of Deadman Canyon. Archaeological work and site descriptions have been published for several locations adjacent to the survey area.

Nine Mile Canyon is aproximately 30 miles east of the survey are and since the early 1920's has been a focus for archaeological research. Montgomery (1894) of the University of Utah and Morss (1931) of the Peabody Museum conducted the first reported archaeological surveys of Nine Mile Canyon. Additional archaeological investigation in the canyon followed: the Claflin-Emerson Expedition (Gunnerson 1969), Reagan (1931a, 1931b), Beckwith (1931, 1932), Gillin (1938, 1955), Schaafsma (1971), Siefrist (1972), Hauck (1977a, 1977b) and others. Schulman (1948) using Douglas fir specimens, conducted a dendrochronological study for the Laboratory of Tree-ring Research in Tucson, Arizona.

The most recent archaeological work close to the survey area has been conducted by Berge (1977), Walker (1976a, 1976b, 1979), Hauck (1976(, Hauck et al. (1978), Hauck and Harmon (1977) and Patterson (1975).

Little information about prehistoric settlement patterns outside of Nine Mile Canyon has resulted from the substantial amount of field work performed in the area. However, the small number of recorded prehistoric sites should not discourage further archaeological study of the area.

HISTORICAL CONTEXT

Regional

Regional history of the area begins largely with the discovery of coal in Pleasant Valley in 1874. The Winterquarters Mine was opened in 1877. A narrow guage railroad was constructed in 1879 connecting the mine with Springville, Utah. The Denver and Rio Grande Railroad reached Carbon County in 1882, making large scale development economically feasible (Powell 1972). Between 1890 and 1900, 204 beehive kilns were erected at Castle Gate to improve the cooking quality of the coal. Production continued to increase until the 1920's. Production declined during the 1920's and 30's due to competition from oil and gas. Increased demains during World War II increased production until 1957 (Doelling 19720.

Local

History of the Deadman's and Straight Canyon area results

from the activities of miners, prospectors, surveyors and trappers. Prospecting has occurred in Deadman's and Straight canyons as early as 1900. Active mining began in 1925 with opening of the Zion Mine and continued sporadically until the closure of the Sutton Mines in 1964 (Doelling 1972).

A Cadastral survey party consisting of Ernest Toone, Oliver London, and Bert Birch surveyed sections 7, 8, 17, and 18 during April, 1900 (Cadastral Survey notes 1900). The surveyors noted the prospect tunnel and cabin of Jesse Knight approximately 15 - 16 chains north of the line between Sections 7 and 18 in Deadman's Canyon.

Mr. Willis Butolph of Wellington, Utah is reported to have been trapped in Straight Canyon for a number of years (Son of Willis Butolph 1980, personal communication).

HISTORIC SITES

Six historic sites were recorded during the survey. The sites include 3 coal mine complexes, 1 cabin, 1 coal prospect, and a historic petroglyph.

42Cb176 is the Zion Mine (Figure 2), active from 1925 to 1948 (Doelling 1972). The site is located on the east flank of the right fork of Deadman's Canyon across from the outlet of Fiasco Canyon the SW 1/4 of the SW 1/4 of Section 7, Township 13 South, Range 11 East at an elevation of 7,030 feet.

The site contains the remnants of a structure of unknown use. The stone forming the walls is held together with a mud mortar ais approximately 6 feet high. The floor is a prepared

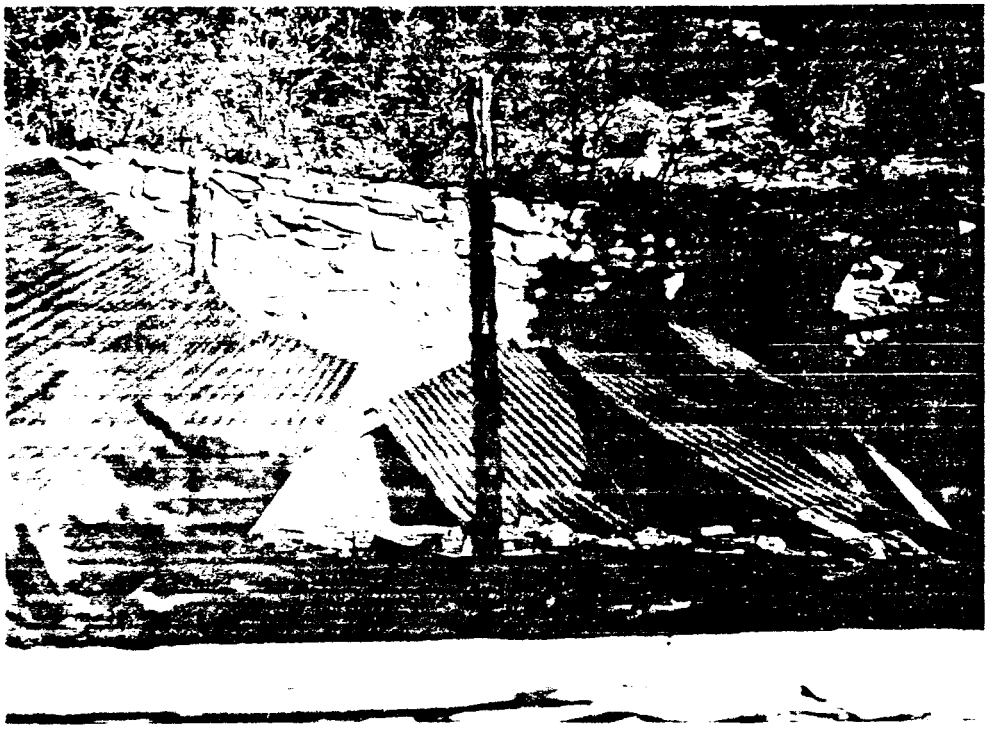


Figure 2. 42Cb176. Habitation Structure at Zion's Mine. Note inset juniper supports, stone wall and metal roof with stove-hole. Storage to right.

dirt surface. Nine juniper logs serve as support posts for the collapsed corrugated metal roofing. Two holes in the roofing indicate that stoves were used in the structure. A juniper log ramada has been built against the south wall of the structure. An underground storage area is attached to the north wall of the structure and is accessible through a window in the north wall.

An isolasted 5 foot high stone retaining wall is located north of the structure along the wash. It is built of shaped stone similar to those used in the structure described above.

42Cb177 (Figure 3) is the Blue Flame/Sutton Mine, active from 1945 to 1964 (Doelling 1972). This site is located approximately 1 1/2 miles up Starlight Canyon at the end of the present road in the NE 1/4 of the SE 1/2 of the NE 1/4, Section 18, Township 13 south, Range 11 East at an elevation between 7,150 and 7,250 feet.

This site contains 3 mine portals, 3 structures, a coal loading bin, an outhouse, a coal storage and loading area and a ventilator foundation. The 3 mine portals are heavily covered with debris from a slide. A concrete block lining is visible in one of them (Figure 4).

Structure 1 (Figure 5) is located in the bottom of the canyon. It measures approximately 10 by 10 by 9 feet high. Structure 1 is built on a square plan with an addition. The structure has a gable roof. The walls of structure 1 are constructed of stone. The addition is constructed of concrete block. The roof of structure 1 is constructed of milled lumber

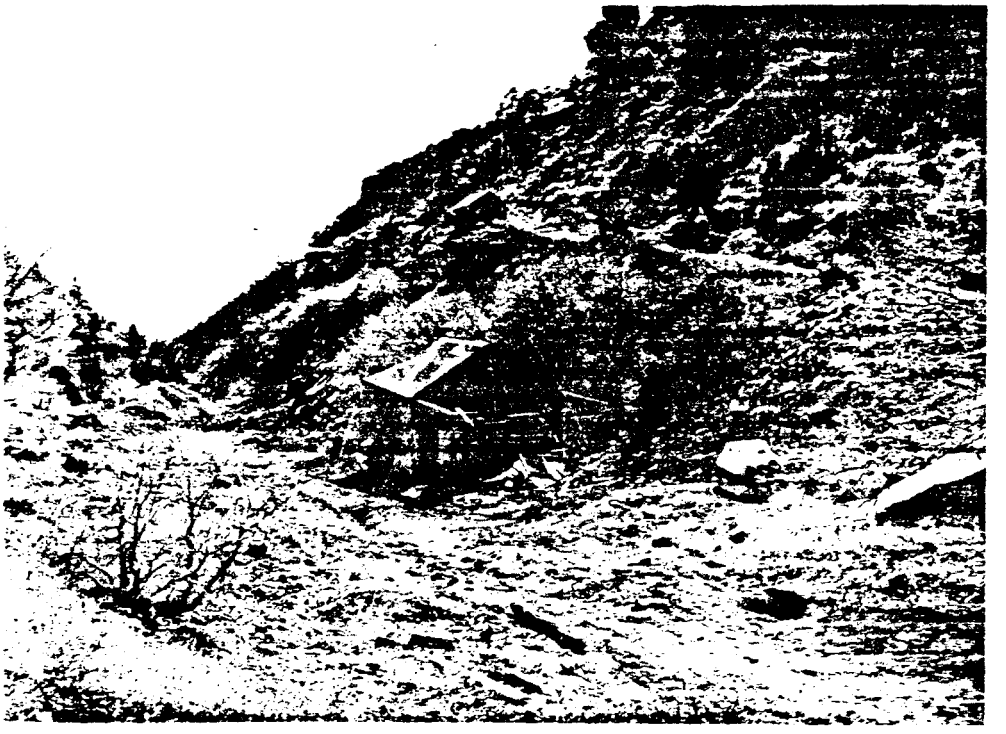


Figure 3. 42Cb177. Blue Flame/Sutton Mine. View Looking South Down Starlight Canyon.

Figure 4. 42Cb177. Collapsed Mine Portal.

Figure 5. 42Cb177. Structure 1. Note stone structure with cement block addition.

on a truss design and is shingled with asphalt shingles. Structure 1 contains 2 windows. One in the south wall is built into the stone wall. The other windows of wood frame construction is contained in the north wall. Three doorways are contained in Structure 1. One doorway is framed in wood and located in the east wall of the addition. A second doorway is also framed in wood and located in the concrete block wall separating the main structure from the additions. The third doorway is located in the south wall of the structure and opens onto a porch area which is roofed and walled with concrete block. A concrete pad is located on a framework of timbers in the southeast corner of the structure. There is no apparent wood floor. The structure interior contains coal, burnt wood, rusted metal, nails, and broken block. Function of the structure is unknown.

Structure 2 (Figure 6) is located on the west flank and approximately 100 feet above the canyon bottom. Structure 2 measures 15 by 12 by 9 feet high. The structure is constructed on a rectangular plan and has a gable roof. The structure is walled on 3 sides with concrete block and opens to the north. The roof is built on a truss design with 2 by 8, 2 by 6, and 1 by 6 inch limber. Asphalt shingles were observed on the surrounding surface. One window measuring 3 by 3 feet is contained in the east wall of the structure. A concrete pad forms the floor of structure 2. A 3 sided rectangular pit is located in the pad. A concrete footing with embedded bolts runs east-west approximately midway across the pit. Ten by 10

Figure 6. 42Cb177. Structure 2. Wood Frame Concrete Block Construction.

inch timbers, bottle glass (post 1903), gaskets, bolts, sheet metal and cans (post 1915) were found within the structure. Structure 2 probably served as a shop or housed machinery.

Structure 3 (Figure 7) is located approximately 80 feet above the canyon bottom on its east flank. Structure 3 measures 12 by 12 by 6 feet high. The structure is built on a square plan. The walls are constructed using 10 by 10 inch wood beams as studs. Two by 12 inch planks and corrugated sheet metal serve as roofing materials. A large rectangular opening in the west wall of the structure functioned as a window. An entranceway is incorporated into the north wall. No artifacts were noted in the structure interior. The function of structure 3 is unknown.

The remains of a coal loading bin (Figure 8) are located on the west flank of Starlight Canyon between structures 1 and 2. The area covered by the bin remnants is approximately 50 by 80 feet. A platform for dumping coal at the top of the bin area is constructed of railroad ties laid on top of a retaining wall of horizontal planks bolted to upright vertical timbers. Logs covered with sheet iron are positioned on the slope, utilizing gravity for the loading operation. Coal slides down these surfaces into chutes at the bottom for loading. Concrete foundation piers and remnants of a collapsed wall suggest a wooden superstructure of some size (20-30 feet high).

The outhouse (Figure 9) is located in the bottom of an east side canyon between structure 3 and the coal loading area. The outhouse is presently disconnected from its pad and resting on

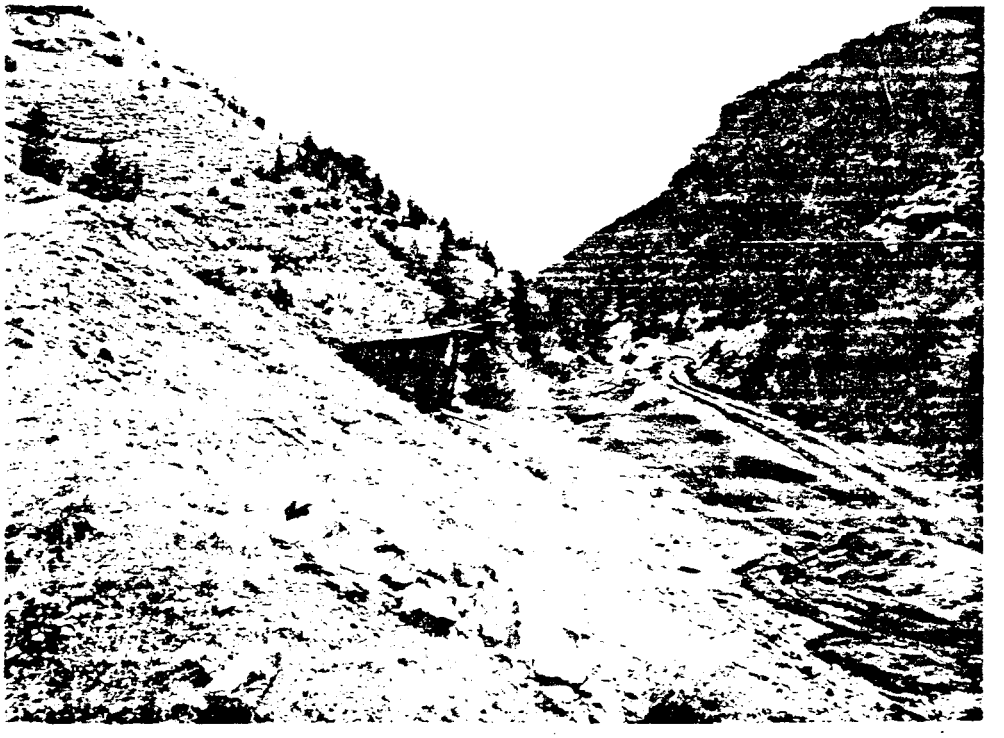


Figure 7. 42Cb177. Structure 3 on West Slope of Canyon Wall.

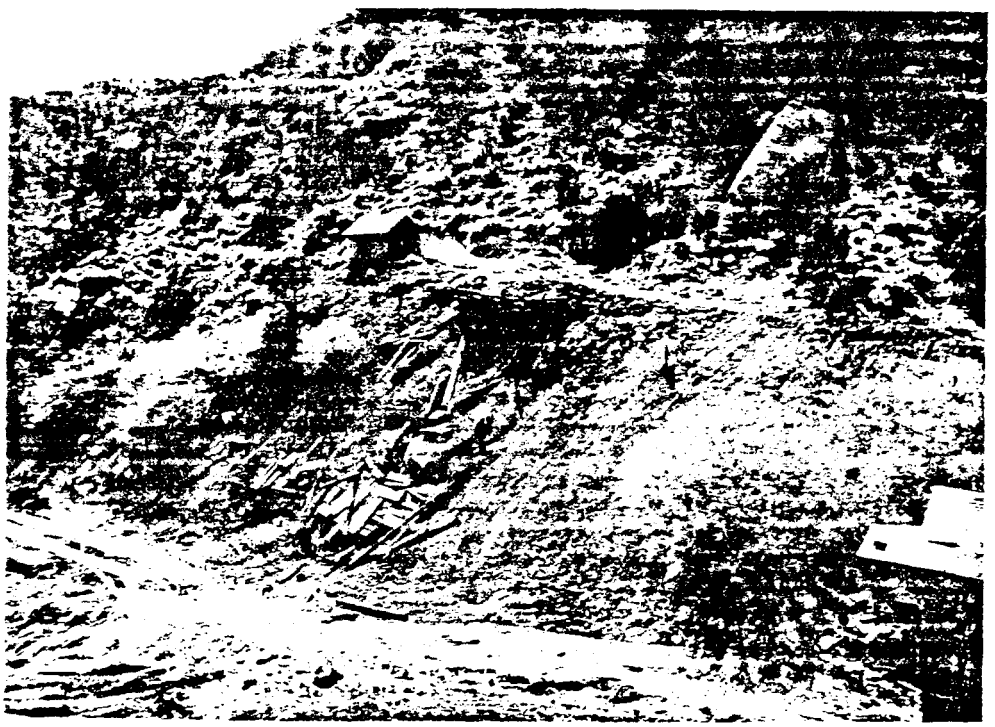


Figure 8. 42Cb177. Coal Loading Bin. Note combined use of wood, cement block and metal sheeting materials.

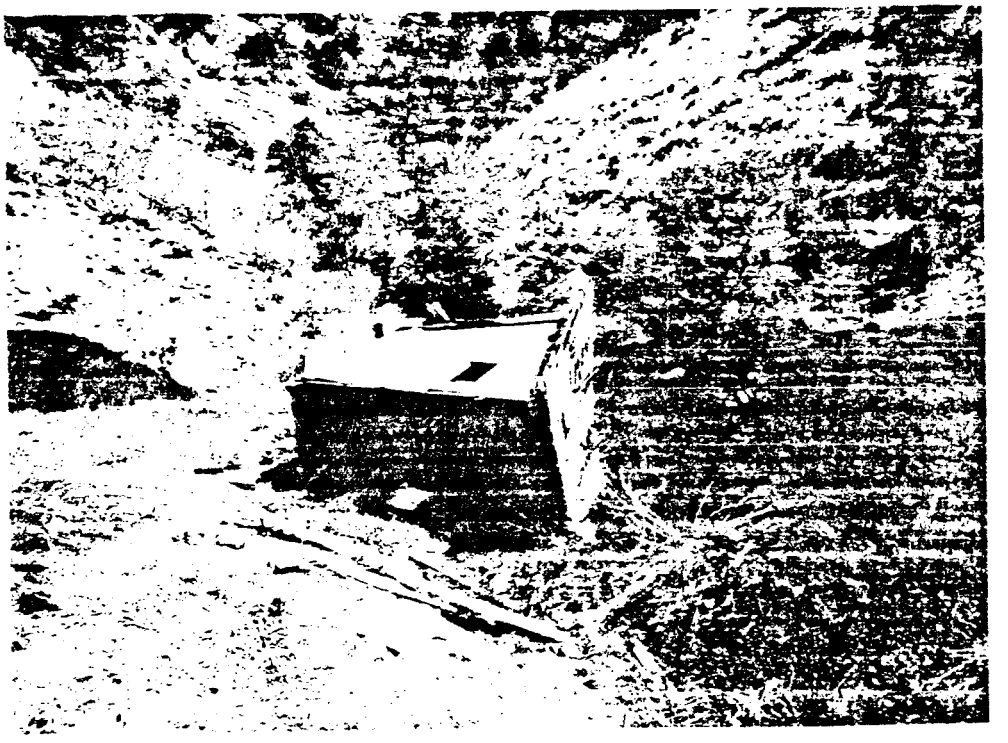


Figure 9. 42Cb177. Outhouse.

its side. The structure pad is pre-cast. The superstructure measures 4 by 4 by 7 feet high and is constructed of wood stud walls and siding. A window exists in the north wall. A door is contained in the west wall. The superstructure has a slant roof constructed with 1 by 6 inch planks. The coal loading hare (Figure 10) consists of a road, coal piles, and the remnants of a frame structure. The loading area is north of the end of the Starlight Canyon road and is oriented east-west. The coal piles measure 2-3 feet high, 12-14 feet wide and approximately 45 feet wide. The road measures 5 feet wide. The structure remnants consist of a stud wall, made of 2 by 4 inch wood studs and 1 by 6 inch planks.

The ventilator foundation (Figure 11) is located west of the coal bin, across the road. It is constructed of stone and concrete and probably contained the ventilating fan located to the northeast (Figure 12). The foundation may have also supported a building superstructure.

42Cb178 is the Rio Grande mine, active from 1940 to 1956 (Doelling 1972). The site is located in the right fork of Deadman's Canyon at the mouth of Fiasco Canyon in the W 1/2 of the NW 1/4 of the SW 1/4 of the SE 1/4, Section 7, Township 13 South, Range 11 East at an Elevation between 7,030 and 7,100 feet. The site consists of a coal loading facility, a structure pad with concrete block pillars, a concrete pad, concrete footings presently supporting a steel coal storage tower, a possible mine portal and a collapsed structure.

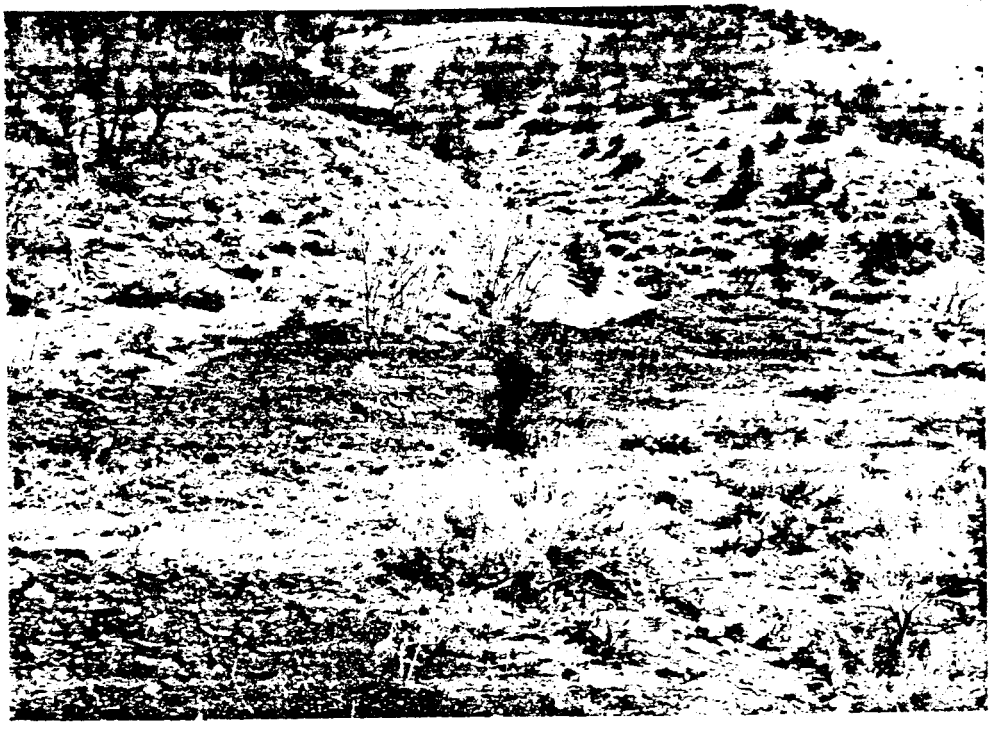


Figure 10. 42Cb177. Coal Piles on North End of Blue Flame/Sutton Mine.

Figure 11. 42Cb177. Ventilator Foundation Looking Northwest.

Figure 12. 42Cb177. Ventilator Fan Looking Northeast.

The coal loading facility (Figure 13) consists of an angled sheet iron platform supported by an "I" beam framework which gravity-feeds coal to a conveyor which is attached to a concrete retaining wall. The movement of coal from this point is unknown. A "Vulcan Denver" apparatus is situated immediately beneath the conveyor and two concrete pedestals are located approximately 50 feet south of the retaining wall. A considerable portion of the loading facility materials appear to have been salvaged.

The structure pad with concrete block pillars (Figure 14) is northeast of the loading facility. The concrete pad measures approximately 25 by 65 feet. Ten concrete block pillars are spaced around the perimeter of the pad. The pillars measure 15-18 inches square. Many of the pillars have collapsed to the south. The pillars appear to have originally been 14 to 15 courses high. Iron plates and bolts in the top of these piers indicate that a superstructure was attached to the piers at one time. No remains of a superstructure were observed. The materials may have been salvaged. Function of this structure is unknown.

A second concrete pad (Figure 15) is located south of the loading facility on the west side of the road. The pad measures 25 by 8 feet. A collapsed concrete ramp measuring 8 by 6 feet is attached to the south end of the pad. A 10 by 12 foot concrete pad is attached to the west side of the main pad. A wood framed, concrete block lined shaft measuring 1 by 1 foot is contained in the center of the pad. Function of the pads is unknown.

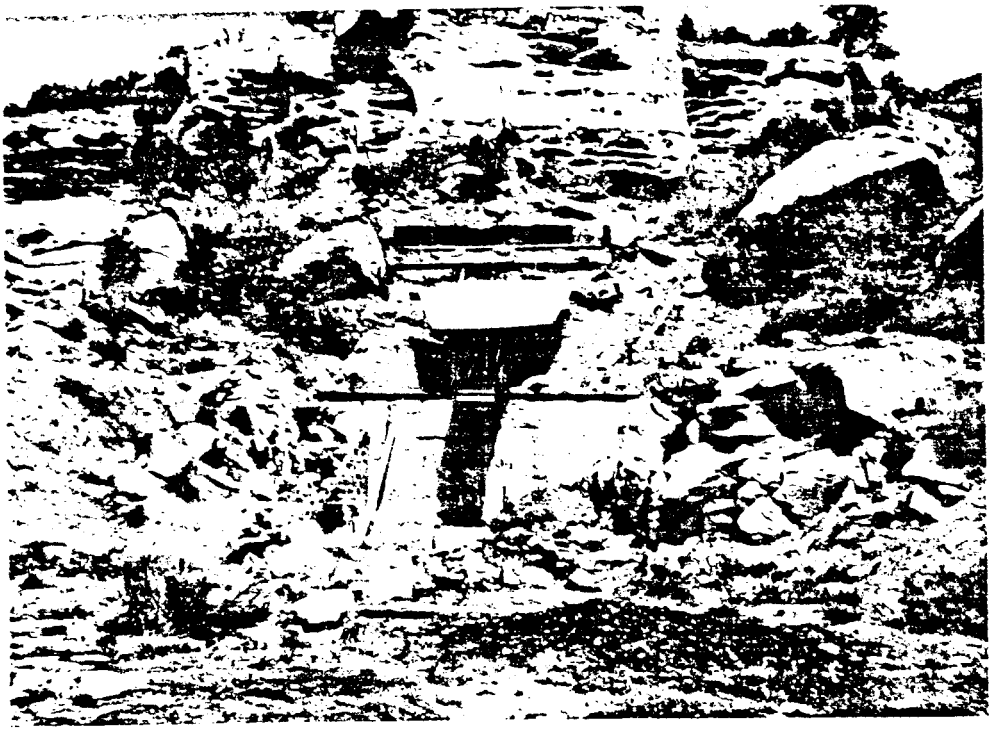


Figure 13. 42Cb178. Coal Loading Facility.

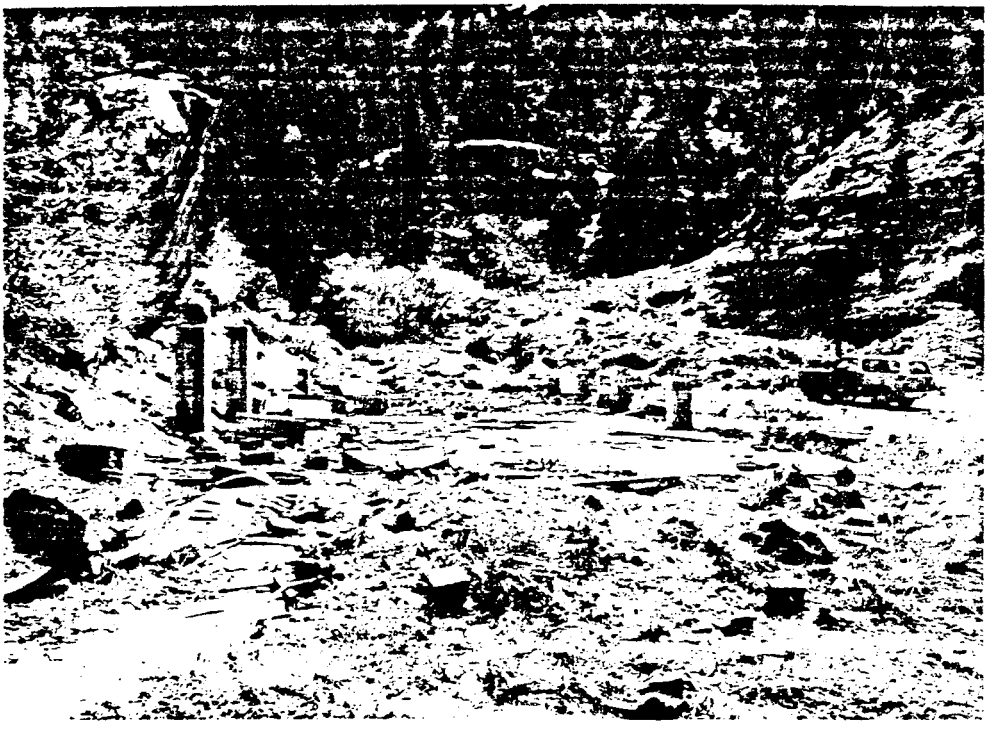


Figure 14. 42Cb178. Structure Pad with Concrete Block Pillars.

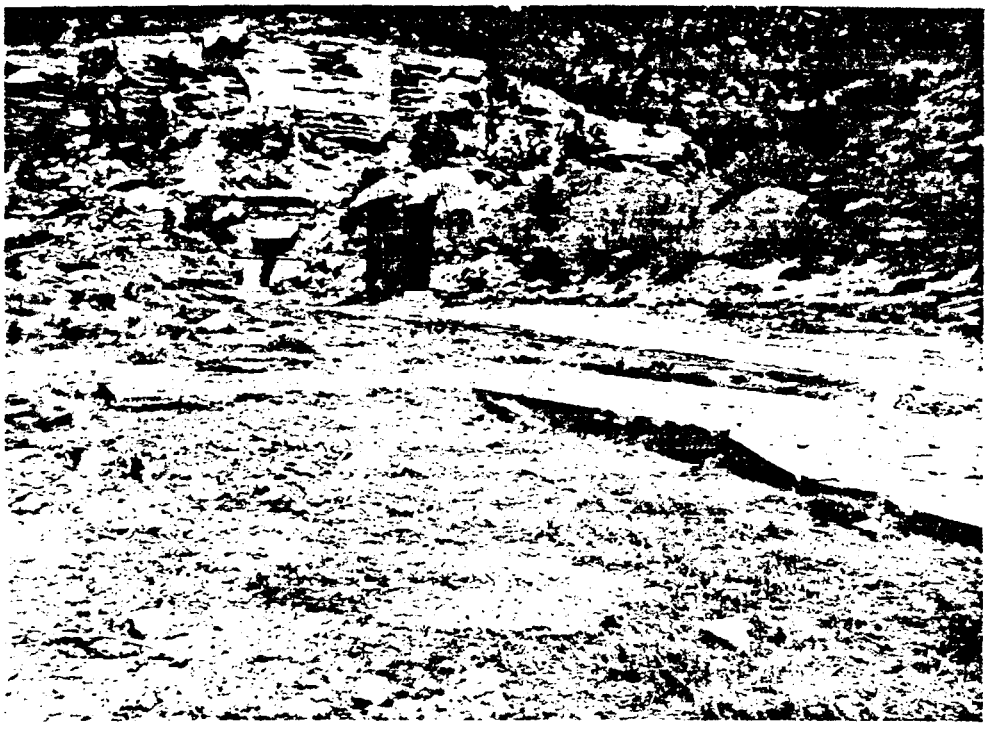


Figure 15. 42Cb178. Concrete Pad.

A series of concrete footings (Figure 16) presently support a steel tower which was used to store coal. Two footings are aligned north-south. The remaining two are aligned east-west. The area covered by the footings measures 30 by 15 feet.

A possible mine portal extends into the slope north of the loading facility. It appearently collapsed under the weight of slide debris. The portal may have been lined with concrete block with a pre-cast concrete lintel decorating the top. The width of the portal appears to be approximately 10 feet.

The wooden debris of a collapsed structure (Figure 17) is concentrated on the eastern part of the site south of a mining cut. Electrical equipment in the debris suggest that this structure may have served as a control or communication center for mine operations.

42Cb179 is a coal prospect. The site is located approximately 3/4 miles into Straight Canyon, 250 feet east of the creek and 60 feet above the canyon bottom in the NE 1/4 of the NW 1/4, Section 17, Township 13 South, Range 11 East at an elevation of 7,125 feet. The site consists of a cut revealing stratigraphy of a coal seam, a cleared area, a road leading to the site from the main canyon road and a pile of logs, one of which was squared, augered, and mortised.

42Cb180 is a log cabin (Figure 18). The site is located approximately 1 mile into the canyon, 60 feet west of the main canyon road in the SE 1/4 of the SW 1/4, Section 8, Township 13 South, Range 11 East. The cabin measures 10 by 10 by 6 feet high and is built on a square plan. The walls are constructed

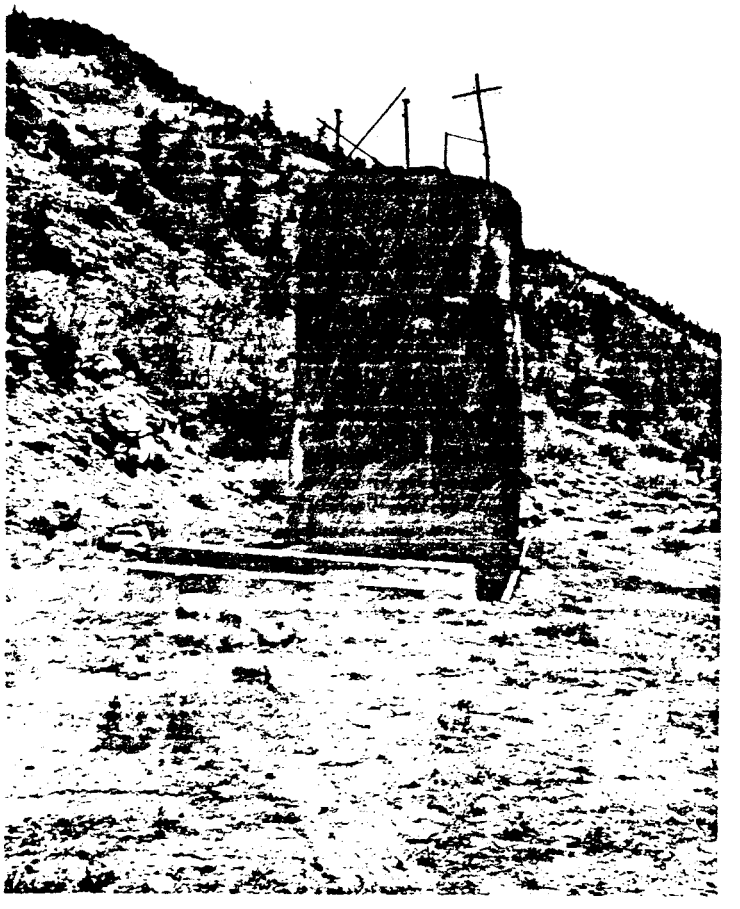


Figure 16. 42Cb178. Concrete Footings and Steel Tower.

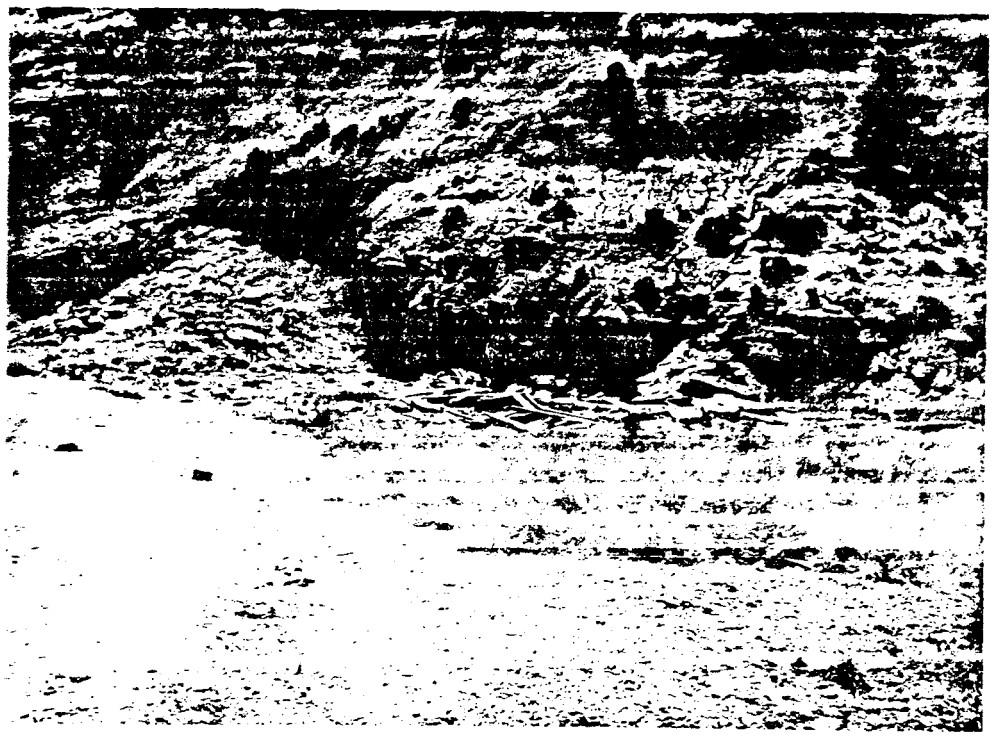


Figure 17. 42Cb178. Wooden Debris of a Collapsed Structure.

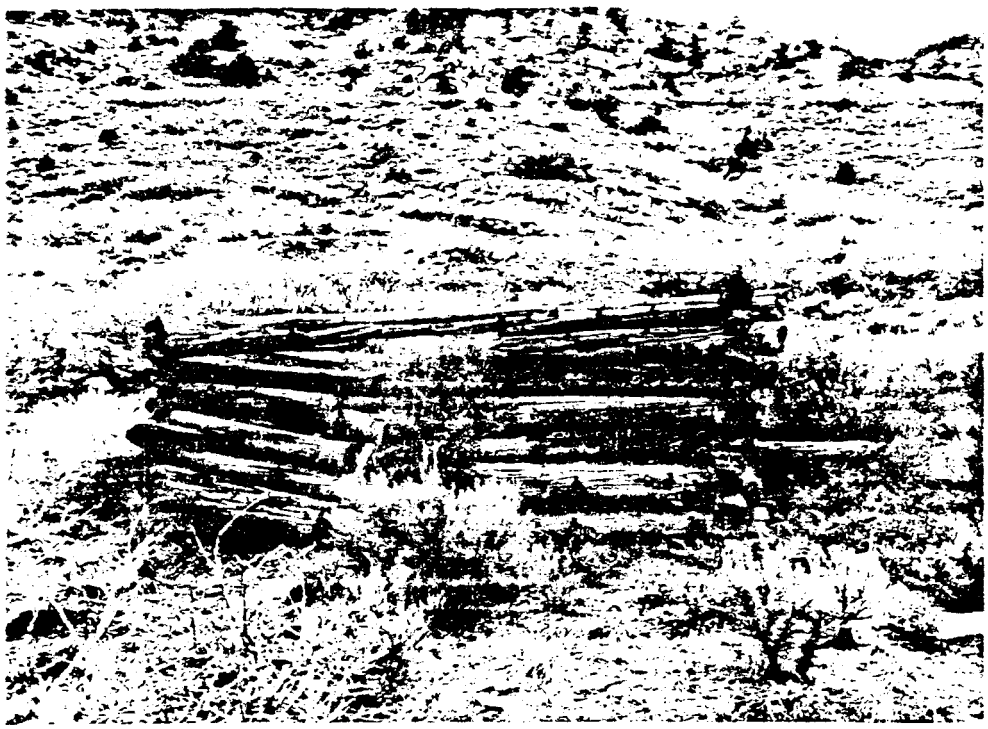


Figure 18. 42Cb180. Cabin.

of saddle notched round logs which have been squared on the interior surface. Saddle notching was done with a saw. A possible ridge pole is suspended across the center of the structure running north-south. No other roofing remains. One window is centered in the west wall and a door is centered in the east wall. A vertical slab is nailed to each side of the entrance to hold the east wall vertical. Each corner of the structure is supported by a stone. The floor appears to be earth with no artifacts other than a bedspring in association. 42Cb181 is a historic petroglyph (Figure 19) pecked on a sandstone boulder at the mouth of Straight Canyon on the east side of the road in the SW 1/4 of the SW 1/4 of the SE 1/4, Section 17, Township 13 South, Range 11 East at an elevation of 6,760 feet. The inscription reads "J.A. Peterson, May 11, 1901."

RECOMMENDATIONS

Sites 42Cb176 through 42Cb179 are not old enough to satisfy the National Register Criteria. The significance of these mines is contained in the spatial arrangement of their surface structures and in the building construction styles employed there. These aspects have been documented and all that remains is to document structure function through research in company records or conducting oral histories. These activities can be conducted at any time and should not stand in the way of development.

Figure 19. 42Cb181.

42Cb180

The occupant and date of construction for this cabin are presently unknown and could potentially qualify the site for the National Register. Avoidance is recommended for this site.

42Cb181

The information and location of this petroglyph has been recorded. This site is recommended cleared for development.

BIBLIOGRAPHY

Aikens, C. Melvin
1970 Hogup Cave. University of Utah Anthropological Papers, No. 93. Salt Lake City.

Beckwith, F.
1931 Some Interesting Pictographs in Nine Mile Canyon, Utah. El Palacio, Vol. 31, No. 14.

1931 Serpent Petroglyphs in Nine Mile Canyon, Utah. El Palacio, Vol. 33, Nos. 15-16.

Behle, W.H. and M.L. Perry
1975 Utah Birds. Utah Museum of Natural History. Salt Lake City.

Berge, D. L.
1977 Pictograph Site Evaluation Near Wellington, Carbon County, Utah. Department of Anthropology and Archaeology, Brigham Young University. Provo.

Bureau of Land Management
1900 Cadastral Land Survey Notes, April 11, 1900. Book A-276, pp. 471. Bureau of Land Management, Utah State Office. Salt Lake City.

Burnham, R.C.
1950 The Climates of Utah. M.S. Thesis on file at Department of Anthropology, University of Utah. Salt Lake City.

Butler, B.R.
1973 Folsom and Plano Points from the Peripheries of the Upper Snake County. Tebiwa, Vol. 16, No. 1. Pocatello.

Cadastral Land Survey notes
1980 April 11, 1900. Book A-276, page 471. Bureau of Land Management, Utah STate Office. Salt Lake City, utah.

Doelling, H.H.
1972 Book Cliffs Coal Field In Central Utah Coal Fields: Wellington, Minnie Maud West Quadrangle by H.H. Doelling. Utah Geological and Mineralogical Survey. Salt Lake City.

Doelling, H.H.
1972 Central Utah Coal Fields. Utah Geological and Mineralogical Survey, Monograph Series No. 3.

Durrant, S.D.
1952 Mammals of Utah. University of Kansas Publications. Lawrence.

Euler, R.C.
1966 Southern Paiute Ethnohistory. University of Utah Anthropological Papers, No. 78. Salt Lake City.

Fenneman, N.M.
1931 Physiography of the Western United States. McGraw-Hill. New York.

Gillin, J.
1938 Archaeological Investigations in Nine Mile Canyon, Utah. University of Utah Bulletin, Vol. 28, No. 11. Salt Lake City.

Gunnerson, J.H.
1956 A Fluted Point Site in Utah. American Antiquity, Vol. 21, No. 4. Washington, D.C.

1969 The Fremont Culture: A Study in Culture Dynamics on the Northern Anasazi Frontier. Papers of the Peabody Museum of Archaeology and Ethnology, Harvard University. Vol. 59, No. 2. Cambridge.

Hauck, F.R.
1976 An Archaeological Survey of the Banning Railroad Siding Locality in Carbon County, Utah. Archaeological-Environment Research Corporation. Salt Lake City.

1977a Archaeological Reconnaissance in the Nine Mile Canyon Locality of Carbon County, Utah. Archaeological-Environment Research Corporation. Salt Lake City.

1977b Archaeological Clearance of a Pipeline Corridor and Access Roads in the Jack Creek Locality near Nine Mile Canyon in Carbon County, Utah. Archaeological-Environment Research Corporation. Salt Lake City.

1979 Cultural Rsource Evaluation in Central Utah: 1977. Cultural Resource Series No. 3. Bureau of Land Management. Salt Lake City.

Hauck, F.R. and L. M. Harmon
1977 The Central Coal Project, Vol. III. Archaeological-Environment Research Corporation. Salt Lake City.

Hauck, F.R., V.G. Norman, L. M. Harmon and S. D. Hayes
1978 Archaeological Reconnaissance in the East Central Utah Area. Archaeological Environment REsearch Corporation. Salt Lake City.

Hintze, L.F.
1979 Geological History of Utah. Brigham Young University Geology Series, Vol. 20, Pt. 3. Provo.

Hunt, C.B.
1974 National Regions of the Uniged States and Canada. W.H. Freeman. San Francisco.

Jennings, J.D.
1957 Danger Cave. University of Utah Anthropological Papers, No. 27. Salt Lake City.

1978 Prehistory of Utah and the Eastern Great Basin. University of Utah Anthropological Papers, No. 98. Salt Lake City.

Lindsay, L.W. and C.K. Lund
1976 Pint-Size Shelter, Antiquities Section Selected Papers, Vol. III, No. 10. Salt Lake City.

Madsen, D.b.
1975 Dating Paiute-Shoshoni Expansion in the Great Basin. American Antiquity, Vol. 40, No. 1. Washington, D.C.

Madsen, D.B. and M.Berry
1975 A Reassessment of Northeastern Great Basin Prehistory. American Antiquity, Vol. 40, No. 4. Washington, D.C.

Madsen, D.B., D.Currey and J. H. Madsen
1976 Man, Mammoth, and Lake Fluctuations in Utah. Antiquities Section Selected Papers, Vol. 2, No. 5. Salt Lake City.

Marwitt, J.P.
1970 Median Village and Fremont Cultural Regional Variation. University of Utah Anthropological Papers, No. 95. Salt Lake City.

Miller, S. J. and W.Dort, Jr.
1978 Early Man at Owl Cave: Current Investigations at the Wasden Site, Eastern Snake River Plain, Idaho In Early Man in America from a Circum-Pacific Perspective, ed. by A.L.Bryan. Occasional Papers, No. 1, Department of Anthropology, University of Alberta. Edmonton.

Montgomery, H.
1894 Prehistoric Man in Utah. The Archaeologist, Vol. II. Waterloo, Indiana.

Morss, N.
1931 Ancient Culture of the Fremont River in Utah. Papers of the Peabody Museum of Archaeology and Ethnology, Harvard University, Vol. 12. Cambridge.

Patterson, G.
1975 Archaeological and Paleontological Investigation for the Price River Water Improvement District. Department of Anthropology and Archaeology, Brigham Young University. Provo.

Personal Communication
1975 Son of Willis Butolph to Bruce Hawkins and Deborah Truell, May 23, 1980.

Powell, A. Kent
1972 Labor at the Beginning of the 20th Century. The Carbon County, Utah Coal Fields 1900 to 1905. M.A. Thesis on file at Department of History, University of Utah. Salt Lake History.

Reagan, A.B.
1931a Some Archaeological Notes on Nine Mile Canyon, Utah. El Palacio, Vol. 31, No. 4.

1931b Ruins and Pictograhs in Nine Mile Canyon, Utah. Transactions of the Illinois Academy of Sciences, Vol. 24, No. 2.

Schaafsma, P.
1971 The Rock Art of Utah. Papers of the Peabody Museum of Archaeology and Ethnology, Vol. 65. Cambridge.

Schulman, E.
1948 Dendrochronology in Northeastern Utah. Tree-Ring Bulletin, Vol. 15, Nos. 1 and 2. Tucson.

Sharrock, F.W.
1966 Prehistoric Occupation Patterns in Southwest Wyoming and Cultural Relationships with the Great Basin and Plains Culture Areas. University of Utah Anthropological Papers, No. 77. Salt Lake City.

Siegrist, R.
1972 Prehistoric Petroglyphs and Pictographs in Utah. Utah State Historical Society. Salt Lake City.

Steward, J.
1938 Basin-Plateau Aboriginal Sociopolotical groups. Bureau of American Ethnology, Bulletin 120. Smithsonian Institution. f Washington, D.C. (Reprint 1970 by the University of Utah Press. Salt Lake City).

Stokes, W.L. and J.H. Madsen Jr.
1961 Geologic Map of Utah - northwest quarter. Utah Geological and Mineralogical Survey. Salt Lake City.

Stokes, W.L.
1977 Subdivisions of the Major Physiographic Provinces in Utah In Utah Geology, Vol. 4, No. 1. Salt Lake City.

Tripp, G.
1964 Authentic Clovis Point Find. Utah Archaeology, Vol. 10, No. 4. Salt Lake City.

1966 A Clovis Point Find From Central Utah. American Antiquity, Vol. 31, No. 3. Washington, D.C.

Walker, J.T.
1967a Archaeological Reconnaissance in Deadman Canyon, Carbon County, Utah. Department of Anthropology and Archaeology, Brigham Young University. Provo.

1967b Archaeological Survey Report for Dry Canyon near Helper, Utah. Department of Anthropology and Archaeology, Brigham Young University. Provo.

1969 The Archaeological Survey of the AMCA Coal Leasing Inc. Centennial Project 46Kv Powerline. Department of Anthropology and Archaeology, Brigham Young University. Provo.

RECEIVED
6-23-80

SCOTT M. MATHESON
GOVERNOR

STATE OF UTAH
DEPARTMENT OF COMMUNITY AND
ECONOMIC DEVELOPMENT

Division of
State History
(UTAH STATE HISTORICAL SOCIETY)

MELVIN T. SMITH, DIRECTOR
307 WEST 2ND SOUTH
SALT LAKE CITY, UTAH 84101
TELEPHONE 801/533-5755

June 19, 1980

Mr. Mike Glasson
AMCA-Coal, Incorporated
Walker Bank Building
Price, Utah

Dear Mr. Glasson:

Please find enclosed a report of our archeological survey in the Fiasco Straight Canyon area north of Price. You will note attached is the cover letter to the Bureau of Land Management indicating our recommendations, also attached is the bill for our five field days work.

If you have any questions, please let me know.

Sincerely,

La Mar W. Lindsay
Assistant State Archeologist

LWL:ro

Enclosures

State History Board: Milton C. Abrams, Chairman • Theron H. Luke • Ted J. Warner • Elizabeth Montague • Thomas G. Alexander
David G. Dayton • Wayne K. Hinton • Helen Z. Papanikolas • David S. Monson • Elizabeth Griffith • William D. Owens

SCOTT M. MATHESON
GOVERNOR

STATE OF UTAH
DEPARTMENT OF COMMUNITY AND
ECONOMIC DEVELOPMENT

Division of
State History
(UTAH STATE HISTORICAL SOCIETY)

MELVIN T. SMITH, DIRECTOR
307 WEST 2ND SOUTH
SALT LAKE CITY, UTAH 84101
TELEPHONE 801/533-5755

June 19, 1980

Bruce Louthan
Bureau of Land Management
Box 970
Moab, UT 84532

Dear Bruce:

Please find enclosed a copy of our report of an archeological survey for AMCA-Coal Company north of Price. Six of the sites encountered are historic - early 20th century construction, associated with mining; the seventh is historic graffiti. It is the opinion of Bruce Hawkins, Historic Archeologist, that these sites would not impede development.

This report along with necessary BLM forms has been distributed to the Price area office and the Utah State office.

If you have any questions, please let me know.

Sincerely,

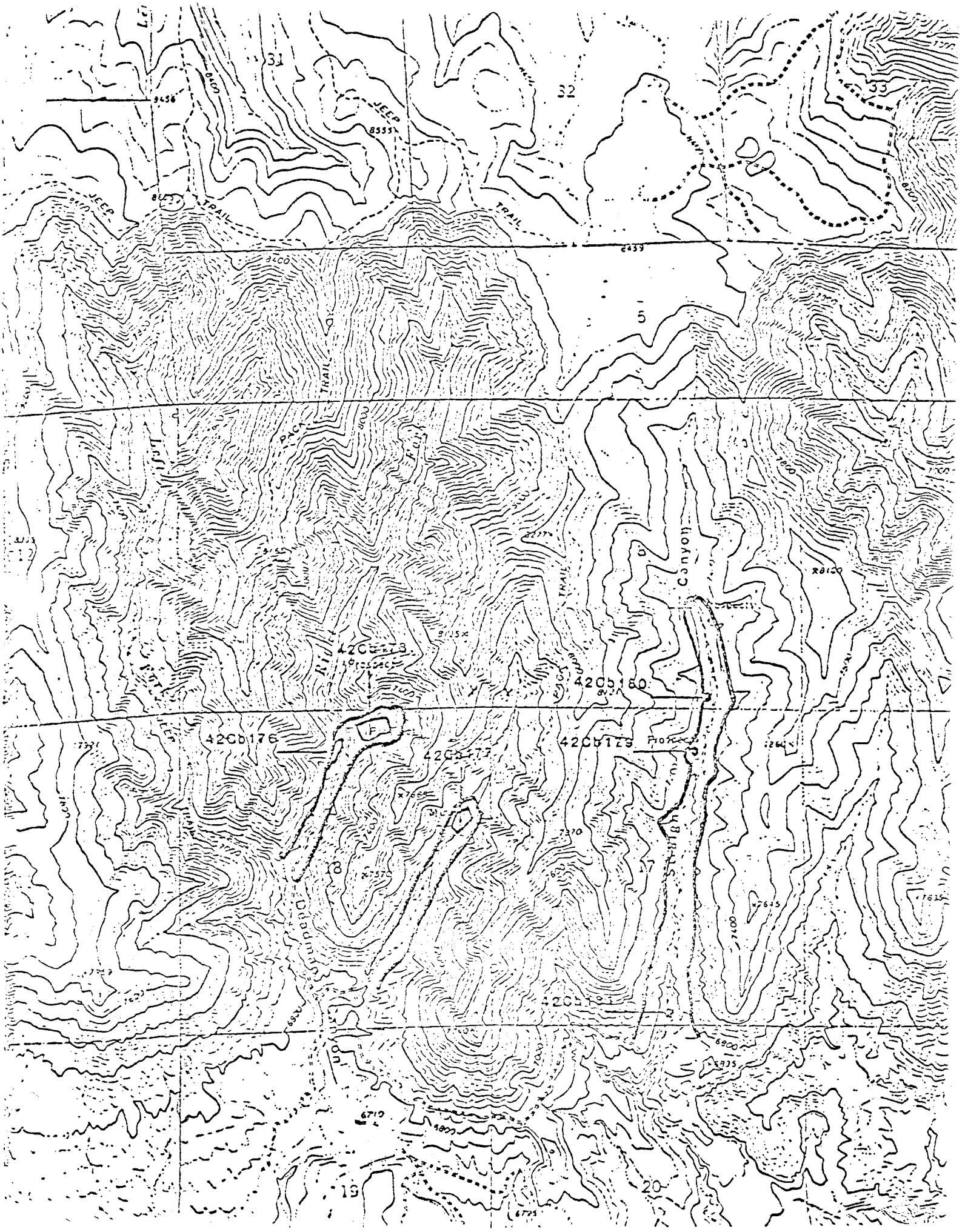
La Mar W. Lindsay
Assistant State Archeologist

LWL:ro

Enclosures

cc: Mike Glasson, AMCA-Coal Company
Mike Benson, Price BLM
Rich Fike, Salt Lake BLM

Alice C. Abrams Chairman • Theron H. Luke • Ted J. Warner • Elizabeth Montague • Thomas G. Arnold
• Warren Hooker • Helen J. Papanikolas • David S. Monson • Elizabeth Griffith • Victor D. Simons


31
32
33
JEEP
TRAIL
5
PACK
TRAIL
Ridge
Canyon
42Cb160
42Cb176
42Cb177
42Cb179
18
17
20
19

Site No. 42Cb178 County Carbon State Utah

Site name Rio Grande Mine

1. Map reference U.S.G.S. Deadman's Canyon 7.5 Min. Quad.

2. Location At the mouth of Fiasco Canyon in Deadman's Canyon

W½, NW¼ SW¼ SE¼ Sec. 7 T. 13S R. 11E

3. UTM Grid: Zone 12 Easting 523400 Northing 4394950

4. Type of site Coal mine and associated service facilities prospected 1900, active 1940-56.

5. Cultural affiliation (list basis of designation)

6. Owner and address

7. Informants

8. Previous designations and published reference for site

Central Utah Coal Fields p. 394

9. Site description and condition Coal dump and possible adit, prospect/possible adit area; coal storage tower, concrete pad, structure foundation, collapsed structure possibly associated with electrical control of some sort.

10. Cultural features, area of occupation, depth and character of fill

(See attached continuation sheet)

11. Environmental setting (vegetation, water, topography, etc.)

Situated at junction of 2 washes in right fork of Deadman's Canyon, Vegetation includes grasses, sage, ponderosa pine, scrub oak, juniper, ephedra, yucca and prickly pear cactus

12. Elevation 7030-7100 feet.

13. Material collected and deposition None

14. Material observed (See attached)

15. Material reported and owner/address None

16. Recommendations for further work

17. National Register potential

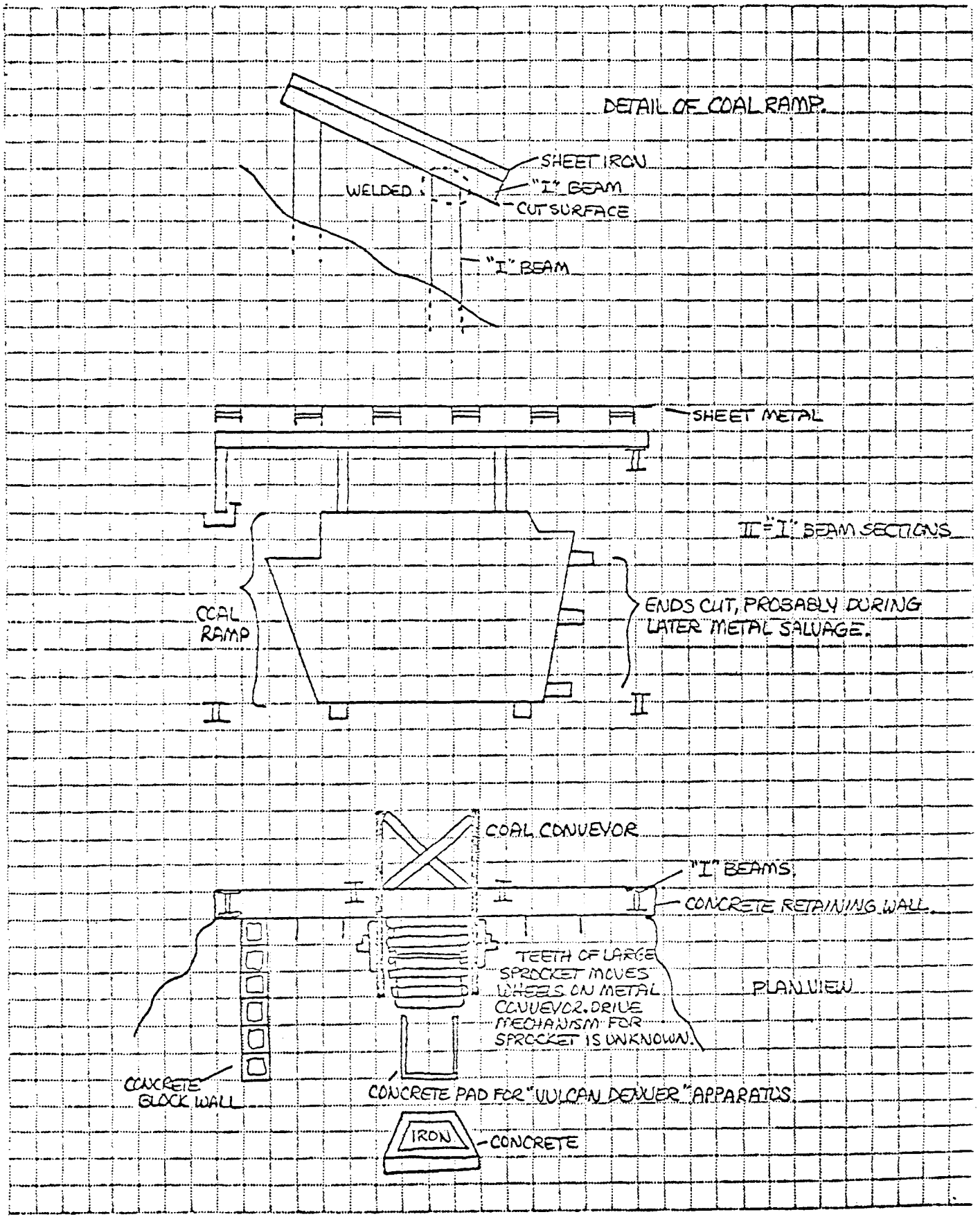
18. Photo Nos.

19. Type of map made by survey party Sketch

5-27-80

Antiquities Section *Division of State History*

Feature No. 1 SITE 42Cb178 DATE 5/22/80



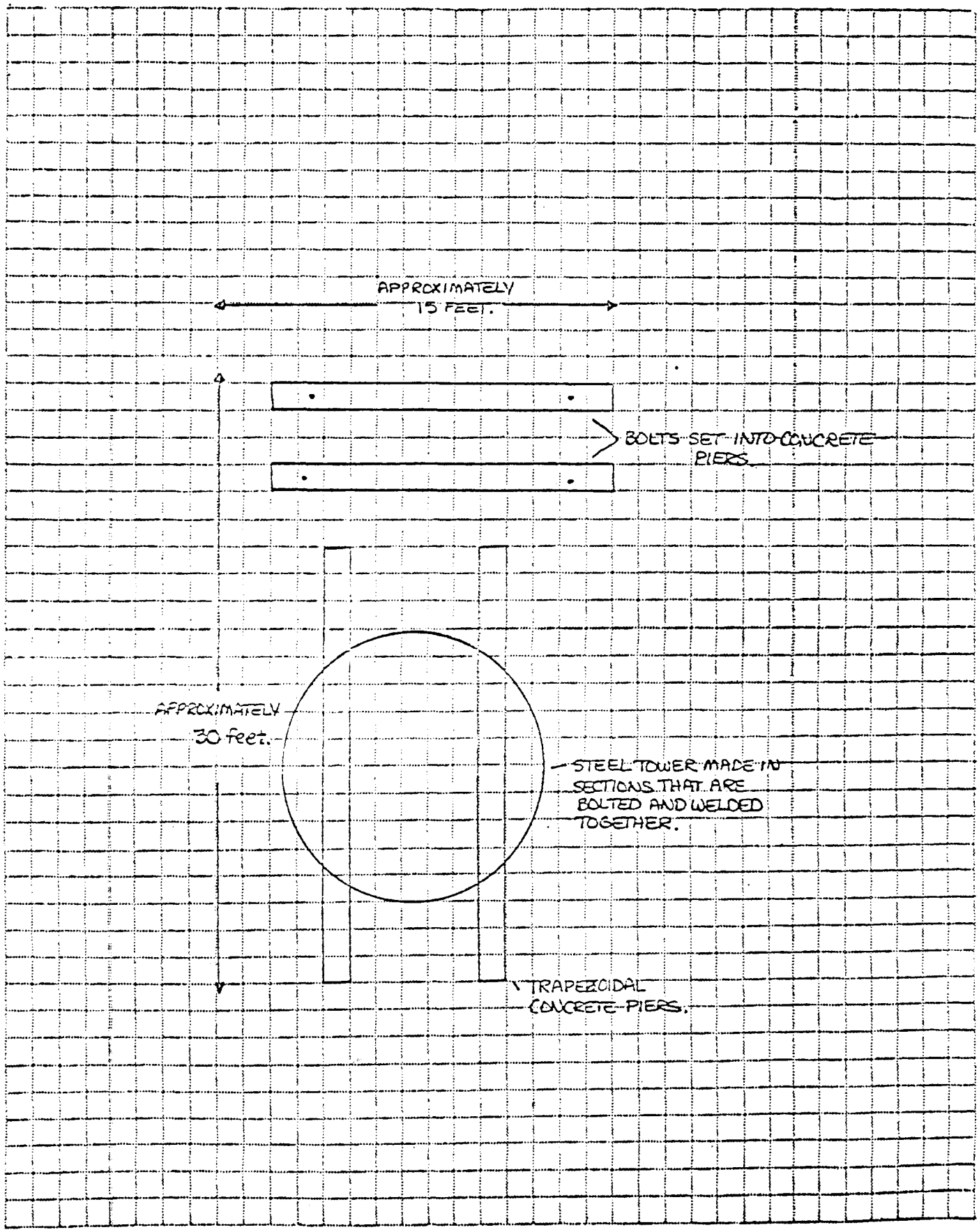
FINAL SHEET YES ☐ NO ☐ RECORDER _____

CONTINUATION FORM

PAGE

Antiquities Section *Division of State History*

Feature No. 2 SITE 42 Cb 178 DATE 5/22/80



FOLD SHEET YES ☐ NO ☐

RECORDER

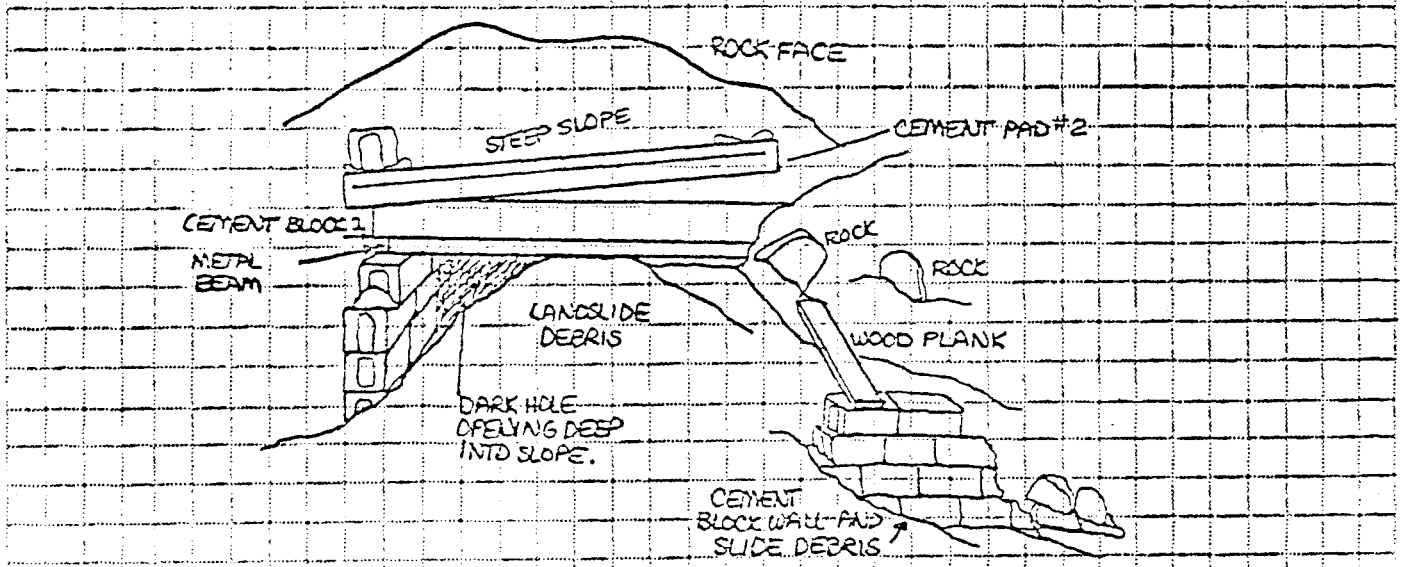
CONTINUATION FORM

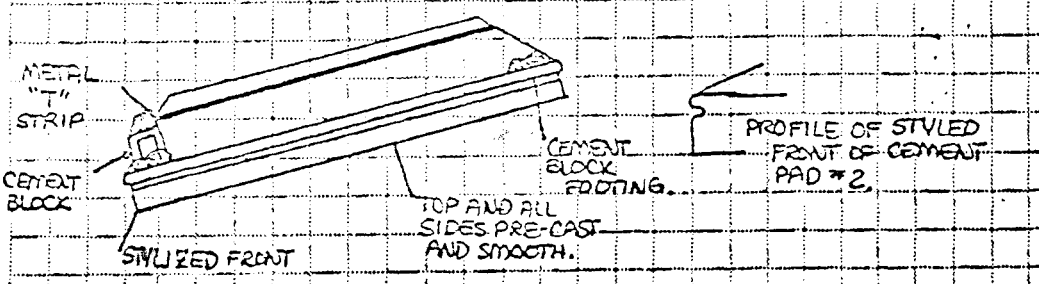
PAGE

Antiquities Section Rio Grande *Division of State History*

Feature No. F-3 SITE 42Cb178 DATE 5/22/80

F-3 is a collapsed (?) structure in the south face of the slope rising north from the upper road in rio grande mine. Dirt and rock block the "front" opening of it but a top left corner is clear. Parts of 2 cement block walls emerge perpendicular to the road which runs east/west. These are connected on top by a metal beam approximately 3 inches thick. The walls themselves are 1 cement block thick. On the right side of the structure (E) a broken wall can be seen through the rubble that runs parallel to the road and stands slightly in front of the structure area. It is 4 blocks high and broken off 4 blocks wide. At this point a weathered plank connects it to the structure that has collapsed (?) Across the metal beam that connects these two sides is a cement "pad" with a crumbled face. It is 4 inches thick and 10 feet in length. The width of the structure is probably about this length (10 feet). On top of this cement pad another has fallen with the landslide. It sits at an angle, its left (west) side resting on the pad below it and its right on debris that partially buried its end. It is different in the front, it has a definite (decorative ?) smoothed face. It too has 2 cement block wall footings at either end (east and west) and is 4 inches thick. The top is smoothed horizontally and is approximately 3 feet wide (lying east/west its width is north/south) and 10 feet long. It is different too in that it has a definite and smoothed back. There is a metal T-shaped brace or support beam inlaid in it with the top of the "T" on level with the top of the cement pad. The structure seems to have been blocked by a large slide from the talus slope above and there is little else there. Strangely perhaps, there are no other cement blocks or fragments in evidence, anyway, around F-3 the debris is solely natural dirt, sand and rock material.



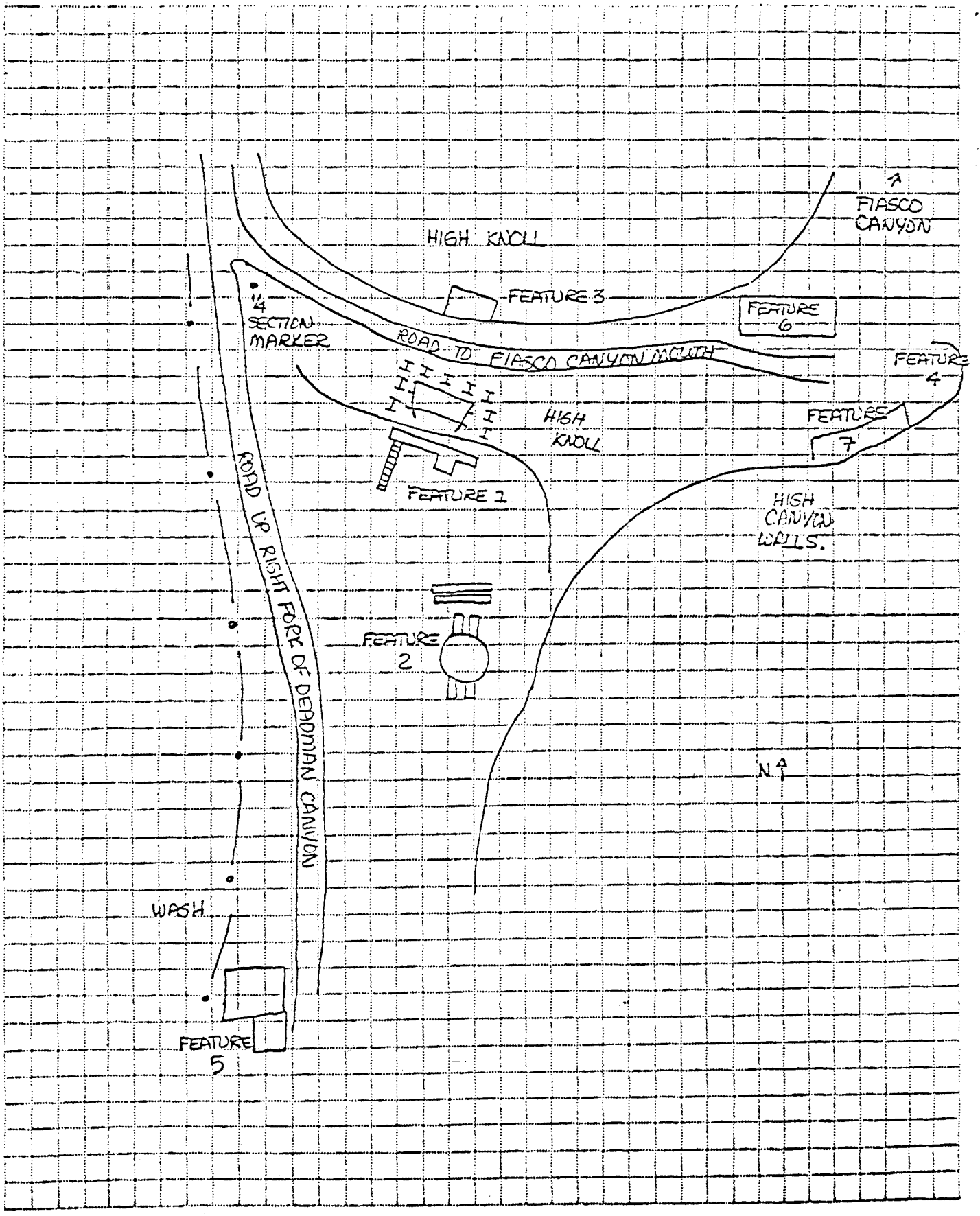


recorder Debi Truell

Division of State History

Antiquities Section

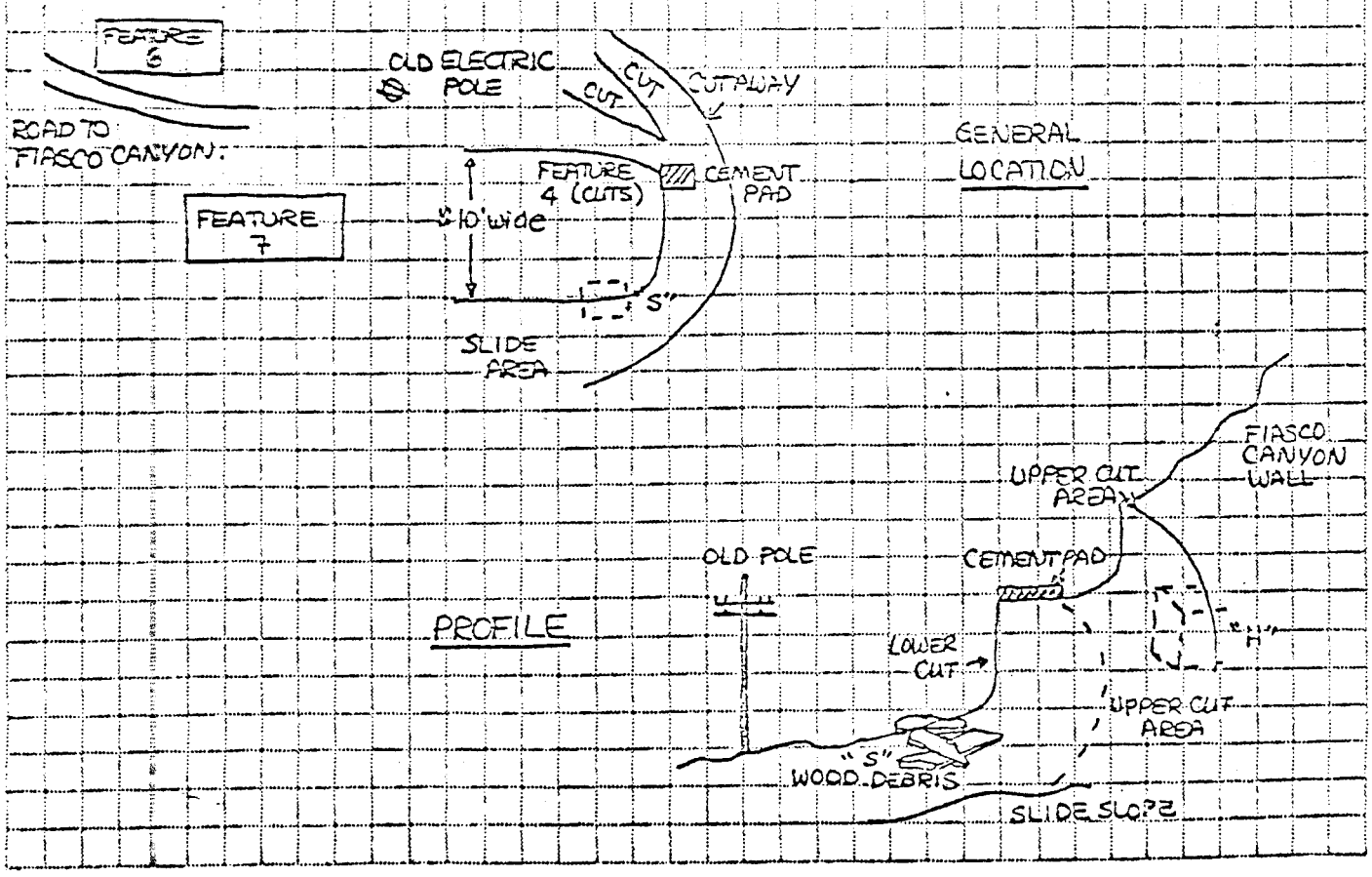
Feature No. [illegible] 178 DATE 5/22/80



RECORDER

Feature No. F-4 SITE 42Cb178 DATE 5-22-80

F-4 is a small series of rather large cuts east of F-7 and southeast of F-6. The lowest level one (and deepest cut) is 12-15 feet high and strewn with small boulders. The upper cut begins near the old electric pole and makes a semi-circle around the top of the lower larger one. It is only 8 or 9 feet deep at the deepest point. The southern "wall" of these cuts appears to have been a landslide and looks quite different. Under the soil of this slide slope are rather large pieces of cut lumber and planks and it appears that a structure similar to F-7 may once have stood on the southern side of F-4 (See "S" on map). Along the upper cut area on the edge of the lower cut is a small cement pad 3 inches thick by 3 feet by 5 feet. There are no other building materials near it such as metal, cement blocks, fragments, etc. The north/south width of the lower large cut is 10 feet while the width of the higher cut "step" area is 10-12 feet. The slope resumes behind this cut and rises naturally into Fiasco Canyon on the north and east. In the southeast corner of the second cut is a small (5 foot diameter) sunken area approximately 5 1/2 feet deep at the "back" nearest the high part of the slope. Rocks and dirt have fallen in on this hole and although there is no evidence at all of any man-made construction materials (i.e. cement, cement block, metal, wood planks), there is a very small opening in the debris that shows a hole of undetermined depth goes down into the hillside. (A small stone tossed down seemed to fall fairly freely for quite a way). See "H" on profile map.

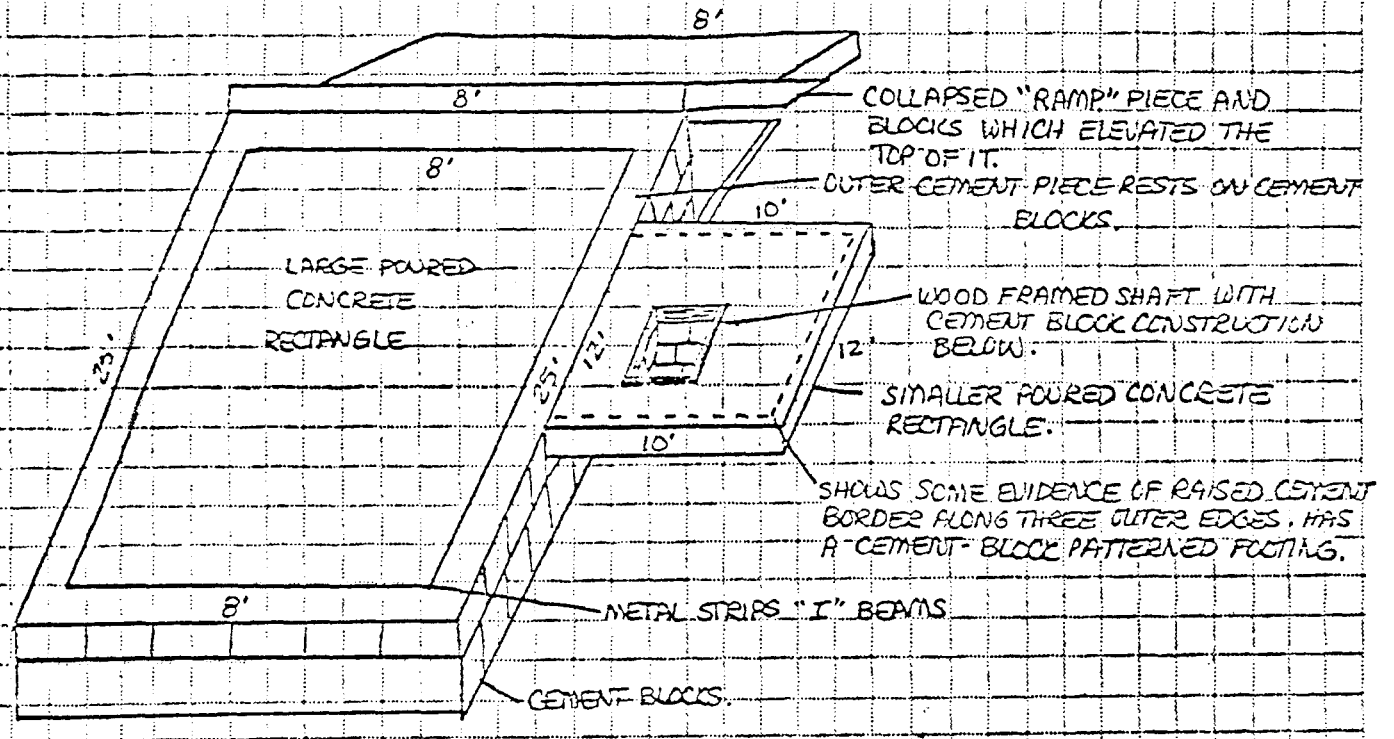


FINAL SHEET YES ☐ NO ☒ RECORDER Debi Tewell

Antiquities Section Rio Grande *Division of State History*

Feature No. F-5 SITE 42Cb178 DATE 5/22/80

F-5 lies southwest of the silo-type F-2 structure of the Rio Grande mine. It is on the east side of the wash that runs down from Deadman's (right fork) Canyon and just below Fiasco Canyon. It consists of a large "pad" of poured cement. A large rectangular part is closest to the road. To the west (its left facing north) lies a smaller poured cement pad with a wood framed opening ( ) constructed beneath the pad of cement block. This has been filled in for the most part and it is impossible to guess how deep a shaft this may be. The large rectangle has a border of two metal strips, placed about 2 inches apart and rimmed with a layer of cement block topped with poured concrete (see diagram). To the south of this large rectangle in a separate piece is another slab of poured concrete. The northern edge of this (almost touching the large rectangular pad) is elevated by a cement block while the southern edge lies on the ground, forming a rough ramp. (The concrete has cracked and the "ramp" collapsed). A few wooden planks with nails lie around the area particularly on the west (wash) side. There is a metal and wood frame underneath.



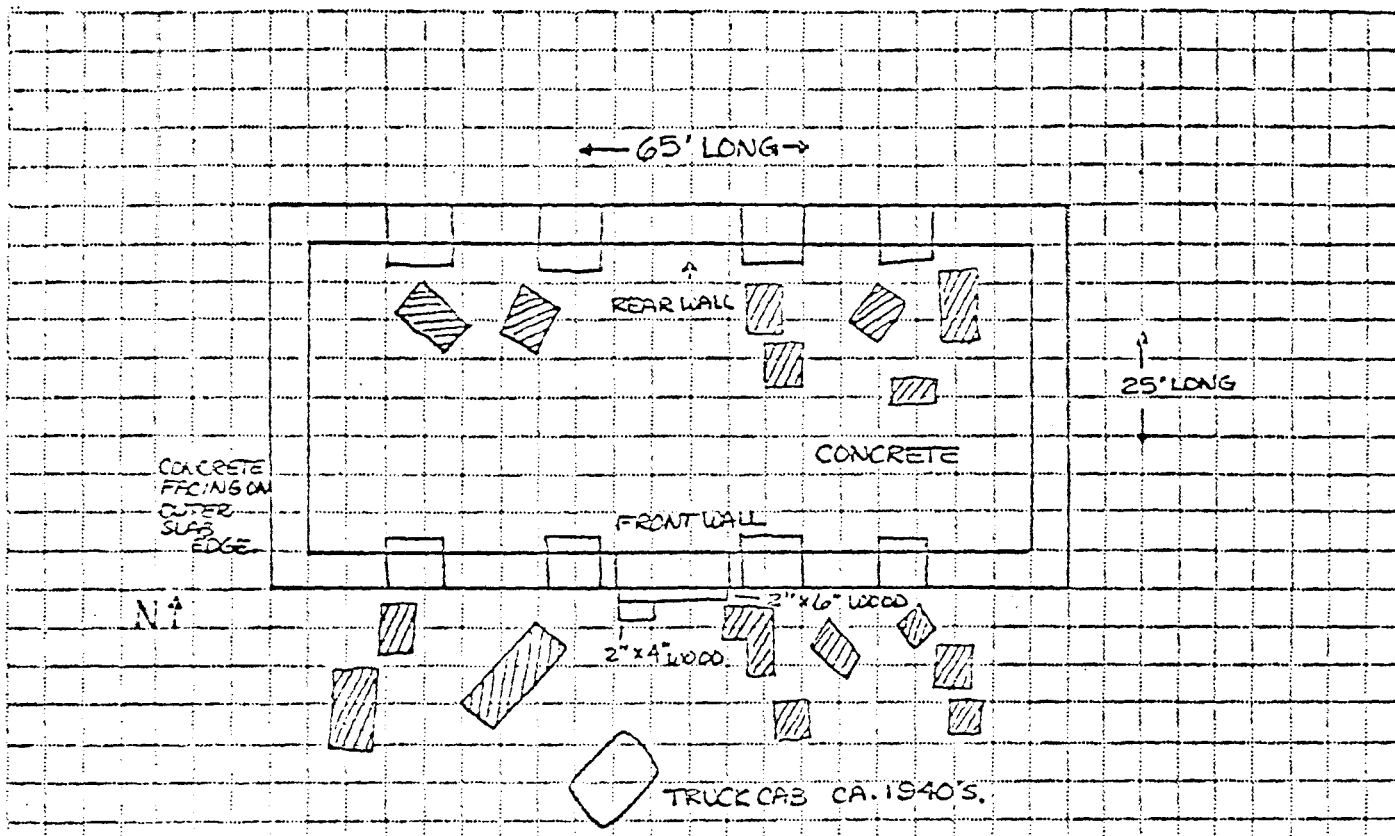
LARGER RECTANGLE: 25'x8'
SMALLER RECTANGLE: 10'x12'
SHAFT: 1'x1'
RAMP: 8'x6'
RAMP HEIGHT AT APEX: 1'

S

FIELD SHEET YES ☐ NO ☒ RECORDER Debi Truett

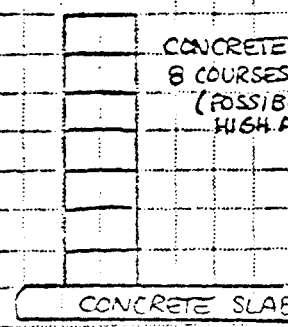
Antiquities Section — Division of State History

Feature No. 6 — SITE 42 Cb 178 — DATE 5-22-80



PLAN VIEW

CEMENT PILLARS (FALLEN)

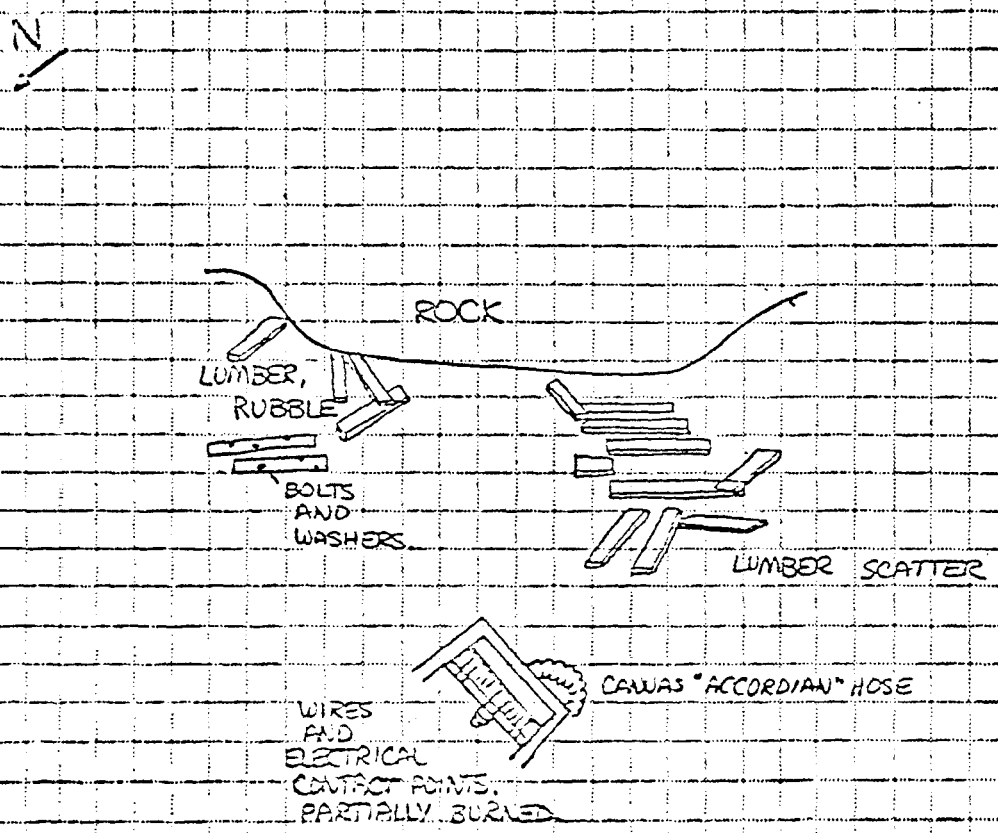


CROSS-SECTION - FRONT WALL PILLAR.

ARTIFACTS: ROUND NAILS, (16 penny and 8 penny), CONCRETE BLOCK FRAGS, WINDOW GLASS FRAGMENTS, RUBBER INNER TUBE, LUMBER FRAGS, FLUE TILE, SHEET METAL, GAS CAN, ELECTRIC (or GAS) STOVE, ELECTRICAL CABLE?, LIGHT BULB SOCKETS.

Antiquities Section | Division of State History

Feature No. 7 SITE 42 CD 178 DATE 5/22/80



DEBRIS OF STRUCTURE FUNCTION UNKNOWN

TOTAL SHEET YES ☐ NO ☐ RECORDER

Archeological Survey

Site No. 42Cb179 County Carbon State Utah

Site name

1. Map reference U.S.G.S. Deadman's Canyon 7.5 Min. Quad.

2. Location 60 feet above and 250 feet east of Creek in Straight Canyon

NE¼ NW¼ Sec. 17 T. 13S R. 11E

3. UTM Grid: Zone Easting Northing

4. Type of site Prospect (coal mining)

5. Cultural affiliation (list basis of designation) Historic

6. Owner and address

7. Informants

8. Previous designations and published reference for site
U.S.G.S. Quad and central Utah Coal Fields

9. Site description and condition on 20 degree slope north of creek on north flank of Straight Canyon. A zig-zag road leads up slope from main canyon road to cut and possible adit.

10. Cultural features, area of occupation, depth and character of fill
Prospect cut (possible adit), pile of notched, mortised, and augered logs. One log is squarred by adze and is mortised, ends are sawed; small tailings pile with small coal debris content.

11. Environmental setting (vegetation, water, topography, etc.)
grasses, pines, scrub oak, sage

12. Elevation 7125 feet.

13. Material collected and deposition None

14. Material observed Sawn and adzed logs.

15. Material reported and owner/address Not available

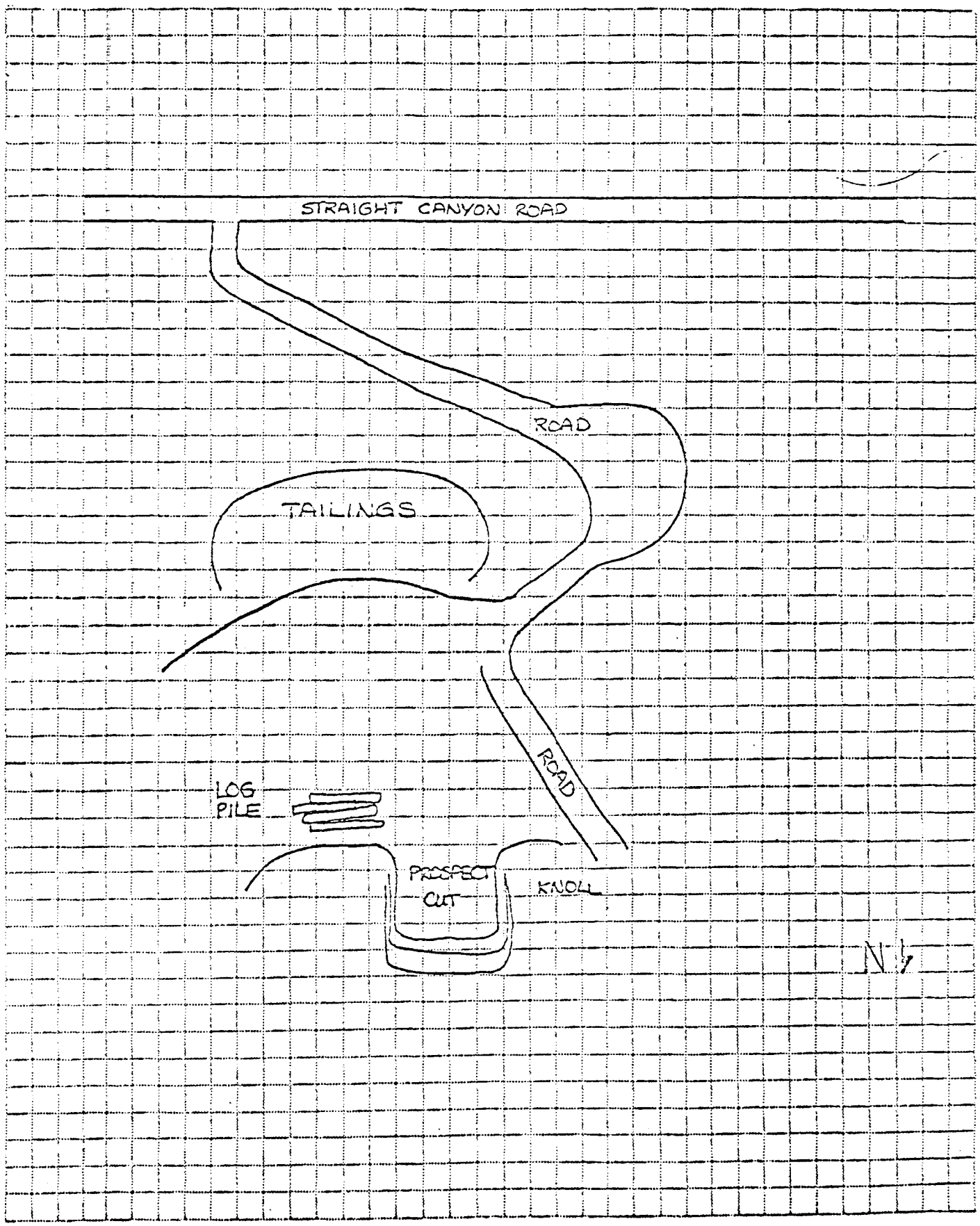
16. Recommendations for further work None

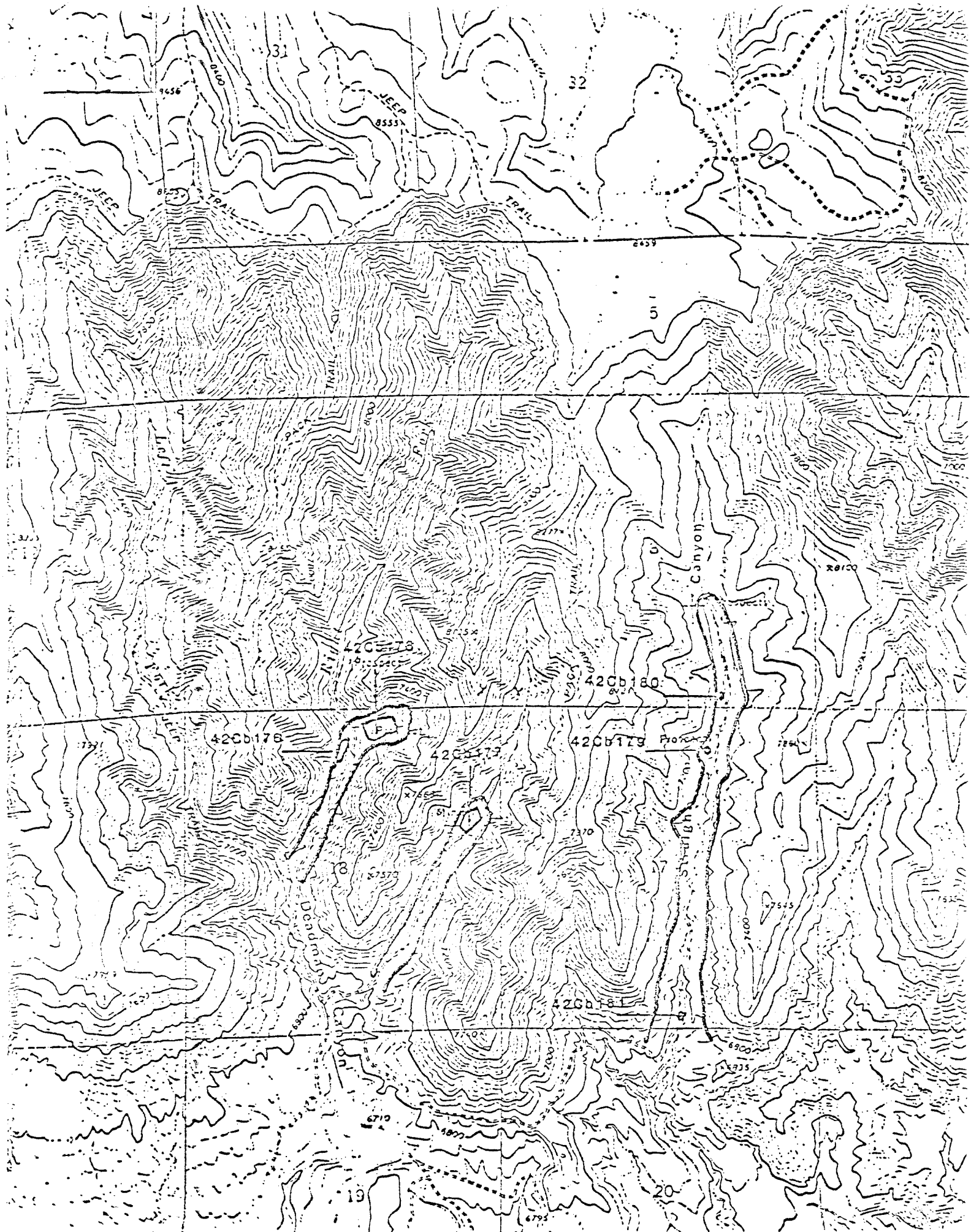
17. National Register potential None

18. Photo Nos. 2-13,14

Antiquities Section *Division of State History*

Feature No. _____ SITE 42 CO 179 DATE 5/23/80




31
32
33
5
8
19
20
JEEP TRAIL
PACK TRAIL
42Cb178
42Cb180
42Cb179
42Cb181
Canyon
Dead
9656
8555
8639
7310
7579
7545
6935
6710
6795

Antiquity Section

Archeological Survey

Site No. 42Cb180 County Carbon State Utah

Site name

1. Map reference U.S.G.S. Deadman's Canyon 7.5 Min. Quad.

2. Location 60 feet west of Straight Canyon road.

SE¼, SW¼ Sec. 8 T.13S R.11E

3. UTM Grid: Zone Easting Northing

4. Type of site Historic Cabin and Coal Prospect Cut

5. Cultural affiliation (list basis of designation)

6. Owner and address

7. Informants

8. Previous designations and published reference for site

9. Site description and condition

10. Cultural features, area of occupation, depth and character of fill
Cabin 10 feet x 10 feet, presently standing 6 feet high rests on corner foundation stones saddle notched (using saw and axe); log insides are hewn flat while outsides are still rounded cut consists of a cut 10 feet high paralelling the north canyon flank. The roof is/was apparently flat and 25 feet high.

11. Environmental setting (vegetation, water, topography, etc.)
pines, grasses, sage, scruboak; water source 80 feet south of cabin.

12. Elevation 7080 - 7160 feet.

13. Material collected and deposition None

14. Material observed Cans of unknown date

15. Material reported and owner/address

16. Recommendations for further work

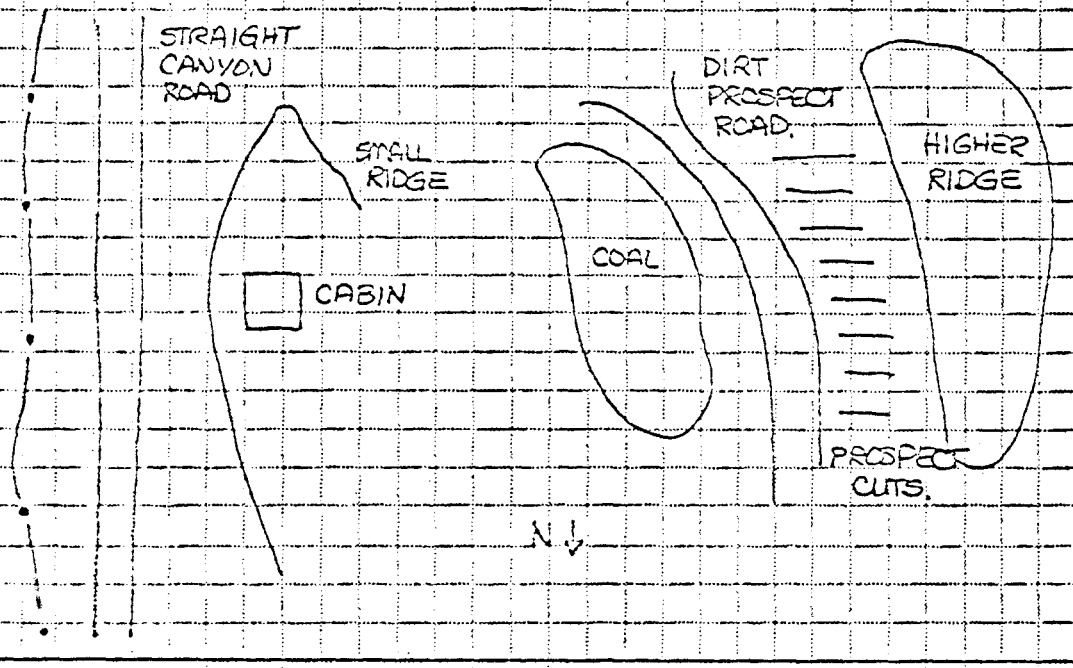
17. National Register potential

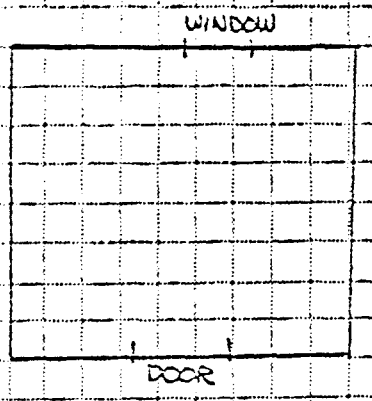
18. Photo Nos.

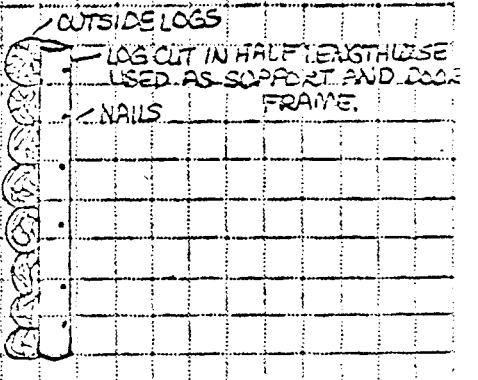
19. Type of map made by survey party Sketch and elevation and plan

Antiquities Section *Division of State History*

Feature No. _____ SITE 42 Cb 180 DATE 5/23/80





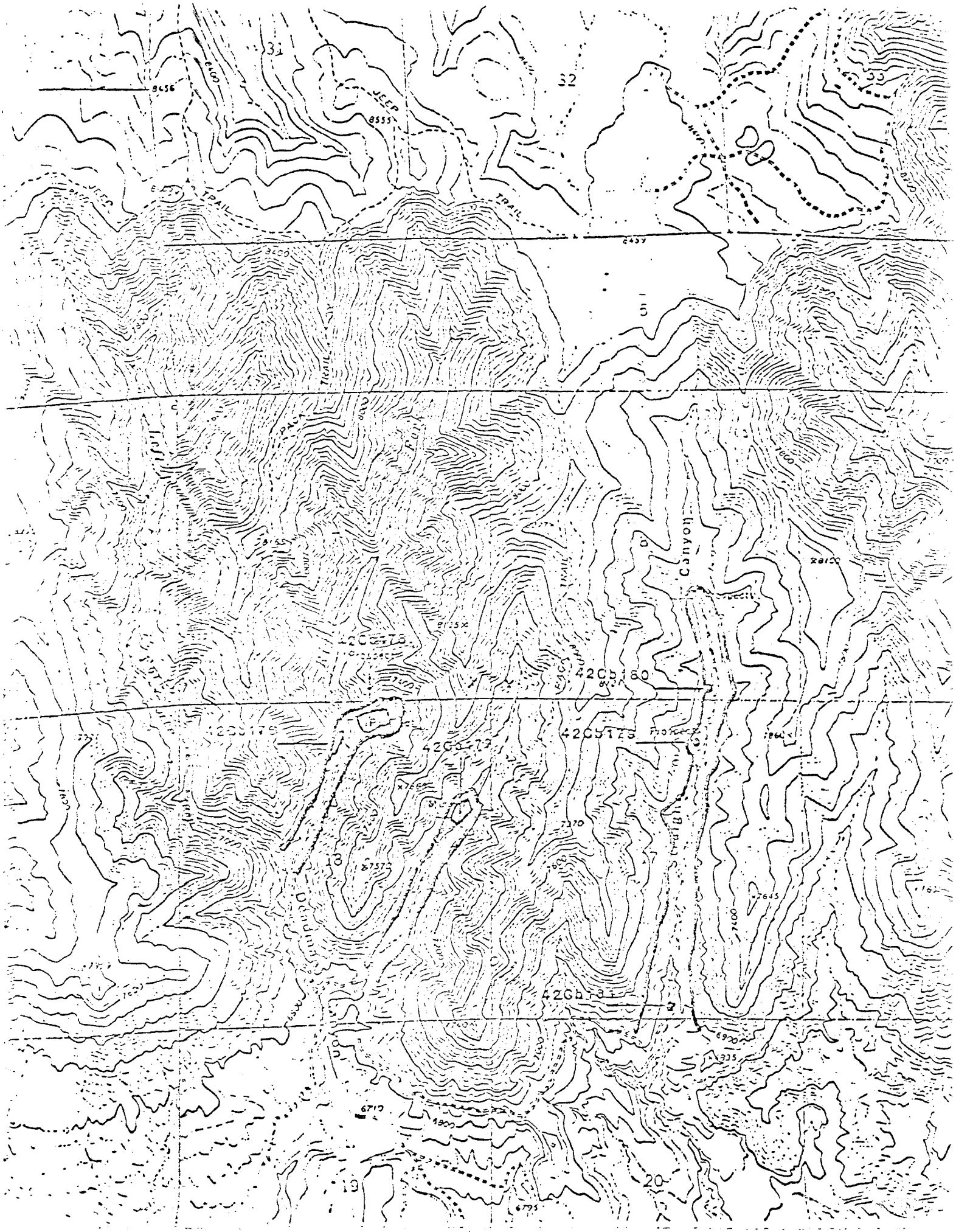


CROSS-SECTION OF CABIN WALL AT DOORWAY.

STRUCTURE MAY HAVE BEEN FLAT-ROOFED WITH LOGS.

ARTIFACTS: A RUSTED MATTRESS SPRING&BARD HAD BEEN DISCARDED INSIDE.

FINAL SHEET YES ☐ NO ☐ RECORDER _____


31
32
33
JEEP
TRAIL
8555
8656
6459
5
PACK
TRAIL
Fork
Canyon
42Cb178
42Cb180
42Cb179
42Cb173
42Cb181
18
19
20
7370
7645
6920
6710
6795

Archeological Survey

Site No. 42Cb181 County Carbon State Utah

Site name

1. Map reference U.S.G.S. Deadman's Canyon 7.5 Min. Quad.

2. Location 1/16 mile north of section line in Straight Canyon 5-10 feet from (west) existing road on boulder face.

Sec. 17 T. R.

3. UTM Grid: Zone Easting Northing

4. Type of site Historic Petroglyph/Inscription

5. Cultural affiliation (list basis of designation)

6. Owner and address

7. Informants None

8. Previous designations and published reference for site Not available

9. Site description and condition Condition good (see photo)
Inscription is pecked into sandstone face of boulder and reads "J.A. Peterson, May 11, 1901".

10. Cultural features, area of occupation, depth and character of fill

11. Environmental setting (vegetation, water, topography, etc.)

12. Elevation

13. Material collected and deposition None

14. Material observed None

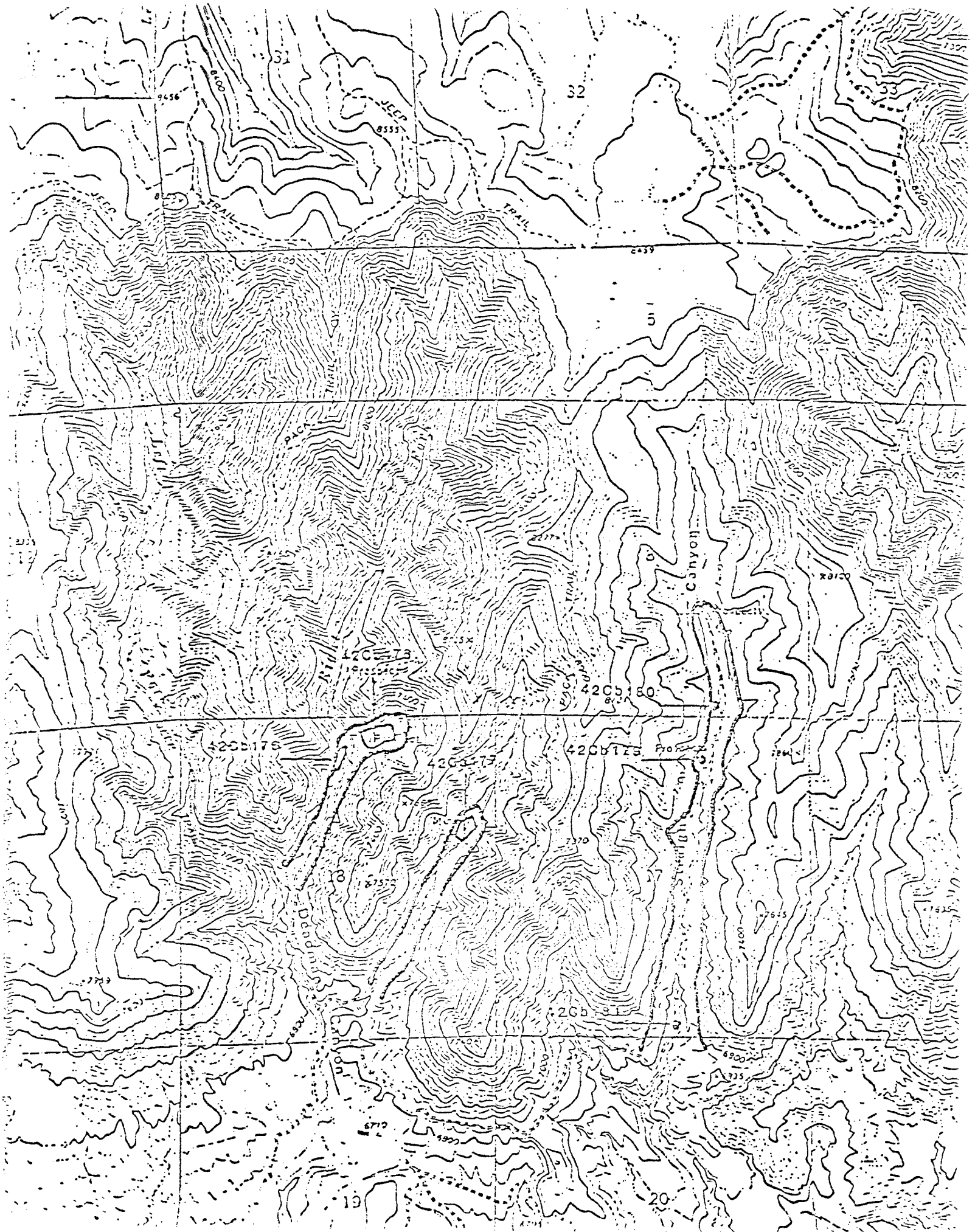
15. Material reported and owner/address None

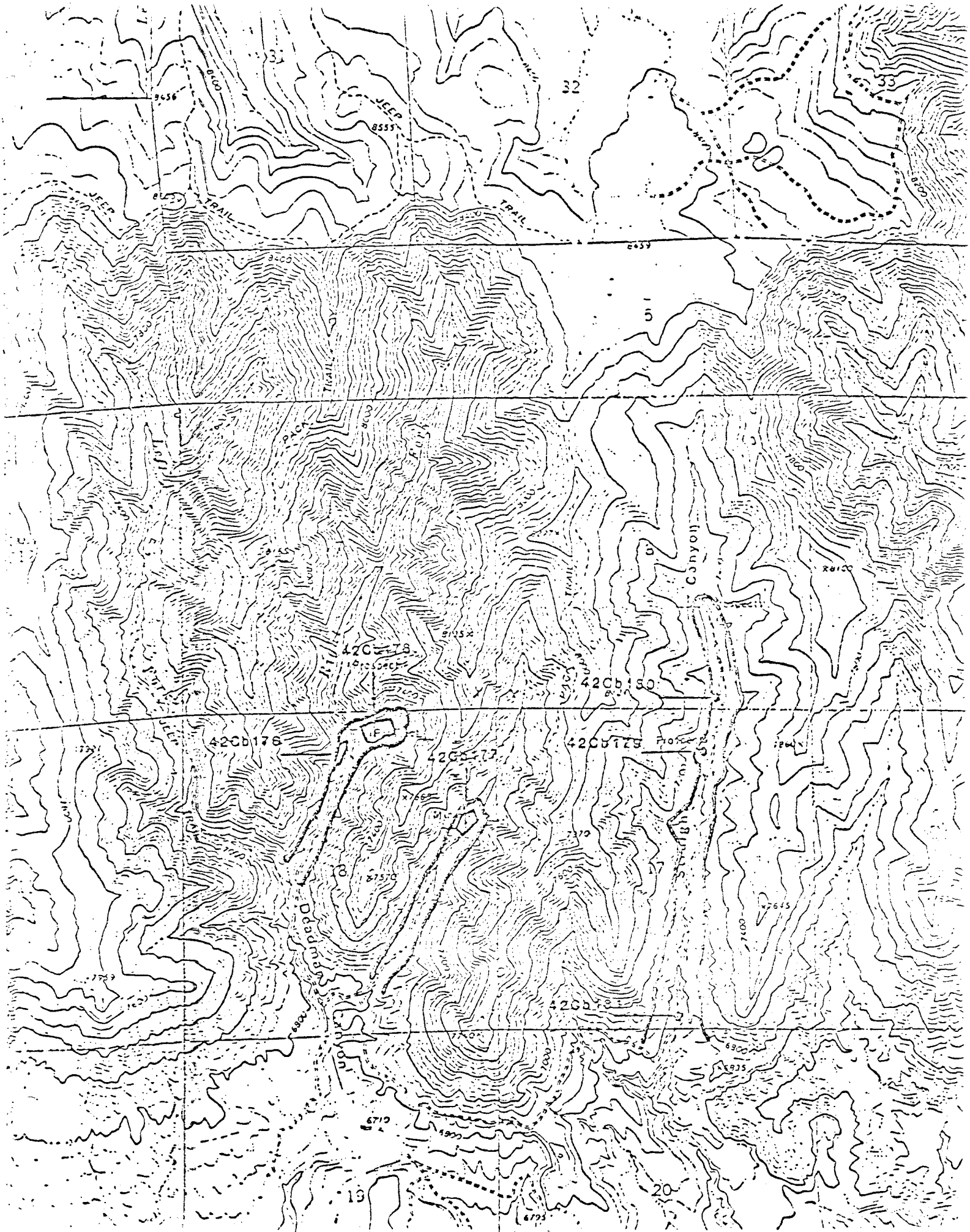
16. Recommendations for further work 1. Avoid. 2. If avoidance not possible, remove to Price Museum

17. National Register potential Possibly

18. Photo Nos.

19. Type of map made by survey party None


31
32
33
JEEP
TRAIL
5
PACK
TRAIL
Canyon
42Cb 160
42Cb 175
42Cb 173
42Cb 31
18
17
19
20
9456
8555
8100
6900
6710


32
33
31
5
JEEP
TRAIL
PACK
TRAIL
Canyon
42Cb178
Prospect
42Cb180
42Cb176
42Cb177
42Cb179
Prospect
Deadman
Wash
19
20

Site No. 42Cb177 County Carbon State Utah

Site name Blue Flame/Sutton Mines

1. Map reference U.S.G.S. Deadman's Canyon 7.5 Min. Quad.

2. Location Approximately 2/3 distance up Starlight Canyon of present road end (approximately) 1 1/2 miles from canyon intersection with Deadman's Canyon.

NE of SE of NE¼ Sec. 18 T.13S R.11E

3. UTM Grid: Zone 12 Easting 523940 Northing 4394370

4. Type of site Coal mines and associated service structures, active 1945-1954

5. Cultural affiliation (list basis of designation)

6. Owner and address

7. Informants

8. Previous designations and published reference for site Central Utah Coal Fields p. 390-91, 394

9. Site description and condition Coal storage and loading bin, 3 coal prospect/adit areas, 2 service structures, coal storage and loading area, outhouse, roads

10. Cultural features, area of occupation, depth and character of fill

(See attached continuation sheet)

11. Environmental setting (vegetation, water, topography, etc.)

Situated on either side of Starlight Canyon Creek into which excess coal from loading operations has been dumped. Vegetation includes: grasses, sage, ponderosa pine, scrub oak, juniper, ephedra, yucca, and prickly pear cactus.

12. Elevation 7150-7250 feet

13. Material collected and deposition None

14. Material observed (see attached)

15. Material reported and owner/address None

16. Recommendations for further work

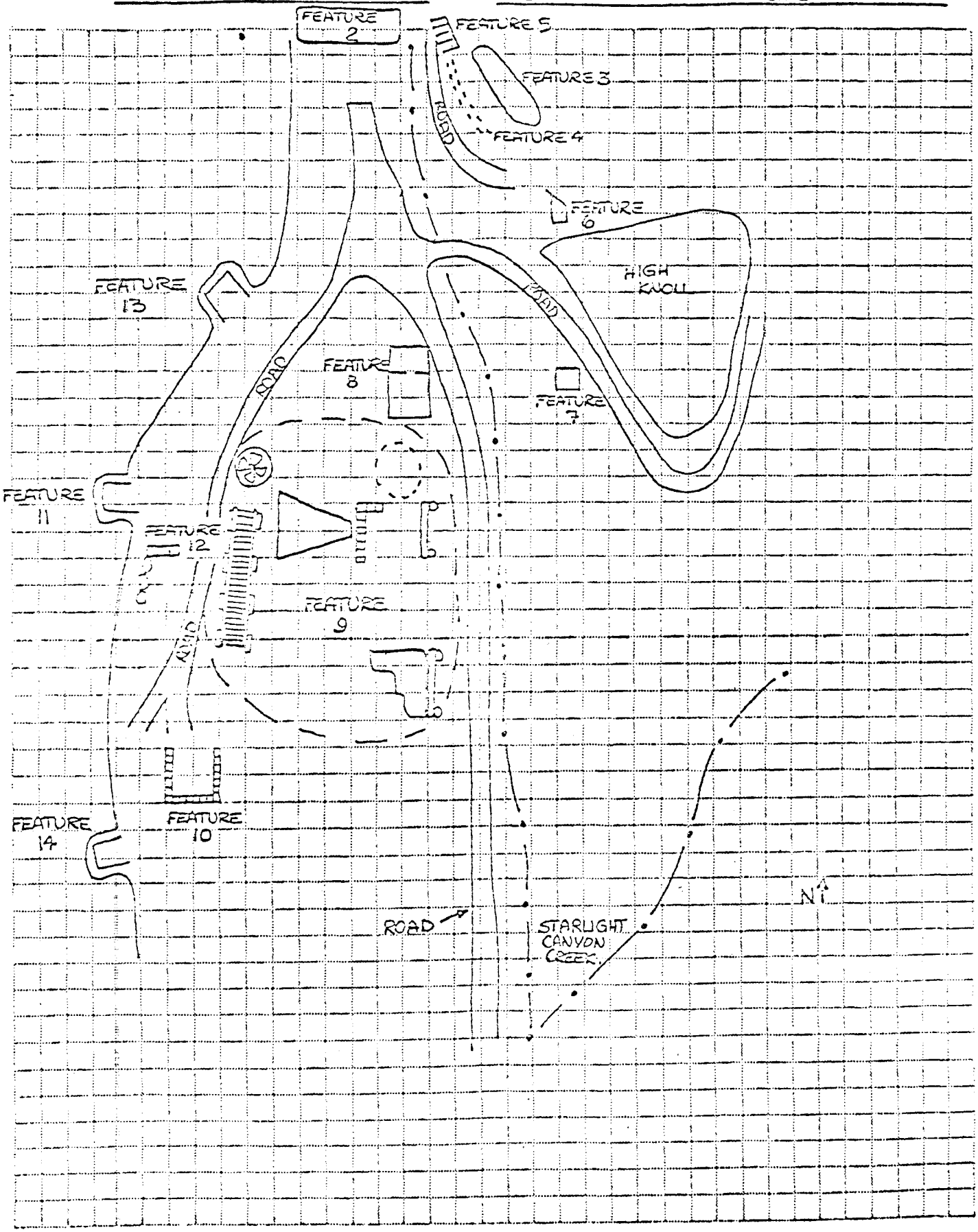
17. National Register potential

18. Photo Nos.

19. Type of map made by survey party Sketch

Antiquities Section *Division of State History*

Feature No. SKETCH PLAN MAP SITE 42 Cb 177 DATE 5/21/80



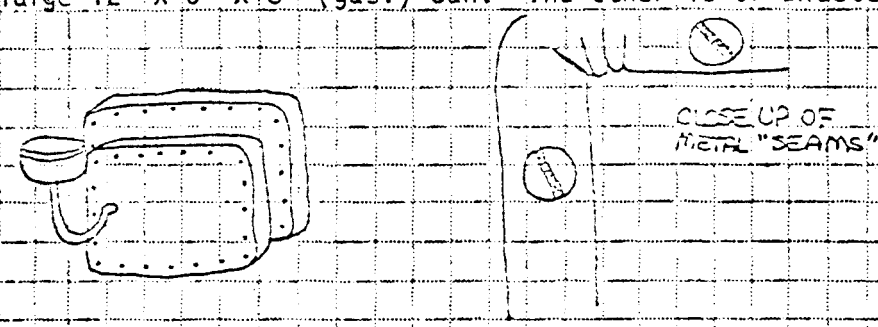
FOR SUBMITTED YES ☐ NO ☐ RECORDER

Antiquities Section Sutton, Blue Flame Mine, Starlight Canyon *Division of State History*

Feature No. F-2, F-3, F-4, F-5 SITE 42Cb177 DATE 5-21-80

F-2,3,4,and 5 lie north of road fork where existing structures stand.

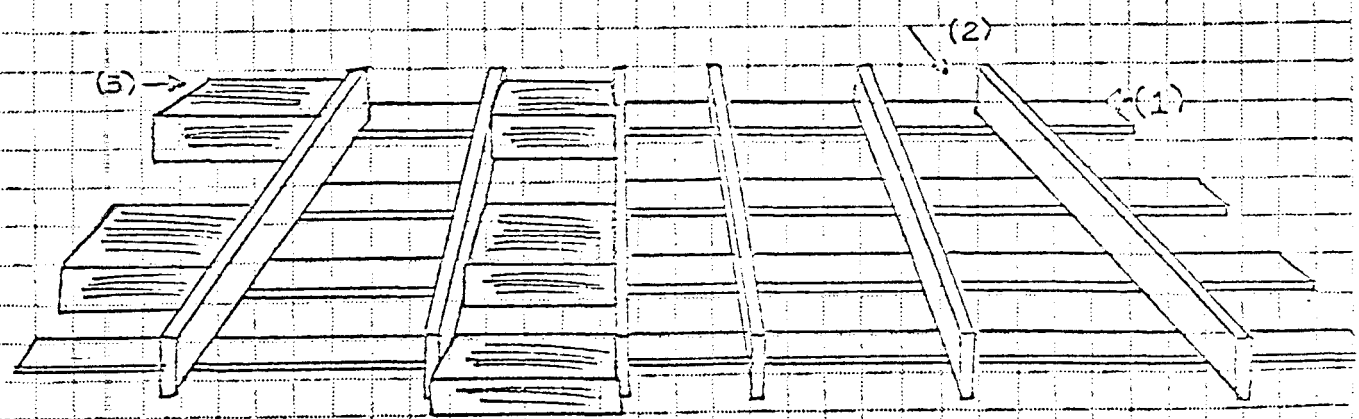
F-2 piles of coal are on the east side are a few very rustic metal artifacts. One a large 12" x 6" x 8" (gas?) can. The other is of undetermined use and looks thus:



F-3 piles of coal north and east of a possible old road (F-4). Although the piles are fairly high (2-3 feet) they appear to lie on leveled ground. As this is on the slope of a large hill, it was possibly leveled intentionally perhaps as a building/habitation site. It is approximately 12-14 feet wide (east/west) AND 15 yards long (north/south) along F-4. Below it and the possible road the regular line of the slope resumes and drops to the natural wash 10 feet below.

F-4 is a leveled and cleared "path" running approximately north-south along the bottom of a large slope. It is approximately 5 feet in width and continues for about 18 yards. Above (east and up toward the high point of the hill) is F-3 on a slightly higher level area. Below F-4 the natural line of the slope resumes and drops 8 feet into the wash area.

F-5 is a foundation (?) wood plank frame.(1) It is composed of planks set into the earth slightly. They are 5-6 inches wide and only 1 inch thick. Set sideways above these planks (spaced about 3 inches apart) are "beams, cut by machine approximately 2" thick and 4" wide.(2) These sit perpendicular to the inland thinner planks. In some places there is evidence of larger 4 x 4" thick beams perpendicular to the 2 x 4's and parallel to the inlaid planks(3) These are all connected with "modern" (not handmade) 2" nails. Some pieces of the same configuration--that is the thick 4 x 4 beam connected perpendicular to the 2 x 4 beam are not inset and appear to have simply fallen on top.



FINAL SHEET YES ☐ NO ☒ RECORDER [illegible]

CONTINUATION FORM

PAGE

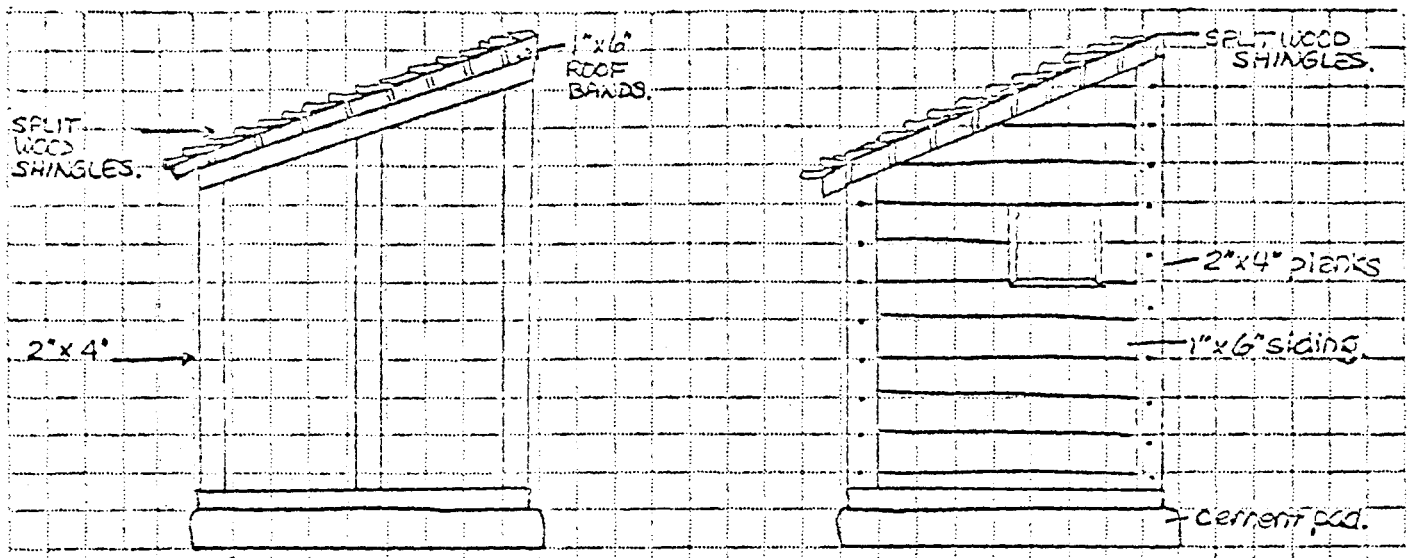
Antiquities Section

Division of State History

Feature No. 6

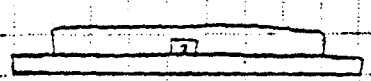
SITE 42 CB 177

DATE 5/21/80

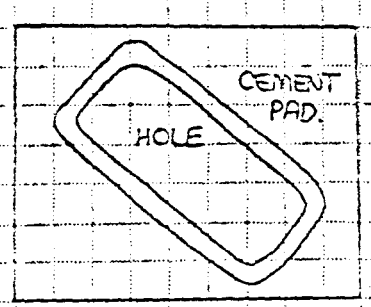


PRE-CAST CONCRETE PAD.

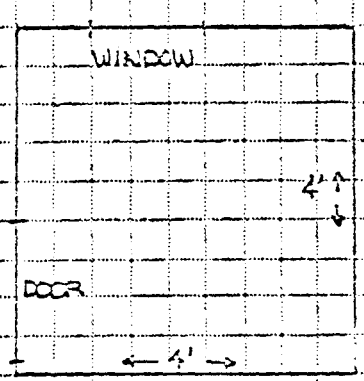
VIEW WITH SIDING



ELEVATION: CONCRETE PAD.



PLAN VIEW: CONCRETE PAD.



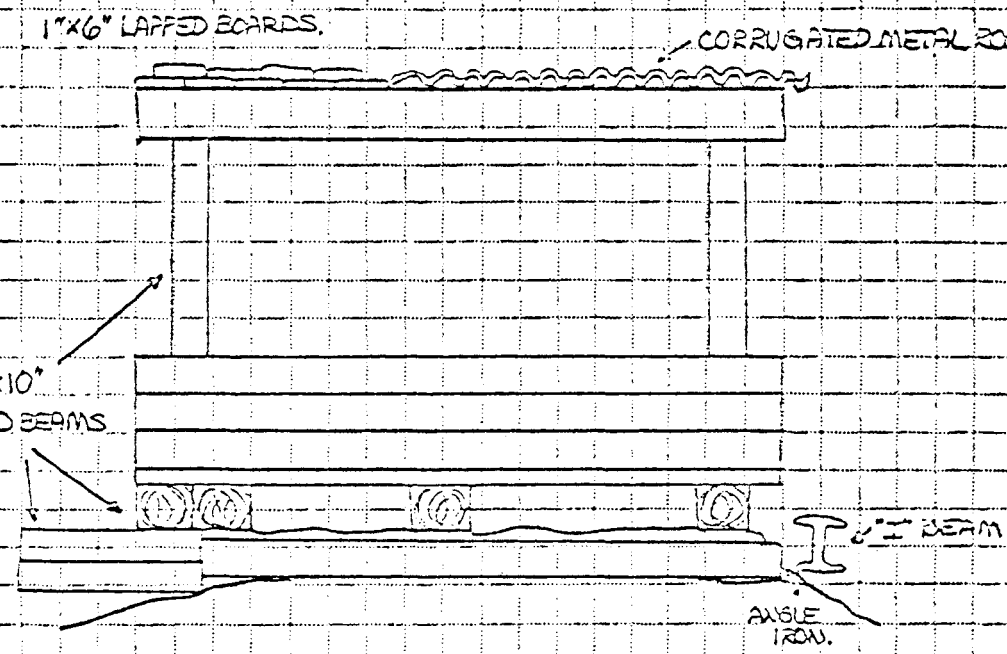
PLAN VIEW.

INTERPRETATION: OUTHOUSE/PRIVY

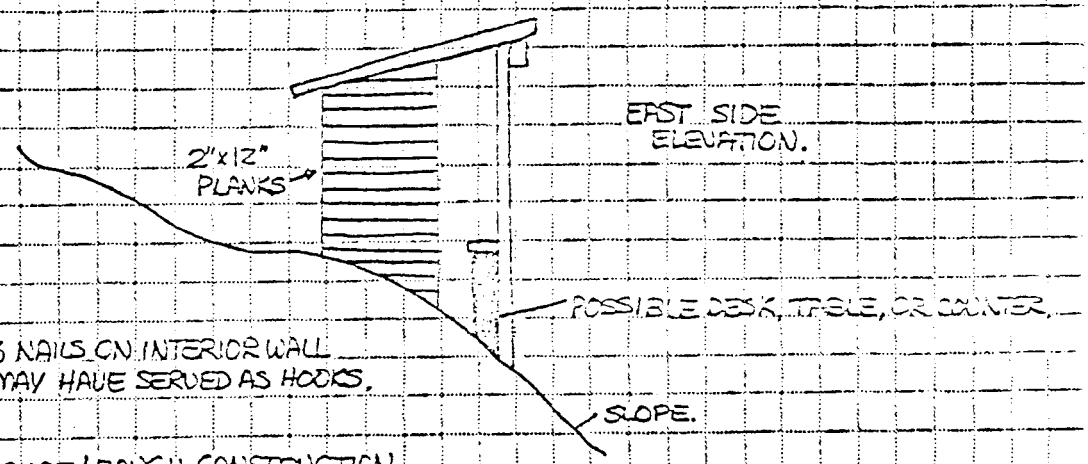
RECORDER

Antiquities Section Division of State History

Feature No. 7 SITE 42 CO 177 DATE 5/21/80



12' x 10' x 6' HIGH.
FRONT VIEW LOOKING SOUTH.



3 NAILS ON INTERIOR WALL MAY HAVE SERVED AS HOOKS.

CRUDE/ROUGH CONSTRUCTION.

FUNCTION: UNKNOWN
PERIOD OF USE: UNKNOWN.

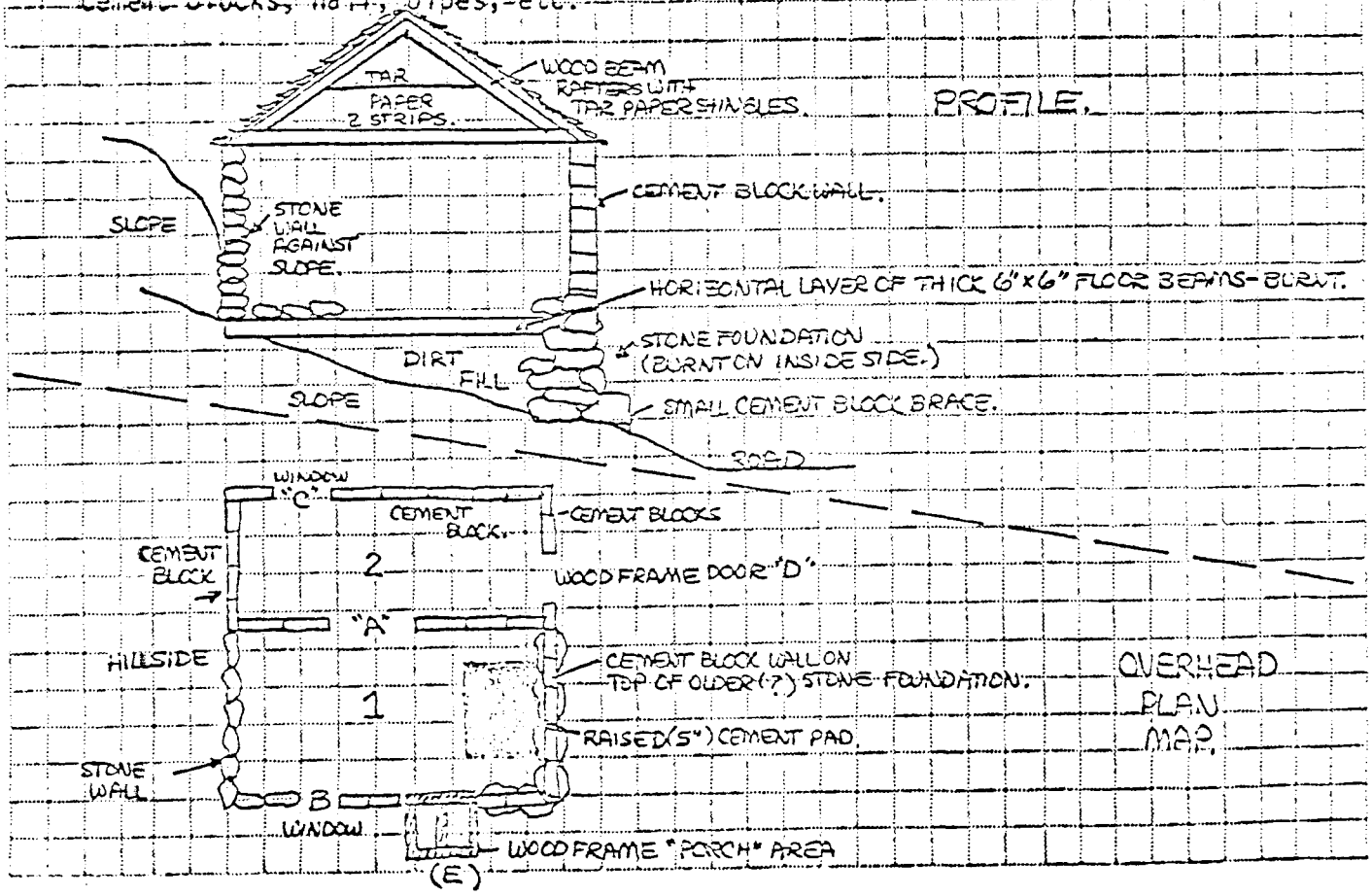
CONTINUATION FORM

PAGE

Antiquities Section Starlight Canyon-Sutton Blue Flame Mine *Division of State History*

Feature No. F-8 SITE 42Cb177 DATE 5/21/80

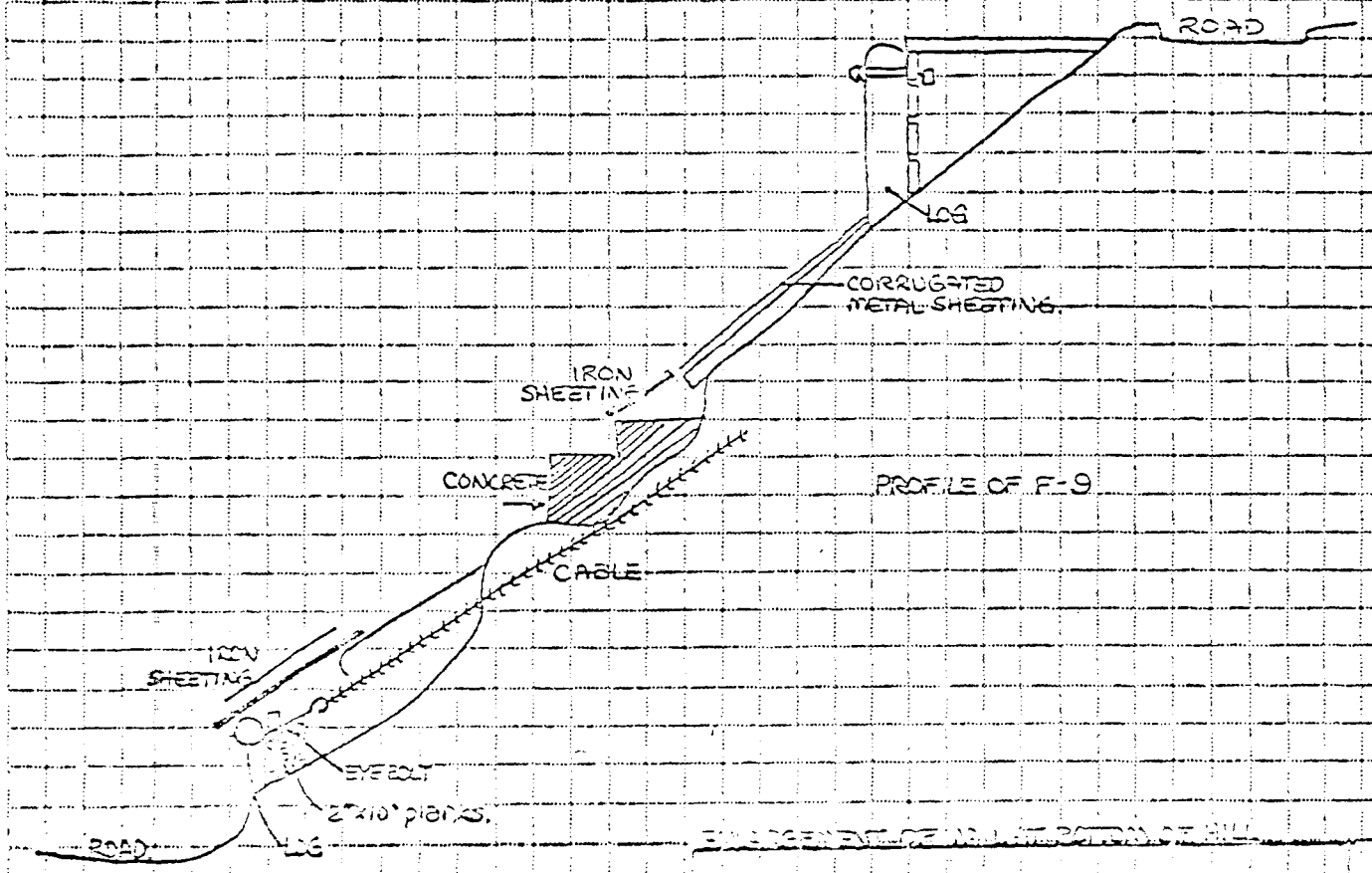
F-8 was apparently built in 2 phases. Phase one consists of a stone foundation and stone walls to a large room (10 x 10 feet) now on the south side of the final building. The stone foundation is cemented roughly together and also serves as a brace on the east, down slope side near the road. Following the stone construction north, it turns back into the hill (west) at a present height of only 2 stones. The rest of the north wall is now cemented back as is the east wall. There is a large doorway framed by wood (A in overview). The back (west) wall against the slope itself is still completely made of stone and chinked with small rocks and cement. It stands 9 feet high and meets the better wood frame roof. The south wall is half stone to about the middle where there is a window (B in overview), but is full height up to there. From the window (B) to the east wall, the wall is now cement block standing on a base of the once stone wall. Room one is constructed then in two phases. The window was built in with the stone phase. All the stones are burnt on some parts of the wall but there is no sign of this same blackening on the cement blocks. room 2, smaller, to the north side of F-8 is constructed entirely of cement block and cement with a wood framed (C) window and wide east side entryway (D) (about 6 x 6 feet). It does not rest on a stone foundation or have any of the older stone about. It was apparently constructed in building phase 2, when the cement blocks replaced/repaired the stone building that had been there earlier. This room has no remaining roof structure at all and none has fallen in. On the east inner wall of room 2 an effort has been made to "plaster" and smooth the cement blocks by applying a thin layer of cement. South of room one lies a small "porch"-type area, built of 2 cement block walls with a miniature wood frame roof over the top of it (E). The "floors" of both rooms are under a thick dirty layer of blackened coal, burnt wood, rusted metal, broken cement blocks, nail, pipes, etc.

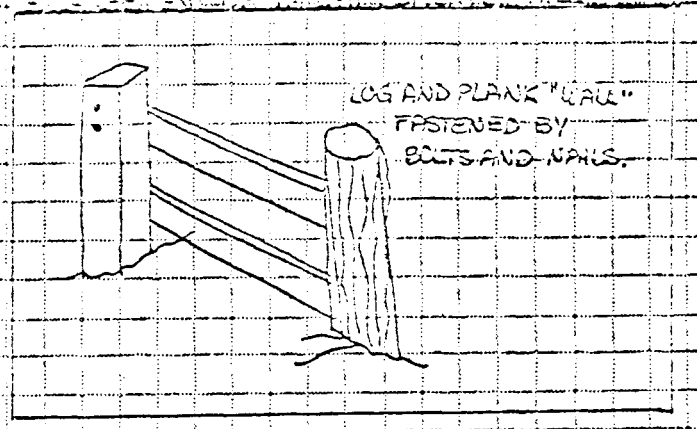


RECORDER Debi Trail

Antiquities Section *Division of State History*

Feature No. 9 SITE 42 CB 177 DATE 5/21/80





ASSOCIATED ARTIFACTS:
MACHINE RUBBERIZED BOLTS, GLASS, MISCELLANEOUS METAL PARTS, COAL, RUBBER VEHICLE TIRE PARTS.

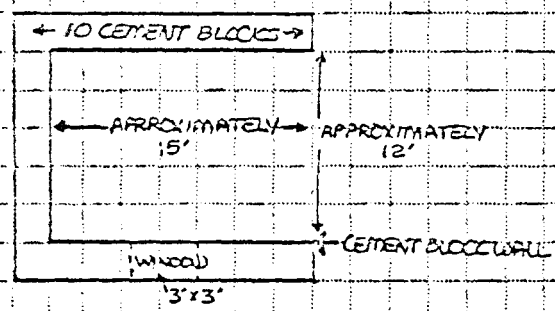
INTERPRETATION: COAL STORAGE BIN AND TIPPLE CIRCA pre-1920
≈50'x80'

RECORDER

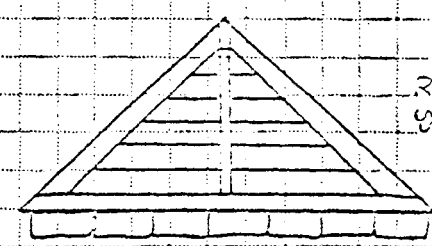
Feature No. F-10 SITE 42Cb177 DATE 5-21-80

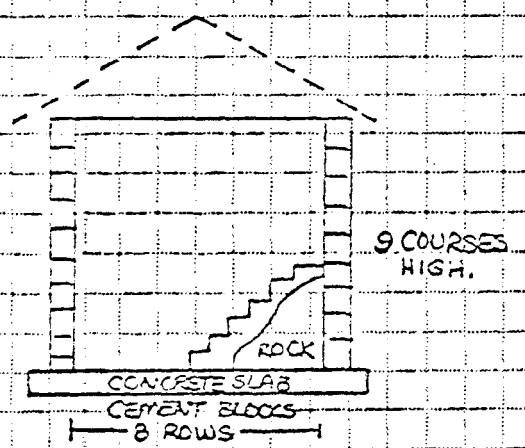
3/4 inches steel cables (1) appear to run under structure.

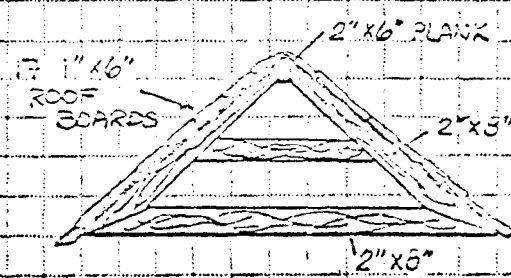
INTERPRETATION: 1920-30's structure skidded to location and jacked up under dry laid rock foundation, probably used as a shop. Structure probably skidded to area formerly occupied by Feature Remnants of which are piled on the hill below.



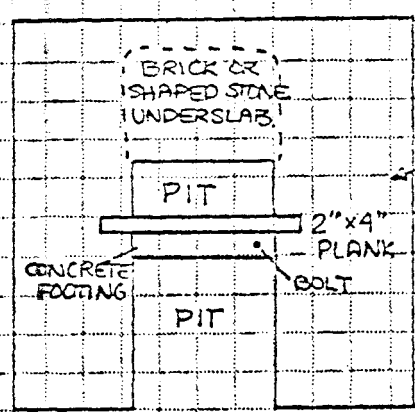
PLAN VIEW







TRUSS CONSTRUCTION.



INTERIOR PLAN.

SURFACE INTERIOR ARTIFACTS: GASKETS, BOLTS, BROWN AND GREEN BOTTLE GLASS, (AUTOMATIC BOTTLE MACHINE), POST-1915 CANS, SHEET METAL FOR STOVE PIPE OPENING, RUBBER HOSE.

FINAL SHEET YES ☐ NO ☒ RECORDER Bruce Hawkins

Feature No. 11, 12, 13, 14 SITE 42Cb177 DATE 5-23-80

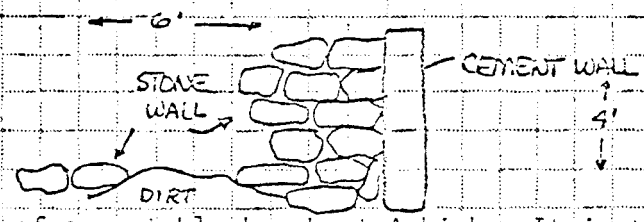
F-11 Cut and Depression

Measures 10 feet wide x 25 feet long x 20 feet high. Made into coal vein. If adit, entrance probably sealed by rubble slide. One narrow guage rail in association.

Interpretation/ Prospect/ possible mine adit.

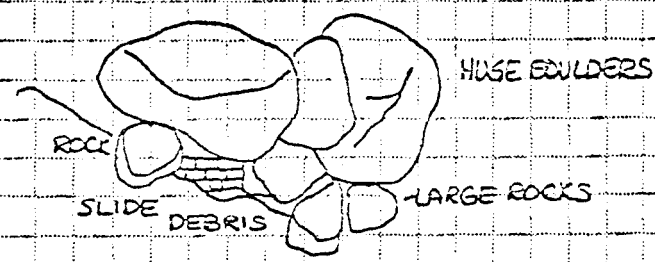
F-12 Concrete rock cemented together appears to have been added to the stone wall (which is made of cut stone). Indentation and curvature appear to match ventilatin fan to the southeast.

Feature 12 may be a structure foundation associated with Feature 9.



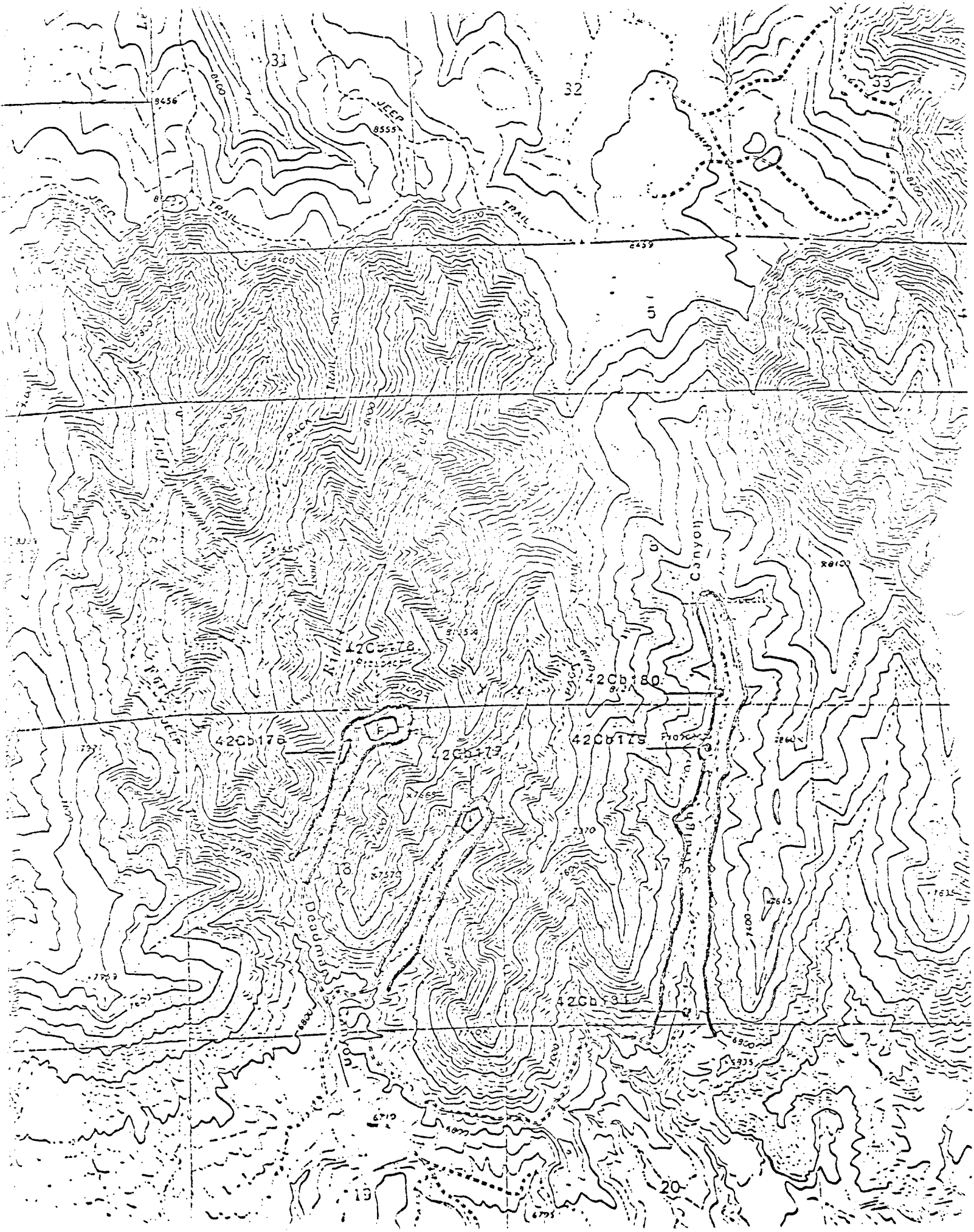
F-13 is a cement wall of cement blocks about 4 high. It is the corner of some kind of structure, the major exposed part running north/south and disappearing into the slope to the west under caved-in debris. It appears to have been an underground shaft or casement. The cut is 20 feet high, 20 feet long into a coal vein. Cable, standard and narrow guage rail, concrete, concrete blocks, stone rubble, iron sheeting, and sawn logs are concentrated into a rubble pile at the mouth of the cut.

Interpretation: possible mine adit - completely covered over by rubble slide debri



F-14 is a prospect or possible adit totally covered over by rock rubble.

FINAL SHEET YES [X] NO [ ] RECORDER Bruce Hawkins


31
32
33
JEEP
TRAIL
PACK
TRAIL
42Cb178
42Cb180
42Cb176
42Cb179
42Cb175
42Cb181
Canyon
Deadman
18
19
20
5
8100
8555
8456
8459
7570
7370
7200
6900
6710
6795
6935
7645

Site No. 42Cb176 County Carbon State Utah

Site name Zion Mine

1. Map reference U.S.G.S. Deadman's Canyon 7.5 Min. Quad.

2. Location On the east flank of Right Fork of Deadman's Canyon across from outlet of Fiasco Canyon

SE of SW¼ Sec. 18 T. 13S R. 11E

3. UTM Grid: Zone 12 Easting 523100 Northing 4395000

4. Type of site Historic coal mine and service facilities. Prospected 1906, active 1925-1948

5. Cultural affiliation (list basis of designation)

6. Owner and address

7. Informants

8. Previous designations and published reference for site Central Utah Coal Fields p. 394

9. Site description and condition Structure, outhouse and retaining wall condition; standing remains

10. Cultural features, area of occupation, depth and character of fill
(See attached continuation sheet)

11. Environmental setting (vegetation, water, topography, etc.)

12. Elevation 7030 feet.

13. Material collected and deposition Medicine bottle (green)

14. Material observed 2 large (14") buckets, 1 piece green glass, window glass, knife fragment, leather glove

15. Material reported and owner/address None

16. Recommendations for further work

17. National Register potential

18. Photo Nos.

19. Type of map made by survey party Sketch

[illegible] Powell 5-20-80

Antiquities Section *Division of State History*

Feature No. 42Cb176 = Zion Mine SITE Outhouse (F-2) Structure (F-1) DATE 5-20-80

Although the water supplying this canyon was reported to be sizeable only in the spring, then still very minimal. The north/south wash down Deadman is indeed flowing rapidly and rather deep for a seasonal wash.

Structure a few hundred meters south (?) of survey area, but along the access road and Deadman's Wash was investigated. It was built of "shaped" rock and "cemented" with mud mortar containing very few chinking pieces. It was checked to determine if the stone used had been borrowed from a prehistoric ruin. The stone appears to be naturally shaped but is used in construction here much like it was in Anasazi ruins. Its placement is much rougher (cruder) though. Larger rocks protrude to 6 inches out of the walls in places but only on the outside of the structure. This may be merely the result of building into the earth that has since eroded from around the wall in places. The inside surfaces of the walls are very straight and smooth with blackened areas of burning. (The blackening took place within this structure.) In some instances, stones taken from prehistoric ruins are already blackened from prehistoric fires and when used again, the placement of these blackened ones doesn't make sense. (Another evidence of this structure not being built from "Anasazi" rock is the firing then.) Located at the merging of two washes at the right fork of Deadman's Canyon and a very small canyon that stretches NW(?). See #1 on xeroxed map. To the left (south) of the structure is a large "ramada" of juniper logs with some smaller wood intertwined still in place in the "roof". A few very large boulders lie along its border on the outer 3 sides. a 3 seater outhouse built south toward old wash next to huge blown-out boulder.

F-3 of Zion Mine is a stone wall already impacted by stripping machinery. It is west of the Rio Grande site "C" directly across the wash from Rio Grande F-1 and F-2. It is southwest of the quarter section marker and directly on a vein of coal that they are now exposing. This exposure has ripped out part of the wall and/or structure that once stood there. The impact has been rather indirect in that the wall is collapsing because of cuts made immediately below it, undercutting its footing base. It is, of course, mostly sandstone masonry held together with chinking of mud and smaller rocks. It stands at its highest point at 5 feet high. It is impossible to tell whether the wall once extended west into the slope of the hill because of all the debris that has been pushed down on top of it by the machinery working above. The ends of the wall as they now stand seem to show no sign of a "corner" though, and it is possible that this served as a retaining wall. In any case, with all the debris piling up behind it, now during construction, it serves as a retaining wall above the new roadway, albeit a feeble one. The stone construction, like that of F-1 to the south resembles Anasazi architecture to a degree. There are a few cut logs lying around in the debris but it is impossible to tell if they have been pushed down from above.

RECORDER Debi Truell

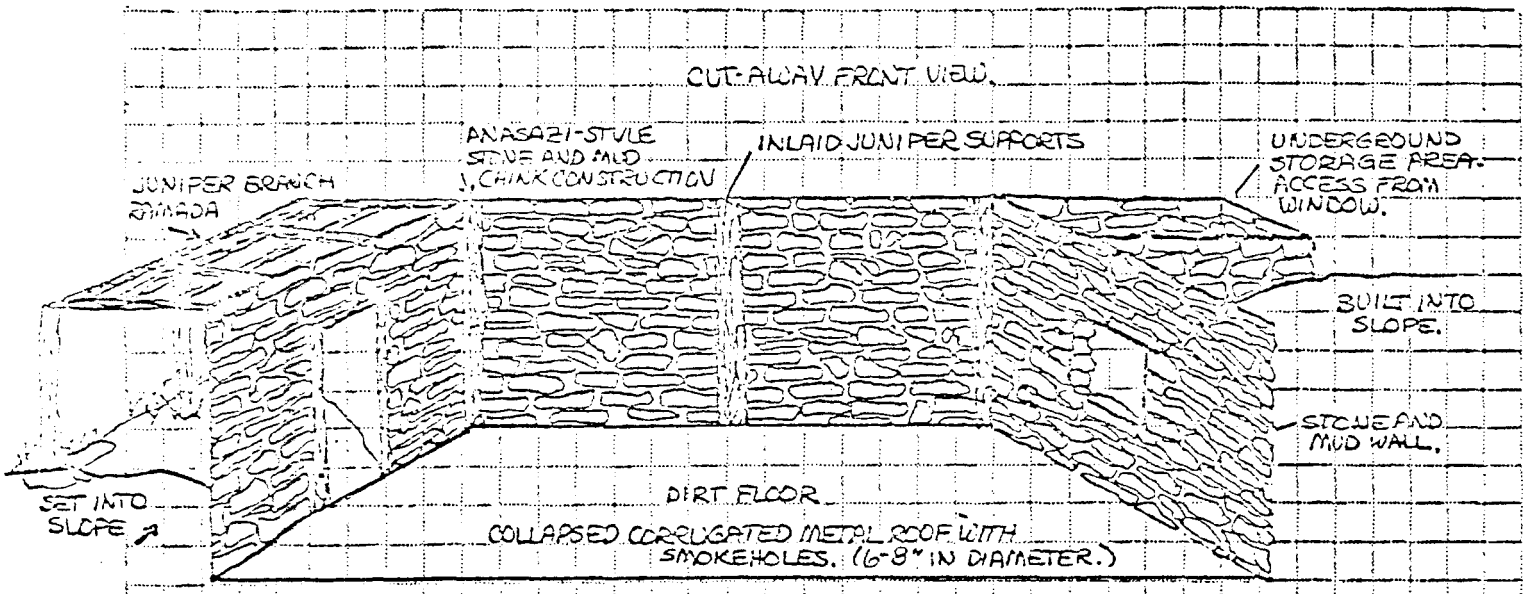
CONTINUATION FORM

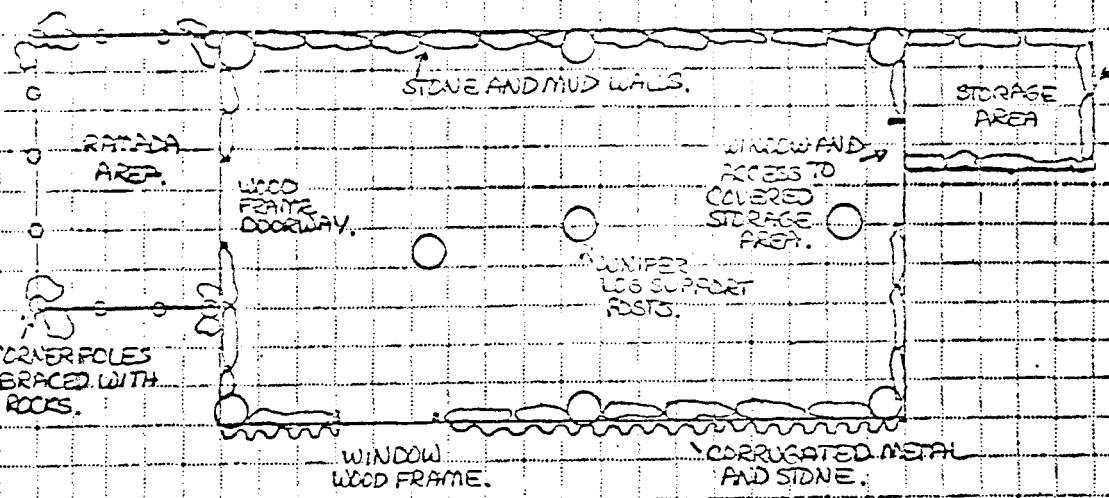
PAGE

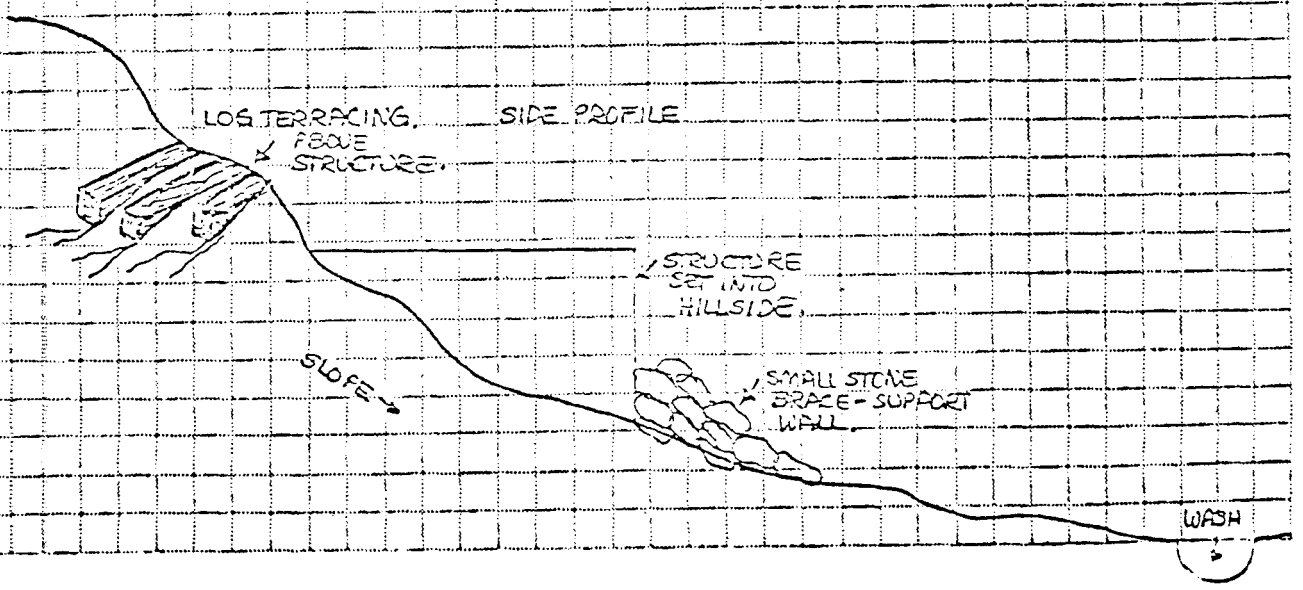
Antiquities Section

Division of State History

Feature No. _____ SITE 42 Cb 176 DATE 5/20/80



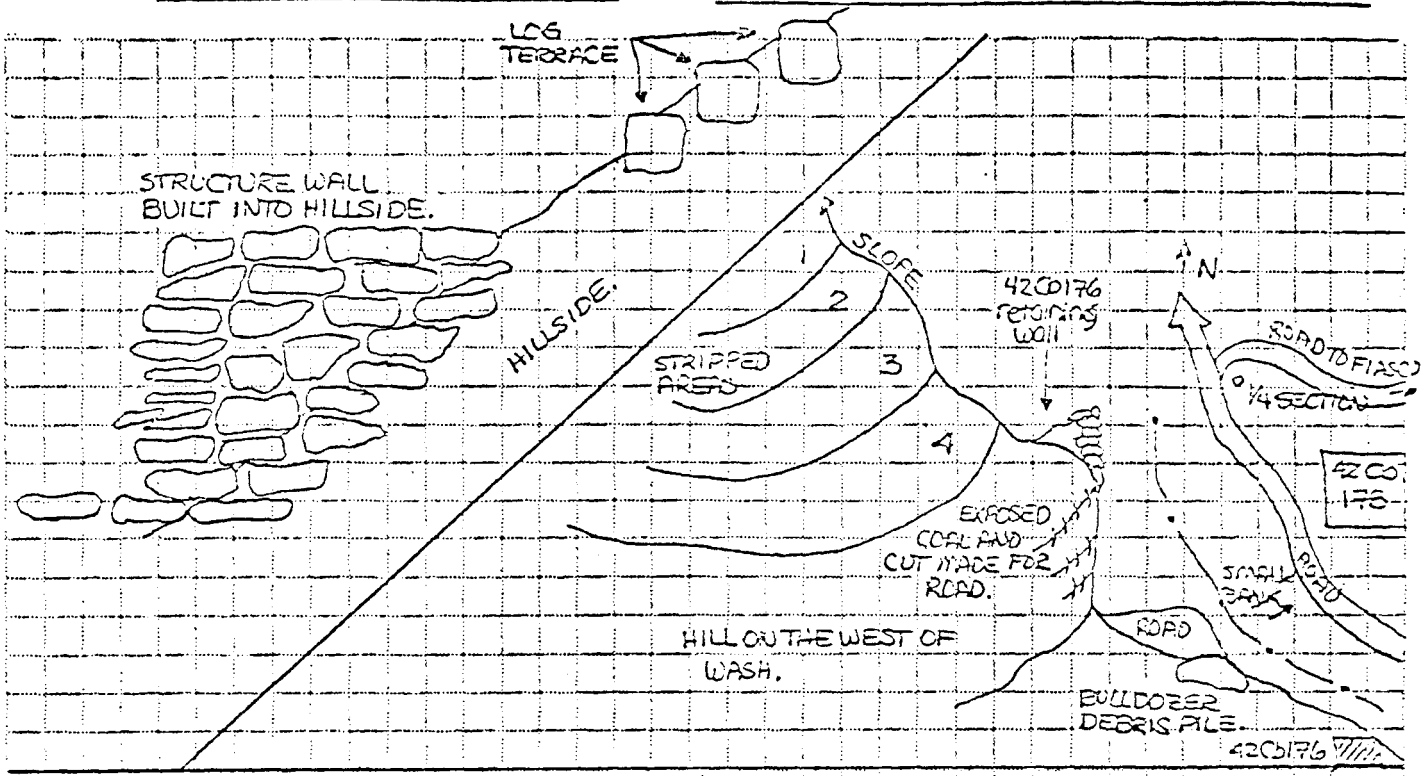


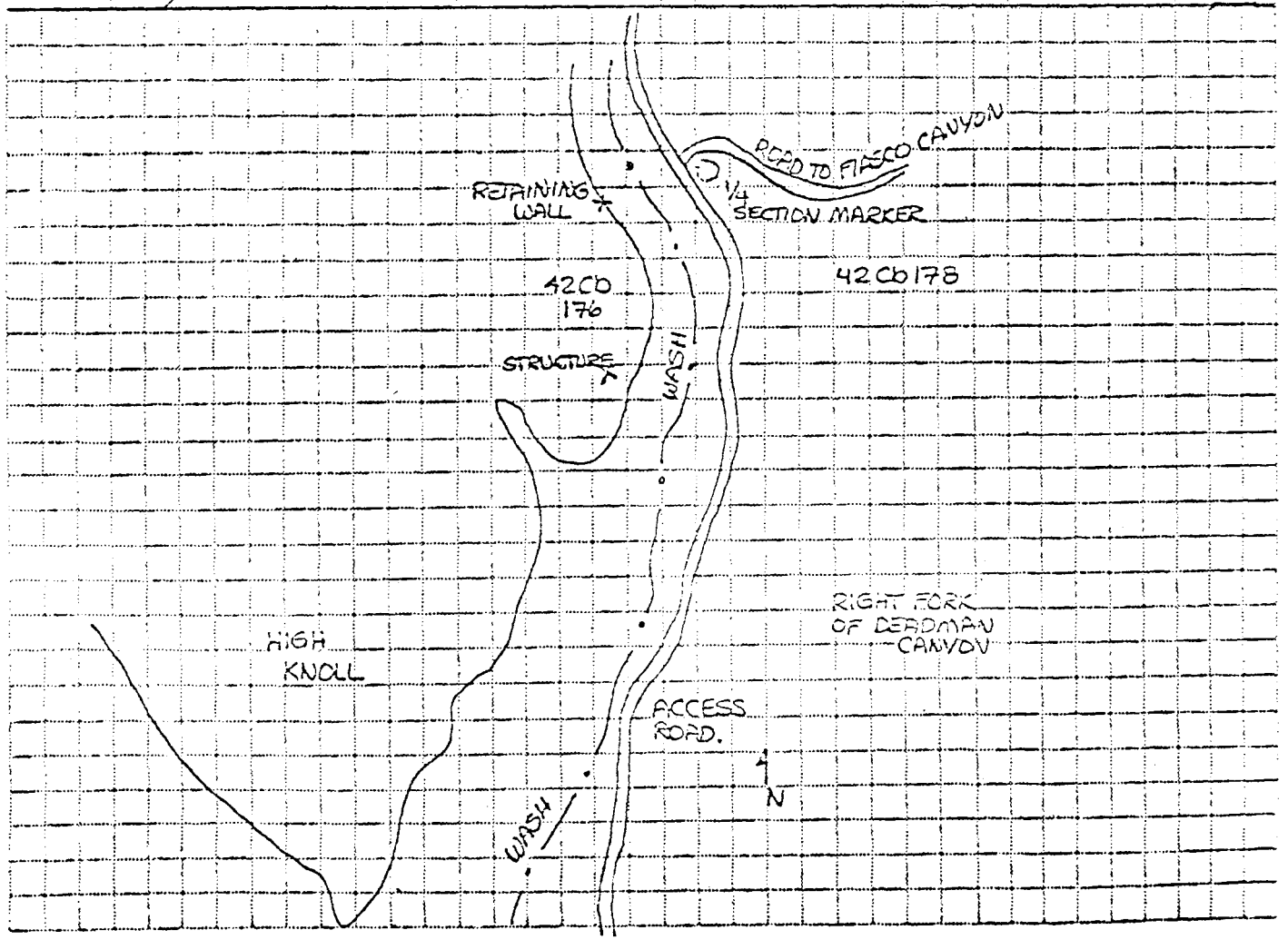


RECORDER _____

Antiquities Section *Division of State History*

Feature No. _____ SITE 42 Cb176 DATE 5/20/80





MAP SHEET YES ☐ NO ☐ RECORDER _____

TOWER RESOURCES, INC.

CENTENNIAL PROJECT

MINING AND RECLAMATION PLAN

ADDENDUM

Table of Contents

I. Introduction

II. Laboratory Analysis

- A. Laboratory Analysis by Seam
- B. Original Report of Analysis
- C. Letter of Explanation

III. Newspaper Advertisement and Proof of Publication

- A. Copy of Newspaper Advertisement
- B. Proof of Publication

IV. Hydrologic Inventory

V. History of Violations

A.

I. INTRODUCTION

Introduction

This is an addendum to Tower Resources', Inc., Mining and Reclamation Plan for the Centennial Project submitted under Title 30 CFR. It consists of the Laboratory Analysis of strata immediately overlying and underlying the coal seams, a copy of the Newspaper Advertisement for the Plan and Proof of Publication, a Hydrologic Study of the area, and a History of Violations.

The Laboratory Analysis consists of a copy of the original "Report of Analysis" of the strata immediately overlying and underlying the coal seams as performed by Camp Dresser and McKee, Inc. Also included are tables listing the analysis by specific coal seam (roof and floor), as well as a letter from Camp Dresser and McKee explaining discrepancies in the analysis results. References were made to this part of the addendum in Chapter IV-A, Geology; specific sections 3.2-2.2-2, 3.2-2.2-3, 3.3-2.2-1, 3.3-2.3-2, 3.3-2.3-3, 3.3-2.4-2, 3.3-2.4-3, and 3.3-2.4-4.

The Proof of Publication consists of a copy of the newspaper advertisement for the Mining and Reclamation Plan and an affidavit as proof of publication as required by 30 CFR 782.21. References were made to this part of the addendum in Chapter II, Legal, Financial, Compliance, and Related Information; specific part J.

The Hydrologic Study consists of the "Surface and Groundwater Hydrologic Inventory of the Tower Mine Plan and Adjacent Areas, Carbon County, Utah" performed by Vaughn Hansen Associates. References were made to the portion of the addendum in Chapter IV, Hydrology; specific sections 2.1-1.1, 2.1-2.1, and 2.2-2.1.

The History of Vilations consists of violations for all Tower Resources and AMCA Resources mining operations.

B.

II. LABORATORY ANALYSIS

LABORATORY ANALYSIS - LOWER SUNNYSIDE SEAM

ROOF

TERMINATION (%)	DH-1 55'7"-60'7"	DH-5 407'-412'	DH-6 1793'10"-1798'10"	DH-6 1796'10"-1798'10"
pH (paste)	7.0	7.1	7.7	7.6
Electrical Conductivity @25°C (mmhos/cm)	2.2	3.2	1.2	1.1
Saturation Percentage	30	27	29	34
Calcium (meq/l)	14	19	1.1	1.1
Magnesium (meq/l)	12	23	1.1	0.62
Sodium (meq/l)	2.0	3.8	10	9.8
SAR	0.55	0.83	9.5	11
ESP	-0.44	-0.04	11	12
Calcium Carbonate Equiv.	14	18	20	15
Pyritic Sulfur	-	-	-	-
Particle Size Analysis	-	-	-	-
Very Fine Sand	-	-	-	-
Sand	67	68	75	78
Silt	22	17	12	11
Clay	11	15	13	11
Texture (USDA)	sl	sl	sl	sl

FLOOR

DETERMINATION (%)	DH-1 65'-70'	DH-5 418'2"-423'2"	DH-6 1802'9"-1809'9"
(paste)	3.8	7.4	3.6
Electrical Conductivity @25°C (mmhos/cm)	5.2	2.6	4.3
Saturation Percentage	32	30	34
Calcium (meq/l)	47	6.7	45
Magnesium (meq/l)	15	6.3	21
Sodium (meq/l)	0.68	17	1.3
SAR	0.12	6.7	0.23
ESP	-1.1	7.9	-0.93
Calcium Carbonate Equiv.	0.24	19	0.38
Pyritic Sulfur	0.28	-	0.29
Particle Size Analysis	-	-	-
Very Fine Sand	-	-	-
Sand	82	73	77
Silt	13	15	13
Clay	5	12	10
Texture (USDA)	ls	sl	sl

Analysis performed by Camp Dresser & McKee Inc.

Locations of drill holes DH-1, DH-5, and DH-6 are shown on Plates VI, VII, and VIII.

LABORATORY ANALYSIS - GILSON SEAM

ROOF

DETERMINATION (%)	DH-1 260'3"-265'3"
pH (paste)	7.5
Electrical Conductivity @25°C (mmhos/cm)	2.4
Saturation Percentage	28
Calcium (meq/l)	4.3
Magnesium (meq/l)	2.2
Sodium (meq/l)	19
SAR	10
ESP	12
Calcium Carbonate Equiv.	8.3
Pyritic Sulfur	-
Particle Size Analysis	-
Very Fine Sand	-
Sand	61
Silt	28
Clay	11
Texture (USDA)	sl

FLOOR

DETERMINATION (%)	DH-1 272'4"-277'4"
pH (paste)	6.9
Electrical Conductivity @25°C (mmhos/cm)	1.0
Saturation Percentage	26
Calcium (meq/l)	2.7
Magnesium (meq/l)	1.4
Sodium (meq/l)	3.4
SAR	2.4
ESP	2.2
Calcium Carbonate Equiv.	0.81
Pyritic Sulfur	-
Particle Size Analysis	-
Very Fine Sand	-
Sand	49
Silt	41
Clay	10
Texture (USDA)	l

Analysis performed by Camp Dresser & McKee Inc.

Location of drill hole DH-1 is shown on Plates VI, VII, and VIII.

LABORATORY ANALYSIS - ABERDEEN SEAM

DETERMINATION (%)	ROOF DH-1 472'7"-476'	DH-1 476'-477'7"	DH-6 2247'-2252'
pH (paste)	7.8	7.3	7.4
Electrical Conductivity @25°C (mmhos/cm)	0.67	0.5	2.2
Saturation Percentage	26	53	26
Calcium (meq/l)	0.35	0.79	2.9
Magnesium (meq/l)	0.20	0.38	9.8
Sodium (meq/l)	5.0	3.0	19
SAR	9.5	3.9	7.5
ESP	11	4.3	9.0
Calcium Carbonate Equiv.	0.98	0.91	8.8
Pyritic Sulfur	-	-	-
Particle Size Analysis	-	-	-
Very Fine Sand	-	-	-
Sand	64	83	65
Silt	23	11	25
Clay	13	6	10
Texture (USDA)	sc	ls	sl

DETERMINATION (%)	FLOOR DH-1 483'3"-488'3"	DH-6 2256'3"-2261'3"
pH (paste)	7.8	6.7
Electrical Conductivity @25°C (mmhos/cm)	1.3	0.96
Saturation Percentage	25	32
Calcium (meq/l)	0.38	2.8
Magnesium (meq/l)	0.14	2.9
Sodium (meq/l)	12	2.1
SAR	23	1.2
ESP	25	0.57
Calcium Carbonate Equiv.	0.81	0.45
Pyritic Sulfur	-	-
Particle Size Analysis	-	-
Very Fine Sand	-	-
Sand	58	81
Silt	28	11
Clay	14	8
Texture (USDA)	sl	ls

Analysis performed by Camp Dresser & McKee Inc.

Locations of drill holes DH-1, DH-5, and DH-6 are shown on Plates VI, VII, and VIII.

B. ORIGINAL REPORT OF ANALYSIS

CDM
environmental engineers, scientists, planners, & management consultants

RECEIVED 2-9-81

CAMP DRESSER & McKEE INC.
11455 West 48th Avenue
Wheat Ridge, Colorado 80033
303 422-0469

February 6, 1981

Allen D. Emmel
Amca Coal Leasing, Inc.
P.O. Box 1027
Price, UT 84501

RE: 810-11742-14
Date Samples Recd 2-2-81

REPORT OF ANALYSIS

Lab Designation Sponsor Designation	810-11742-14-1 Lower Sunnyside Roof 55'7"-60'7"	810-11742-14-2 Lower Sunnyside Floor 65'-70'	810-11742-14-3 Gilson Roof 260'3"-265'3"	810-11742-14-4 Gilson Floor 272'4"-277'4"	810-11742-14- Aberdeen Roo 472'7"-476'
Determination (%)					
pH (paste)	7.0	3.8	7.5	6.9	7.8
Electrical Conductivity @25°C (mmhos/cm)	2.2	5.2	2.4	1.0	0.67
Saturation Percentage	30	32	28	26	26
Calcium (meq/1)	14	47	4.3	2.7	0.35
Magnesium (meq/1)	12	15	2.2	1.4	0.20
Sodium (meq/1)	2.0	0.68	19	3.4	5.0
SAR	0.55	0.12	10	2.4	9.5
ESP	-0.44	-1.1	12	2.2	11
Caclium Carbonate Equiv.	14	0.24	8.3	0.81	0.98
Pyritic Sulfur	-	0.28	-	-	-

RE: 810-11742-14

REPORT OF ANALYSIS

Lab Designation Sponsor Designation	810-11742-14-1 Lower Sunnyside Roof 55'7"-60'7"	810-11742-14-2 Lower Sunnyside Floor 65'-70'	810-11742-14-3 Gilson Roof 260'3"-265'3"	810-11742-14-4 Gilson Floor 272'4"-277'4"	810-11742-14-5 Aberdeen Roof 472'7"-476'
Determination (%)					
Particle Size Analysis	-	-	-	-	-
Very Fine Sand	-	-	-	-	-
Sand	67	82	61	49	64
Silt	22	13	28	41	23
Clay	11	5	11	10	13
Texture - USDA	sl	ls	sl	l	sc

RE: 810-11742-14

REPORT OF ANALYSIS

Lab Designation Sponsor Designation	810-11742-14-6 Aberdeen Roof 476'-477'7"	810-11742-14-7 Aberdeen Floor 483'3"-488'3"	810-11742-14-8 Lower Sunnyside 407'-412'	810-11742-14-9 Lower Sunnyside 418'2"-423'2"	810-11742-14 Lower Sunnys 1793'10"-179
Determination (%)					
pH (paste)	7.3	7.8	7.1	7.4	7.7
Electrical Conductivity @25°C (mmhos/cm)	0.5	1.3	3.2	2.6	1.2
Saturation Percentage	53	25	27	30	29
Calcium (meq/l)	0.79	0.38	19	6.7	1.1
Magnesium (meq/l)	0.38	0.14	23	6.3	1.1
Sodium (meq/l)	3.0	12	3.8	17	10
SAR	3.9	23	0.83	6.7	9.5
ESP	4.3	25	-0.04	7.9	11
Calcium Carbonate Equiv.	0.91	0.81	18	19	20
Pyritic Sulfur	-	-	-	-	-
Particle Size Analysis	-	-	-	-	-
Very Fine Sand	-	-	-	-	-
Sand	83	58	68	73	75
Silt	11	28	17	15	12
Clay	6	14	15	12	13
Texture (USDA)	ls	sl	sl	sl	sl

RE: 810-11742-14

REPORT OF ANALYSIS

Lab Designation Sponsor Designation	810-11742-14-11 Lower Sunnyside Roof 1796'6"-1798'10"	810-11742-14-12 Lower Sunnyside Floor 1802'9"-1809'9"	810-11742-14-13 Aberdeen Roof 2247'-2252'	810-11742-14-1 Aberdeen Floor 2256'3"-2261'3
Determination (%)				
pH (paste)	7.6	3.6	7.4	6.7
Electrical Conductivity @25°C (mmhos/cm)	1.1	4.3	2.2	0.96
Saturation Percentage	34	34	26	32
Calcium (meq/1)	1.1	45	2.9	2.8
Magnesium (meq/1)	0.62	21	9.8	2.9
Sodium (meq/1)	9.8	1.3	19	2.1
SAR	11	0.23	7.5	1.2
ESP	12	-0.93	9.0	0.57
Calcium Carbonate Equivalent	15	0.38	8.8	0.45
Pyritic Sulfur	-	0.29	-	-

CAMP DRESSER & McKEE INC.

Allen D. Emmel
February 6, 1981
Page 5

RE: 810-11742-14

REPORT OF ANALYSIS

Lab Designation Sponsor Designation	810-11742-14-11 Lower Sunnyside Roof 1796'6"-1798'10"	810-11742-14-12 Lower Sunnyside Floor 1802'9"-1809'9"	810-11742-14-13 Aberdeen Roof 2247'-2252'	810-11742-14-14 Aberdeen Floor 2256'3"-2261'3"
Determination (%)				
Particle Size Analysis	-	-	-	-
Very Fine Sand	-	-	-	-
Sand	78	77	65	81
Silt	11	13	25	11
Clay	11	10	10	8
Texture - USDA	sl	sl	sl	ls

These samples are scheduled to be disposed of 90 days after the date of this report. Please notify us in writing if additonal storage time is needed. Extensions are subject to a storage charge.

BY Chris Shugarts

Chris Shugarts
Soils and Overburden Supervisor

CS/rjf

C. LETTER OF EXPLANATION

(CAMP DRESSER AND MCKEE)

CDM
environmental engineers, scientists, planners, & management consultants

CAMP DRESSER & McKEE INC.

11455 West 48th Avenue
Wheat Ridge, Colorado 80033
303 422-0469

February 13, 1981

Mr. Allen Emmel
AMCA Coal Leasing, Inc.
P.O. Box 1027
Price, Utah 84501

Dear Mr. Emmel:

I share your concern that the laboratory data we presented you did not correlate with your expectations. I hope the following explanation will clear up the major discrepancies.

In regards to the high amounts of sand found in all samples, we spot checked our results. We carried out sieve fraction analysis on sample number 2 (Lower Sunnyside floor material) and found 82% sand (2mm-0.05mm) which agreed with the result we previously found using the ASTM hydrometer method. The distribution of particle size fractions were found to be as follows:

medium sand (0.5mm-0.25mm)	13%
fine sand (0.25mm-0.1mm)	57%
very fine sand (0.1mm-0.05mm)	12%

In addition, over 50% of the medium sand was actually comprised of coal fragments. This preponderance of fine and very find sand can be obscured macroscopically and lead one to characterize the roof and floor material as carboniferous shale. I suspect that these fine and very find sands account for the discrepancy in the particle size classification between the laboratory and field workers.

Variation in the chemical data we presented can be accounted for by variation in lithology and oxidation. Samples 2 and 12 were found to have low pH values and significant quantities of pyritic sulfur, probably of the fine grained framboidal type. The acid generated from pyrite oxidation is neutralized by reaction with calcium carbonate and primary base containing minerals such as feldspars. High levels of calcium and magnesium in the saturated paste can be accounted for by the neutralization of calcium and magnesium carbonates respectively. When all the calcium and magnesium carbonate is consumed the pH normally drops and is generally buffered at between pH 3-4 by the gradual neutralization of primary minerals such as feldspars.

At these low pH values, an appreciable quantity of the calcium, magnesium and especially sodium and potassium may come from the acidic weathering of primary minerals. Thus the amount of pyrite

and its degree of oxidation effects the levels of soluble salts. It is highly likely that variations in the amount, size and degree of pyrite oxidation can account for most of the variation in chemical composition between these samples.

I hope this explanation helps to clear up some of the questions you have. Please feel free to call back if you have further questions.

Sincerely,

Chris Shugart for

Jim Robbins

JR/ca

AFFIDAVIT OF PUBLICATION

STATE OF UTAH
County of Carbon, } ss.

I, Dan Stockburger, on oath, say that I am the General Manager of The Sun-Advocate, a weekly newspaper of general circulation, published at Price, State and County aforesaid, and that a certain notice, a true copy of which is hereto attached, was published in the full issue of such newspaper for Four (4) consecutive issues, and that the first publication was on the 17th day of October, 19 86 and that the last publication of such notice was in the issue of such newspaper dated the 29th day of October, 19 86

Dan Stockburger

Subscribed and sworn to before me this 29th day of October, 19 86

Holly Jo Baker
Notary Public.

My Commission expires My Commission Expires October 22, 1990, 19

Publication fee, $ 192.00

NOTICE OF APPLICATION FOR RENEWAL OF PERMIT UTAH ACT 007/019

BEFORE THE BOARD OF OIL, GAS, AND MINING, DEPARTMENT OF NATURAL RESOURCES in and for the STATE OF UTAH.

IN THE MATTER OF THE PERMANENT MINING AND RECLAMATION PLAN SUBMITTED BY ANDALEX RESOURCES, INC., P.O. Box 902, Price, Utah 84501.

ANDALEX RESOURCES, INC.; TO ALL OPERATORS, TAKERS OF PRODUCTION, MINERAL AND ROYALTY OWNERS AND PARTICULARLY ALL PERSONS INTERESTED IN TOWNSHIP 13 SOUTH, RANGE 11 EAST, CARBON COUNTY, UTAH.

Notice is hereby given that a Mining and Reclamation Plan has been resubmitted under Title 30 of the Code of Federal Regulations pertaining to the Surface Affects of Underground Coal Mining by Andalex Resources, Inc., as an application to continue Underground Room and Pillar Coal mining on Federal leases ten (10) miles north-northeast of Price, Utah. Present mining is in the Pinnacle Mine and Apex Mine. The name of the present and proposed activities is the Centennial Project and the person representing the company is Mr. Samuel C. Quigley, P.O. Box 902, Price, Utah 84501. Access to said property is via Carbon County Road No. 299.

Description of said Federal Leases:

1. Federal lease SL-027304, 120 acres, Township 13 South, Range 11 East, Carbon County, Utah S½SE¼ Section 7 and NW¼NE¼ Section 18. Tract 2 (Lease Modification), 115.96 acres, Township 13 South, Range 11 East, Lot 4, Section 7, and Lot 1, N½NE¼NW¼, SW¼NE¼NW¼.

2. Federal lease SL-063058, 240 acres, Township 13 South, Range 11 East. Carbon County, Utah, S½SW¼ Section 8, NE¼NW¼ NW¼NW¼, SE¼NW¼ Section 17, and NE¼NE¼ Section 18. Tract 2 (Lease Modification), 160 acres, Township 13 South, Range 11 East, SW¼NW¼, NE¼NW¼SW¼, W½NW¼SW¼, Section 17 and E½SE¼NE¼, NW¼SE¼NE¼, SW¼NE¼, E½NE¼SE¼ Section 18.

3. Federal lease U-010581, 1,682.39 acres, Township 13 South, Range 11 East, Carbon County, Utah, Section 5 (All), Section 6 (All), NE¼, N½NW¼, N½SE¼ Section 7, N½, N½SW¼, SE¼ Section 8, W½SW¼ Section 9, and N½NE¼ Section 17. Tract 2 (Lease Modification), 160 acres, Township 13 South, Range 11 East, S½NE¼, N½NE¼SW¼, NE¼SE¼, N½NW¼SE¼ Section 17.

4. Federal lease U-52341, 120 acres, Township 13 South, Range 11 East, Carbon County, Utah, E½SW¼, SW¼SE¼ Section 9.

Description of fee lease:

1. Zion's fee leases, 200 acres, Township 13 South, Range 11 East, Carbon County, Utah S½NW¼, N½SW¼, SE¼SW¼ Section 7.

The described areas are contained on the Deadman Canyon Quadrangle (Utah-Carbon Co.) of the United States Geological Survey 7.5 minute quadrangle map series (topographic).

A copy of the Mining and Reclamation Plan submitted by Andalex Resources, Inc., is available for public inspection at the Office of the County Clerk of Carbon County, Carbon County Courthouse, Price, Utah. Any person aggrieved by this Mining and Reclamation Plan as application for permit renewal is hereby requested to submit written comments to the Division of Oil, Gas, and Mining, ~~1588 West~~ 355 W. North Temple, 3 Triad Center, Suite 350, Salt Lake City, Utah 84180.

Published in the Sun Advocate October 17, 22, 24 and 29, 1986.

C.

A. COPY OF NEWSPAPER ADVERTISEMENT

III. NEWSPAPER ADVERTISEMENT AND PROOF OF PUBLICATION

NOTICE OF PROPOSED COAL MINING AND RECLAMATION OPERATIONS

BEFORE THE BOARD OF OIL, GAS, AND MINING, DEPARTMENT OF NATURAL RESOURCES in and for the STATE OF UTAH. BEFORE THE OFFICE OF SURFACE MINING, RECLAMATION AND ENFORCEMENT, DEPARTMENT OF THE INTERIOR in and for the UNITED STATES.

IN THE MATTER OF THE PERMANENT MINING AND RECLAMATION PLAN SUBMITTED BY TOWER RESOURCES, INC., P.O. BOX 1027, Price, Utah 84501.

TOWER RESOURCES, INC., TO ALL OPERATORS, TAKERS OF PRODUCTION, MINERAL AND ROYALTY OWNERS AND PARTICULARLY ALL PERSONS INTERESTED IN TOWNSHIP 13 SOUTH, RANGE 11 EAST, CARBON COUNTY, UTAH.

Notice is hereby given that a Mining and Reclamation Plan has been submitted under Title 30 of the Code of Federal Regulations pertaining to the Surface Effects of Underground Coal Mining by Tower Resources, Inc., as an application for permit to commence Underground Room and Pillar Coal mining on Federal leases ten (10) miles north - northeast of Price, Utah. Present mining is in the Pinnacle Mine - Zion's fee lease. The name of the present and proposed activities is the Centennial Project and the person representing the company is Mr. Samuel C. Quigley, P.O. Box 1027, Price, Utah 84501. Access to said property is via Carbon County Road No. 299.

Description of said Federal leases:

1. Federal lease SL-027304, 120 acres, Township 13 South, Range 11 East, Carbon County, Utah, S½SE¼ Section 7 and NW¼NE¼ Section 18.

2. Federal lease SL-063058, 240 acres, Township 13 South, Range 11 East, Carbon County, Utah, S½SW¼ Section 8, NE¼NW¼, NW¼NW¼, SE¼NW¼ Section 17, and NE¼NE¼ Section 18.

3. Federal lease U-010581, 1,682.39 acres, Township 13 South, Range 11 East, Carbon County, Utah, Section 5 (All), Section 6 (All), NE¼, N½NW¼, N½SE¼ Section 7, N½, N½SW¼, SE¼ Section 8, W½SW¼ Section 9, and N½NE¼ Section 17.

Description of said fee lease:

1. Zion's fee leases, 200 acres, Township 13 South, Range 11 East, Carbon County, Utah, S½NW¼, N½SW¼, SE¼SW¼ Section 7.

The described areas are contained on the Deadman Canyon Quadrangle (Utah - Carbon Co.) of the United States Geological Survey 7.5 minute quadrangle map series (topographic).

A copy of the Mining and Reclamation Plan submitted by Tower Resources, Inc., is available for public inspection at the Office of the County Clerk of Carbon County, Carbon County Courthouse, Price, Utah. Any person aggrieved by this Mining and Reclamation Plan as application for permit is hereby requested to submit written comments, objections or requests for informal conferences on said application within thirty (30) days of February 25, 1981 to the Division of Oil, Gas, and Mining, 1588 West North Temple, Salt Lake City, Utah 84116 and to the Office of Surface Mining, Reclamation and Enforcement, Brook Towers, 1020 15th Street, Denver, Colorado 80202, setting forth factual reasons for his complaint as to why this plan should not be approved.

Published in the Sun Advocate Feb. 4, 11, 18 and 25, 1981.

B. PROOF OF PUBLICATION

AFFIDAVIT OF PUBLICATION

STATE OF UTAH
County of Carbon, } ss.

I, Robert L. Finney, on oath, say that I am the Publisher of The Sun-Advocate, a weekly newspaper of general circulation, published at Price, State and County aforesaid, and that a certain notice, a true copy of which is hereto attached, was published in the full issue of such newspaper for Four (4) consecutive issues, and that the first publication was on the 4th day of February, 1981 and that the last publication of such notice was in the issue of such newspaper dated the 25th day of February, 1981

Robert L. Finney

Subscribed and sworn to before me this 25th day of February, 1981

Rebecca Francis
Notary Public.

My Commission Expires October 26, 1983

My Commission expires ....., 19 .....

Publication fee, $ 120.80

RECLAMATION OPERATIONS

BEFORE THE BOARD OF OIL, GAS, AND MINING, DEPARTMENT OF NATURAL RESOURCES in and for the STATE OF UTAH. BEFORE THE OFFICE OF SURFACE MINING, RECLAMATION AND ENFORCEMENT, DEPARTMENT OF THE INTERIOR in and for the UNITED STATES.

IN THE MATTER OF THE PERMANENT MINING AND RECLAMATION PLAN SUBMITTED BY TOWER RESOURCES, INC., P.O. BOX 1027, Price, Utah 84501.

TOWER RESOURCES, INC., TO ALL OPERATORS, TAKERS OF PRODUCTION, MINERAL AND ROYALTY OWNERS AND PARTICULARLY ALL PERSONS INTERESTED IN TOWNSHIP 13 SOUTH, RANGE 11 EAST, CARBON COUNTY, UTAH.

Notice is hereby given that a Mining and Reclamation Plan has been submitted under Title 30 of the Code of Federal Regulations pertaining to the Surface Effects of Underground Coal Mining by Tower Resources, Inc., as an application for permit to commence Underground Room and Pillar Coal mining on Federal leases ten (10) miles north - northeast of Price, Utah. Present mining is in the Pinnacle Mine - Zion's fee lease. The name of the present and proposed activities is the Centennial Project and the person representing the company is Mr. Samuel C. Quigley, P.O. Box 1027, Price, Utah 84501. Access to said property is via Carbon County Road No. 299.

Description of said Federal leases:

1. Federal lease SL-[illegible] [illegible], Township 13 South, Range 11 East, Carbon

Enforcement, Brook Towers, 1020 15th Street, Denver, Colorado 80202, setting forth factual reasons for his complaint as to why this plan should not be approved.

Published in the Sun Advocate Feb. 4, 11, 18 and 25, 1981.

IV. HYDROLOGIC INVENTORY

D.

Surface and Groundwater Hydrologic Inventory of the Tower Mine Plan and Adjacent Areas, Carbon County, Utah

The Centennial Project

Prepared for
TOWER RESOURCES, INCORPORATED
Price, Utah

February 1981

CONSULTANTS / ENGINEERS
VAUGHN HANSEN ASSOCIATES
SALT LAKE CITY, UTAH

SURFACE AND GROUNDWATER HYDROLOGIC INVENTORY OF THE TOWER MINE PLAN AND ADJACENT AREAS, CARBON COUNTY, UTAH

THE CENTENNIAL PROJECT

Prepared for

TOWER RESOURCES, INCORPORATED

Price, Utah

February 1981

1. TABLE OF CONTENTS

2. GROUNDWATER HYDROLOGY..... 1

2.1 Scope..... 1

2.2 Methodology..... 3

2.3 Existing Groundwater Resources..... 3

2.3.1 Regional Groundwater Hydrology..... 4

2.3.2 Mine Plan Area Aquifers..... 10

2.4 Groundwater Development and Mine Dewatering..... 14

2.4.1 Water Supply..... 15

2.4.2 Mine Dewatering..... 16

2.5 Effects of Mining Operation on the Groundwater Hydrologic Balance..... 20

2.6 Mitigation and Control Plans..... 21

2.7 Groundwater Monitoring Plan..... 22

3. SURFACE WATER HYDROLOGY..... 26

3.1 Scope..... 26

3.2 Methodology..... 26

3.3 Existing Surface Water Resources..... 28

3.3.1 Regional Surface Water Hydrology..... 28

3.3.2 Mine Plan Area Watersheds and Streams, Spring and Seep Characteristics, Stream Characteristics, and Watershed Characteristics..... 31

3.4 Surface Water Development Control and Diversions 32

3.5 Effect of Mining on the Surface Water Hydrologic Balance..... 37

3.5.1 Quantity..... 37

3.5.2 Quality..... 40

1. TABLE OF CONTENTS (continued)

3.6 Mitigation and Control Plans..... 40

3.7 Surface Water Monitoring Plan..... 41

4. ALLUVIAL VALLEY FLOOR DETERMINATION..... 43

5. BIBLIOGRAPHY..... 44

ATTACHMENT A..... 46

ATTACHMENT B..... 52

LIST OF FIGURES

Figure		Page
1	Location of the Tower mine plan area.	2
2.	Surface geology of the Tower mine plan area.	5
3.	Generalized columnar section of the Tower Mine plan area.	6
4.	Water quality data of water wells, streams, and identified seeps and springs within and adjacent to the Tower mine plan area.	11
5.	Surface and ground water rights on and adjacent to the Tower mine plan area.	19
6.	Location of the proposed ground and surface water monitoring stations.	23
7.	Price and San Rafael river basins.	30

LIST OF TABLES

Table		Page
1	Groundwater rights located on and adjacent to the Tower mine plan area.	17
2.	Water quality analytical schedule.	24
3.	Utah Division of Health numerical standards for water in the state.	35
4.	Numerical standards for class 3C water use.	36
5.	Surface water rights located on and adjacent to the Tower mine plan area.	38
6.	Field Methods used for the analysis of water quality samples.	47
7.	Laboratory methods used for the analysis of water quality samples, with standard reference page numbers.	48
8.	Results of chemical analyses of water quality samples.	53

2. GROUNDWATER HYDROLOGY

Regulations set forth by the U.S. Office of Surface Mining Reclamation and Enforcement (OSM) (Volume 44, number 50 of the Federal Register, dated Tuesday, March 13, 1979) and by the Utah Division of Oil, Gas, and Mining (DOGM) (Utah Code Annotated 40-10 et. seq.) require that water monitoring programs be established in areas of underground coal mining to monitor the effects of mining activities and protect the hydrologic balance of such areas. Therefore, a hydrologic investigation has been conducted on the mine plan area owned by Tower Resouces, Incorporated (hereinafter called the Tower mine plan area or mine plan area), which is currently developing coal resources by underground mining. The mine plan area, located north and east of Price, Utah in the Deadman Canyon area (see Figure 1), contains approximately 2240 acres of land. The project is entitled the Centennial Project.

2.1 Scope

The scope of the groundwater section of this report is to describe the existing groundwater hydrologic conditions of the Tower mine plan and adjacent areas and to describe the methods that have been and will be used to predict and monitor the impacts from mining. Sections within the groundwater section of this report will cover the following major topics: methodology, existing groundwater resources, groundwater development and mine

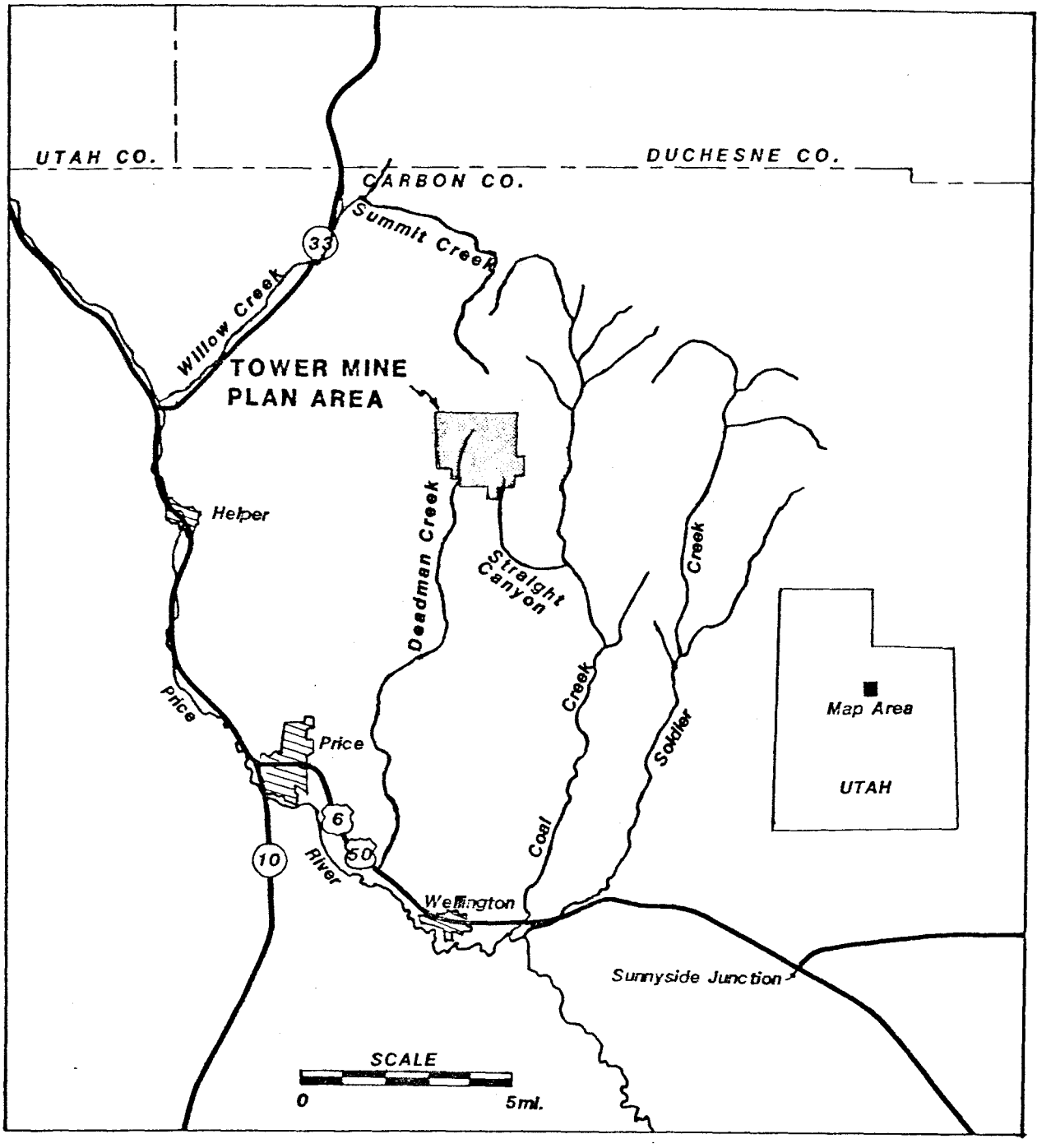


Figure 1. Location of the Tower mine plan area.

dewatering, effects of mining operation on the groundwater hydrologic balance, mitigation and control plans, and groundwater monitoring plans.

2.2 Methodology

Information used in preparing the groundwater hydrologic section of this report has been gathered by field investigations. Water quality samples have been collected and analyzed. Pertinent literature has been examined. In addition, experience of personnel working for the mine has been utilized to obtain pertinent information of conditions encountered underground.

All water quality samples have been and will continue to be analyzed by a certified laboratory. Attachment A lists the laboratory methods used for sample analyses. Pumping tests have been used on the existing water wells. Water rights were determined by examining current records of the Utah Division of Water Rights.

2.3 Existing Groundwater Resources

This section of the report deals with the groundwater resources of not only the Tower mine plan area, but also of the region as a whole. An understanding of geology as it relates to groundwater hydrology is very important, and consequently will be discussed briefly.

2.3.1 Regional Groundwater Hydrology

The Tower mine plan area is located within the Book Cliffs coal field, which extends from the Utah-Colorado state line to Castlegate, Utah. The general dip of the strata in the vicinity of the mine plan area is to the north and east at approximately 10 percent (6 degrees) (Doelling, 1972). The strike of the strata coincides in general with the trend of the cliffs (Spieker, 1925).

Geologic formations exposed within the mine plan area are the Blackhawk and Price River formations of the Mesaverde Group and the North Horn and Flagstaff members of the Wasatch Formation (see Figures 2 and 3).

Blackhawk Formation. The Blackhawk Formation, which directly overlies the Mancos Shale in the vicinity of the Tower mine plan area (Doelling, 1972), is the middle and coal bearing unit of the Mesaverde Group. The Blackhawk consists of a basal sandstone (the Aberdeen Sandstone), overlain by massive beds of gray to buff sandstone with alternating beds of sandy shale, shale, and coal (Clark, 1928), In the vicinity of the Tower mine plan area, the Blackhawk Formation is about 1000 feet thick (Doelling, 1972).

According to Clark (1928, p. 19):

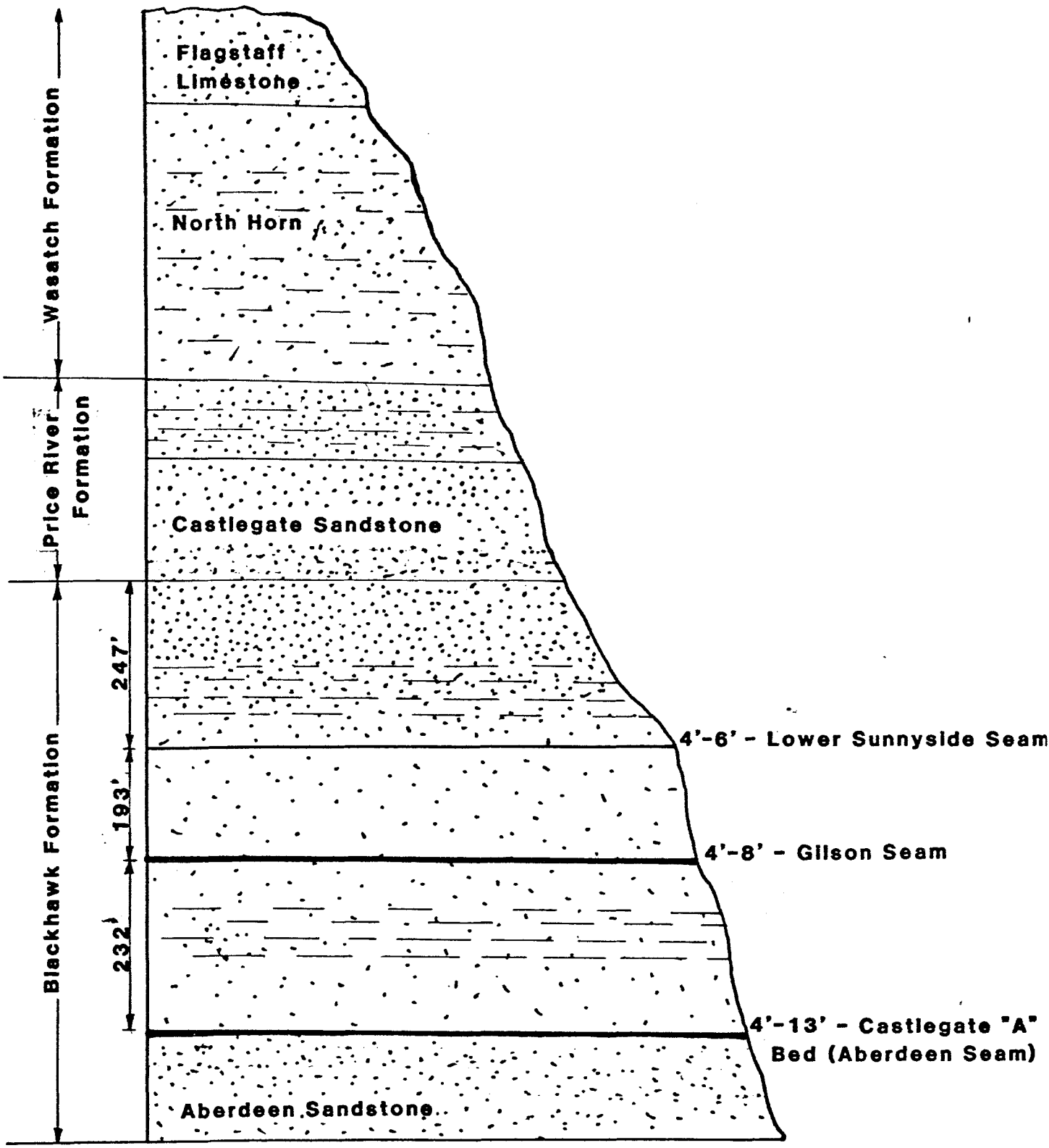


Figure 3. Generalized columnar section of the Tower mine plan area (Doelling, 1972).

> The coal bearing part of the Blackhawk Formation consists of massive beds of gray to buff sandstone, alternating with smaller amounts of sandy shale, shale and coal beds. The sandstone is composed largely of semirounded quartz grains cemented by carbonate of lime and is reasonably well consolidated but not greatly indurated except some of the fine-grained and highly calcareous beds. The shale, as a rule, is more or less sandy and adjacent to the coal beds usually contains some carbonaceous material. The coal beds have been extensively burned at the surface, and the associated rocks are greatly altered in character and composition. At many places where coal beds have burned, the rocks overlying them have fused, and everywhere they are predominantly red instead of gray and buff, their original colors.
>
> The dominant feature of the coal-bearing part of the Blackhawk Formation consists of the massive, cliff-forming beds of sandstone, which lie beneath many of the principle coal beds. Some of these sandstones beds are exposed for 20 to 30 miles in east-west extent.

The presence of shale layers in the Blackhawk Formation acts as an effective barrier to the vertical movement of the water within the formation. Therefore, water penetrating into the Blackhawk probably percolates downward until it encounters a shale layer, which then causes horizontal movement to the surface or to another sandstone finger within the formation.

<u>Price River Formation.</u> Overlying the Blackhawk Formation is the Price River Formation; composed of a massive basal sandstone, (referred to as the Castlegate Sandstone) and upper beds overlying the Castlegate (Clark, 1928).

The Castlegate Sandstone consists of massive, fine-grained to medium-grained sandstone beds (Doelling, 1972) which are gray to buff and composed mainly of semirounded grains of quartz (Clark,

1928). The basal portion of the Castlegate is a transition zone from sandy shale to sandstone and in many areas shale and sandy shale are encountered near the top of the sandstone bed (Clark, 1928). The Castlegate Sandstone is approximately 250 feet thick near the Tower mine plan area (Doelling, 1972).

The upper portion of the Price River Formation consists of two or more thick beds of sandstone, interbedded with thin-bedded shale and sandy shale (Clark, 1928). The sandstone layers are massive, white to gray beds, consisting of semi-angular grains of quartz. The shales are predominantly gray in color with occasional traces of olive-green shales in certain areas (Doelling, 1972).

North Horn Formation. The North Horn Formation, the lower-most member of the Wasatch Formation, consists of a series of shale, sandstone, minor conglomerate and freshwater limestone. The shales vary from yellow to gray or gray-green in color and are usually calcareous and silty (Doelling, 1972; Clark, 1928). The sandstones are tan to yellow-gray, fine to coarse-grained conglomerate sandstones with interbedded highly colored sandy shale (Clark, 1928). Limestone increases near the upper portion of the member (Doelling, 1972). Near the Tower mine plan area, the North Horn is about 600 feet thick.

Flagstaff Limestone. The Flagstaff Limestone, also a member of the Wasatch Formation, consists of thin-bedded limestones, shales, and sandstones (Doelling, 1972). The varicolored shales

are interbedded with lacustrine and microcrystalline limestone. The sandstones are fine-grained to medium-grained, reddish-brown, and generally less plentiful than the other constituents (Doelling, 1972), The Flagstaff Limestone surfaces just north of the mine plan area on the plateau (Figure 2).

Faults. There are no faults known to exist within the Tower mine plan area. No major faults exist in the area adjacent to the mine plan area, however Doelling (1972) shows that one minor fault may exist about one-half mile south of the portal area.

Groundwater. The principal factor controlling the occurrence and availability of groundwater in any area is geology. As noted by Price and Waddell (1972), nearly all of the region surrounding the Tower mine plan area is underlain by rocks of continental and marine origin, consisting predominately of interbedded sandstones and shales. Although some of the sandstones in the region serve as the principal water-bearing strata, their ability to yield water for extended periods of time is largely controlled by the fact that the sandstone beds are relatively impermeable and by the existence of the impermeable interbedded shale layers, which prevent the downward movement of a significant amount of water.

According to the U.S. Geological Survey (1979), groundwater in the region exists under water table, artesian, and perched conditions. Water table conditions exist primarily in shallow alluvial deposits along larger perennial streams and in

relatively flat lying sedimentary rocks. Artesian conditions exist at greater depths where a confining layer overlies a more permeable member. However, pressures are generally not sufficient to produce flowing wells. Perched or impeded conditions exist where the confining layer lies beneath the water bearing strata.

2.3.2 Mine Plan Area Aquifers.

Springs and seeps. Springs and seeps were inventoried within and adjacent to the Tower mine plan area to obtain an index of groundwater hydrologic conditions in the area. The inventory was conducted during the fall of 1980 during which time the mine plan area was walked and flown over, and seeps and springs found are shown on Figure 4. A field analysis was made of each spring, including discharge, water temperature, and conductivity measurements. A water quality sample was collected and analyzed from each spring found near the mine plan area. The results of these analyses are found in Attachment B and shown graphically on the map in Figure 4.

No springs were found on the Tower mine plan area. One small spring was identified about one-half mile south of the portal area. A spring was also located about one mile northeast of the mine plan area adjacent to Clearwater Creek. Flows measured in these springs ranged considerably as a result of recent precipitation. Flow at S18-1 changed from almost no flow to 13 gpm (0.03 cfs). Spring S34-1 had a flow rate of 10 gpm (0.02

cfs). Four small ponds about a mile north of the mine plan area boundary were sampled. These ponds may be partially fed by springs during part of the year. However, it appeared at the time of sampling that the water in these ponds probably was stored storm runoff.

Wells. Water for use by the mine is supplied from two wells located near the portal area and shown on Figure 4. Some data was obtained from pumping tests on these wells. Well #1 is 130 feet deep and had a static water level of 58 feet. After four hours of pumping at 50 gpm, the water level had been lowered to 67 feet. In January 1981, after about three months of use, this well was almost dry. Recharge is very meager. These facts seem to substantiate the lenticularity and tightness of the formation. It appears that the aquifer supplying the well was perched and very small and thus does not produce a sustained yield even though the initial pump test appeared favorable. This well is now being deepened in an attempt to improve the yield.

Well #2 was initially drilled to a depth of 155 feet and had a static water level at 57 feet. After two hours of pumping at 30 gpm, the level was lowered to 88 feet. The well was then drilled to a depth of 280 feet and pumped again. This second pump test produced almost twice as much drawdown with only one-half as much pumping as the first test. After only one hour of pumping at the same rate of 30 gpm the water level had dropped from 57 feet to 100 feet. The flow at the end of the pump test was only 25 gpm.

These results also seem to show that the water is perched and is quite limited in extent. After three weeks of pumping, in February 1981, this well also almost dried up. Recharge is very slow.

Groundwater Quality. Water quality samples were collected and analyzed from the two identified small springs referred to previously (S18-1 and S34-1). In addition, water quality samples have been obtained from Well #1 and Well #2. The results of the chemical analyses are presented in Attachment B and in Figure 4.

Groundwater from spring S18-1 varied with the four samples collected from a sodium-sulfate, to a magnesium-sulfate, and then to a magnesium-bicarbonate type. Total dissolved solids (TDS) levels ranged from 840 to 1560 milligrams per liter. Flows ranged from just a seep to only 13 gpm (0.03 cfs). Quality of the water improved with time even though flow generally decreased. This improvement in quality is not expected to be a long-term trend, but more likely is a seasonal variation or a short-term fluctuation. Water in spring S34-2 had a TDS level of 465 milligrams per liter and was a magnesium-bicarbonate. TDS levels in Well #1 and Well #2 were 1164 and 846 milligrams per liter respectively. The sample from Well #1 was a calcium-sulfate while the sample from Well #2 was a magnesium-bicarbonate. The average TDS concentration from all groundwater samples collected was 998 milligrams per liter. The general trend was for the highest quality water to come from the higher

elevation station, and the lowest quality water to come from the lowest elevation station. This trend is consistent with the trend found in the Book Cliffs and Wasatch Plateau region as a whole. As water percolates down through the formations, quality of the groundwater decreases as constituents are picked up from the formations. Springs issuing from the shallow sandstones are primarily calcium-bicarbonates. As water seeps through the shales, the water gradually picks up more magnesium and sulfate ions, and the total dissolved solids concentrations increase.

Trace metal concentrations were all relatively low except for one sample from Well #1 which had a relatively high total boron concentration of 2.68 milligrams per liter (dissolved boron was not measured). All other boron concentrations were significantly lower. Groundwater ortho-phosphate concentrations ranged from less than 0.001 milligrams per liter at S18-1 and S34-1 to 0.05 milligrams per liter at S18-1. The highest nitrate level was only 1.06 milligrams per liter at S18-1. Hydrogen ion activity as measured by pH ranged from 7.1 to 7.7 in the groundwater samples.

2.4 Groundwater Development and Mine Dewatering.

This section of the report discusses the groundwater supply and usage in the mine plan and adjacent areas as well as the plan for use of water within the mine.

2.4.1 Water Supply

The Book Cliffs, where the Tower mine plan area is located, and the adjacent Wasatch Plateau act as recharge areas for regional groundwater systems (Price and Arnow, 1974). Only a small portion of the annual precipitation, probably much less than five percent, recharges the groundwater supply (Price and Arnow, 1974; U.S. Geological Survey, 1979). The depth of water infiltrating through the surface to saturated beds is small due to the presence of the relatively impermeable shale layers near the surface over much of the area and to the potential evapotranspiration being greater than the rainfall.

Price and Arnow (1974) indicate that properly constructed wells in the Price River Basin would have only limited yields (normally less than 50 gpm). Wells immediately adjacent to the Tower mine plan area could normally be expected to yield less than 10 gallons per minute (Price and Wadell, 1973). Increased yields could possibly be expected from wells penetrating highly fractured sandstones.

Rocks in the mountainous areas near the Tower mine plan area generally have low specific yields (0.2 to 0.7 percent) and low hydraulic conductivities (Price and Waddell, 1973). The volume of recoverable water in the area is small, averaging less than 600 acre-feet per square mile in the upper 100 feet of saturated rock (Price and Arnow, 1974).

The quality of groundwater in the Price River Basin deteriorates

with distance downstream much the same as surface water. Dissolved solids concentrations in groundwater range from less than 500 milligrams per liter near the Tower mine plan area to 3000 milligrams per liter or more near the confluence of the Price River with the Green River (Price and Waddell, 1973). This increase in dissolved solids concentration is the result of increased contact of water and rock as travel distance increases, with saline shales contributing a major portion of the dissolved constituents.

Water Rights. Groundwater rights in and adjacent to the Tower mine plan area on file as of February 1981 with the Utah Division of Water Rights are listed in Table 1 and shown in Figure 5. All groundwater rights on or adjacent to the mine plan area are specified for use as stockwater except for the water rights obtained for use in Tower's mine.

2.4.2 Mine Dewatering

Very little water has been encountered in the Pinnacle Mine (the currently operating mine within the Tower mine plan area). Water that has been encountered has been in the form of very small roof leakers that dry up within a few days or weeks after mining progresses downdrift. If any usable supplies of water are encountered as mining progresses, they will be stored and used within the mine. No mine water has been discharged nor is any water expected to be discharged in the future.

Table 1. Groundwater rights located on and adjacent to the Tower mine plan area.

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-351	Funnon T. and Donna Shimmin	Unnamed Spring	.011	Stockwatering	May 1 to November 30
91-844	J. D. & Inez Critchlow	Unnamed Spring	.011	Stockwatering	March 1 to November 30
91-856	Jay L. Critchlow (1/2 interest)	Unnamed Spring	.011	Stockwatering	March 1 to November 30
91-859	Jay L. Critchlow (1/2 interest)	Unnamed Spring	.011	Stockwatering	March 1 to November 30
91-861	Jay L. Critchlow (1/2 interest)	Unnamed Spring	.011	Stockwatering	March 1 to November 30
91-884	John C. Critchlow (1/2 interest)	Unnamed Spring	.011	Stockwatering	March 1 to November 30
91-887	John C. Critchlow (1/2 interest)	Unnamed Spring	.011	Stockwatering	March 1 to November 30
91-889	John C. Critchlow (1/2 interest)	Unnamed Spring	.011	Stockwatering	March 1 to November 30
91-1194	Vera T. Shimmin	Clear Water Cabin Spring	.011	Stockwatering	May 1 to November 30
91-1196	Vera T. Shimmin	Unnamed Spring	.011	Stockwatering	May 1 to November 30
91-1202	Vera T. Shimmin	Unnamed Spring	.011	Stockwatering	May 1 to November 30
91-1205	Funnon T. & Donna Shimmin	Big Summit Spring No. 1	.011	Stockwatering	May 1 to November 30
91-1206	Funnon T. & Donna Shimmin	Big Summit Spring No. 2	.011	Stockwatering	May 1 to November 30
91-1213	Funnon T. & Donna Shimmin	Unnamed Spring	.011	Stockwatering	May 1 to November 30
91-1214	Funnon T. & Donna Shimmin	Wild Cattle Spring	.011	Stockwatering	May 1 to November 30
91-1216	Funnon T. & Donna Shimmin	Buck Meadow Spring	.011	Stockwatering	May 1 to November 30
91-1220	John A. Mathis	Unnamed Spring	.011	Stockwatering	April 1 to November 30
91-1228	Rex Mathis	Buck Creek Spring	.011	Stockwatering	May 1 to November 30
91-1230	Rex Mathis	Tank Spring	.022	Stockwatering	May 1 to November 30
91-1233	Rex Mathis	Fork of Big Summit Spring	.011	Stockwatering	April 1 to November 30

Table 1. Continued.

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-1235	Rex Mathis	Unnamed Spring	.011	Stockwatering	April 1 to November 30
91-1378	Ezra Branch	Unnamed Spring	.011	Stockwatering	May 1 to November 30
91-2571	U.S. Bureau of Land Management	Fish Creek Spring	.033	Stockwatering	January 1 to December 31
91-2572	U.S. Bureau of Land Management	Straight Canyon Spring	.033	Stockwatering	January 1 to December 31
91-4171	AMCA Coal Leasing	4 wells	.5	Underground Mining	January 1 to December 31
91-4173	AMCA Coal Leasing	Olsen Mine	.2	Underground Mining	January 1 to December 31

2.5 Effects of Mining Operation on the Groundwater Hydrologic Balance

As has been noted, the occurence and quality of water in any region is highly controlled by geology. The geology of the Tower mine plan area, as evidenced by similar areas in the Book Cliffs and the Wasatch Plateau is such that the effects on groundwater by mining activities will have very little adverse impact on the areal hydrologic system.

As shown in Figure 2, the Tower mine plan area is extremely rugged. The area is characterized by steep rocky slopes and narrow ridges. The cover over the recoverable coal reserves ranges from 0 to 2200 feet.

Geologic Formations. As discussed previously, the highest terrain is composed of the Flagstaff Limestone and North Horn members of the Wasatch Formation. The recoverable coal reserves are contained within the Blackhawk Formation which lies on top of the Mancos Formation. These formations above the Mancos are layers of sandstone interbedded with shale and are lenticular. The sandstones in the formation are well cemented and tight due to the roundness of grains.

The dip of the formation is about six degrees in a north-northeast direction. There are no known faults within the mine plan area.

Springs. No springs were located in the initial field survey on the mine plan area. Most precipitation enters the soil and is used by the vegetation. As mentioned earlier, only two springs were located adjacent to the Tower mine plan area. Flows ranged from almost zero to 13 gpm (0.03 cfs) (see Section 2.3.2). The formations are very lenticular, and a few small, perched aquifers exist over the mine plan area. Both springs that have been found are located near the base of a dominant sandstone formation. Spring S18-1 issues near the interface between a unit within the Mancos shale and the impermeable shale below (Glasson, 1981). Spring S34-1 issues near the interface between the North Horn Formation and the upper portion of the Price River Formation. This is consistent with the pattern shown throughout the whole region. Shale layers (such as the Mancos Shale or a shale bed in the Price River Formation) act as impeding members to deep percolation, sometimes forcing at least a portion of the water that percolates through the soil mantle to move somewhat horizontally to be discharged at the surface as spring water. The lack of springs in the Tower mine plan area consequently indicates the lack of much water percolating in through the soil mantle.

2.6 Mitigation and Control Plans

As was previously discussed, no significant impacts to the groundwater system are expected from the mining operation.

2.7 Groundwater Monitoring Plan

This groundwater monitoring plan supercedes the one mentioned in the original permit application. Because of limited groundwater in the Tower mine plan area and the absence of springs in the area, a simple groundwater monitoring plan is justified. The two wells shown on Figure 6 are the only current diversion points of groundwater within the mine plan area. The groundwater will be sampled by sampling the water produced out of these wells (depending on which one, if any is producing water at the time). Because of the remoteness of the spring north of the mine plan area from the mining operation, sampling of this source is not considered to be necessary. Groundwater samples will also be obtained from within the mine if significant amounts of water are encountered. S18-1 will also be monitored. Other monitoring wells have previously been proposed, but based on the results of this study, it is felt that the information that may be obtained from these wells is not very useful.

Water quality samples will be collected monthly during the 1981 baseline period. Beginning in 1982, sampling will be conducted on a quarterly basis. Each sample collected will be analyzed as outlined by the list contained in Table 2 with the exception of suspended solids. Measurements taken from the mine will give an indication of quality impacts on the deep groundwater system. The derivation of Table 2 was based on the need to clarify background conditions and future impacts. Suspended solids has been included in the abbreviated schedule as the single most

Table 2. Water Quality analytical schedule.

Field Measurements	Laboratory Measurements	
Discharge	Acidity	Manganese, Total
pH	Alkalinity	Nitrate (NO_3 as N)
Specific Conductance	Ammonia	Oil & Grease (as appropriate)
Temperature, Air	Bicarbonate	Potassium
Temperature, Water	Calcium	Sodium
	Carbonate	Sulfate
	Chloride	Total Dissolved Solids
	Iron, Dissolved	Total Suspended Solids*
	Iron, Total	
	Magnesium	

* Surface waters only

important impact indicator for surface waters. Ammonia and phosphate are included because of the high background concentrations found previously. Total dissolved solids, specific conductance, temperature, and the major cations and anions are included as indexes of major change. Total iron, dissolved iron, total manganese, nitrate. oil and grease, and pH determinations are required by OSM regulations and/or DOGM regulations.

Groundwater monitoring will continue on a quarterly basis during post mining operations until the reclamation effort is approved by the regulatory agency.

As required, groundwater quality data collected from the mine plan area will be submitted to the Utah Division of Oil, Gas, and Mining. Such reports will normally be submitted within 60 days of the ends of each quarter, depending upon the speed of laboratory analyses.

3. SURFACE WATER HYDROLOGY

As was explained under Section 2, OSM and DOGM regulations require that water monitoring programs be established in areas of underground coal mining to monitor the effects of mining activities and protect the hydrologic balance of such areas. This section of this report outlines the surface water hydrologic investigation conducted on the Tower mine plan area.

3.1 Scope

The scope of this surface water section of this report is to describe the existing hydrologic conditions of the Tower mine plan and adjacent areas and to describe the methods that have been and will be used to predict, monitor, and mitigate the impacts of mining. Sections within this surface water section of this report will cover the following topics: methodology, existing surface water resources, surface water development, control and diversions, effects of mining on the surface water hydrologic balance, mitigation and control plans, and surface water monitoring plans.

3.2 Methodology

Information used in preparing the surface water hydrologic section of this report has been gathered by field investigations

conducted both on the ground and by airplane. Pertinent literature has been examined. Water quality samples have been and will continue to be analyzed by a certified laboratory. Attachment A lists the laboratory methods used for sample analyses. Water rights were determined by examining current records of the Utah Division of Water Rights.

The mean annual water yield from the Tower mine plan area was calculated by two separate methods and compared with an estimate of the mean annual water yield given in Jeppson et al. (1968) to increase the level of confidence. The first method of calculation, referred to as "Grunsky's Rule", was originally developed by Grunsky (1908) and later adapted by Sellars (1965). In accordance with this method, the average annual water yield can be determined from

$$Q = \alpha P^2 \quad [\text{ for } P \geq 1/(2\alpha) \text{ }] \qquad (1)$$

or

$$Q = P - 1/(4\alpha) \quad [\text{ for } P \geq 1/(2\alpha) \text{ }] \qquad (2)$$

where Q is the mean annual water yield, in inches; P is the normal annual precipitation, in inches; and α is the runoff coefficient, in inches^{-1}. Alpha (α) was determined from guidelines set forth by Hawkins (1976). The second method of calculation is known as Ol'deKop's formula (Sellars, 1965). According to this method, the mean annual water yield is determined from

$$Q = P - E_o \tanh (P/E_o) \qquad (3)$$

where Q and P are as previously defined and E_o is the annual

potential evapotranspiration, in inches.

3.3 Existing Surface Water Resources

This section of the report deals with the region in general and the Tower mine plan area more specifically. Watershed and stream characteristics are both described.

3.3.1 Regional Surface Water Hydrology

The Tower mine plan area is situated in the Book Cliffs near the headquarters of the Price River Basin. The mine plan area is drained by ephemeral creeks which flow towards the Price River.

Snowmelt is the major source of water for the perennial streams of the Price River Basin. Ephemeral streams are abundant in the basin, existing primarily at lower elevations where potential evapotranspiration exceeds precipitation (such as on the Tower mine plan area).

Water use upstream from Castle Valley (the monoclinal valley containing most of the agricultural land noted in Figure 7) is primarily for stockwatering and industrial purposes (coal mining and electrical power generation). Within Castle Valley, agriculture and power production utilize nearly all of the inflowing water (Mundorff, 1972), with minimum flows in the gaged streams and rivers in the basin occasionally reaching zero. Storage reservoirs are common at higher elevations. Transbasin

diversions occur in the headwaters of the Price River.

In general, the chemical quality of water in the headwaters of the Price River Basin is excellent, with this watershed providing most of the domestic water needs of the people below. However, this quality rapidly deteriorates downstream as the streams cross shale formations (particularly the Mancos Shale in and adjacent to Castle Valley) and receive irrigation return flows from lands situated on Mancos-derived soils (Price and Waddell, 1973). Within the Price River Basin, for example, Mundorff (1972) reports that the Price River and its tributaries generally have a dissolved solids concentration of less than 400 milligrams per liter upstream from Helper. The water in this area is of a calcium-bicarbonate type. Between this point and the confluence with Miller Creek, most of the flows originate on or traverse Mancos shales. Much of the flow is derived from irrigation return flows. The Price River at Wellington, which is near the center of the basin, has an average dissolved solids content of about 1700 milligrams per liter and is of a mixed chemical type (calcium-magnesium-sodium-sulfate). At Woodside, which is about 22 miles upstream from the confluence of the Price River with the Green River, the weighted average dissolved solids content has generally been between 2000 and 4000 milligrams per liter, with the water type being strongly sodium-sulfate.

Sediment yield from the upper portion of the basin is probably negligible (Mundorff, 1972). According to the U.S. Soil

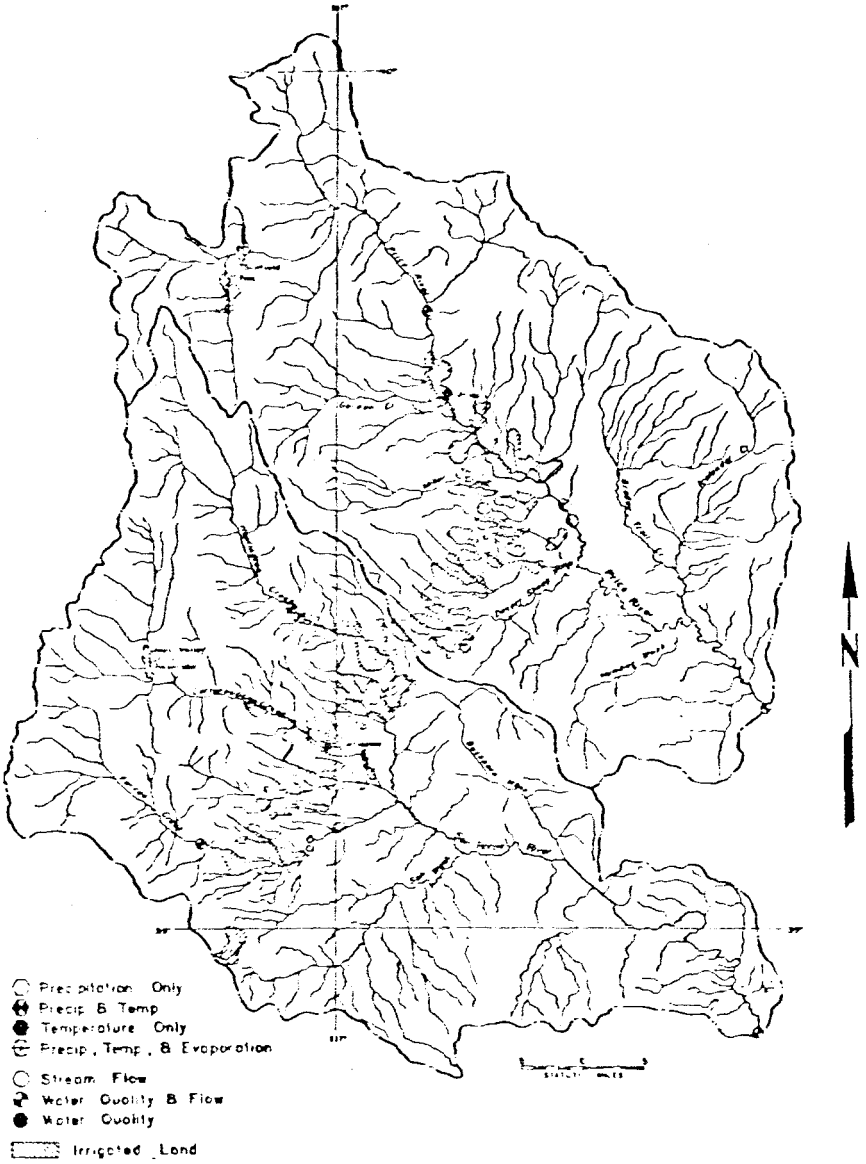


Figure 7. Price and San Rafael river basins (taken from Hyatt et al., 1970).

Conservation Service (1975), erosion rates in the Price and San Rafael River basins vary from 0.1 to 3.0 acre-feet per square mile per year. The bulk of the sediment yielded each year at the mouth of the Price River comes from limited areas covered with highly erodable shales (Mundorff, 1972).

3.3.2 Mine Plan Area Watersheds and Streams, Spring and Seep Characteristics, Stream Characteristics, and Watershed Characteristics

The Tower mine plan area is drained by ephemeral streams heading primarily in a southerly direction. The Right and Left forks of Deadman Creek drain the western portion of the mine plan area including the area of the surface facilities. Straight Canyon and Hoffman Creek drain the southeastern portion of the mine plan area and flow into Coal Creek. Coal Creek is a tributary of the Price River as is Deadman Creek. The northernmost part of the mine plan area on the Plateau drains toward Summit Creek which flows north and west into Willow Creek.

Topography in the area is generally very steep and rugged, with elevations varying from about 7200 feet to about 8500 feet above sea level. Slopes vary from vertical cliffs to less than 2 percent (1.2 degrees) on the plateau. The dominant aspect of the Tower mine plan area is to the south.

Water sources within or adjacent to the mine plan area consist of a few springs and ephemeral streams, which will be discussed in subsequent sections of this report. There are no major water bodies located within or adjacent to the mine plan area.

3.4 Surface Water Development, Control and Diversions

Because of the remoteness and the limited amount of surface water in and adjacent to the Tower mine plan area, essentially no development of the surface water has occurred except for some stock watering ponds on the north and in conjunction with runoff control facilities associated with the Pinnacle Mine. This section of the report deals with the surface water supply in the area. The supply will be discussed in terms of quantity, quality, and the water rights in the area. Runoff control facilities of the Pinnacle Mine are described in the permit application.

Flow Characteristics. According to Jeppson et al. (1968), the mean annual water yield for the Tower mine plan area is approximately one inch. Two other hydrologic methods (described in Section 3.2) were used to determine the mean annual water yield to increase the confidence level of the estimate. According to Grunsky's Rule, the mean annual water yield is less than zero which is obviously in error. According to Ol'deKop's formula (Sellars, 1965), the mean annual water yield from the mine plan area is 1.8 inches. These two methods utilize the

information that mean annual precipitation and potential evapotranspiration over the mine plan area are 14 and 21 inches respectively (Jeppson et al., 1968). The estimated mean annual water yield from Ol'deKop's formula compares quite favorably with the estimate from the Hydrologic Atlas of Utah prepared by Jeppson et al. (1968).

As mentioned previously, the mine plan area drains in a generally southerly direction in ephemeral streams.

Surface Water Quality. Surface water quality data were collected during the fall and winter period of 1980 and 1981. Samples were collected from four stockwater ponds north of the mine plan area, a station at the mouth of Clearwater Creek and on Coal Creek east of the mine plan area (see Figure 4). Attachment A summarizes the analytical methods used in both the field and laboratory, and Attachment B contains the results of the chemical analyses of the samples. Cation-anion diagrams have been included on Figure 4 as indicators of general water quality.

Total dissolved solids concentrations of the surface water samples ranged from 200 to 330 milligrams per liter at the four high elevation ponds to 660 and 700 milligrams per liter at lower elevation on Clearwater and Coal creeks, respectively. This trend follows the strong regional trend for water quality to significantly deteriorate as the water flows down over the shales. Suspended solids ranged from a low of 2.0 milligrams per

liter in Clearwater Creek to a high of 127 milligrams per liter in Coal Creek. Hydrogen ion activity (pH) of the monitored surface waters varied between 7.0 and 8.3 units. The basic nature of the waters is probably due to the high concentration of bicarbonates (American Public Health Association et al., 1976). Most natural waters are buffered to some extent by reactions involving dissolved carbon dioxide species, with the most effective buffering action from these species being within the range from 6.0 to 8.5 pH units. Therefore, the relatively constant and basic pH coupled with the low acidity and high alkalinity concentrations, indicates that waters in the area are not significantly influenced by pollution (Hem, 1970).

Dissolved iron concentrations ranged between 0.01 milligrams per liter at Station 33-1 to 0.06 milligrams per liter at three other ponds. Total iron concentrations ranged from 0.13 to 1.88 milligrams per liter at Stations 34-2 and 18-1, respectively. Total manganese concentrations varied from 0.015 to 1.22 milligrams per liter at Stations 33-1 and 34-2, respectively.

The Utah Division of Health has classified the waters within the Tower mine plan area as 3C (protected for non-game fish and other aquatic life) and 4 (protected for agricultural uses including irrigation of crops and stockwatering). Tables 3 and 4 contain the numerical water quality standards applicable to these various classifications. Only one exceedance of these chemical standards by surface waters was noted from data gathered during the

Table 3. Utah Division of Health numerical standards for water in the State.

Constituent	CLASSES										
	Domestic Source			Recreation & Aesthetics		Aquatic Wildlife				Agri-culture	Indus-try	Special
	1A	1B	1C	2A	2B	3A	3B	3C	3D	4	5	6
Bacteriological (no./100 ml)												
(30-day Geometric Mean) Maximum Total Coliforms	1	50	5,000	1,000	5,000	*	*		*	*	STANDARDS WILL BE DETERMINED ON A CASE-BY-CASE BASIS (see Table 4)	STANDARDS WILL BE DETERMINED ON A CASE-BY-CASE BASIS
Maximum Fecal Coliforms	*	*	2,000	200	2,000	*	*		*	*		
Physical												
Total Dissolved Gasses	*	*	*	*	*	(b)	(b)		*	*		
Minimum DO (mg/l) (a)	*	*	5.5	5.5	5.5	6.0	5.5		5.5	*		
Maximum Temperature	*	*	*	*	*	20°C	27°C		*	*		
Maximum Temp. Change	*	*	*	*	*	2°C	4°C		*	*		
pH	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0		6.5-9.0	6.5-9.0		
Turbidity increase (c)	*	*	*	10 NTU	10 NTU	10 NTU	10 NTU		15 NTU	*		
Chemical (Maximum mg/l)												
Arsenic, dissolved	.05	.05	.05	*	*	*	*		*	.1		
Barium, dissolved	1	1	1	*	*	*	*		*	*		
Cadmium, dissolved	.010	.010	.010	*	*	.0004(d)	.004(d)		*	.01		
Chromium, dissolved	.05	.05	.05	*	*	.10	.10		.10	.10		
Copper, dissolved	*	*	*	*	*	.01	.01		*	.2		
Cyanide	*	*	*	*	*	.005	.005		*	*		
Iron, dissolved	*	*	*	*	*	1.0	1.0		1.0	*		
Lead, dissolved	.05	.05	.05	*	*	.05	.05		*	.1		
Mercury, total	.002	.002	.002	*	*	.00005	.00005		.00005	*		
Phenol	*	*	*	*	*	.01	.01		*	*		
Selenium, dissolved	.01	.01	.01	*	*	.05	.05		*	.05		
Silver, dissolved	.05	.05	.05	*	*	.01	.01		*	*		
Zinc, dissolved	*	*	*	*	*	.05	.05		*	*		
NH_3 as N (un-ionized)	*	*	*	*	*	.02	.02		*	*		
Chlorine	*	*	*	*	*	.002	.01		*	*		
Fluoride, dissolved (e)	1.4-2.4	1.4-2.4	1.4-2.4	*	*	*	*		*	*		
NO_3 as N	10	10	10									
Boron, dissolved	*	*	*	*	*	*	*		*	.75		
H_2S	*	*	*	*	*	.002	.002		*	*		
TDS (f)	*	*	*	*	*	*	*		*	1200		
Radiological (Maximum pCi/l)												
Gross Alpha	15	15	15	*	*	15(g)	15(g)		15(g)	15(g)		
Radium 226, 228 combined	5	5	5	*	*	*	*		*	*		
Strontium 90	8	8	8	*	*	*	*		*	*		
Tritium	20,000	20,000	20,000	*	*	*	*		*	*		
Pesticides (Maximum ug/l)												
Endrin	.2	.2	.2	*	*	.004	.004		.004	*		
Lindane	4	4	4	*	*	.01	.01		.01	*		
Methoxychlor	100	100	100	*	*	.03	.03		.03	*		
Toxaphene	5	5	5	*	*	.005	.005		.005	*		
2, 4-D	100	100	100	*	*	*	*		*	*		
2, 4, 5-TP	10	10	10	*	*	*	*		*	*		
Pollution Indicators (g)												
Gross Beta (pCi/l)	50	50	50	*	*	50	50		50	50		
BOD (mg/l)	*	*	5	5	5	5	5		5	5		
NO_3 as N (mg/l)				4	4	4	4		*	*		
PO_4 as P (mg/l)(h)	*	*	*	.05	.05	.05	.05		*	*		

* Insufficient evidence to warrant the establishment of numerical standard. Limits assigned on case-by-case basis.

(a) These limits are not applicable to lower water levels in deep impoundments.

(b) Not to exceed 110% of saturation.

(c) For Classes 2A, 2B, 3A, and 3B at background levels of 100 NTUs or greater, a 10% increase limit will be used instead of the numeric values listed. For Class 3D at background levels of 150 NTUs or greater, a 10% increase limit will be used instead of the numeric value listed. Short term variances may be considered on a case-by-case basis.

(d) Limit shall be increased threefold if $CaCO_3$ hardness in water exceeds 150 mg/l.

(e) Maximum concentration varies according to the daily maximum mean air temperature.

Temp. °C	mg/l
12.0 and below	2.4
12.1 to 14.6	2.2
14.7 to 17.6	2.0
17.7 to 21.4	1.8
21.5 to 26.2	1.6
26.3 to 32.5	1.4

(f) Total dissolved solids (TDS) limit may be adjusted on a case-by-case basis.

(g) Investigations should be conducted to develop more information where these pollution indicator levels are exceeded.

(h) PO_4 as P(mg/l) limit for lakes and reservoirs shall be .025.

Table 4. Numerical standards for class 3C water use.

Physical	
Minimum D.O. (mg/l)	5
Maximum Temperature	27°C
Maximum Temperature Change	4°C
pH	6.5-9.0
Turbidity Increase (NTU)	15****
Chemical (Maximum Mg/l)	
Cadmium, dissolved	0.004
Chromium, dissolved	0.1
Copper, dissolved	0.01
Cyanide	0.005
Iron, dissolved	1.0
Lead, dissolved	0.05
Mercury, total	0.0005
Phenol	0.01
Selenium, dissolved	0.05
Silver, dissolved	0.01
Zinc, dissolved	0.05
Chlorine	0.2
H_2S	0.02
Radiological (Maximum pCi/l)	
Gross Alpha	15
Gross Beta	30
Pesticides (Maximum mg/l	
Endrin	0.004
Lindane	0.01
Methoxychlor	0.03
Toxaphene	0.005
Pollution Indicators***	
BOD (mg/l)	5.0
NO_3 as N (mg/l)	4.0

***Investigations should be conducted to develop more information where these pollution indicator levels are exceeded.

****At background levels of 150 NTU's or greater, a 10% increase limit will be used instead of the numeric values. Short term variances may be considered on a case-by-case basis.

hydrologic inventory (dissolved copper was measured at 0.02 milligrams per liter at Station 32-1).

Water Rights. Surface water rights in and adjacent to the Tower mine plan area on file as of February 1981 with the Utah Division of Water Rights are listed on Table 5 and shown on Figure 5. All surface water rights in the area are for stockwatering uses except for one irrigation diversion on Coal Creek slightly over a mile southeast of the mine plan area.

3.5 Effect of Mining on the Surface Water Hydrologic Balance

As has been previously mentioned in this report, the occurrence and quality of water in any region is highly controlled by geology. It is felt that mining activities will have insignificant adverse impact on the areal hydrologic system.

3.5.1 Quantity

As mentioned earlier in the report, the major ephemeral drainages conveying runoff away from the mine plan area are the Right and Left Forks of Deadman Canyon, Straight Canyon, and Hoffman Creek. The surface facilities are located in the Right Fork of Deadman Canyon. No mine water will be discharged into surface streams, as any that may be encountered will be used within the mine. As a result, it is felt that the mining operation will have no significant impact on the surface water system.

Table 5. Surface water rights located on and adjacent to the Tower mine plan area.

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-140	George M. & Ardith Thayn	Coal Creek	----	Stockwatering	January 1 to December 31
91-761	George M. & Ardith Thayn	Coal Creek	2.0	Irrigation	April 1 to October 31
91-843	J. D. and Inez Critchlow	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-845	J. D. and Inez Critchlow	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-846	J. D. and Inez Critchlow	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-847	J. D. and Inez Critchlow	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-854	Jay L. Critchlow (1/2 interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-855	Jay L. Critchlow (1/2 interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-857	Jay L. Critchlow (1/2 interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-858	Jay L. Critchlow (1/2 interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-860	Jay L. Critchlow (1/2 interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-882	John C. Critchlow (1/2 interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-883	John C. Critchlow (1/2 interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-885	John C. Critchlow (1/2 interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-886	John C. Critchlow (1/2 interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-888	John C. Critchlow (1/2 interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-1187	Funnon T. & Donna Shimmin	Big Summit Creek	----	Stockwatering	May 1 to November 30
91-1188	Funnon T. & Donna Shimmin	Big Summit Creek	----	Stockwatering	May 1 to November 30
91-1195	Vera T. Shimmin	Clear Water Creek	----	Stockwatering	May 1 to November 30
91-1197	Vera T. Shimmin	Clear Water Creek	----	Stockwatering	May 1 to November 30
91-1203	Vera T. Shimmin	Big Summit Creek	----	Stockwatering	May 1 to November 30
91-1204	Vera T. Shimmin	Big Summit Creek	----	Stockwatering	May 1 to November 30

Table 5. Continued.

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-1709	Funnon T. & Donna Shimmin	Clear Water Creek	----	Stockwatering	May 1 to November 30
91-1712	Funnon T. & Donna Shimmin	Unnamed Stream	----	Stockwatering	May 1 to November 30
91-1715	Funnon T. & Donna Shimmin	Unnamed Stream	----	Stockwatering	May 1 to November 30
91-1727	Rex Mathis	Buck Creek	----	Stockwatering	May 1 to November 30
91-1729	Rex Mathis	Buck Creek	----	Stockwatering	May 1 to November 30
91-1731	Rex Mathis	Tributary to Antone Creek	----	Stockwatering	April 1 to November 30
91-1732	Rex Mathis	Tributary to Antone Creek	----	Stockwatering	April 1 to November 30
91-1734	Rex Mathis	Unnamed Stream	----	Stockwatering	April 1 to November 30
91-1737	Rex Mathis	Antone Creek	----	Stockwatering	April 1 to November 30
91-1372	Ezra Branch	Clear Water Creek	----	Stockwatering	May 1 to November 30
91-1567	Rex Mathis	Tributary to Antone Creek	----	Stockwatering	April 1 to November 30
91-1942	John A. Mathis	Clear Water Creek	----	Stockwatering	April 1 to November 30
91-2570	U.S. Bureau of Land Management	Coal Creek	----	Stockwatering	January 1 to December 31
91-2575	U.S. Bureau of Land Management	Coal Creek	----	Stockwatering	January 1 to December 31
91-3663	Big Summit Creek	Jay L. Critchlow	----	Stockwatering	March 1 to November 30

3.5.2 Quality

The quality of flow from the headwaters of the Price River Basin is excellent. However, this quality rapidly deteriorates downstream as the stream crosses shale formations and receives irrigation return flows from Mancos-derived soils. Mining within the Tower mine plan area is expected to have no impact on this system.

The construction and upgrading of surface facilities utilized in conjunction with the Centennial Project (yard areas, roads, conveyor lines, etc.) will result in temporary increases in the suspended sediment concentration of the adjacent stream. However, because of the regulatory requirement that sediment control be provided for all areas of surface disturbance, concentrations should be quickly normalized.

3.6 Mitigation and Control Plans

Runoff from all disturbed areas will be passed through sediment control facilities, as discussed earlier in this report. Any discharge from facilities will be monitored in accordance with NPDES permit standards and state and federal regulations.

The effects of the mining operation on the surface water system will be analyzed through the surface water monitoring plan described in the next section. In the unlikely event that

monitoring shows that the surface water system is being adversely affected by the mining activities, additional steps will be taken to rectify the situation in consultation with State and Federal agencies.

3.7 Surface Water Monitoring Plan

An ongoing hydrologic monitoring program will be conducted at each of the stations shown on Figure 6. Stations 7-1 and 18-4 (located above and below the disturbed area in the Right Fork of Deadman Canyon) will be used as indicators of the effect of surface disturbances in the canyon on water quality. Stations 8-1 and 17-1 (located above and below the proposed surface facilities in the small drainage basin just east of the Right Fork of Deadman Canyon) will be used as indicators of the effect of surface disturbances in that canyon on water quality. Portals may also be constructed in the future in Straight Canyon. If so, Stations 8-1 and 17-2 will be established above and below the area of surface disturbance two years prior to the commencement of construction. As mentioned previously, all of these streams are ephemeral and will consequently not have water to be sampled most of the time.

Samples will be collected monthly during the 1981 baseline period when accessible and flowing from all surface water stations shown on Figure 6, and will be analyzed according to the schedule listed in Table 2. Samples will be analyzed according to

Attachment A. Beginning in 1982, after the baseline data has been gathered, the sampling frequency will be reduced to a quarterly basis.

Surface water monitoring will continue on a quarterly basis, when accessible, during post mining operations until the reclamation effort is approved by the regulatory agency. Post-mining samples will be analyzed in accordance with the water quality analytical schedule in Table 2 (or an abbreviated schedule approved by the appropriate regulating agencies).

In addition to the above outlined monitoring program, an NPDES discharge permit will be acquired as necessary for new surface facilities. Monitoring of all discharges will be conducted in accordance with these permits.

As required, water quality data collected from surface water monitoring stations will be submitted to the regulatory authority (Utah Division of Oil, Gas, and Mining). Such reports will normally be submitted within 60 to 90 days at the end of each quarter, depending upon the speed of the laboratory analyses.

4. ALLUVIAL VALLEY FLOOR DETERMINATION

The geomorphic criteria for identification of potential alluvial floors are not met within the Tower mine plan or adjacent areas within a two mile radius. Doelling (1972) did not identify any alluvial deposits within a two mile radius of the mine plan area. Consequently, no further investigations in regard to alluvial valley floors should be required.

5. BIBLIOGRAPHY

Anderson, Paul. Geologist. Eureka Energy Company, Salt Lake City, Utah. Personal Communication in August, 1979.

American Public Health Association, American Water Works Association, and Water Pollution Control Federation. 1976. Standard Methods for the Examination of Water and Wastewater. Fourteenth Edition, Washington, D.C.

Clark, Frank R., 1928. Economic Geology of Castlegate, Wellington and Sunnyside Quadrangles, Carbon County, Utah: U.S. Geological Survey Bulletin 793.

Doelling, H. H. 1972. Wasatch Plateau Coal Fields. In Doelling, H. H. (ed.). Central Utah Coal Fields; Sevier-Sanpete, Wasatch Plateau, Book Cliffs and Emery. Utah Geological and Mineralogical Survey Monograph Series No. 3. Salt Lake City, Utah.

Glasson, M. 1981. Tower Resources Company, Incorporated. Personal Communication dated February 20, 1981.

Grunsky, C. E. 1908. Rain and Runoff Near San Francisco, California. Transactions of the American Society of Civil Engineers. p. 496-543.

Hawkins, R. H. 1976. Estimating Annual Water Yield-Grunsky's Rule. Class handout prepared for WS540 (Watershed Operations). Watershed Science Unit. Utah State University. Logan, Utah.

Hem, J. D. 1970. Study and Interpretation of the Chemical Characteristics of Natural Water. U.S. Geological Survey Water-Supply Paper 1473. Second Edition. Washington, D.C.

Jeppson, R. W., G. L. Ashcroft, A. L. Huber, G. V. Skogerboe, and J. M. Bagley, 1968. Hydrologic Atlas of Utah. Utah Water Research Laboratory and State of Utah Department of Natural Resources. PRWG35-1. Utah State University. Logan, Utah.

Mundorff, J. C. 1972. Reconnaissance of Chemical Quality of Surface Water and Fluvial Sediment in the Price River Basin, Utah. Utah Department of Natural Resources, Division of Water Rights. Technical Publication No. 39. Salt Lake City, Utah.

Price, D., and T. Arnow. 1974. Summary Appraisals of the Nation's Ground Water Resources - Upper Colorado Region. U.S Geological Survey Professional Paper 813-C. Washington, D.C.

Price, D. and K. M. Waddel. 1973. Selected Hydrologic Data in the Upper Colorado River Basin. U.S. Geological Survey Hydrologic Investigations Atlas HA-477. Washington, D. C.

Sellars, W. D. 1965. Physical Climatology. University of Chicago Press. Chicago, Illinois.

Spieker, E. M., 1925. Geology of Coal Fields in Utah: U.S. Bureau of Mines Technical Paper 345, p. 13-72.

U.S. Soil Conservation Service. 1975. Erosion, Sediment, and Related Salt Problems and Treatment Opportunities. Special Projects Division. Golden, Colorado.

ATTACHMENT A

Water Quality Analysis Methods

Table 6. Field methods used for the analysis of water quality samples.

Parameter	Units	Instrument
Flow	cfs	Marsh-McBirney current meter, float measurement, or volumetric measurement
Temperature	^{o}C	Thermometer
pH	units	Beckman Model 1009 pH meter
Conductivity	micromhos/cm @ 25°C	Hydrolab TC-2 conductivity meter

Table 7. Laboratory methods used for the analysis of water quality samples, with standard reference page numbers.

Parameter	Unit	Method	1974 EPA Methods Page No.	14th Ed. Standard Methods Page No.
Acidity, as $CaCO_3$	mg/l	Titration	1	273
Alkalinity, as $CaCO_3$	mg/l	Manual or automated electrometric titration to pH 4.5, or automated method	3 5	278 ---
Ammonia, as N	mg/l	Manual distillation (at pH 9.5) followed by nesslerization, titration, electrode, automated phenolate	--- 159 165 168	410 412 --- ---
Arsenic	mg/l	Digestion followed by silver diethyldithiocarbamate, or atomic absorption	--- 9 95	285 283 159
BOD, 5-day	mg/l	Winkler (azide modification) or electrode method	--	543
Barium	mg/l	Digestion followed by atomic absorption or colorimetric	97	152
Bicarbonate	mg/l	Titration	278	--
Boron	mg/l	Colorimetric (Curcumin)	13	287
Cadmium	mg/l	Digestion followed by atomic absorption or colorimetric	101 ---	148 182
Calcium	mg/l	Digestion followed by atomic absorption or titration	103 ---	148 182

Table 7. Continued.

Parameter	Unit	Method	1974 EPA Methods Page No.	14th Ed. Standard Methods Page No.
Chloride	mg/l	Silver nitrate, mercuric nitrate, or automated clorimetric	--- 29 31	303 304 613
Chromium, VI	mg/l	Extration and atomic absorption, colorimetric	89 105	--- 192
Copper	mg/l	Digestion followed by atomic absorption or colorimetric	108 ---	148 196
Cyanide	mg/l	Distillation followed by silver nitrate titration or pyridine pyrazolone (or barbituric acid) colorimetric	40	361
Fluoride	mg/l	Distillation followed by ion electrode, SPANDS, or automated complexone	--- 65 59 61	389 391 393 164
Gross Alpha Radioactivity	pCi/l	Scintillation counter	--	641
Gross Beta Radioactivity	pCi/l	Scintillation counter	--	642
Iron	mg/l	Digestion followed by atomic absorption or colorimetric	110 ---	148 208
Lead	mg/l	Digestion followed by atomic absorption or colorimetric	112 ---	148 215

Table 7. Continued.

Parameter	Unit	Method	1974 EPA Methods Page No.	14th Ed. Standard Methods Page No.
MPN Fecal Coliform	MPN/100 ml	MPN procedure	--	922
MPN Total Coliform	MPN/100 ml	MPN procedure	--	922
Magnesium	mg/l	Digestion followed by atomic absorption or gravimetric	114 ---	148 221
Manganese	mg/l	Digestion followed by atomic absorption or colorimetric	116 ---	148 225
Mercury	mg/l	Flameless atomic absorption	118	156
Nitrate, as N	mg/l	Cadmium reduction, brucine sulfate, automated cadmium or hydrazine reduction	201 197 207	423 427 620
Oil & Grease	mg/l	Liquid extraction with freongravimetric	229	515
Phenol	mg/l	Colorimetric (4-AAP)	241	582
Phosphate, as P	mg/l	Manual or automated ascorbic acid reduction	249 256	481 624
Potassium	mg/l	Digestion followed by atomic absorption, colorimetric or flame photometric	143 --- ---	--- 235 234
Selenium	mg/l	Digestion followed by atomic absorption	145	159
Silver	mg/l	Digestion followed by atomic absorption or colorimetric	146	148

Table 7. Continued.

Parameter	Unit	Method	1974 EPA Methods Page No.	14th Ed. Standard Methods Page No.
Sodium	mg/l	Digestion followed by atomic absorption, flame photometric	147 ---	--- 250
Sulfate	mg/l	Gravimetric, turbidimetric, or automated colorimetric	--- 277, 279	493 496
Suspended Solids	mg/l	Glass fiber filtration, 105°C	268	94
Total Suspended Solids	mg/l	Glass fiber filtration, 180°C	266	92
Total Organic Carbon	mg/l	Combustion - infrared	236	532
Turbidity	NTU	Nephelometric	295	132
Zinc	mg/l	Digestion followed by atomic absorption or colorimetric	155 ---	148 265

ATTACHMENT B

Results of Surface Water Quality Analysis

Table 8. Results of chemical analyses of water quality samples.

Station	S18-1	S18-1	S18-1	S18-1
Date	10/21/80	11/26/80	12/30/80	1/6/81
Flow, gpm	13	2	Seep	1
Conductance, umhos/cm (field)	----	----	750	510
Temperature, Air °C	14	5	-3	1
Temperature, Water °C	11	4	5	4
Acidity as CaCO3 mg/l	12.0	28.0	<.1	8.0
Alkalinity as CaCO3 mg/l	444.00	462.00	454.00	436.00
Ammonia as NO3-N mg/l	<.01	<.01	.10	<.01
Arsenic as As (Tot) mg/l	.013	.010	.001	<.001
Arsenic as As (Dissolved) mg/l	.010	.006	<.001	<.001
Barium as Ba (Dissolved) mg/l	.965	.950	.035	.040
Barium as Ba (Total) mg/l	2.500	2.810	.080	.040
Bicarbonate as HCO3 mg/l	541.68	563.64	551.44	531.92
Boron as B (Dissolved) mg/l	.098	.088	.240	.220
Boron as B (Total) mg/l	.139	.150	.250	.220
Cadmium as Cd (Tot) mg/l	.002	<.001	<.001	<.001
Cadmium as Cd (Dissolved) mg/l	<.001	<.001	<.001	<.001
Calcium as Ca mg/l	124.00	188.00	117.60	108.00
Carbonate as CO3 mg/l	<.01	<.01	<.01	<.01
Chloride as Cl mg/l	21.9	12.30	12.10	13.60
Chromium as Cr (Tot) mg/l	<.001	<.001	<.001	<.001
Chromium as Cr (Dissolved) mg/l	<.001	<.001	<.001	<.001
Conductivity umhos/cm	2,280	1,770	1,350	1,200
Copper as Cu (Dissolved) mg/l	.001	.002	.010	.010
Copper as Cu (Total) mg/l	.006	.005	.012	.010
Fluoride as F mg/l	.46	.39	.26	.35
Iron as Fe (Dissolved) mg/l	1.580	1.330	.150	.230
Iron as Fe (Total) mg/l	4.530	4.410	.220	.300
Lead as Pb (Dissolved) mg/l	.055	<.001	<.001	.001
Lead as Pb (Total) mg/l	.250	<.001	<.001	.002
Magnesium as Mg mg/l	106.08	117.60	114.72	134.40
Manganese as Mn (Tot) mg/l	.139	.030	.020	.015
Manganese as Mn (Dissolved) mg/l	.110	.015	.010	.010
Mercury as Hg (Tot) mg/l	.0005	.0003	<.0002	<.0002
Mercury as Hg (Dissolved) mg/l	.0003	<.0002	<.0002	<.0002
Molybdenum as Mo (Tot) mg/l	.014	.012	<.001	<.001
Molybdenum as Mo (Dissolved) mg/l	.008	.010	<.001	<.001
Nitrate as NO3-N mg/l	.76	.68	1.00	1.06
Oil and Grease mg/l	.60	1.50	1.60	.80
Phosphate PO4-P Ortho mg/l	.020	.050	.050	<.001
Phosphate as PO4-P (Total) mg/l	.090	.140	.130	.100
Potassium as K mg/l	54.80	7.70	4.65	7.20
Selenium as Se (Tot) mg/l	<.001	<.001	.004	.004
Selenium as Se (Dissolved) mg/l	<.001	<.001	.004	.006
Silver as As (Dissolved) mg/l	<.001	<.001	<.001	<.001
Silver as As (Total) mg/l	<.001	<.001	<.001	<.001
Sodium as Na mg/l	215.80	52.50	20.00	48.60
Sulfate as SO4 mg/l	770	568	330	300
Suspended Solids mg/l	43.0	14.0	8.0	11.0
Total Dissolved Solids mg/l	1,560	1,220	890	840
Total Kjeldahl Nitrogen mg/l	.10	.11	.25	<.01
Zinc as Zn (Dissolved) mg/l	.228	.002	.012	.012
Zinc as Zn (Total) mg/l	.456	.125	.030	.015
pH Units	7.20	7.25	7.10	7.40

Table 8. Continued.

Station	534-1	36-1	31-1	33-1
Date	12/22/80	12/22/80	12/22/80	12/22/80
Flow, gpm	10	----	----	----
Conductance, umhos/cm (field)	----	205	198	274
Temperature, Air °C	1	0	1	2
Temperature, Water °C	2	2	2	3
Acidity as CaCO3 mg/l	<.1	<.1	<.1	10.0
Alkalinity as CaCO3 mg/l	340.00	214.00	204.00	310.00
Ammonia as NO3-N mg/l	<.01	<.01	<.01	.40
Arsenic as As (Tot) mg/l	.001	.004	.007	.008
Arsenic as As (Dissolved) mg/l	.001	.002	.002	.006
Barium as Ba (Dissolved) mg/l	.020	.022	.018	.035
Barium as Ba (Total) mg/l	.040	.040	.036	.050
Bicarbonate as HCO3 mg/l	456.28	236.68	185.44	378.20
Boron as B (Dissolved) mg/l	.004	.016	.005	.010
Boron as B (Total) mg/l	.012	.010	.009	.013
Cadmium as Cd (Tot) mg/l	<.001	<.001	<.001	<.001
Cadmium as Cd (Dissolved) mg/l	<.001	<.001	<.001	<.001
Calcium as Ca mg/l	60.00	48.00	54.00	72.00
Carbonate as CO3 mg/l	9.60	12.00	31.20	<.01
Chloride as Cl mg/l	4.00	6.00	4.00	12.00
Chromium as Cr (Tot) mg/l	.001	.001	.002	.002
Chromium as Cr (Dissolved) mg/l	<.001	<.001	.001	<.001
Conductivity umhos/cm	710	340	300	510
Copper as Cu (Dissolved) mg/l	.010	.010	.010	.010
Copper as Cu (Total) mg/l	.010	.010	.020	.020
Fluoride as F mg/l	.20	.08	.07	.09
Iron as Fe (Dissolved) mg/l	.030	.060	.060	.010
Iron as Fe (Total) mg/l	.060	.490	1.600	1.060
Lead as Pb (Dissolved) mg/l	.002	<.001	<.001	<.001
Lead as Pb (Total) mg/l	.007	.005	.018	.016
Magnesium as Mg mg/l	62.40	4.80	13.20	16.80
Manganese as Mn (Tot) mg/l	.010	.475	1.050	1.220
Manganese as Mn (Dissolved) mg/l	.010	.195	.005	.010
Mercury as Hg (Tot) mg/l	<.0002	<.0002	<.0002	<.0002
Mercury as Hg (Dissolved) mg/l	<.0002	<.0002	<.0002	<.0002
Molybdenum as Mo (Tot) mg/l	<.001	<.001	<.001	<.001
Molybdenum as Mo (Dissolved) mg/l	<.001	<.001	<.001	<.001
Nitrate as NO3-N mg/l	<.01	<.01	<.01	.02
Oil and Grease mg/l	1.20	24.20	26.20	21.40
Phosphate PO4-P Ortho mg/l	.031	.130	.080	.480
Phosphate as PO4-P (Total) mg/l	.070	.240	.420	.770
Potassium as K mg/l	2.82	11.40	11.85	30.00
Selenium as Se (Tot) mg/l	<.001	<.001	<.001	<.001
Selenium as Se (Dissolved) mg/l	<.001	<.001	<.001	<.001
Silver as As (Dissolved) mg/l	<.001	<.001	<.001	<.001
Silver as As (Total) mg/l	<.001	<.001	<.001	<.001
Sodium as Na mg/l	30.00	29.00	5.90	15.00
Sulfate as SO4 mg/l	73.0	<3.0	7.0	<3.0
Suspended Solids mg/l	9.0	14.0	46.0	47.0
Total Dissolved Solids mg/l	465	220	200	330
Total Kjeldahl Nitrogen mg/l	.05	.03	.01	.05
Zinc as Zn (Dissolved) mg/l	.012	.007	.007	.005
Zinc as Zn (Total) mg/l	.018	.025	.035	.030
pH Units	7.30	8.00	8.30	7.00

Table 8. Continued.

Station	32-1	10-1	34-2
Date	12/22/80	1/6/81	1/6/81
Flow, gpm	Pond	490	90
Conductance, umhos/cm (field)	262	520	----
Temperature, Air °C	1	5	0
Temperature, Water °C	2	0	0
Acidity as CaCO3 mg/l	6.0	<.1	<.1
Alkalinity as CACO3 mg/l	260.00	418.00	398.00
Ammonia as NO3-N mg/l	.20	<.01	<.01
Arsenic as As (Tot) mg/l	.001	.002	<.001
Arsenic as As (Dissolved) mg/l	<.001	<.001	<.001
Barium as Ba (Dissolved) mg/l	,040	.105	.085
Barium as Ba (Total) mg/l	.055	.105	.085
Bicarbonate as HCO3 mg/l	317.20	505.08	466.04
Boron as B (Dissolved) mg/l	.015	.185	.095
Boron as B (Total) mg/l	.018	.185	.095
Cadmium as Cd (Tot) mg/l	<.001	.001	<.001
Cadmium as Cd (Dissolved) mg/l	<.001	<.001	<.001
Calcium as Ca mg/l	44.00	64.00	72.00
Carbonate as CO3 mg/l	<.01	2.40	9.60
Chloride as Cl mg/l	10.00	13.50	5.64
Chromium as Cr (Tot) mg/l	.002	<.001	<.001
Chromium as Cr (Dissolved) mg/l	<.001	<.001	<.001
Conductivity umhos/cm	400	1,000	940
Copper as Cu (Dissolved) mg/l	.020	<.001	<.001
Copper as Cu (Total) mg/l	.020	.040	.010
Fluoride as F mg/l	.05	.31	.25
Iron as Fe (Dissolved) mg/l	.060	.030	.040
Iron as Fe (Total) mg/l	.360	1.880	.130
Lead as Pb (Dissolved) mg/l	<.001	<.001	.001
Lead as Pb (Total) mg/l	.004	.022	.003
Magnesium as Mg mg/l	30.00	74.40	81.60
Manganese as Mn (Tot) mg/l	.135	.085	.015
Manganese as Mn (Dissolved) mg/l	.120	.030	.010
Mercury as Hg (Tot) mg/l	<.0002	<.0002	<.0002
Mercury as Hg (Dissolved) mg/l	<.0001	<.0002	<.0002
Molybdenum as Mo (Tot) mg/l	<.001	<.001	<.001
Molybdenum as Mo (Dissolved) mg/l	<.001	<.001	<.001
Nitrate as NO3-N mg/l	.04	<.01	<.01
Oil and Grease mg/l	15.00	.80	.60
Phosphate PO4-P Ortho mg/l	.080	.020	<.001
Phosphate as PO4-P (Total) mg/l	.340	.170	.060
Potassium as K mg/l	15.00	3.95	3.26
Selenium as Se (Tot) mg/l	<.001	.004	.003
Selenium as Se (Dissolved) mg/l	<.001	.004	.001
Silver as As (Dissolved) mg/l	<.001	<.001	<.001
Silver as As (Total) mg/l	<.001	<.001	<.001
Sodium as Na mg/l	9.00	105.00	32.10
Sulfate as SO4 mg/l	<3.0	265	171
Suspended Solids mg/l	9.0	127	2.0
Total Dissolved Solids mg/l	265	700	660
Total Kjeldahl Nitrogen mg/l	.04	<.01	<.01
Zinc as Zn (Dissolved) mg/l	.012	.010	.015
Zinc as Zn (Total) mg/l	.015	.050	.015
pH Units	7.30	7.80	8.00

Table 8. Continued.

Station	Well #1 Pinnacle Mine	Well #2 Pinnacle Mine
Date	8/29/80	9/7/80
Flow, gpm	----	----
Conductance, umhos/cm (field)	----	----
Temperature, Air	----	----
Temperature, Water	----	----
Acidity as CaCO3 mg/l	0	0
Alkalinity as CACO3 mg/l	452.6	461.2
Ammonia as NO3-N mg/l	----	----
Arsenic as As (Tot) mg/l	0.0007	0.0013
Arsenic as As (Dissolved) mg/l	----	----
Barium as Ba (Dissolved) mg/l	----	----
Barium as Ba (Total) mg/l	<0.2	<0.20
Bicarbonate as HCO3 mg/l	452.6	461.2
Boron as B (Dissolved) mg/l	----	----
Boron as B (Total) mg/l	2.680	0.7
Cadmium as Cd (Tot) mg/l	< 0.02	< 0.02
Cadmium as Cd (Dissolved) mg/l	----	----
Calcium as Ca mg/l	1.0	64.50
Carbonate as CO3 mg/l	0	0
Chloride as Cl mg/l	26.4	41.0
Chromium as Cr (Tot) mg/l	0.08	< 0.05
Chromium as Cr (Dissolved) mg/l	----	----
Conductivity umhos/cm	1290	1690
Copper as Cu (Dissolved) mg/l	----	----
Copper as Cu (Total) mg/l	< 0.02	< 0.03
Fluoride as F mg/l	0.30	.219
Iron as Fe (Dissolved) mg/l	----	----
Iron as Fe (Total) mg/l	0.04	< 0.05
Lead as Pb (Dissolved) mg/l	----	----
Lead as Pb (Total) mg/l	< 0.1	< 0.05
Magnesium as Mg mg/l	14.08	27.6
Manganese as Mn (Tot) mg/l	0.01	< 0.01
Manganese as Mn (Dissolved) mg/l	----	----
Mercury as Hg (Tot) mg/l	0.0035	< 0.0002
Mercury as Hg (Dissolved) mg/l	----	----
Molybdenum as Mo (Tot) mg/l	----	< 0.1
Molybdenum as Mo (Dissolved) mg/l	----	----
Nitrate as NO3-N mg/l	0.35	0.37
Oil and Grease mg/l	----	----
Phosphate PO4-P Ortho mg/l	< 0.1	< 0.1
Phosphate as PO4-P (Total) mg/l	< 0.1	< 0.1
Potassium as K mg/l	5.8	12.8
Selenium as Se (Tot) mg/l	< 0.0002	< 0.0002
Selenium as Se (Dissolved) mg/l	----	----
Silver as As (Dissolved) mg/l	----	----
Silver as As (Total) mg/l	< 0.03	< 0.01
Sodium as Na mg/l	22.8	39.8
Sulfate as SO4 mg/l	251.4	483.9
Suspended Solids mg/l	4.0	105
Total Dissolved Solids mg/l	846	1164
Total Kjeldahl Nitrogen mg/l	----	0.50
Zinc as Zn (Dissolved) mg/l	----	----
Zinc as Zn (Total) mg/l	< 0.01	< 0.01
pH Units	7.5	7.7

E.

V. HISTORY OF VIOLATIONS

O.S.M. VI ATIONS

IME NAME	VIOLATION NO.	STATE PERMIT NO.	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPOSI
ow	715.17(a) 79-II-20-29(1)	054-0010	15-08046	July 11,12,13'79	1:00PM - 4:30PM	Aug. 1, 1979	conte $1000.00 No Penal
"	715.17(a) 79-II-20-29(2)	054-0010	15-08046	"	"	Aug. 13, 1979	No Penal
"	715.16 80-2-82-4	054-0009	15-08046	March 18, 1980	11:00AM - 2:00PM	March 27, 1980	No Penal
"	715.17(a) 80-2-47-19	054-0059	15-08046	May 15, 1980	1:00PM - 4:00PM	--	No Penal
"	715.16 (c) 80-2-47-36	054-0010	15-08046	Sept.26,29,30'80	9:00AM - 4:30PM	Oct. 15, 1980	No Penal
"	715.7 (g) 80-2-47-49	054-0059	15-08046	Dec. 17, 1980	9:00AM - 3:30PM		

O.S.M. ATIONS

MINE NAME	VIOLATION NO.	STATE PERMIT NO.	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPOS
nture Mine	715.16 (c) 80-2-20-5	289-0227	15-03845	Feb. 29, 1980	9:00AM - 4:00PM	April 4, 1980	No Penal
" "	715.17(h) 80-2-20-6	289-0320	15-03845	Feb. 29, 1980	9:00AM - 4:00PM	March 25, 1980	$360.00 Paid 8-8
" "	715.12(b) 80-2-20-8	289-0320	15-03845	April 2, 1980	10:00AM - 11:00AM	April 4, 1980	$700.00
" "	80-2-28-8	289-0320	15-03845				$700.00

O.S.M. ATIONS

MINE NAME	VIOLATION NO.	STATE PERMIT NO.	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPOS
Dry Creek	715.17 (a) 79-II-37-9	289-0354	15-02063	Aug. 9,13,1979	11:00AM - 2:30PM	Aug. 18, 1979	$460.00 comb $260.00
" "	715.12(b) 80-2-20-18(1)	089-0083	15-02063	July 16,17,1980	11:00AM - 4:00PM	July 23, 1980	No Penal
" "	715.17(h) 80-2-20-18(2)	089-0083	15-02063	"	"	Vacated July 28, 1980	$900.00 com No Penalt
" "	715.12(f) 80-2-20-19	289-0354	15-02063	July 17, 1980	10:30AM - 4:00PM	July 23, 1980	
" "	715.17(h) 80-2-20-22	289-0133	15-02063	July 24, 1980	1:30PM - 4:00PM		$900.00 com No Penalt

O.S.M.V. ACTIONS

MINE NAME	VIOLATION NO.	STATE PERMIT NO.	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPOSI
CA Processing	715.17 79-11-37-4	---	15-02067	May 9, 1979	2:00PM - 3:00PM	June 25, 1979	cont $1700.00 $ 420.00
" "	715.17 (a) 80-2-20-20	5778-76	15-02067-0	July 23, 1980	10:30AM - 2:30PM		No Penalt
" "	715.17 (a) 80-2-20-21	None	15-02067-0	July 23, 1980	10:30AM - 3:00PM	Aug. 6, 1980	No Penal

O.S.M. V[illegible]ATIONS

[illegible]E NAME	VIOLATION NO.	STATE PERMIT NO.	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPOSIT
[illegible]ter Mine	715.17 (a) 78-II-21-2	2437-74 S#1	---	Aug. 10, 1978	12:30PM - 4:00PM		

O.S.H. VIOLATION

MINE NAME	VIOLATION NO.	STATE PERMIT NO.	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPOS
Jimmron	715.16 78-II-3-13	5016-76	15-02013	Oct. 16,18,1978	9:00AM - 2:30PM		
"	78-II-3-14	None	15-02013	Oct. 18,26,1978	10:00AM -11:45AM	Nov. 7, 1978	No Penal
"	79-2-20-39(1)	254-0291	15-02013	Sept. 13,1979	1:00PM - 2:00PM	Oct. 19, 1979	No Penal
"	79-2-20-39(2)	254-0291	15-02013	Sept, 13,1979	"		
"	715.17(a) 80-2-47-35(1)	254-0291	15-02013	Sept.18,19,23'80	9:00AM - 3:00PM	Oct. 7, 1980	contest $1500.00
"	30 USC 502 (a) 80-2-47-35(2)	254-0291	15-02013	Sept.18,19,23'80	"		contest $1100.00

MINE NAME	VIOLATION NO.	VIOLATION CODE PART & SECTION	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPOSITION
Venture	1 - CVT	77.107-1	15-03845	1-9-78	8:00	1-20-78	
"	395791	77.400 (1)	"	7-6-78	10:00	8-2-78	
"	395788	77.404 (a)	"	7-6-78	0915	7-7-78	
"	395789	77.404 (a)	"	7-6-78	0930	7-7-78	
"	395790	77.404 (a)	"	7-6-78	0945	7-7-78	
"	9948400	71.108	"	1-5-79	0800	1-10-79	

MSHA [illegible]

MINE NAME	VIOLATION NO.	VIOLATION CODE PART & SECTION	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPO
[illegible]ey Creek	8-0001	77.107-1	15-02063	1-9-78	8:00 AM	1-20-78	$52.00 Paid 8-[illegible]
"	401321	77.701	"	11-22-78	9:00 AM	11-22-78	$56.00 [illegible] Paid 1-[illegible]
"	401322	77.402	"	11-22-78	10:00 AM	11-22-78	$90.00 [illegible] Paid 1-[illegible]
"	0800769	77.400	"	10-30-79	0900		
"	0799249	77.0701	"	11-19-79	1220	11-19-79	
"	01031121	77.408	"	7-22-80			$38.00 Paid 1[illegible]
"	0800547	77.1007 (b)	"	7-22-80	1015	7-22-80	
"	9949072	71.101	"	8-4-80	0800		

MSHA VIOLATIONS

MINE NAME	VIOLATION NO.	VIOLATION CODE PART & SECTION	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPOS
% Processing	8-0001	77.107-1	15-02067	1-9-78			$32.00 I Paid 10-
"	09948034	71.108	"	4-27-78			$34.00 F Paid 10-
"	09948133	71.108	"	6-2-78			$28.00 F Paid 10-
"	0799249	77.0701	"	11-19-79	1220	11-20-79	$40.00 Paid 12
"	9948828	71.108	"	1-4-80	0800	1-4-80	$20.00 Paid 4-
"	9948844	71.108	"	2-4-80	0800	3-20-80	$60.00 Paid 6-
"	9948964	71.108	"	5-30-80	1445	6-16-80	$32.00

MSHA VIOLATIONS

MINE NAME	VIOLATION NO.	VIOLATION CODE PART & SECTION	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPOSITION
DonBow	1029628	77.1109 (c) (1)	15-08046	6-25-80	0930	6-25-80	$16.00
"	1029629	77.1007 (b)	"	6-25-80	1030	6-25-80	$16.00
"	1031191	Fire on Loader	"	11-5-80	1000	11-6-80	

MSHA V(ATIONS

MINE NAME	VIOLATION NO.	VIOLATION CODE PART & SECTION	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPO
Center Mine	401061	77.1110	15-03998	11-7-78	0915		
"	401062	77.1605 (a)	"	11-7-78	1230	11-8-78	
"	401063	77.1605 (d)	"	11-7-78	1235	11-8-78	
"	401064	77.1605 (b)	"	11-8-78	0850	11-13-78	
"	401065	77.1605 (b)	"	11-8-78	0945	11-13-78	
"	401066	77.1605 (a)	"	11-8-78	1030	11-13-78	
"	401067	77.1708	"	11-8-78	1115	11-24-78	
"	401068	71.300	"	11-13-78	0900		
"	400842	77.0701	"	12-19-78	1320		

MSHA VIOLATIONS

MINE NAME	VIOLATION NO.	VIOLATION CODE PART & SECTION	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPO
Invacron	399234	77.802	15-02013	10-2-78	10:00	10-3-78	
"	9948534	71.108	"	5-2-79	8:00	6-14-79	$60.00 Paid 8-
"	9948664	71.107	"	8-30-79	8:00	9-21-79	$48.00 Paid 1
"	9948665	71.108	"	8-30-79	8:00	9-21-79	$48.00 Paid 11
"	0799228	77.0701	"	9-24-79	10:05	9-25-79	$114.0 Paid 1
"	0799229	77.0400-A	"	9-25-79	11:45	9-26-79	$195.0 Paid 1
"	0799234	77.0506-1	"	9-27-79	10:45	10-1-79	$78.00 Paid 1
"	0799235	77.0701	"	9-27-79	13:00	10-1-79	$78.00 Paid 1
"	07990236	77.0402	"	9-28-79	9:20	9-28-79	$78.00 Paid 1
"	0799237	77.0701	"	9-28-79	10:45	9-28-79	$72.00 Paid 1
"	0799238	77.0410	"	10-1-79	12:40	10-3-79	$150.0 Paid 1
"	0799240	77.0807-2	"	10-2-79	8:45	10-18-79	$106.0 Paid 1
"	0799241	77.0803	"	10-2-79		10-18-79	

MSHA VIOLATIONS

MINE NAME	VIOLATION NO.	VIOLATION CODE PART & SECTION	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPO
Cimarron	9948833	71.107	15-02013	1-7-80	8:00	2-7-80	$ 40.00 Vacated
"	0801523	77.1710 (I)	"	1-7-80	9:00	1-9-80	$48.00 Paid 4-
"	0801524	77.404 (A)	"	1-7-80	9:30	1-15-80	$48.00 Paid 4-
"	0801525	77.400 (A)	"	1-7-80	12:30	1-8-80	$32.00 Paid 4-
"	0801526	71.300	"	1-8-80	6:30	3-25-80	$36.00 Paid 10
"	9949017	71.302	"	7-22-80	8:00	8-18-80	$60.00 Paid 10
"	9949018	71.101	"	7-22-80	8:00	8-27-80	$84.00 Paid 10
"	0800548	77.1007 b	"	7-29-80	10:30	7-31-80	$98.00 Paid 10
"	0800549	77.208 (e)	"	7-29-80	11:00	7-29-80	$40.00 Paid 10
"	0800550	71.400	"	7-29-80	11:35	9-19-80	$32.00
"	1029637	77.1007 (b)	"	7-29-80	10:30	7-31-80	$66.00 Paid 10
"	1029638	77.1007 (b)	"	7-29-80	11:00	7-31-80	$28.00 Paid 11
"	1031261	77.0502	"	8-4-80	8:00	8-5-80	$52.00 Paid 11
"	1031262	77.0701	"	8-4-80	9:45	8-4-80	$170.00
"	1031263	77.0803	"	8-4-80	11:00	8-19-80	$150.00 Paid 10
"	1031264	77.0803	"	8-4-80	11:00	8-8-80	$150.00 Paid 10
"	1031265	77.0604	"	8-5-80	8:30	8-6-80	$60.00 Paid 10
"	1031266	77.1301-00005	"	8-5-80	10:15	8-5-80	$150.00 Paid 10
							$78.00

MSHA V[illegible]

MINE NAME	VIOLATION NO.	VIOLATION CODE PART & SECTION	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPO
Jackson	1031268	77.0400-0000A	15-02013	8-6-80	10:30	8-7-80	$140.0 Paid 1
"	1031269	77.0400-0000A	"	8-7-80	11:00	8-8-80	$140.00 Paid 1
"	1031270	77.0400-0000B	"	8-7-80	9:10	8-8-80	$122.00 Paid 10
"	1031385	103-K	"	8-28-80	8:15	8-28-80	
"	1031386	77.0807-2	"	8-28-80	8:50	8-28-80	$400.0

D.E.L. STATE DIVISION OF [illegible]

MINE NAME	VIOLATION NO.	STATE PERMIT NO.	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPOSI
Barron	405 KAR 1:170 1088	1169-72		8-6-79		10-26-79	No Penal
"	405 KAR 1:170 1089	1169-73		8-6-79		10-26-79	No Penal
"	405 KAR 1:170 1155	1169-74		8-6-79		10-26-79	No Penal
"	405 KAR 1:170 1156	1169-75		8-6-79		10-26-79	No Penal
"	405 KAR 1:170 1168	5016-76		8-17-79		9-28-79 $1000 Fine	Paid 10-1
"	405 KAR 1:100	5016-76R		3-7-79		7-2-79	No Penal
"	405 KAR 1:100	6652-77		3-6-79		7-2-79 $1200 Fine	Paid 7-1
"	405 KAR 1:090 000156	6652-77		7-18-78		10-23-78	No Penal

D.E.R. [illegible]

[illegible] NAME	VIOLATION NO.	STATE PERMIT NO.	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPOS[illegible]
[illegible]ter	KAR 1:070(1) KRS 350.093 Reg.6 0001532	2437-74 S#1	15-03998	6-4-79			
"	405 KAR 1:170 0001230	2437-74 S#1	"	3-6-79	2:20 PM	7-20-79	$1000.00
"	402 KAR 1:055 000192	2437-74 S#1	"	7-13-78			
"		2437-74	"	11-22-77		1-17-78	No Penal[illegible]

D.N.R. STATE DIVISION OF OPERATIONS & ENFORCEMENT

NAME	VIOLATION NO.	STATE PERMIT NO.	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPOSITION
Processing	405 KAR 1:170 0125 (S 1&2)	5778-76	15-02067	July 12, 1978			
"	405 KAR 1:200 405 KAR 1:190 01291	5778-76	15-02067	Jan. 23, 1979		Feb. 15, 1979	No Penalty
"	KAR 1:150, 1:160, 1:170, 1:190 & 1:200 1059	None	15-02067	June 26, 1979			No Penalty
"	405 KAR 1:130 405 KAR 1:050 1212	None	15-02067	Oct. 4, 1979		Oct. 17, 1979	No Penalty

MINE NAME	VIOLATION NO.	STATE PERMIT NO.	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPOS
Caney Creek	KRS 350.100	407-70		4-5-71			
" "	KRS 350.100	407-70		5-3-71			
" "	KRS 350.095 RG8	407-71		11-29-72			
" "	405 KAR 1:130, 1:050 1212	None		10-4-79			
" "	405 KAR 1:100 1330	407-74		11-27-79		11-27-79	
" "	405 KAR 1:050 1331	407-74		11-27-79		11-27-79	
" "	405 KAR 1:100 1552	289-0354		6-4-80			
" "	405 KAR 1:260 1661	289-0354		2-17-81			

D.N.R. STATE DIVISION OF PERMITS & ENFORCEMENT

MINE NAME	VIOLATION NO.	STATE PERMIT NO.	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPOS
Rhodes	405 KAR 1:080, 1:100 010830	089-0026		12-16-80		1-15-81	

D.E.R. STATE DIVISION OF OPERATIONS & ENFORCEMENT

MINE NAME	VIOLATION NO.	STATE PERMIT NO.	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPOS
Venture	405 KAR 1:200	289-0227	15-03845	May 30, 1979		July 3, 1979	

D.L.E. STATE DIVISION OF INSPECTION & ENFORCEMENT

MINE NAME	VIOLATION NO.	STATE PERMIT NO.	MSHA I.D. NO.	INSPECTION DATE	INSPECTION TIME	TERMINATION	DISPOSI
DonBow	405 KAR 1:200 1785	054-0010	15-08046	9-29-80		11-3-80	
"	405 KAR 1:050 1003	Triangle D 6263-77	"	7-24-80			
"	405 KAR 1:200 1580	054-0010	"	6-12-80		Vacated - 7-29-80	No Penal
"	405 KAR 1:050 1578	054-0010	"	6-9-80		Vacated 8-14-80	No Penal
"	S.M.R. RG11 (1c)	3721-74		3-19-75	3:30PM		
"	S.M.R. RG11 (12) (2)	3721-74		3-19-75	3:30PM		
"	Water leaving in excess of 150 JTU's	3721-75		2-17-77		2-21-77	No Penal
"	805 KAR 4:060 Par. 6 Div. Explosives & Blasting 004660	054-0010		10-1-79	4:05PM		Paid 10- $250.00