SUBSIDENCE CONTROL PROGRAM AT SOUTHERN UTAH FUEL COMPANY

(Revised June, 1986)

INTRODUCTION

The Applicant has used surface surveying methods to monitor subsidence since 1976 when full extraction mining began. Reports detailing subsidence progress and measurement results have been regularly submitted to the regulatory authorities throughout this period. During the ten year period of monitoring, the Applicant has been able to quantify some of the subsidence behavior associated with full extraction mining using continuous miners.

In keeping abreast with new technology, the Applicant has chosen to implement a subsidence monitoring program using aerial photogrammetrics patterned after a program developed by the Manti-LaSal National Forest to determine the effects of underground coal mining on surface renewable resources and surface improvements. The monitoring program will secure adequate baseline data prior to any subsidence of an area to quantify the existing surface renewable resources and surface improvements on and immediately adjacent to the area. The baseline data will be established so that future programs of observation can be incorporated at regular intervals for comparison. The monitoring program will also establish a system to locate, measure, and quantify the progressive and final affect of underground mining activities on the surface renewable resources and surface improvements. The system utilizes techniques which will provide a continuing record of change over time and an analytical method for location and measurement of a number of points over the permitted area. The continuum of data will incorporate and be an extension of the baseline data.

MONITORING METHODS

A network of survey control monuments located in accordance with the desired photogrammetric map accuracy has been established over both the permit area and the immediate adjacent areas not expected to be disturbed by subsidence. These monuments are tied to the same coordinate system which is used for both the surface and mine control surveys. This allows the surface surveys to be superimposed over surveys of the subsurface mine workings. The monuments will have the X, Y, and Z coordinates accurately measured and established by ground survey methods.

The initial aerial photography obtained in 1985 covers the entire permit area. It was photograhed at a mean scale of 1:6,000 with a 6" focal length camera; such that, elevations to within one foot vertically and horizontally ($\pm$0.5') can be determined by photogrammetric methods. This photography will be used as the baseline for future photogrametric work. It will also provide the master base to assist in documenting changes caused by future subsidence.

To aid in the collection of additional base data on surface renewable resources, color infrared aerial photography (CIR) of the permit area may be utilized. If this technique is used, the photographs will be of the same scale as the other aerial photography.

Subsequent annual black and white or color photography for monitoring surface elevation changes due to subsidence will cover the area mined and the area to be mined in the next 18 months (plus angle of draw). Once a subsided area is determined to have reached equilibrium again, that is no further subsidence is detected, the area may be eliminated from future mointoring. Subsequent CIR photography for monitoring surface resource trends will be flown as needed.

On all aerial photography, a photographic overlap of 30 percent between adjacent flight lines and an average of 60 percent overlap of photographs along the same flight line will be obtained. The baseline data will be digitized to show the undisturbed pre-subsided ground elevations and will use a grid with a nominal mean grid scale of 200 x 200 feet in areas where subsidence may occur. The subsequent flights for subsidence will also be digitized using the same grid scale as the baseline to show the elevational deviation from the baseline elevations. The digitized information will be submitted annually as part of the subsidence report to the regulatory agency.

An on-the-ground visual inspection will be made annually of the ground surface of subsidence areas (including angle of draw). This inspection will attempt to locate, photograph, and document the presence of subsidence effects to surface improvements, tension cracks, fissures and other surface effects.

GENERAL LAND DESCRIPTION

Southern Utah Fuel Company Mine Number 1 is located in Townships 21 and 22 South, Ranges 4 and 5 East on the Wasatch Plateau. The mine property is bounded by Convulsion Canyon on the south and by Quitchupah Canyon on the east, and is intersected by several smaller tributary canyons. Most of the surface area of the mine property is covered by sagebrush grasslands. The canyon rims are covered by Ponderosa Pine, Aspen, and Mahogany; the canyon slopes and bottoms are covered by mixed Conifers, and occasionally, Aspen.

Precipitation varies from 16 to 20 inches per year with 75% falling as snow. Temperatures range from -30°F to 110°F.

The mine property has very little cultural development on it, the only access above the mine being a U.S. Forest Service graded dirt road. Quitchupah Creek is the only perennial stream in the area; few developed springs exist. All springs are located on Map 80-10A.

Spring #1 was developed by the U.S. Forest Service for livestock use and has a flow of approximately three gallons per minute. Spring #2 has an intermittent flow; Spring #3 is created by mine discharge water NPDES Point 001.

Two small run-off water catchment ponds are located in the area as well as unmeasurable seeps along sandstone outcrops in the canyons.

The mine is located in the Upper Hiawatha bed in the Blackhawk Formation. The Blackhawk is overlain by the Castlegate Sandstone and underlain by the Starpoint Sandstone. The Starpoint is approximately 200 feet thick and the Castlegate ranges from 100 to 200 feet in thickness. Both of these sandstones are the primary cliff-forming members showing in the canyons.

The Blackhawk Formation is made up of sandstones, siltstones, shales, coals, and other carbonaceous material interbedded to varying degrees. Thickness of the formation in the mine area is approximately 700 feet. The mineable coal seam varies from 4.5 to 12 feet in thickness with in-place thicknesses of 18 feet in isolated areas. It dips 2° to the northwest. A general strata cross-section is shown on Figure 1.

LANDS AFFECTED BY SUBSIDENCE

Most of the area bounded by Southern Utah Fuel Company's permit lines will eventually be affected by subsidence. The anticipated subsidence area is shown on Map 80-10B (revised 1988). The area where Quitchupah Creek crosses the leases will be protected from subsidence by the establishment of a stream buffer zone within the mine in which only limited recovery will take place. Except at specifically approved locations, underground mining operations will be conducted in a manner to prevent surface subsidence that would cause the creation of hazardous conditions; such as escarpment failure and landslides. Subsidence will not be experienced over the pre-1977 workings known as the "Old Mine" in Lease SL-062583.

Mining in such a manner to leave support pillars is planned under the bottom of Quitchupah Canyon. Quitchupah Creek is the only perennial stream in the area, and the establishment of these buffer zones will ensure that the flow will not be disrupted. Before the area is abandoned, a plan will be submitted to the regulatory authority for approval. The plan will utilize the best feasible technology to provide for maintaining the integrity of Quitchupah Creek.

Southern Utah Fuel Company monitors the stream flow of Quitchupah Creek as part of its hydrologic monitoring program. Flows of the stream above and below the permit area are measured. This data is submitted to the regulatory authority annually. Should the flow of Quitchupah Creek be disrupted by subsidence during the life of the operation, a mitigation plan will be submitted to the regulatory authority and the Forest Service for approval.

To keep the steep side slopes of Convulsion and Quitchupah Canyons stable, low recovery mining or controlled full extraction mining in specifically approved areas is planned in the zone from the plateau rim to the outcrop. Where low recovery mining is used, the coal will be fully extracted to a point where a line from the workings, upward along the draw angle, intercepts the canyon rim. Continuing from this point to the outcrop, coal pillars of sufficient size will be left to support the overburden.

Where controlled full extraction mining under the canyon is used the mining sequence will be planned; such that, subsidence from either continuous miner or longwall mining techniques will not cause hazardous landslides or escarpment failures to develop. On the Fee Lease at the northern end of the Applicant's property, this has been accom- plished by mining from the plateau toward the outcrop; thus, the subsidence flattened the existing angle of the slope and caused no hazardous conditions. A similar approach was utilized on Lease U-28297 and will be utilized on Lease U-63214 in specifically approved locations using longwall mining methods as shown on Map 80-10B.

The "Old Mine" workings were mined in such a manner that coal pillars were left for support throughout the entire workings. Since these pillars are large enough to support the overburden, and further mining is not anticipated, the surface area above these workings should remain as it is now.

MEASURED SUBSIDENCE EFFECTS

Southern Utah Fuel Company began high recovery mining operations in June, 1976. Since that time (1976-1985), approximately 730 acres of land have been subsided. Several studies have been initiated to determine subsidence behavior for the area above the mine. Studies completed above the Applicant's mine include the U.S. Forest Service subsidence tension crack investigation and three studies conducted by Southern Utah Fuel Company's engineering staff. One of the company studies was to determine the draw angle, which is the angle made by a line drawn from a edge of the underground excavation upward to the limit of measurable movement of the surface. Another study was made to establish a relationship between the advancing face and the rate of subsidence. The third study was done to determine the relationship between expected subsidence and overburden depth. Subsidence has varied from several hundredths of a foot up to a maximum of 8.5 feet. Current data have shown that subsidence occurs rapidly and causes little surface disturbance.

Tension Cracks

The only readily observable disturbance on the surface is tension cracks which occur primarily over the excavation barriers. These cracks are mainly oriented in directions parallel and perpendicular to natural jointing and parallel to the exca- vation boundaries. Subsequent to subsidence, the cracks average 56 percent closure of the maximum width attained when subsidence is active. These cracks continue to heal and become difficult to observe as they fill with normal surface debris.

Surface tension cracks vary in orientation, length, and severity. The principle directions in which cracks occur are parallel and perpendicular to natural jointing and parallel to excavation boundaries. Lengths vary from a few feet to several hundred feet. Cracks with the longest continuous length have been observed to occur along pre-existing natural joints in the rock which have been intensified by subsidence action.

The severity of the tension cracks has also varied. Most are just noticeable cracks in the rocks, but several have attained widths of several inches. Those which have opened the widest are located above the mining panel 1L1W. In this area, the surface is cut by a small canyon for a depth of approximately 120 feet. The free space provided by the canyon has allowed the upper strata freedom to move, causing the cracks to widen considerably. As the mine workings progressed away from the canyon, the intensity of the surface cracks decreased.

A few cases of displacement along tension cracks have been observed. One crack was measured with 18 inches of displacement when it was first created. Since then, active subsidence has ceased and the area has settled leaving the crack with only nine inches of displacement. As with the case of the longest crack, the cracks which have had displacement were found to occur along natural faults or joints with natural displacement. No noticeable displacement has been observed around the excavation boundaries.

The U.S. Forest Service completed a study in November 1978 titled "Geologic Investigation of Subsidence Tension Crack Self-Healing Phenomena". Twenty-two different cracks distributed over the subsiding area were measured on a weekly basis. Initial crack widths ranged from six inches to 1/8 inch of which several cracks closed to less than 1/16 inch. Self-healing closure rates averaged slightly more than 1/16 inch per week. The average amount of crack closure was 56 percent with measured amounts ranging from 13 to 100 percent.

It has been the Applicant's experience that tension cracks tend to heal rapidly. After one winter most are not observable. Recent visual observations of the subsiding area have been made. Most cracks which were formed a few years ago are now difficult to locate. Exceptions are some of the cracks near the canyon above 1L1W discussed previously. These cracks are healing, but will require a longer time period than the others. Besides the remains of the cracks, there is no observable indication of any other effect of subsidence.

Subsidence Behavior

Subsidence behavior is characterized for purposes of this section as the amount and distribution of subsidence observed. Three areas have been investigated: angle of draw, subsidence/face advance relationship, and the maximum subsidence that can be expected.

Some aspects of subsidence are still unclear due to insufficient data in a few areas. Current data, however, indicates that the draw angle is 12° to 21° from vertical. The draw angle was measured in different panels with a series of survey stations placed on 50 feet centers beginning above the excavation edge and extending for 400 to 500 feet out over undisturbed ground. The stations were installed before pillar extraction began and were monitored until movement ceased. From the last station with detectable movement, a line was drawn down to the excavation edge, and the draw angle was calcualted. Table 1 summarizes the results of the draw angle studies to date.

The survey for the subsidence/face advance relationship was conducted above 5L1W. In this survey, two lines of stations were installed above the center and edge of the mining panel. They were placed on 60 feet centers from the panels beginning to a distance of 900 feet inside the panel. The stations were placed on 60 feet centers to correspond with the rooms being driven underground. Each room driven for pillar extraction was 60 feet, center to center, and therefore the survey stations correspond with rooms one to sixteen.

Figures 2, 2A, and 2B illustrate the general layout and results of the above survey. Figure 2 shows a portion of the mine with the survey stations located in respect to the mining panel 5L1W. Figures 2A and 2B present the survey results of the two lines of stations. As shown on Figures 2A and 2B, noticeable subsidence began when the face had advanced approximately 240 feet. Shown below each figure is a diagram of the position of the working face when each survey was perfomed.

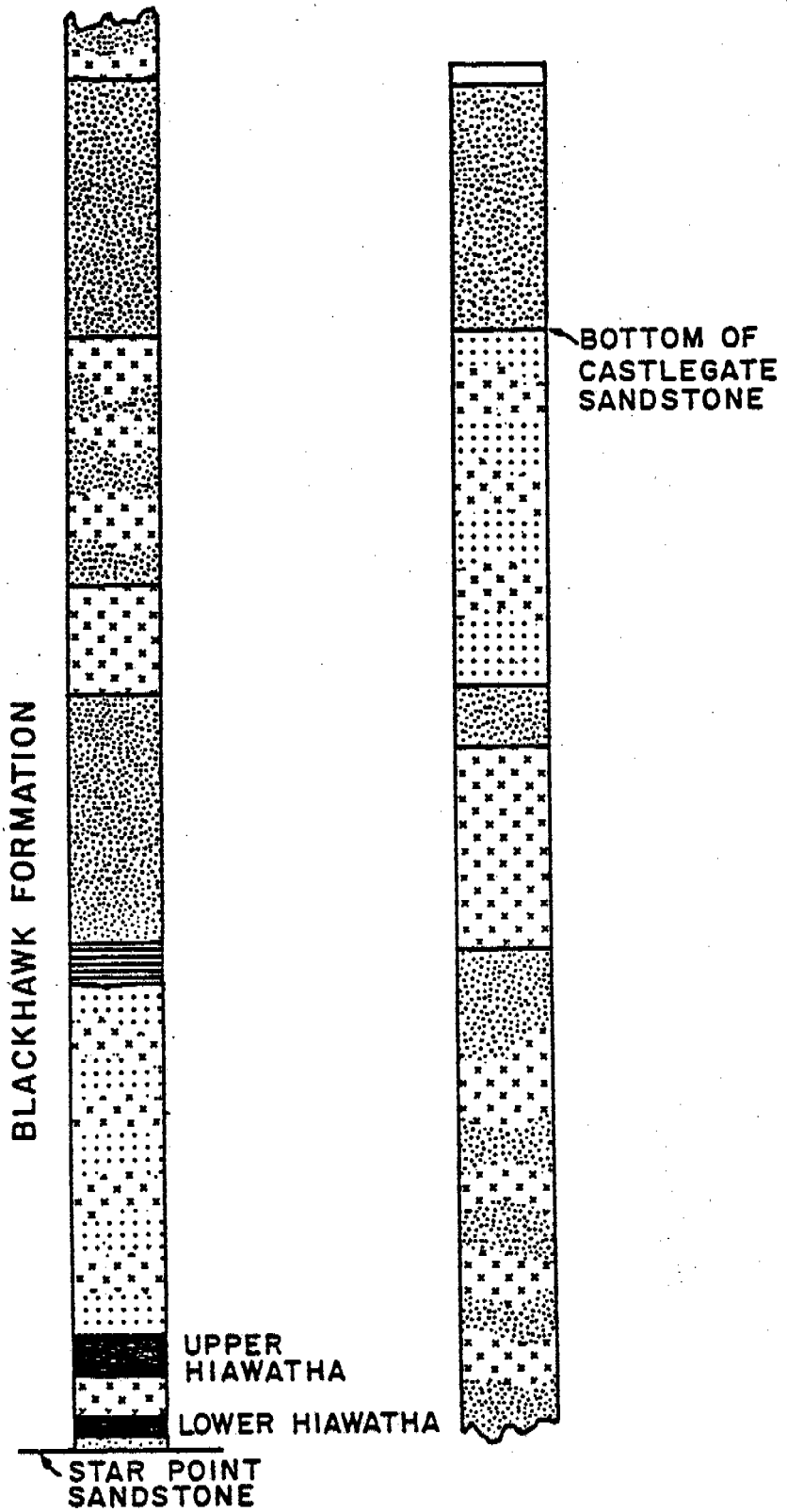
Subsidence may vary from approximately eight feet with 700 feet of overburden, to 3.5 feet with 1,000 feet of overburden. A maximum subsidence profile is shown in Figure 4. This graph depicts subsidence varying with overburden depth. The graph is included to show what relationship is indicated by current data. Enough data have been accumulated to show that subsidence in this area is not behaving in a general "text book" manner. Future studies will be used to refine the collected data in an attempt to accurately determine the subsidence that can be expected and its effect on the renewable resources.

The Subsidence Map 80-9B shows the location of the subsidence stations monitored with surveying techniques. The differential subsidence of the mined areas is contoured in 1 foot increments on Map 80-9B. The differential subsidence data is presented in tabular form in Table 2.

MITIGATION OF SUBSIDENCE EFFECTS

Should significant subsidence impacts occur that diminish existing or reasonably foreseeable surface use, the applicant will repair to the extent technologically and economically feasible, those affected surface lands such that the pre-subsidence level of potential usefulness is restored.

Any roads, fences, stock ponds, earth dams, or water troughs which are materially damaged by subsidence will be repaired and regraded to restore them to their pre-subsidence usefulness.



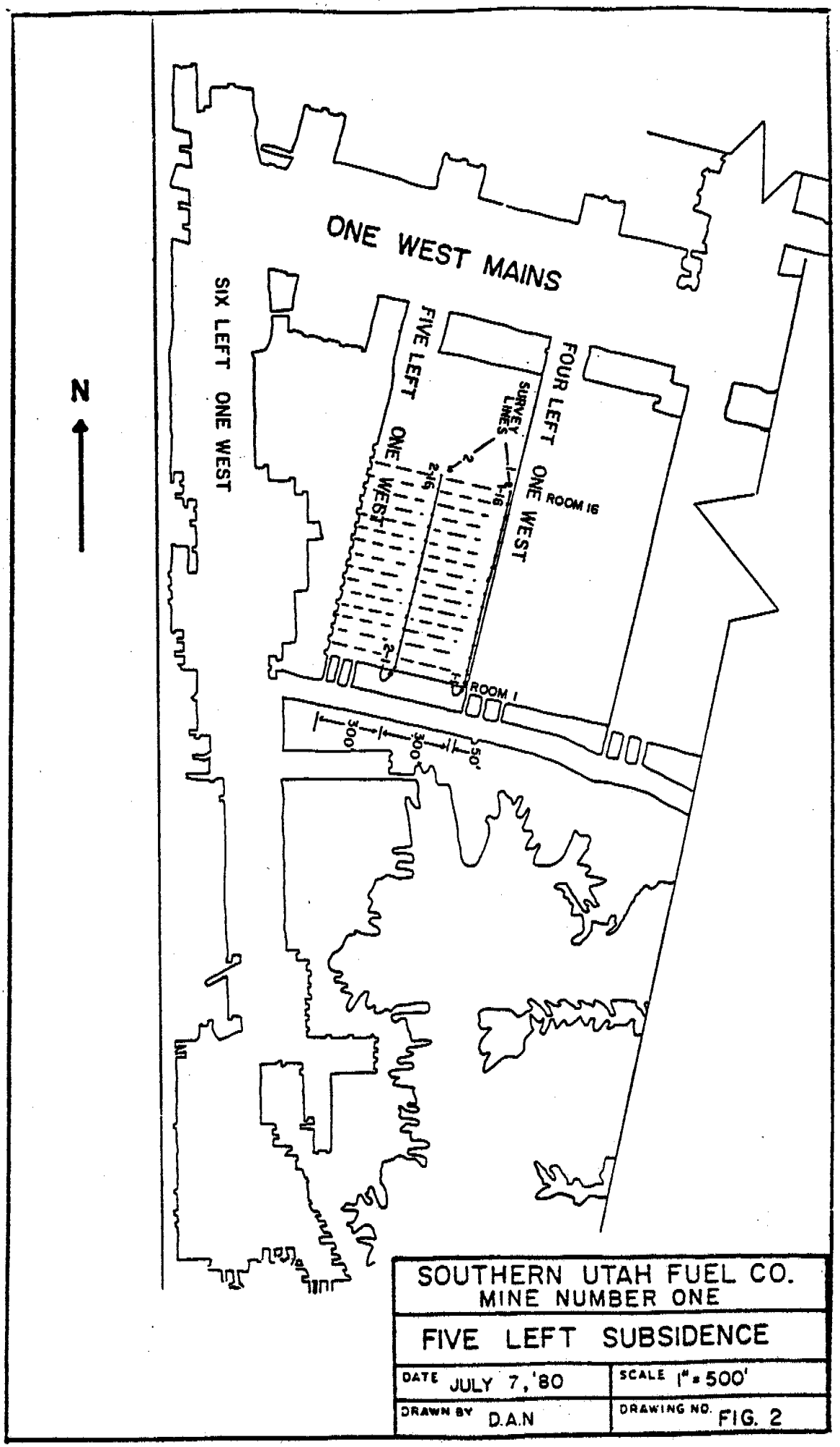
LEGEND:

- ALLUVIUM
- SANDSTONE
- CLAYSTONE
- LAM. SILTSTONE & CLAYSTONE
- LAM. CLAYSTONE & SANDSTONE
- CARBONACEOUS SHALE
- COAL

TYPICAL OVERBURDEN CROSS-SECTION

SCALE: 1"=60' DATE: AUG. 18, 80

FIGURE 1



SOUTHERN UTAH FUEL CO. MINE NUMBER ONE	
FIVE LEFT SUBSIDENCE	
DATE JULY 7, '80	SCALE 1" = 500'
DRAWN BY D.A.N	DRAWING NO. FIG. 2

FIGURE 2A

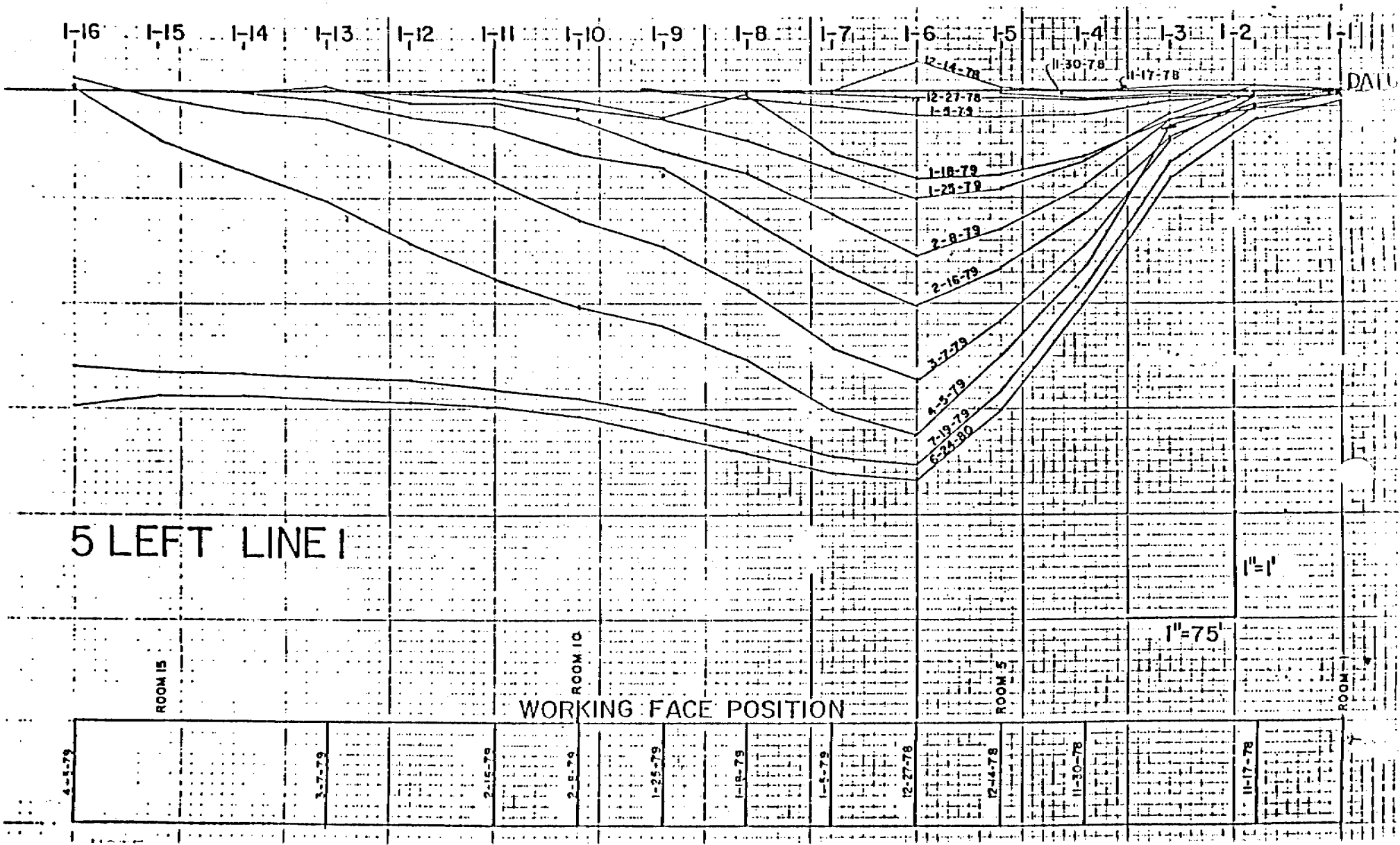
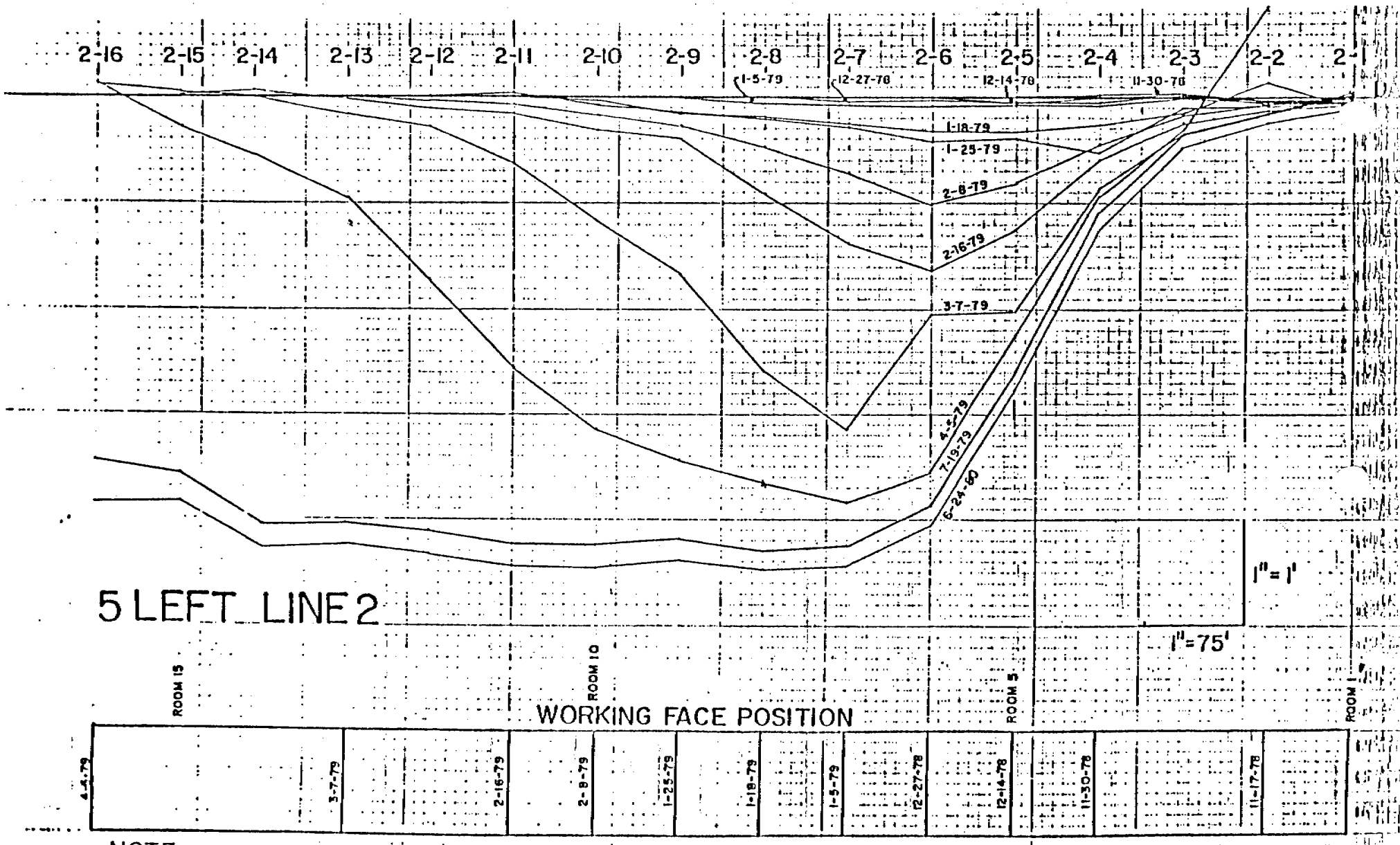
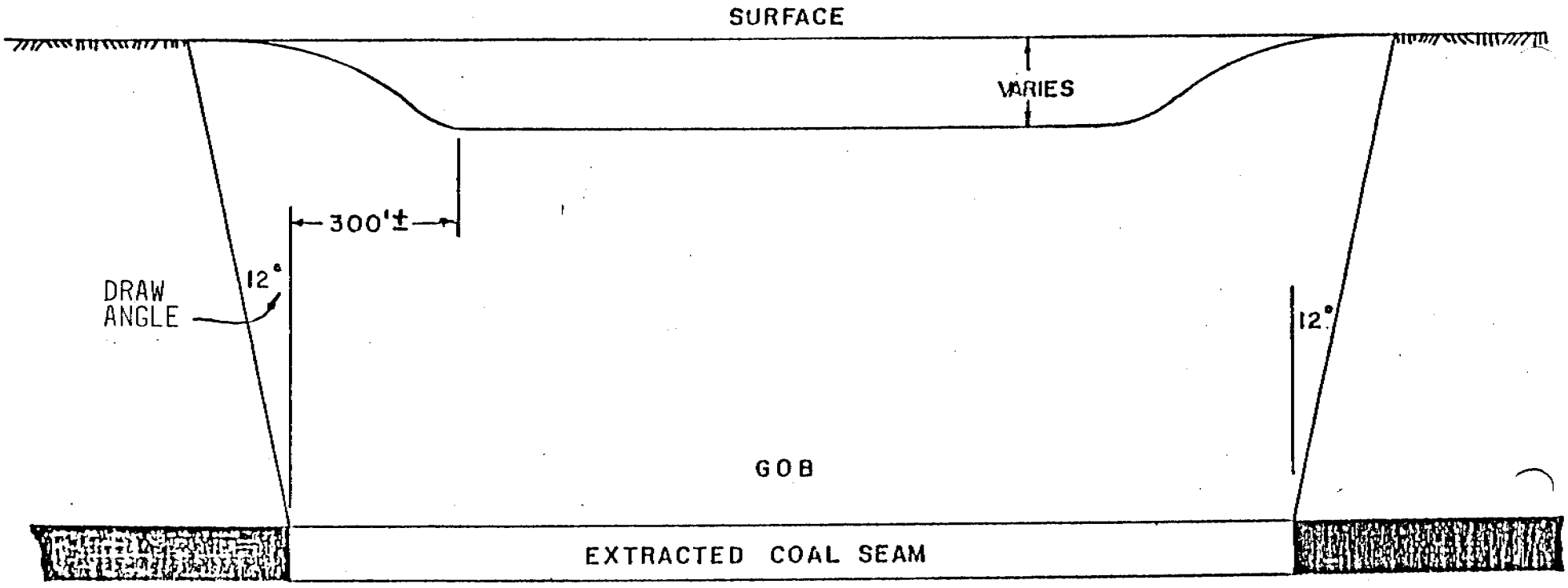

I-16
I-15
I-14
I-13
I-12
I-11
I-10
I-9
I-8
I-7
I-6
I-5
I-4
I-3
I-2
I-1
12-14-78
11-30-78
11-17-78
12-27-78
1-5-79
1-18-79
1-25-79
2-8-79
2-15-79
3-7-79
4-5-79
7-19-79
6-24-80
5 LEFT LINE I
1"=1'
1"=75'
ROOM 15
ROOM 10
ROOM 5
ROOM 1
WORKING FACE POSITION
4-5-79
3-7-79
2-15-79
2-8-79
1-25-79
1-18-79
1-5-79
12-27-78
12-14-78
11-30-78
11-17-78

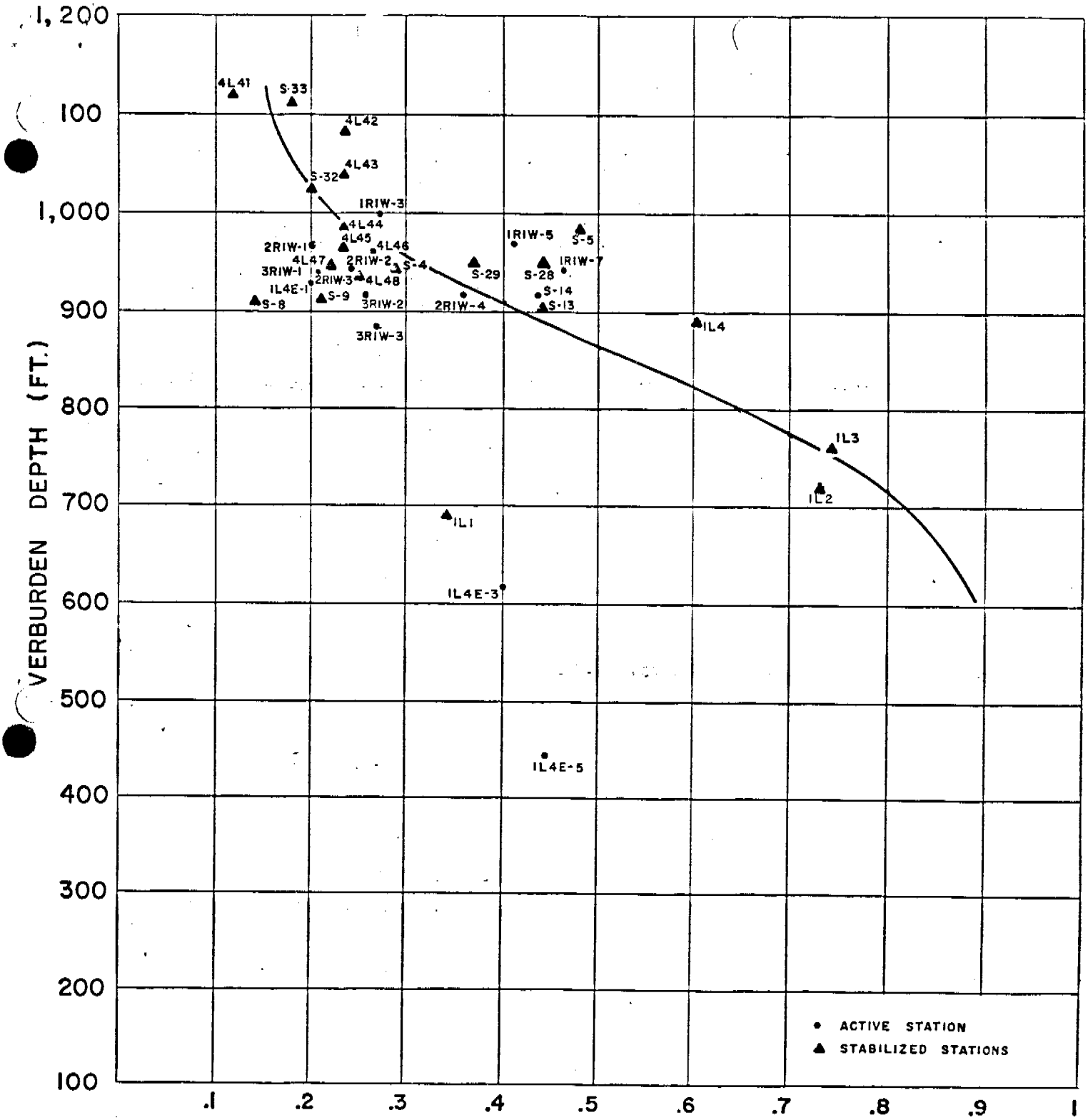
FIGURE 2B


2-16
2-15
2-14
2-13
2-12
2-11
2-10
2-9
2-8
2-7
2-6
2-5
2-4
2-3
2-2
2-1
1-5-79
12-27-78
12-14-78
11-30-78
1-18-79
1-25-79
2-8-79
2-16-79
3-7-79
4-4-79
7-19-79
6-24-80
1"= 1'
5 LEFT_LINE 2
1"=75'
ROOM 15
ROOM 10
ROOM 5
ROOM 1
WORKING FACE POSITION
4-4-79
3-7-79
2-16-79
2-8-79
1-25-79
1-18-79
1-5-79
12-27-78
12-14-78
11-30-78
11-17-78



TYPICAL SUBSIDENCE PROFILE

FIG. 3



NOTE: Only those subsidence stations positioned over good recovery areas in full extraction panels are used for this plot.

FIG. 4

SUBSIDENCE / MINING HEIGHT vs. OVERBURDEN DEPTH

(After fig.4 in Mining and Reclamation Plan, Subsidence Section)

TABLE 1

SUBSIDENCE DRAW ANGLE SUMMARY

General Selected Stations:

Subsidence* Station	Total Subsidence	Overburden Depth (OD)	Hor. Dist. To** Mined Area (HD)	HD/OD	Draw Angle	Comments
1L4E-4	0	257 (ft)	100 (ft)	.389	21°	
1L4E-6	0	285	70	.246	14	
Specific Draw Angle Stations						
4L1WA-H	0.01 (ft)	886	188	.212	12	1980
4L1WA-H	0.02	886	150	.169	10	1980
L4E1-1	0.02	977	300	.307	17	1985
2L4E2-8.5	0.02	977	200	.205	12	1985
3R1W1-8	0.02	920	350	.380	21	1985

The average draw angle using 0.02 feet as the measurable limit is 15°.

*Only those stations positioned over barrier pillars or undeveloped areas.

**Mined areas are full extraction areas only.

TABLE 2

SUBSIDENCE DATA SUMMARY 1985

	Subsidence Station	Surface Elevation	Mine Elevation	Overburden Depth (ft)	Total Subsidence (Smax) (ft)	Mining Height (t) (ft)	Smax / t	Recovery
1.	S-1	8545.31	7526	1019	0	11		Over North Main Pillars
2.	S-2	8452.20	7505	947	.13	11	.01	Over North Main Pillars
3.	S-3	8487.93	7512	976	1.01	11	.09	Over Barrier Pillar
4.	S-4	8466.82	7520	947	3.16	11	.29	Good
5.	S-5	8524.14	7540	984	5.12	11	.47	Good
6.	S-6	8503.78	7560	944	.44	11	.04	Over 2 East Main Pillars
7.	S-7	8329.80	7390	940	1.44	11	.13	Over First Mined Area
8.	S-8	8354.92	7435	920	1.53	11	.14	Good
9.	S-9	8358.17	7436	922	2.27	11	.21	Good
10.	S-10	8362.30	7443	919	.97	11	.09	Over 1 West Main Pillars
11.	S-11	8372.66	7450	923	1.08	11	.02	Over 1 West Main Pillars
12.	S-12	8361.43	7477	884	2.42 (?)	11	.22	Moderate, Few Large Stumps
13.	S-13	8355.18	7450	905	4.86	11	.44	Good
14.	S-14	8337.65	7430	908	4.36	11	.44	Good

	Subsidence Station	Surface Elevation	Mine Elevation	Overburden Depth (ft)	Total Subsidence (Smax) (ft)	Mining Height (t) (ft)	Smax / t	Recovery
15.	S-15	8323.19	7415	908	.84	11	.08	Over Barrier Pillars
16.	S-16	8305.10	7429	876	1.27	11	.12	Over First Mined Pillars
17.	S-17	8331.73	7442	890	.37	11	.03	Over First Mined Area
18.	S-18	Vandalized						Over Barrier Pillars
19.	S-19	8381.25	7490	891	.39	11	.04	Over Barrier Pillars
20.	S-20	8440.11	7408	1032	1.24	11	.11	Over 1 West Main Pillars
21.	S-21	8504.55	7381	1124	.47	11	.04	Good, but Near Barrier Pillar
22.	S-22	8429.25	7409	1020	.91	11	.08	Over Barrier Pillar
23.	S-23	8417.17	7366	1051	1.61	11	.15	Good, but Near Chain Pillars
24.	S-24	8406.44	7377	1029	2.64	11	.24	Over Chain Pillars
25.	S-25	8614.21						Over Barrier Pillars

	Subsidence Station	Surface Elevation	Mine Elevation	Overburden Depth (ft)	Total Subsidence (Smax) (ft)	Mining Height (t) (ft)	Smax / t	Recovery
26.	S-26	8557.43	7386	1171	.26	11	.02	Over Large Panel Pillars
27.	S-27	8567.50	7570	998				Over 2 East Main Pillars
28.	S-28	8497.13	7545	952	4.87	11	.44	Good
29.	S-29	8497.88	7540	958	4.12	11	.37	Good
30.	S-30	8737.27						No Mining This Area
31.	S-31	8379.02	7425	954	1.52	11	.14	Over First Mined Area
32.	S-32	8435.81	7409	1027	2.19	11	.20	Good
33.	S-33	8484.02	7377	1107	1.97	11	.18	Good
34.	S-34	8396.63	7412	985	1.05	11	.10	Moderate, Large Stumps
35.	S-35	8479.15	7363	1116	-	11		Over Barrier Pillar
36.	S-36	8452.77	7389	1064	1.27	11	.12	Over Panel Pillars
37.	S-37	8402.08	7408	994	.41	11	.04	Poor, Large Stumps & Pillars
38.	4L38	Vandalized						Good but Close to Large Pillar
39.	4L39	Vandalized						Good

	Subsidence Station	Surface Elevation	Mine Elevation	Overburden Depth (ft)	Total Subsidence (Smax) (ft)	Mining Height (t) (ft)	Smax / t	Recovery
40.	4L40	8709.09	7558	1151	.65	11	.06	Good, but Close to Barrier
41.	4L41	8674.32	7557	1117	1.29	11	.12	Good
42.	4L42	8642.37	7560	1082	2.69	11	.24	Good
43.	4L43	8600.70	7560	1041	2.61	11	.24	Good
44.	4L44	8562.14	7567	995	2.65	11	.24	Good
45.	4L45	8540.47	7571	969	2.69	11	.24	Good
46.	4L46	8535.36	7572	963	3.01	11	.27	Good
47.	4L47	8527.83	7573	955	2.43	11	.22	Good
48.	4L48	8516.05	7579	937	2.70	11	.25	Good
49.	4L49	8503.90	7581	923	1.79	11	.16	Good, but close to Barriers
50.	4L50	8500.68	7582	919	-	11		Good but Close to Barriers
51.	4L51	8564.45	7580	984	1.21	11	.11	Good, but Close To Barriers
52.	1R1W-1	8472.59	7415	1058	1.63	10	.16	Over Barrier Pillar
53.	1R1W-3	8426.33	7427	999	2.74	10	.27	Good
54.	1R1W-5	8400.93	7432	969	4.11	10	.41	Good
55.	1R1W-7	8383.04	7435	948	4.75	10	.48	Good

	Subsidence Station	Surface Elevation	Mine Elevation	Overburden Depth (ft)	Total Subsidence (Smax) (ft)	Mining Height (t) (ft)	Smax / t	Recovery
56.	2R1W-1	8413.19	7440	973	2.06	10	.21	Good
57.	2R1W-2	8391.84	7444	948	2.50	10	.25	Good
58.	2R1W-3	8373.93	7438	936	2.18	10	.22	Good
59.	2R1W-4	8362.35	7450	912	3.91	11	.36	Good
60.	2R1W-5	8391.04	7478	913	.75	11	.07	Over Barrier Pillar
61.	3R1W-1	8390.84	7462	929	2.08	11	.19	Good
62.	3R1W-2	8387.15	7470	917	2.81	11	.26	Good
63.	3R1W-3	8372.00	7482	890	2.93	11	.27	Good
64.	3R1W-4	8393.38	7490	903	1.74	11	.16	Poor
65.	3R1W-5	8421.94	7490	932	.55	11	.05	Over Main Entry Pillars
66.	1L2W2-1	8601.87	7362	1240	.23	10	.02	Fair
67.	1L2W2-2	8538.53	7365	1173	.10	10	.01	Poor
68.	1L2W2-3	8492.97	7375	1118	.02	10	.002	First Mined
69.	1L2W1-1	9183.63	7340	1844	0	10		First Mined
70.	1L2W1-2	8898.19	7342	1556	0	10		First Mined
71.	1L2W1-3	8837.46	7350	1487	.27	10	.03	First Mined
72.	1L2W1-4	8663.39	7356	1308	.05	10	.01	Fair
73.	1L2W1-5	8611.82	7370	1242	.46	10	.05	Over Barrier Pillar

	Subsidence Station	Surface Elevation	Mine Elevation	Overburden Depth (ft)	Total Subsidence (Smax) (ft)	Mining Height (t) (ft)	Smax / t	Recovery
74.	1L4E-1	8339.76	7407	933	1.60	8	.20	Good
75.	1L4E-2	8338.92	7409	930	2.53	8	.32	Good
76.	1L4E-3	8030.28	7407	623	3.17	8	.40	Good
77.	1L4E-4	7652.03	7402	250	0	8		Over Barrier Pillar
78.	1L4E-5	7853.28	7407	446	3.62	8	.45	Good
79.	1L4E-6	7663.47	7413	250	0	8		Over Barrier Pillar
80.	2L4E-1	8373.35	7533	840	1.74	8	.22	Good
81.	2L4E-2	8371.93	7542	830	2.51	8	.31	Good
82.	2L4E-3	8368.11	7548	820	.59	8	.07	Good
83.	1L1	8190.37	7495	695	3.82	11	.35	Over Panel Pillars
84.	1L2	8214.80	7502	713	8.09	11	.74	Good
85.	1L3	8272.40	7507	765	8.25	11	.75	Good
86.	1L4	8410.41	7512	898	6.76	11	.61	Good
87.	2L1	8380.44	7480	900	0	11		Over Barrier Pillar
88.	2L2	8383.72	7485	899	0.29	11	.03	Over Panel Pillars

	Subsidence Station	Surface Elevation	Mine Elevation	Overburden Depth (ft)	Total Subsidence (Smax) (ft)	Mining Height (t) (ft)	Smax / t	Recovery
89.	2L3	8390.60	7490	901	2.21	11	.20	Moderate, Few Scattered Pillars
90.	2L4	8394.42	7495	899	4.28	11	.39	Moderate, Few Scattered Pillars
91.	2L5	8392.12	7500	892	0.60	11	.05	Over Barrier Pillar

SUBSIDENCE MAP 81-1

This map is replaced by Map 80-10B revised June, 1986.

Revised June, 1986

SUBSIDENCE REPORT 1981

Please refer to subsidence section in Volume 5 for current description of program and complete tabulation of subsidence data.

Revised June, 1986

SUBSIDENCE REPORT 1982

Please refer to subsidence section in Volume 5 for current description of program and complete tabulation of subsidence data.

Revised June, 1986

WILDLIFE ASSESSMENT OF THE SOUTHERN UTAH FUEL COMPANY MINING PROPERTY AND ADJACENT AREAS, SEVIER COUNTY, UTAH

Prepared for

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INTRODUCTION

Prior to any perturbation or manipulation of the environment it is essential to conduct a pre-manipulation study. This facilitates understanding the dynamics of the environment such that perturbation consequences can be predicted and avoided or considered in any situation requiring mitigation for ecological and/or economic reasons. The proposed expansion of the Southern Utah Fuel Company (SUFCo) Mine in the Salina Planning Unit of the Fish Lake National Forest, Utah by Coastal States Energy Company, the owner of Southern Utah Fuel Company, is different than most projects of this sort in that it is an expansion of an existing rather than an entirely new operation. Nevertheless, the initial impact of the mine expansion must be considered.

The mine site expansion will potentially subside and impact a total of 2,632 acres of habitat. Ventilation intakes will be constructed along visible cliffs and traffic will likely increase along the 11 mile corridor of the access and haul road (Fig. 1). The major consideration is: What will these proposed actions do to the existing non-avian terrestrial vertebrates living in or utilizing the area of concern? This area of potential impact contains distinct vegetation habitats and faunal components of concern to management agencies and vested interest groups. Therefore, it is essential that sufficient information on these biotic components be gathered, synthesized and analyzed to facilitate proper evaluation of the proposed action and its alternatives. The alternatives in this case being no expansion or limited expansion.

It is possible to gather, synthesize and analyze the data in any degree of detail ranging from a cursory survey to elaborate detail that would allow predictive modeling of not only this but similar situations.

Although the elaborate detail is of scientific interest and would surely meet the needs of those concerned, it is not necessary (in fact, excessive) considering the objectives of the client and the lead agencies preparing the documents to meet permitting application requirements.

The data collected, synthesized and presented herein are considerably less in scope and detail than the ideal academic approach but not cursory and are sufficient in detail to facilitate decision making in regards to the permitting process. The methodologies and data analyses techniques for the non-avian faunal components are all proven for their utility and practicality for the vegetation habitats encountered in the prescribed geographic area of potential impact. The personnel involved in the data gathering and reporting have had previous experience utilizing the methodologies in the habitat types involved and have previously prepared acceptable reports for permit applications and environmental impact statements.

AFFECTED ENVIRONMENT

The area of potential impact contains a variety of important habitats for several species that are considered of "high interest" to various management agencies because these species are of economic or recreational value. There are ten recognizeable vegetation habitats from a faunal stand point: chaparrall (ponderosa pine, curl-leaf mountain mohagany, manzanita, aspen), spruce-fir (englemann spruce, douglas fir, sub-alpine fir, white-fir), aspen, sagebrush, mountain brush (oak, curl-leaf mountain mahogany, smooth-leaf mountain mahogany, service berry sagebrush), streamside, pinyon-juniper, pondersoa pine, grass, and scotch pine-spruce. Conifer, aspen, high sage and meadow areas on Duncan Mountain

are used as summer range and calving areas for elk and fawning areas for mule deer. Ponderosa pine along ridge tops are heavily used by elk during the late winter, early spring and occasionally during the summer. The cliff areas harbor mountain lion, bobcat and bear. Mountain brush habitats are heavily utilized by deer and elk during the winter and spring. Deer and elk winter on the lower elevation areas, particluarly in the vegetation communities traversed by the haul road. In all habitats, water is a critical resource and is possibly the limiting factor.

OBJECTIVES

Primary Objective

The main objective of this study was to conduct a survey of the non-avian terrestrial vertebrates in the potential areas of impact resulting from the expansion of an underground mining procedure for the SUFCo Mine and the 11 mile access and haul road.

In order to accomplish this objective, it was necessary to establish the following working objectives with the accompanying time-table for accomplishment of the specific tasks necessary to accomplish the objectives.

Working Objectives

1. Conduct a cursory literature review and detailed analysis of WESTECH reports (later known as Hydrometrus) pertaining to the non-avian terrestrial vertebrate fauna of the geographic area of concern.
2. Establish study sites in the potentially perturbed habitat types.
3. Identify and inventory the non-avian terrestrial vertebrate components and provide density or relative abundance estimates by species for each of the potentially perturbed habitat types.

4. Categorize the status of the species and highlight those that deserve special attention (high interest species) because they are endangered, threatened, protected or of economic or recreational value.
5. Evaluate and discuss in report form the significant interactions and results of the perturbations on the non-avian terrestrial vertebrates present. High interest species will be the major thrust.
6. Coordinate with Coastal States Energy Company and provide comments at their request.

METHODS

This research was designed to quantitatively and qualitatively evaluate the non-avian terrestrial components in the habitats that might be potentially impacted by the expansion of and subsidence associated with the mining operation in the SUFCo Mine and along its access or haul road. Methodologies were selected to provide reliable use, abundance or population estimates and establish faunal compositions and status by habitat type for the sampling area and period of concern. Replicates of both habitats and plots were studied for the pellet group census. The field data were collected from May through August 1980.

The approach and procedures (methods) used are presented in reference to the specific working objective to which they apply. It is recognized that subsidence is the paramount concern since the mine portal and haul road are already in existence, but placement of intake vents and increased traffic are also important.

Objective 1. This objective is paramount. Considerable work is often done in many geographic and scientific areas but is unknown due to inappropriate literature review procedures. This is particluarly true in

WORK SCHEDULE

Task	Working Objective	Month M	Ju	Jl	A	S	O	N
1. Conduct Literature and Report Review	1	X	X		X			
a. State and Federal Agencies								
b. Private concerns								
c. Public references and records								
2. Establish Study Sites	2	X	X					
a. Contact coal company								
b. Visit area								
c. Select observation and data collection sites								
d. Establish study sites								
3. Identify and Inventory Faunal Components	3		X	X	X	X	X	X
4. Determine Significant Habitat	3,4		X		X			X
5. Determine Status of Species	4	X			X	X	X	X
6. Evaluate Perturbation Impact	4,5				X			X
7. Write Formal Report	5			X				X
8. Provide Comments	6							

the case of unpublished theses and state and federal agency reports. A cursory literature review was conducted but heavy reliance was placed upon the literature summary presented in WESTECH's 1978 report prepared for Coastal States Energy Company and reviewed for completeness by Willard Owens Associates, Inc. Visits were made to state and federal agencies who have jurisdiction or control over the study areas. Pertinent reports and management plans were reviewed and appropriate personnel questioned. Private vested interest groups were contacted for access to their data.

Objective 2. Individuals concerned with actual study site selection visited the potential and presently impacted areas to determine and make the final selection of the specific habitat types of concern. Within these habitat types specific replicate study sites were selected to represent the habitat. At each of these sites a combination of plots and transects was established to subsequently inventory and census non-avian terrestrial vertebrates.

Objective 3. A combination of literature analysis and field observations was conducted according to the work schedule to determine the probable and actual inhabitants of the area of concern and identify habitats (particluarly watering areas) significant to their presence and/or persistence. A combination of plots and line transects was used to determine non-avian vertebrate presence (observation, trapping, sign), population density or relative abundance (Hayne, 1949; Emlen, 1977) and habitat utilization (pellet group counts, spotlight census). The transects were 250 m long and placed in representative areas of the vegetation habitats of concern. The transects were centered on, in the case of the mine, or placed perpendicular to surface perturbation sources in each

habitat type. This design allows not only projected impact analysis but gradients of impact to be determined from the perturbation sources when and if they occur. Spacing of traps and/or observation sites along the transects was 10 m. This guaranteed that spacing was not in excess of the potential home range of the fauna being sampled.

Specific approaches and procedures used to accomplish this objective are included in tabular form. The mammalian species that potentially occur on the impacted area are listed in Table 1 and herptile species in Table 2. The methods for censusing the organisms are described. Footnotes referenced in the tables and discussed in the text of the work statement identify specific techniques and pertinent literature references wherein the detail of the method can be obtained.

Objective 4. The methods and procedures essential to accomplishment of this objective involved basically two things. First, all of the species observed or known to inhabit the potential areas of impact were identified to species through objectives 1 and 3 and listed phylogentically in tabular form (Tables 3-5). Second, all species were categorized as: (1) game species, (2) threatened or endangered species, (3) resident species, (4) migratory species, (5) restricted range species, (6) ubiquitous species, and/or (7) high interest species (Table 3-5). The term high interest species designates those that require special attention by scientists and/or public management agencies because they are either endangered, threatened, protected game or of economic or recreational value. The reasons for this high interest designation are many: (1) ranges are small thus restricting the population to perhaps a few individuals, (2) ranges may be small and although populations may be numerically large the entire range is within the area of concern, (3) irrespective of

population numbers or range little is known of the current status and in some cases information suggests that populations are declining, (4) species are sensitive to perturbations and may be in danger of abnormal declines, (5) species are relict or may have aesthetic or scientific value, (6) economic or recreational importance, and (7) combinations of the above. In this study area there are no endangered nor threatened sepcies present.

Objective 5. This objective is satisfied by discussions of the significant habitats, interactions and potential results of the perturbations on the non-avian terrestrial vertebrates. The data are summarily presented in tabular and mapped format to illustrate the above discussion. Impact on high interest species is rated on a perturbation scale ranging from 1-10, low to high (Table 6). The perturbation scale we have chosen goes from 0 to 10 and represents degrees of harm from no harm = 0, to total loss of the species in the area of concern = 10. The numerical determination for a given species is determined in the following manner. All of the information that can possibly be obtained within the scope of work for the species in question is gathered from both written, field, and verbal sources. The same is true for associated pertinent information regarding the abiotic and biotic habitat as well as the proposed perturbative action. With this information available, a group of knowledgeable people (in this case four biologists) evaluate the consequences of the action on the species in the area. They agree on an acceptable numerical impact value from 0 to 10. Pertinent points are made, data discussed, and the pros and cons of the proposed action evaluated in view of the unsuitability criteria applied to the Salina Planning Unit of the Fish Lake National Forest.

Objective 6. This objective will be met according to the requirements of Coastal States.

Table 1. Mammalian wildlife species censused by appropriate methods as indicated.

Potential wildlife species	Presence or absence[a]	Fecal deposition counts[b]	Strip census per unit area[c]	Grid counts tracks in sand or snow[d]	Ratio estimate census[e]	Mound counts[f]
Sorex vagrans	X				X	
Sorex palustrus	X				X	
Myotis lucifigus	X				X	
Myotis volans	X				X	
Lasionycteris noctivagans	X				X	
Eptesicus fuscus	X				X	
Lasiurus cinerius	X				X	
Corynorhinus rafinesquii	X				X	
Tadarida mexicana	X				X	
*Lepus townsendii	X	X	X	X		
*Lepus californicus	X	X	X	X		
*Sylvilagus nuttali	X	X	X	X	X	
Tamiasciurus hudsonicus					X	
Mormota flaviventris					X	
*Spermophilus armatus	X				X	
Spermophilus variegatus	X				X	
*Spermophilus lateralis					X	
*Eutamias minimus					X	
*Eutamias quadrivittatus					X	
Glaucomys sabrinus	X					
Thomomys tadpoides						X
*Perognathus parvus					X	
Castor canadensis	X					
Reithrodontomys megalotis					X	
*Peromyscus maniculatus					X	
Peromyscus trueii					X	
Onychomys leucoguster					X	
*Neotoma lepida					X	

Table 1. Continued.

Potential wildlife species	Presence or absence[a]	Fecal deposition counts[b]	Strip census per unit area[c]	Grid counts tracks in sand or snow[d]	Ratio estimate census[e]	Mound counts[f]
Neotoma cinerea					X	
Clethrionomys gapperi					X	
Microtus pennsylvanicus					X	
Microtus montanus					X	
*Microtus longicaudus					X	
Microtus richardsoni					X	
Zapus princeps					X	
*Erthizon dorsatum	X			X		
*Canis latrans	X	X				
Vulpes fulva	X			X		
Urocyon cinereoargenteus	X			X		
Ursus americanus	X			X		
Bassariscus astutus	X					
Mustela erminea	X					
Mustela frenata	X					
Taxidea taxus	X			X		
Mephitis mephitis	X					
Spilogale gracilis	X					
*Felis rufus	X			X		
*Felis concolor	X			X		
Cervus canadensis	X	X	X			
*Odocoileus hemionus	X	X	X			

Scientific names used due to nonacceptance of common name.

*Mammals thought to be especially important in established sites.

[a]Presence or absence determined through diurnal, crepuscular, nocturnal and seasonal observation and analyses of habitats.

[b]Rates and amounts of feces voided by certain wildlife have been used to estimate relative habitat utilization. Census for big game followed methods outlined in the Interagency Guidelines for Big Game Range Investigations in Idaho (1974), while taking into account comments by Eberhardt and Van Etten (1956). Scat census for carnivores was to involve counts on established line transects to obtain information on relative density, but so few were found that scat were subsequently identified and only recorded when encountered. Plots established to assess deposition of feces by ungulates and leporids. Population estimations were to take into account established defecation rates (Cochran and Stains 1961, Bear and Hansen 1966, Kundaeli and Reynolds 1972), but such estimates cannot be made until greater game use of the area occurs in late fall, winter, and early spring.

[c]When possible, efforts were made to determine number of animals per unit area. Strip census methodology was designed to provide such data. The King Flush Census, with modifications, (Giles 1971) and Emlen's (1977) line transect flush method have been widely used on a variety of animals and were used where applicable. Night census, via spotlight using an Area-Estimate Method (Flinders and Hansen 1973 and 1975) and/or the Hahn Method (1948) was used to provide estimates of population density for a variety of wildlife, including leporids, big game, and some carnivores (Flinders and Hansen 1975), but populations were too low to adequately estimate.

[d]Widely dispersed wildlife are difficult to census. One method of advancing occurence of species beyond presence or absence is to identify and count different sets of tracks after a fresh snow or on sand on an established area imposed on the study area (Wright 1951, Tyson 1959, Flinders 1977). Relative population densities may be calculated and these compared, via regression, to population estimations derived by the other census methods. Although attempted, this was not feasible in this habitat during the time of the study.

[e]Although widely used, the Peterson or Lincoln Index method (Giles 1971) are inaccurate due to faulty assumptions. Therefore, the widely accepted Hayne regression method (1949) was used to calculate estimations of population density of wildlife species. Ratio-estimate methods were used for bats, colonial and rather sedentary wildlife species to estimate density of populations, but presence and relative abundance are reported and will suffice.

[f]Since gophers present a problem for the ratio estimate techniques, a radius mound count technique (Ward et al. 1967) was to be used to estimate gopher densities. However, gophers were so few that presence and absence are sufficient.

Table 2. Herptile wildlife species censused by appropriate methods as indicated.

Potential Wildlife Species	Presence or Absence[a]
Tiger Salamander	X
Great Basin Spadefoot Toad	X
Boreal Toad	X
Woodhouses Toad	X
Boreal Cricket Frog	X
Western Leopard Frog	X
Fence Lizard	X
Brown-shouldered Uta	X
Sagebrush Lizard	X
Mountain Short-horned Lizard	X
Great Basin Skink	X
Rocky Mountain Rubber Boa	X
Wandering Garter Snake	X
Red-sided Garter Snake	X
Western or Yellow-bellied Racer	X
Striped Whipsnake	X
Western Smooth Green Snake	X
Gopher Snake	X
Milk Snake	X
Utah Mountain Ringsnake	X
Western Rattlesnake	X

Common names are used due to acceptance.

[a]Presence or absence determined through diurnal, crepuscular, and seasonal observation and analyses of habitats.

MAPS AND VITAE - SEE APPENDICES

DATA SUMMARIES - SPECIES STATUS LISTS

Literature and field data were summarized for all terrestrial vertebrates of concern, and the species categorized to determine habitat affinities and high interest species status. These results are reported in tabular form (Tables 3-5). They are listed according to their various ecological classifications (Dalton et al. 1978; Durrant 1952; Hall and Kelson 1959; Hayward 1967; and Hayward et al. 1958). All species whose ranges appear to overlap any or all of the potential area of impact are listed. Generally speaking, the proposed project area could potentially be inhabited by about 59 mammalian, 6 amphibian and 16 reptilian species. Some of these are considered high interest species for the habitats and local area of concern and 50 percent are protected by state and federal law.

No discussion is included in this section of the report. The high interest species of concern are mapped (Figures 1-3) and discussed individually in a separate section, as are the overall impacts by action. Although several of the high interest species are mapped individually, others whose ranges are essentially ubiquitous could not be mapped meaningfully. Generally, if a high interest species is not mapped, it is because its distribution is too broad to be of consequence in a small area such as the new (1979) SUFCo Coal Lease and area of concern. No endangered or threatened species of mammals occur within the boundary of this study, nor are any in proximity close enough to be considered.

Terms used in Tables are defined as follows:

1. Plant communities (discussed in detail in another portion of this paper): (a) spruce-fir, (b) aspen, (c) sage brush, (d) grass (e) riparian habitat, (f) mountain brush, (g) chapparal, (h) ponderosa pine, (i) pinyon-juniper, and (j) scotch pine-spruce.
2. Game species: Any species that is hunted or trapped as a game or fur-bearing animal and requires a trapping permit or a hunting license.
3. Migratory species: Any species that spends only part of the year in the area.
4. Resident species: Any species that inhabits the area during reproduction.
5. Casual or Rare: Any species that is only observed occasionally over a period of several years. There is no connection between this category and a "rare" or endangered" species.
6. High interest: Any species that is endangered, threatened or of economic or recreational value.
7. Density/Hectare: Determined by using an accepted method depending on the species involved.

Table 3. Species list and classification of mammals whose published ranges overlap the proposed SUFCo Mine Site.

A = Abundant
C = Common
U = Uncommon
Ca = Casual or Rare
R = Permanent Resident
S = Summer Only
D = Density/Hectare

	Chaparral	Spruce-fir	Aspen	Sagebrush	Mt. Brush	Stream Side	Pinon-juniper	Observed on Site	High-Interest Species
Masked Shrew *Sorex cinereus*			UR			UR			
Mirriam Shrew *Sorex mirriami*			UR			UR D 1.0		X	
Vagrant Shrew *Sorex vagrans*			UR			CR		X	
Dusky Shrew *Sorex obscurus*			CaR			CaR			
Water Shrew *Sorex palustris*						UR			
Little Brown Myotis *Myotis lucifugus*						CS			
Long-eared Myotis *Myotis evotis*						US			
Fringed Myotis *Myotis thysanodes*						US			

Table 3. Continued.

Species	Chaparral	Spruce-fir	Aspen	Sagebrush	Mt. Brush	Stream Side	Pinon-juniper	Observed on Site	High-Interest Species
Long-legged Myotis *Myotis volans*						US			
California Myotis *Myotis californicus*						US			
Small-footed Myotis *Myotis leibii*						US			
Silver-haired Bat *Lasionycteris noctivagans*						CS			
Big Brown Bat *Eptesicus fuscus*						US			
Red Bat *Lasiurus borealis*						US			
Hoary Bat *Lasiurus cinereus*						CS			
Townsend's Big-eared Bat *Plecotus townsendii*						US			
Brazilian Free-tailed Bat *Tadarida brasiliensis*						CS			
Nuttall's Cottontail *Sylvilagus nuttallii*	CR				CR			X	X
White-tailed Jackrabbit *Lepus townsendii*				UR				X	

Table 3. Continued.

	Chaparral	Spruce-fir	Aspen	Sagebrush	Mt. Brush	Stream Side	Pinon-juniper	Observed on Site	High-Interest Species
Great Basin Pocket Mouse *Perognathus parvus*	UR .49D			CR 1.96D	UR .5D			X	
Beaver *Castor canadensis*						UR		X	X
Western Harvest Mouse *Reithrodontomys megalotis*				UR		UR			
Deer Mouse *Peromyscus maniculatus*	AR D78	AR D30	AR D41	AR D15	AR D13	AR D78	CR D18	X	
Pinon Mouse *Peromyscus trueii*							CR	X	
Bushy-tailed Woodrat *Neotoma cinerea*							ID	X	
Meadow Vole *Microtus pennsylvanicus*			UR			UR		X	
Montane Vole *Microtus montanus*			CR D18		CR D0.5			X	
Long-tailed Vole *Microtus longicaudus*			AR			AR D36		X	
Water Vole *Arvicola richardsoni*									
Western Jumping Mouse *Zapus princeps*			CR D1			AR D281		X	

Table 3. Continued.

	Chaparral	Spruce-fir	Aspen	Sagebrush	Mt. Brush	Stream Side	Pinon-Juniper	Observed on Site	High-Interest Species
Porcupine *Erethizon dorsatum*	CR	CR			CR			X	
Coyote *Canis latrans*	UR	UR	UR	UR	UR	UR	UR	X	X
Gray Fox *Urocyon cinereoargenteus*	UR						CaR	X	X
Black Bear *Ursus americanus*	UR	UR	UR		UR			X	X
Ringtail *Bassariscus astutus*	UR						UR		
Marten *Martes americana*	CaR	CaR							X
Ermine *Mustela erminea*	CaR		CaR		CaR				X
Long-tailed Weasel *Mustela frenata*	UR	UR	UR	UR	UR	UR	UR	X	X
Mink *Mustela vison*						CaR			X
Badger *Taxidea taxus*	UR			UR	UR				X
Striped Skunk *Mephitis mephitis*	CR			CR	CR	CR			X

Table 3. Continued.

	Chaparral	Spruce-fir	Aspen	Sagebrush	Mt. Brush	Stream Side	Pinon-juniper	Observed on Site	High-Interest Species
Black-tailed Jackrabbit *Lepus californicus*				CR				X	X
Snowshoe Hare *Lepus americanus*		CR	CR						
Least Chipmunk *Eutamias minimus*		CR D4	CR D16		CR D1	CR D1		X	X
Uinta Chipmunk *Eutamias umbrinus*	DO.5	CR					CR DO.5	X	
Yellow-bellied Marmot *Marmota flaviventris*			CR	CR				X	
Uinta Ground Squirrel *Spermophilus armatus*				CR		CR		X	
Rock Squirrel *Spermophilus variegatus*					CR	CR		X	
Golden-mantled Ground Squirrel *Spermophilus lateralis*		CR		CR			CR	X	
Red Squirrel *Tamiasciurus hudsonicus*	CR	CR						X	
Northern Flying Squirrel *Glaucomys sabrinus*	UR	UR							
Northern Pocket Gopher *Thomomys talpodes*		CR	CR	CR		CR		X	

Table 3. Continued.

	Chaparral	Spruce-fir	Aspen	Sagebrush	Mt. Brush	Stream Side	Pinon-juniper	Observed on Site	High-Interest Species
Spotted Skunk *Spilogale putoricus*	CaR				CaR				
Mountain Lion *Felis concolor*	CaR	CaR					CaR	X	X
Bobcat *Lynx rufus*	CaR	CaR					CaR	X	X
Wapiti or Elk *Cervus elaphus*	CR	CR	CR	CR	CR	CR	CR	X	X
Mule Deer *Odocoileus hemionus*	CR	CR	CR	CR	CR	CR	CR	X	X

Table 4. Species list and classification of amphibians whose published ranges overlap the proposed SUFCo Mine Site.

	Chaparral	Spruce-fir	Aspen	Sagebrush	Mt. Brush	Stream Side	Pinon-juniper	Observed on Site	High-Interest Species
Tiger Salamander *Ambystoma tigrinum*						X		X	
Great Basin Spadefoot Toad *Scaphiopus intermontanus*						X			
Western Toad *Bufo boreas*						X			
Woodhouse's Toad *Bufo woodhousei*						X			
Boreal Chorus Frog *Pseudacris triseriata*						X			
Western Leopard Frog *Rana pipiens*						X		X	

Table 5. Species list and classification of reptiles whose published ranges overlap the proposed SUFCo Mine Site.

	Chaparral	Spruce-fir	Aspen	Sagebrush	Mt. Brush	Stream Side	Pinon-juniper	Observed on Site	High-Interest Species
Northern Plateau Lizard *Sceloporus undulatus*	X				X			X	
Sagebrush Lizard *Sceloporus graciosus*				X				X	
Tree Lizard *Urosaurus ornatus*	X				X				
Mountain Short-horned Lizard *Phrynosoma douglassi*				X	X			X	
Great Basin Skink *Eumeces skiltonianus*	X								
Western Whiptail *Cnemidophorus tigris*				X	X				
Rocky Mountain Rubber Boa *Charina bottae*	X		X		X				
Wandering Garter Snake *Thamnophis elegans*	X		X	X	X	X			
Red-sided Garter Snake *Thamnophis sirtalis*						X			

Table 5. Continued.

High-Interest Species	Observed on Site	Pinon-Juniper	Stream Side	Mt. Brush	Sagebrush	Aspen	Spruce-fir	Chaparral
Western Yellow-bellied Racer *Coluber constrictor*				X	X			
Striped Whipsnake *Masticophis taeniatus*								
Western Smooth Green Snake *Opheodrys vernalis*								
Gopher Snake *Pituophis melanoleucus*	X			X	X			
Milk Snake *Lampropeltis triangulum*			X	X		X		X
Utah Mountain Kingsnake *Lampropeltis pyromelana*		X	X	X		X		X
Western Rattlesnake *Crotalus viridus*			X		X			X

IMPACT ANALYSIS BY HIGH INTEREST SPECIES

MAMMALS

The potential area of impact is inhabited by about 59 species of mammals (Table 4). Approximately 30 percent are protected and considered of high interest to the State of Utah. As such, each might be considered in relation to the potential perturbations, but only those of major concern to management agencies will be individually discussed.

Elk

The elk herd in the Salina Planning Unit is a significant wildlife resource to the citizens of Utah, and there is considerable hunting pressure; however, the herd is considered to be productive and is thought by Utah Division of Wildlife Resources (D.W.R.) to be increasing. Although the potential area of impact is not critical to the continued existence and perpetuation of the herd it is important to maintenance of current population levels, and portions of the entire lease area are used annually on a seasonal basis. The aspen areas of Duncan Mountain serve as calving areas for the relatively small herd, (10-20 animals observed during the 1980 summer in that area), but based on pellet counts (Table 7) the major portion of the lease area is utilized in late fall, winter, and early spring.

In May while there was still snow on the ground we found considerable fresh elk sign (pellets and tracks) around the Acord Lakes. By June 5, 1980, when we were able to access the other areas we found elk tracks concentrated in the ponderosa, mahogany, aspen and manzanita communities along the ridges and rims of the canyon, plus in the canyons such as Duncan's Draw and Lizonbee Springs. During the summer the elk and elk signs were sighted near the top of Duncan Mountain and at the head of the

Table 6. Projected impact of the proposed coal mine expansion and its associated facilities on High Interest mammals using a perturbation scale of 0 to 10 (low to high).

Species	Perturbation Scale (0-10)
Nuttal's Cottontail *Sylvilagus nuttallii*	1
White-tailed Jackrabbit *Lepus townsendi*	0
Black-tailed Jackrabbit *Lepus californicus*	1
Snowshoe Hare *Lepus americanus*	1
Beaver *Castor canadensis*	0
Coyote *Canis latrans*	1
Gray Fox *Urocyon cinereoargenteus*	1
Black Bear *Ursus americanus*	1
Marten *Martes americana*	0
Ermine *Mustela erminea*	0
Long-tailed Weasel *Mustela frenata*	0
Mink *Mustela vison*	0
Badger *Taxidea taxus*	2
Mountain Lion (Cougar) *Felis concolor*	2
Bobcat *Lynx rufus*	2
Wapiti or Elk *Cervus elaphus*	3
Mule Deer *Odocoileus hemionus*	3

Table 7. Utilization of vegetation habitats as determined by pellet counts.

Habitat Type	Elk $\frac{\text{pellet groups}}{\text{hectare}}$	Deer $\frac{\text{pellet groups}}{\text{hectare}}$	Rabbit Abundance
Grass	$\frac{3.25 \text{ pell}}{.0314 \text{ hec}} = 103.50$	$\frac{7 \text{ pell}}{.0314 \text{ hec}} = 222.93$	Low
Sage	$\frac{8.5 \text{ pell}}{.0314 \text{ hec}} = 270.70$	$\frac{35.75 \text{ pell}}{.0314 \text{ hec}} = 1138.54$	Low-Moderate
Aspen	$\frac{6 \text{ pell}}{.0314 \text{ hec}} = 191.08$	$\frac{40 \text{ pell}}{.0314 \text{ hec}} = 1273.88$	Low
Ponderosa Pine	$\frac{19.67 \text{ pell}}{.0314 \text{ hec}} = 626.43$	$\frac{12 \text{ pell}}{.0314 \text{ hec}} = 382.16$	Low
Scotch Pine & Spruce	$\frac{4 \text{ pell}}{.0314 \text{ hec}} = 127.39$	$\frac{14 \text{ pell}}{.0314 \text{ hec}} = 445.86$	Moderate
Spruce/Fir	$\frac{.75 \text{ pell}}{.0314 \text{ hec}} = 23.88$	$\frac{27 \text{ pell}}{.0314 \text{ hec}} = 859.87$	Moderate-High
Mountain Brush	$419.43 \frac{\text{pellet groups}}{\text{hectare}}$	$2426.26 \frac{\text{pellet groups}}{\text{hectare}}$	Moderate
Pinyon/Juniper	$148.73 \frac{\text{pellet groups}}{\text{hectare}}$	$1321.66 \frac{\text{pellet groups}}{\text{hectare}}$	
Aspen, Mahogany Ponderosa, Manzanita	$69.11 \frac{\text{pellet groups}}{\text{hectare}}$	$1788.85 \frac{\text{pellet groups}}{\text{hectare}}$	Low-Moderate

South Fork of Quitchupah. In general, this agrees (but not entirely) with the utilization assessment of the area by the U.S. Forest Service (1976). The Forest Service reported that part of the current mine and expansion area is considered an elk calving ground, most, an elk winter concentration site, and portions "normal" big game winter range (Figure 2). The point in question is the time of elk utilization. WESTECH (1978) reported from personal conversations with SUFCo personnel that during severe winters as in 1977-78 parts of the elk concentration area and "normal" winter range were not used. When there was 3-4 feet of snow on the plateau no elk were seen, but by late winter and early spring they had returned and were observed. It seems that the elk in question do not always winter on the rims nor the plateau but in the lower elevation areas to the southeast. This observation was substantiated by a conversation with a local forest ranger out of Richfield. The amount of snow is probably the determinant with the elk wintering wherever there is available forage from the rim to the low brush areas in the southeast (Figure 2).

The fact that elk utilize the entire area of concern during some time of the year means that all aspects and timing of the proposed actions must be considered. However, since the SUFCo Mine has been operational since the early 1940's and since there are no plans for additional surface facilities other than ventilation portals along the cliffs, there should be little additional disturbance to the elk. The animals have already accommodated the human disturbance associated with mining and hauling the coal, and subsidence in the existing mine area seems of little consequence to the stability of the vegetation communities and water resources. As long as no venting is allowed, none is planned, in the calving area on Duncan Mountain, nor within ¼ mile either side of the limited trails off

of the southeast cliffs, impacts should be no different than at present and little or no discernable change resulting from the proposed actions should be evidenced in the elk herd.

Mule Deer

Mule deer on the current mine and proposed expansion area are considered part of herd unit 157 by the Utah D.W.R. Historically this herd has experienced the same general fluctuations as the other herd units of the state. The populations decreased in the early 1970's primarily due to abnormal climatic conditions and were severely decreased during the severe 1972-1973 winter. Since 1975, however, with the increase in reproductive potential the population is on a general upswing. The animals in the environs of concern utilize the entire assessment area but seasonally concentrate in and more heavily utilize specific habitat types (Table 7).

During the summer the mule deer generally utilize all of the habitats near watering areas. The most heavily used communities were the sage, mountain brush and the composite of aspen, mountain mahogany, manzanita and ponderosa. This is as expected since there is considerably more browse in these communities than in the others sampled.

With the onset of fall and winter the mule deer altitudinally migrate. Initially (late fall and early winter) they concentrate on the plateau area where they intermingle with the elk but when the snow gets too deep for them to traverse they move into the low elevation sage, and pinyon-juniper areas to the southwest where they no longer intermingle with elk who migrated southeast into more grass covered and less human disturbed areas. The wintering areas for mule deer make them susceptible to road strikes in the vicinity of the haul and access road for the SUFCo Mine and Interstate 70.

Cougar

The entire SUFCo mine and the new lease area provides substantial value, yearlong habitat for cougar. The animal ranges throughout the area as evidenced by a sighting one third of the way down the slope in Quitchupah Canyon, one half mile below the confluence of South Fork, and tracks in the mud near Jack Hadley's Monument, Broad Hollow and in the dust of the road near Acord Lakes. The animals range throughout the area, but their movements are often dictated by migration patterns of their primary food source, mule deer, and human disturbance. Although cougars are not overly abundant and are secretive, concern must be given them particluarly when the females are accompanied by their young who are learning to hunt and survive. This is considered a sensitive period for cougars and it is best if disturbance is minimized during this time. However, this period in their life cycle is difficult to determine for cougars since they are known to reproduce year round. If cougar populations in the area of potential impact were at or near saturation this would be a major concern but since neither is the case the cougars will, as they currently do, avoid the high human activity areas and the overall cougar population will be little affected. A precautionary measure would be to avoid locating the ventilation portals within one quarter of a mile of the major game trails.

Bobcat

The mine, proposed expansion and adjacent areas provide substantial value habitats for bobcats who, were evidenced by sightings and tracks, to occupy or use all terrestrial habitats on the entire area of potential impact. Although little is known about the bobcat for Utah let alone the

area of concern, a sensitive period would be late February when parturition occurs. May and June would also be a sensitive period because young bobcats when first exploring and learning to hunt are not as secretive as cougar, making them less likely to avoid the high human disturbance areas during these months. They are more vulnerable to open human harrassment and illegal killing, but since this is an additional lease for an ongoing mining operation, pressures on bobcats should be unchanged.

Black Bear

Only a limited portion of the mine and proposed lease expansion areas provide substantial value, yearlong habitat for black bear. Bear tracks were observed in Broad Hollow, but Forest Service personnel indicated to us that most of the bear sightings occurred on White Mountain. At best black bear are not abundant nor are they active year round. Sensitive periods in the life cycle of the black bear are February and March when the cubs are born and when they accompany their mother on initial foraging expeditions during early summer. Since parturition occurs within the winter den and since disturbance in the black bear habitat will be limited to subsidence this sensitive period will be little impacted by the proposed action. The same is true of the initial foraging forays.

Mountain Cottontail

The entire mine and proposed lease expansion areas provide substantial value, yearlong habitats for cottontail rabbits. The young are born between April and July which is considered a sensitive period, but the proposed actions will in all probability not seriously alter the reproductive potential of the population. Hunting pressure will likely not increase nor will illegal kills. However, this would not matter since hunted

rabbit populations are more healthy and stable than non-hunted populations. Subsidence could potentially create a problem causing death and limiting reproduction for a short time in the area subsided, but since subsidence is limited to relatively small areas at a time little overall impact will occur. Besides, disturbed vegetation leading to succession if it occurs will enhance reproductive potential of cottontail rabbits.

Snowshoe Hare

The snowshoe hare is present in and dependent upon the spruce-fir vegetation habitat year round. This habitat type is limited in the mine and proposed expansion area, but the proposed actions will do little to harm the habitat type and the hare populations dependent upon it. Although the sensitive period for reproduction is from April 1 to August 15, the snowshoe hare will not be seriously impacted through time. Subsidence will not harm the above ground dweller as it does sub-terranean inhabitants. Little change in showshoe hare populations will result from the proposed actions. Hunting pressure, legal and illegal, will be the most influential activity of man upon snowshoe hares but will be of little far reaching impact and therefore of negligible concern beyond normal law enforcement.

Furbearers

Limited portions of the proposed mine lease and adjacent areas provide substantial value habitats for a few species categorized by management agencies as furbearers: ermine, long-tailed weasel, badger and the striped skunk. Obviously, the breeding and rearing activities of these non-migratory species occurs within the proposed area of concern and their dens and burrow systems are important to maintenance of their populations, but it is highly unlikely that the proposed actions of this

specific project will seriously impact them for any length of time. Subsidence will be localized and new burrows will be built or old ones reconstructed after it occurs. These species are widespread and adaptable to the activities of man.

Small Mammals

Although small mammals do not qualify individually as high interest species, they represent a significant part of the ecosystem. The majority are herbivores and are the primary source of food for higher trophic levels, particularly raptorial birds, canids and felids. This trophic importance warrants consideration. Since this mining project only involves the expansion of an ongoing operation, there will not be habitat loss due to construction and operation of additional surface facilities. Therefore the concern regards subsidence and its impact on underground burrow systems. The potential exists for caving burrows in and/or changing burrow continuity due to fracturing of the strata. Should this occur it is likely that young mammals in the nest would be crushed or cut off from parental care. Although this would temporarily alter the population density and age structure, recovery would be imminent and rapid since the breeding population, contiguous and within the localized area of impact, would not be lost. Additionally, the population densities are more than adequate to supply the limited number of predators present, particulary raptorial birds, that utilize the resource.

HERPETOFAUNA

HERPETOFAUNA

Increasing elevation rapidly reduces the number and kind of reptiles and amphibians. Furthermore, in Utah the effects of the more northern latitude reduces numbers of herptiles in much the same way as does the increase in elevation.

These geographical and associated climatic factors have eliminated most desert species, leaving species that are adapted either to mountain habitats or montane type habitats developed in the more northern areas. Thus, the reptiles and amphibians of Utah, and particularly those inhabiting the areas under consideration, have arrived in Utah by means of dispersal lanes coming from the northeast and the southeast. With few exceptions the species listed have wide distributions and are versatile in their adaptive abilities.

Literature pertaining to the amphibians and reptiles is extensive; but, much of it refers to species occurring in the desert areas and has only limited reference to forms inhabiting Utah mountains. Most of the publications dealing with species lists for the state are old (V. Tanner, Amphibians, 1931; Woodbury, Reptiles, 1931; and Pack, Snakes, 1930). Perhaps the most up-to-date listings for the area under consideration are a checklist of Utah amphibians and reptiles (Tanner, 1975), and Utah Division Publication No. 78-16 (Dalton, 1978) which references a contiguous and similar geographic area.

Other recent literature pertinent to this report are: Schmidt (1953); Stebbins (1954 and 1966); W. Tanner (1953, 1957a and b, 1966-with Banta, 1969-with Morris, and 1972-with Fisher and Willis); and Woodbury (1952).

The area of concern in this report is located in the upper edges of sagebrush (Artemisia) and into the Aspen-Spruce-Fir plant communities.

Amphibians

Based on the extensive literature review and limited field work it was determined that probably two and potentially six species of amphibians (Table 5) inhabit the proposed area of concern which provides substantial value habitat for all the species listed. All amphibians are legally protected, but since the species listed are all widespread throughout the mountains of Utah, none are treated as high-interest species, and, therefore, are not individually discussed. It is doubtful if the proposed action would seriously impact populations but rather localized individuals in the areas of habitat destruction due to subsidence. An exception to this would result if subsidence interrupted underground aquifers and caused drying of present wet habitats essential to reproduction.

Reptiles

Based on the literature search and limited field work it was determined that probably seven and potentially 16 species of reptiles (Table 6) occupy the mine land area that is considered as substantial value habitat for all species. All reptiles are legally protected, but since the species listed are all widespread throughout montane habitats in Utah, none are treated as high-interest species and, therefore, are not individually discussed. It is doubtful if the proposed action would seriously impact populations. If a denning site for any reptile species were discovered during the construction of the ventilation portals, it should be preserved until proper procedures to move the den site to a new location were implemented by the proper Utah D.W.R. personnel. This is relatively easy to do and, therefore, should cause little concern.

IMPACT ANALYSIS BY ACTION

IMPACT ANALYSIS BY ACTION

The perturbation impacts resulting from the proposed actions during expansion and operation of the SUFCo Mine Project are limited since this is an expansion of an existing mine with little additional surface activity and disturbance projected. However, those potential impacts that will result in possible perturbations to the environment that might relate to the stability of the populations of mammals, amphibians and reptiles living in and/or utilizing the area of potential impact must be considered. Those perturbations of potential concern are those that are directly related to: (1) surface disturbance, (2) loss of habitat, (3) noise, (4) human activity. Any one, all or a combination of the above perturbations could impact terrestrial vertebrates.

Surface Disturbance

Surface disturbance in most mining operations is a major concern since extensive surface facilities are usually constructed to facilitate processing, loading and transporting the coal once it is brought to the surface. Such is not the case with the expansion of the SUFCo Mine. The portal facilities and haul roads are already in existence and additional acreage will not be needed except for the ventilation system that will require 4 or 5 surface openings. Approximately 2632 additional acres are scheduled to be undermined, however, and will be subject to subsidence up to 70 percent of the thickness of the mined coal.

Habitat Loss

Since the immediate area of the mine portal, access and haul roads, loading and storage facilities has already been lost as habitat, it

warrants little further consideration, beyond the admonishment to minimize its impact by providing buffer zones. It would be best if the surface facilities including roads could be screened from wildlife use areas by vegetation and/or terrain buffers. Concern should be given to revegetation with species that will not only benefit, but promote wildlife.

The ventilation portals to be constructed along the cliffs in Quitchupah Canyon warrant consideration. These cliff areas are habitat for cougar. The observed animals seem to use them for denning activities, therefore care should be taken to avoid placement of portal openings where there are caves or other natural denning sites. Specific placement of the portal openings should be a cooperative effort between appropriate wildlife and engineering personnel. Another consideration must be made in portal placement. There is a limited number of trails going from the plateau area through the cliffs to the valley floor to the southeast. It appears that these trails are important to elk migration from summer to winter range, and therefore construction for and installation of ventilation portals should not be allowed to interrupt this limited number of access routes.

Subsidence

Surface disturbance associated with certain mining operations and techniques can be extremely detrimental to terrestrial and aquatic vertebrates, but the long-wall and room and pillar techniques proposed for use in the expansion of the SUFCo Mine minimize much of the impact. Since no overburden is removed, the major problem is surface subsidence. The acreage that will be undermined will be subject to subsidence up to 70 percent of the thickness of the mined coal, but it is doubtful that subsidence will

reach 70 percent. Similarly mined areas in comparable habitats in New Mexico have experienced less than 12 percent subsidence with little or no visible disturbance, and the existing mined area has not approached 70 percent but has subsided and only shown surface fissures. It is probable that the integrity of the above ground terrestrial vertebrate communities will generally remain status quo, with occurrence of occasional fractures and minor slippages that will not be detrimental to vegetation or wildlife. Credibility to this statement comes from the lack of detectable differences in terrestrial vertebrates in comparable habitats in expansion areas.

Subterranean changes, however, are not understood. There is the possibility that when subsidence occurs it will collapse underground aquifers and burrow systems thus destroying the home and habitat of fossorial mammals, reptiles and amphibians and possibly killing some in the immediate area at the time of collapse. If subsidence were to occur simultaneously and non-uniformly over the entire area of concern, this would be a major problem not only for the prey species but particularly for predators dependent upon the prey base. However, since subsidence will occur systematically and in small areas at a given time as panels are mined, the impact will be lessened. Only localized populations will be impacted and only for a short while. Reproductive potential coupled with dispersal will facilitate almost immediate recovery and negate the temporary population reduction. There are no threatened nor endangered species present in the area so none will be impacted.

The question of underground aquifer collapse is not easily dismissed. The geology and hydrological system in this area has been studied for several years and is currently being examined. Surface waters and habitats are significant resources to elk and deer during the late summer months

when water becomes the limiting resource to habitat utilization. Loss of said resources would be serious not to the perpetuation of the population and herds as an entity, but to harvestable productivity. Such habitat loss would also be detrimental to amphibians and aquatic dependent reptiles. Prior to and as mining progresses these aquatic and aquatic dependent resources should be monitored to assess potential degradation impacts. It is not known if this problem will occur but if it does surface water equivalents should be permanently provided to maintain the integrity of any areas and populations so impacted.

Haul Road

Although the haul road is in existence, there is a cautionary concern that must be mentioned. The haul road traverses known deer winter range where deer feed along and readily cross the road making them vulnerable to the coal hauling trucks. Although deer can habituate to traffic thus reducing road strikes, more deaths occur than are desireable. If additional coal is to be hauled via more trucks on the exisitng haul road with the expansion of the mine, the potential exists to increase the number of road strikes and to create a semi-barrier to movement of deer from range on one side of the road to the other.

Loss of Habitat

Although approximately 6400 acres might undergo disturbances of which the proposed expansion comprises 2,632 acres, essentially no additional acreage will be lost for habitation and production by non-avian terrestrial vertebrates. The areas of the ventilation portals planned along Quitchupah Canyon will be lost but if consideration is given to potential cougar denning and resting sites and established trails down through the cliffs

the actual habitat loss is of little consequence. This is only true if the portals are opened to the outside from the underground mine and not from the outside in.

Noise

Noise, created from operation of the mine, is not expected to increase in the existing areas of disturbance associated with the mining activity, not even with the additional ventilation intake portals planned for placement along the cliffs in the expansion area. These portals are only for intake air. The fan is at the mine site.

Human Activity

Since this is an expansion of an existing mining operation, little increased human activity is expected; therefore, the impacts of human activity have likely stabilized in the area of concern. The company should educate their employees and habitat users about wildlife needs and their importance. It is especially important that wildlife not be harassed during sensitive periods in their life history. During winter, wildlife are often in a delicate energy state and unnecessary disturbance by man causes them to use up critical and limited energy reserves that, often times, result in mortality. In less severe cases the fetus being carried by gestating mammals may be resorbed or aborted thus reducing reproductive success and productivity of the population.

During breeding seasons, disturbance by man can negatively affect reproductive success by disrupting territorial selection or defense, interrupting courtship displays and disturbing mating animals.

During parturition, lactation and early in the rearing process, young animals need to be undisturbed. It is during this time that young

animals gain the strength and ability to elude predators and man. Undisturbed habitats allow the young animals to develop in a relatively unstressed situation and to utilize habitats that are secure from predators. Disturbance by man can compromise this unstressed situation and result in abandonment of the young by the female, increased accidents that cause mortality or increased natural predation. Then there is the too often occuring situation of man coming upon young animals and taking them home thinking that they are abandoned.

It is essential that the company make every effort to educate all employees associated with the SUFCo Mine operation to the intricate values of the wildlife resources associated with the mine and expansion plan area. Each employee should be advised not to unnecessarily or without proper permits or licenses harass or take any wildlife. They should also be admonished to establish a game alert program wherein they report violators to the proper company and management authorities for reprimand or prosecution. They should be impressed that they as hunting and recreation users stand to gain the most by preserving what they have in proximity to their places of work and abode.

UNSUITABILITY CRITERIA

UNSUITABILITY CRITERIA

This section considers the 20 unsuitability criteria which the Bureau of Land Management (BLM) and United States Forest Service (USFS) applied to the southernmost portion of the area of concern up to R.3E, R.4E, R.5E., T.22 S. as they apply to the remainder of the mine and proposed expansion area. According to 43 CFR 3461.2 Federal lands with coal deposits that are to be mined by underground mining techniques should not be assessed as unsuitable where there are to be no surface coal mining operations. However, where underground mining will include surface operations and surface impacts on Federal lands to which a criterion applies, the lands shall be assessed unsuitable unless a relevant exception or exemption applies. Surface impacts include surface occupancy, subsidence, and other environmental impacts evidenced on the surface.

Since the SUFCo Mine was in production prior to passage of the Surface Mining Control and Reclamation Act of 1977, the unsuitability criteria need not be applied to the existing surface facilities, that includes the portal, loading, and haul road planned for use in the expansion lease area. Since subsidence will occur and ventilation portals opened in the new lease area, the unsuitability criteria must be considered for the expansion area. Not all criteria apply to this study. This study was limited by contract to non-avian terrestrial vertebrates and therefore only Criteria No. 1, 4, 6, 9, 10, 15, and 20 are applied.

Criterion No. 1

There are no National Park Systems, National Wildlife Refuge Systems, National Systems of Trails, National Wilderness Protection Systems,

National Wild and Scenic River Systems, National Recreation Areas, lands acquired with money derived from the Land and Water Conservation Fund or Federal lands in incorporated cities, towns, and villages within KRCRA boundary.

The area of concern meets this criterion as it applies to non-avian terrestrial vertebrate wildlife, however, since a portion of Fishlake National Forest which has been termed unsuitable for future coal lease consideration contains the expansion lease area the exception must be cited and applied.

Exception No. 1

The Secretary of Agriculture has found no significant recreational, timber, economic or other values within Fishlake National Forest which may be incompatible with a lease. Therefore, land within the Fishlake National Forest may be considered as suitable for future coal lease consideration pending assessment of all the criteria. This exception covers non-avian terrestrial vertebrates.

Criterion No. 4

There are no designated wilderness study areas within the KRCRA boundaries.

The area of concern meets this criterion. No such wilderness studies exist for the area.

Cirterion No. 6

There are no lands within the KRCRA boundaries that are being used for scientific studies involving food or fiber production, natural resources, or technology demonstrations.

Although considerable wild and domestic animals reared or fed within the areas are utilized for food, no scientific studies that would violate the criterion are being conducted.

Criterion No. 9

There are no Federally designated critical habitats for threatened and endangered plant and animal species.

Since there are no threatened nor endangered species of non-avian terrestrial vertebrates inhabiting or known to inhabit or to have inhabited the area in the recent past, the area meets the criterion and there is no reason to site the exception that would allow underground mining with proper monitoring.

Criterion No. 10

The Utah D.W.R. does not maintain threatened or endangered species lists for plants and animals.

This criterion is not signficant since the non-avian terrestrial vertebrates that might occur on such a list are not found in the habitats of the proposed expansion area.

Criterion No. 15

The mine expansion area could be inhabited by some 79 species of vertebrate wildlife during different seasons of the year. According to the Utah D.W.R. most of these species are protected by state law. The BLM, USFS and Utah D.W.R. have agreed on essential habitat for these species. The following lands have been identified as essential habitat:

a) all perennial water sources, riparian habitat, associated wetlands along with a one half mile terrestrial habitat buffer zone.

b) all coniferous, spruce-fir and aspen vegetation types.

c) all crucial-critical deer and elk winter range or habitat.

d) cliff areas associated with raptor nests.

These areas are identifiable in the vegetation section of the report, Under strict application of the Unsuitability Criteria, these lands are considered unsuitable for coal lease consideration however exception 15 applies.

Exception No. 15

The BLM and USFS have jointly determined after consultation with Utah D.W.R. that subsurface mining would not have a significant long term impact on the species being protected. Before a final decision is made, approval will be obtained from the state.

The sections of the report dealing with Impact Analysis By Species and Impact Analysis by Action consider the species that would be considered high-interest species by Utah D.W.R. and the potential impacts the proposed actions would have upon them. With the precautions mentioned in these discussions the project meets this criterion and the underground mining planned for the expansion area should be allowed.

Criterion No. 20

The State of Utah has not proposed or adopted any other criteria.

To our knowledge no such criteria have been adopted for such mining operations in this area of the state.

MITIGATION

MITIGATION

Mitigation of mining impacts on wildlife is usually considered and the plans for implementation approved prior to any perturbation. Mitigation actions often follow one of three general forms: (1) design of facilities and access or transportation modes to minimize impacts, (2) operation of the mine and associated facilities to minimize impacts, and (3) enhancement of wildlife habitat both in the vicinity of and away from the mine in order to mitigate losses that may occur from mining.

In new mine operations it is easy to suggest, provide and implement mitigative measures, but in the case of the SUFCo Mine, preconstruction design and associated mitigation does not apply nor can it be implemented without major additions or modifications. The mine has been operating approximately 40 years, and little can or should now be done to change the design of the portal facilities to lessen the impacts. The non-avian territorial vertebrates inhabiting and utilizing the area of concern have likely habituated to the present facilities and consequently adjusted their behavior including migration so that change would be more impacting than status quo. Appropriately placed vegetation buffers would be beneficial.

Construction of the ventilation portals could potentially cause problems if surface access roads were constructed to facilitate equipment placement or repair, however, these portals will be opened to the outside from the underground mine tunnels. This is desireable from a wildlife standpoint. It will reduce habitat loss to the accumulated size of the portal openings and minimize human surface activity in the sensitive cliff habitat. These portals will be placed so that no major big game migration trails are interrupted and no caves or natural cougar denning

or resting ledges destroyed. Noise at the intake ventilation portals should be non-existent. The fans will be placed at the mine entrance.

Efforts have already been made to minimize wildlife loss and/or harassment associated with operation of the mine. Speed limits are variable and posted on haul and access roads to the mine to warn drivers to anticipate the presence of wildlife. Although the danger of road strikes is more harmful to wildlife than transportation vehicles, there is the potential for loss of human life and equipment damage. Therefore avoiding collisions has become a practical company policy. Wildlife crossing areas or sites of limited visibility are adequately marked and the applicant has instituted use of a commuter bus from Salina, Utah to the mine. SUFCo prohibits the handling or discharge of firearms by employees on the road and in East Spring Canyon (portal site), but non-mine personnel cannot be regulated so enforcement is difficult. In conjunction with this restriction the Applicant should initiate an employee education program as suggested in the human activity discussion of the Impact Analyses by Action section of this report. Hopefully, this would reduce harassment and disturbance of wildlife during sensitive stages in their life history.

Perhaps the most promising mitigation action area is that of enhancement or maintenance of wildlife habitat. Improvement of wildlife habitat by creating vegetation buffer zones around the surface facilities and augmenting the present range would be beneficial to the non-avian terrestrial vertebrates of concern. It would improve the habitat, likely increase animal numbers and would attract wildlife away from or prevent them from as much direct contact with the impact areas. Since much of the potential impact area is public, habitat improvement in cooperation with the appropriate management agencies is viable.

Water is perhaps the most limiting resource, and as mentioned in the subsidence discussion, the present resources must not be decreased. It would be advantageous if additional permanent water could be provided via development of springs, wells, or guzzlers at strategic locations within the lease area. These could be fenced to restrict domestic animal use thus preventing not only competition between domestic and wild animals but also cattle trampling of vegetation, erosion and fouling of the water resource.

PERTINENT LITERATURE

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APPENDIX

PROFESSIONAL DOSSIER

Name: H. Duane Smith

Title: Associate Professor of Zoology

Birthdate: June 25, 1941

Place of Birth: Fillmore, Utah

Address: Department of Zoology
Brigham Young University
Provo, Utah 84602
(801) 374-1211 Ex. 2492

1170 South 300 West
Orem, Utah 84057
(801) 225-7723

Academic Record:

Institution and Location	Degree	Scientific Field	Dates Attended
Brigham Young University, Provo, UT	B.S.	Zoology	1959-63
Brigham Young University, Provo, UT	M.S.	Zoology	1963-65
University of Illinois, Urbana IL	Ph.D.	Vertebrate Ecology	1965-69

Employment Record:

University of Illinois, Instructor of Biology, 1968-69.
Brigham Young University, Assistant Professor Zoology, 1969-72.
Brigham Young University, Associate Professor Zoology, 1973-present.
USDA - U.S. Forest Service, Research Collaborator, 1964-present.
Private Consultant, 1970-present.

Professional Experience:

(1) Principle Investigator, Intermountain Forest and Range Experiment Station, 1964-72, "Small Mammal Populations and Trophic Dynamics." (2) Research Collaborator, Intermountain Forest and Range Experiment Station, 1972-present, "Range Manipulation and Pest Control." Consultant with: (3) Grand Canyon Natural History Association, 1970, "Impact of Float Trips on Mammals." (4) Utah State University, 1972-74, "Impact of Diking Utah Lake." (5) Utah Wool Growers, 1973-present, "Determining Causes of Sheep Kills." (6) Four Seasons Incorporated, 1973-74, "Environmental Studies and Proposed Impact of Recreational Development." (Served also as Project Director). (7) Westinghouse Electric Corporation, 1974, "Terrestrial Vertebrates of the proposed areas for site selection." (8) Kaiparowits Power Project, 1974, "Mammal Populations on Proposed Generator Sites." (9) Bureau of Reclamation, 1975, "Biotic Assessment of Crystal Geyser." (10) U.S. Forest Service--DFTM Program, 1976-1978, "Small mammal populations in coniferous forests treated with experimental pesticides." (11) University of Utah Research Institute, 1977-present, "Various Ecological and Environmental Impact Assessments." (12) Coon, King, and Knowlton Engineering, 1975-1978, "Biotic Assessment of the Proposed West Valley Highway. (13) U.S.

Forest Service--CANUSA WSBW, 1978-19__. Ecological relationships of vertebrate wildlife to spruce budworm infestations and control to forest management practice. (14) Ford, Bacon, and Davis Engineering, 1978, "Preliminary biotic assessment of twenty inactive uranium mill tailings situated in Arizona, Colorado, Idaho, New Mexico, Oregon, Texas, Utah, and Wyoming." (15) Burns & McDonnell Engineering, 1979, "Vertebrate Faunal Survey of a Power Plant and Associated Facilities." (16) Western Fuels Association, Inc., 1979, Vertebrate Faunal Survey of a Coal Mine Site and Associated Facilities.

Research Activities:

(1) USDA U.S. Forest Service, "Small Mammal Populations on Mud Creek Sheep Allotment, Utah," 1969-71. $3,000. (2) Brigham Young University, "Energy Dynamics in a Montane Ecosystem," 1970. $1,500. (3) USDA U.S. Forest Service (a) "Effect of Anhydrous Ammonia as a Rodenticide and Residual Fertilizer in Newly Planted Pine Areas," 1970-72. $3,000. (b) "Impact of Humans on Mammal Populations in Forest Service Campgrounds," 1970. $1,500. (4) National Science Foundation USIBP Desert Biome, "Evaluation of Techniques for Estimating Population Sizes of Desert Rodents," 1971-73. $27,000. (with Clive D. Jorgensen) (5) National Science Foundation USIBP Desert Biome, "Demographic and Individual Growth Studies for Dipodomys ordii and Peromyscus maniculatus," 1971--73. $32,000. (with Clive D. Jorgensen) (6) USDA U.S. Forest Service. "Effect of Aspen Burning on Mammal Populations," 1972-74. $4,000. (7) USDA U.S. Forest Service, "Effect of Aspen Clear Cutting on Mammal Populations," 1973-74. $5,000. (8) Brigham Young University, "Use of Radiotransmitters to monitor Trap Activity," 1974-75. $2,700. (9) Brigham Young University, "Interpretive Ecology of Mammals in Zions National Park. 1975-76. $1,000. (10) USDA Bureau of Reclamation, "Biotic Assessment of Crystal Geyser Vicinity. 1975. $4,999. (11) USDA U.S. Forest Service, Aspen Ecosystem Manipulation. 1975. $1,700. (12) National Science Foundation USIBP Desert Biome, "Validation of Pine Valley Study Site. 1972-76. $41,500 (with C. D. Jorgensen). (13) Utah Division of Wildlife Resources, Assessment of Deer Harvest in Utah. 1975. $7,500. (14) USDA - U.S. Forest Service, "Small Mammal Responses to Experimental Pesticide Applications in Coniferous Forests," 1976-1978. $48,904 (with C. D. Jorgensen) (15) USDA - U.S. Forest Service, Aspen Ecosystem Manipulation. 1976. $1700. (16) Utah Division of Wildlife Resources, Assessment of Deer and Grouse Harvest in Utah. 1976-79. $34,000. (17) Coon, King, and Knowlton. Biotic Assessment of Proposed West Valley Highway Route, 1975-78, $5,000. (18) USDA - U.S. Forest Service, "Ecological relationships of vertebrate wildlife to spruce budworm infestations and control to forest management practices. 1978. $28,000. Renewable for 5 years @ $86,000/year. (19) Ford, Bacon, and Davis. Preliminary biotic assessment of twenty inactive uranium mill tailings situated in Arizona, Colorado, Idaho, New Mexico, Oregon, Texas, Utah, and Wyoming. 1978. $10,900 with Stan Welsh. (20) Burns & McDonnell Engineering. Vertebrate Faunal Survey of a Power Plant and its Associated Facilities. 1979. $27,000. (21) Western Fuels Association, Inc. Vertebrate Faunal Survey of a Coal Mine and its Associated Facilities. 1979. $35,000.

Current Research: (1) Methods for Determining Small Mammal Activity, (2) Methods for Estimating Numbers and Density of Small Mammals, (3) Effects of Independent Variables on the Growth of Small Mammals, (4) Effects of Habitat Manipulation on Small Mammals, (5) Impact of Dry Wash Habitat on Small Mammals, (6) Interpretive Ecology of Small Mammals, (7) Inter and Intraspecific Competition of Selected Small Mammals, (8) Biotic Communities of Pine Valley IBP Site, (9) Small Mammal Response to Experimental Pesticide Applications in Coniferous Forests, (10) Assessment of Game Harvests in Utah, (11) Studies on Eclectic Behavior in Mammals, (12) Habitat Partitioning and Niche Utilization by Mammals, (13) Rodent-Ant Competition for Resources, (14) Ecological Modeling of Plant-Animal Dependencies with Predictions for Management, (15) Testing Bergman's Rule from Mexico to Canada.

Creative Works:

Designed and built a new mammal trap that is currently being marketed.
Designed and built a radio-monitored mammal trapping system.

Publications and Writings:

King, M. M., H. D. Smith. 1979. Habitat separation in male and female mule deer. Utah Wldf. Soc. Abs.

King, M. M., H. D. Smith. 1979. Habitat separation in male and female mule deer. Amer. Soc. Mam. Abs. 91.

Smith, H. D., M. A. Bowers. 1979. Seed selection and foraging behavior of three heteromyids. Amer. Soc. Mam. Abs. 135.

Landeen, D. S., C. D. Jorgensen, and H. D. Smith. 1979. Competition between ants and rodents in the cold desert. Amer. Soc. Mam. Abs. 138.

Bowers, M. A., H. D. Smith. 1979. Differential habitat utilization by sexes of the deermouse, Peromyscus maniculatus. Ecology. In press.

Bowers, M. A., H. D. Smith. 1979. Coexistance in desert rodents: a multivariate analysis. Mammalogy. In Press.

Smith, H. D., G. H. Richins, and C. D. Jorgensen. 1978. Growth of Dipodomys ordii. Great Basin Naturalist 38(2):215-221.

Morse, E. L., H. D. Smith, and C. D. Jorgensen. 1978. Laboratory breeding of Dipodomys ordii. Encyclia. In Press.

Smith, H. D. 1978. North American wild sheep, our heritage - their future. Wild Sheep International 1:20-24.

Scott, D. T., C. D. Jorgensen and H. D. Smith. 1978. Comparison of live and removal methods to estimate small mammals densities. Acta Theriologica 23:173-195.

Nichols, D. W., H. D. Smith, and M. F. Baker. 1975. Rodent Populations, biomass, and community relationships in Artemisia tridemtata, Rush Valley, Utah. Great Basin Naturalist, 35:191-202.

Smith, H. D. and C. D. Jorgensen. 1975. Reproductive biology of North American desert rodents. In Rodents of North American Deserts. Junkus. Netherlands (Ed. I. Prakash and P. D. Ghash) (in press)

Jorgensen, C. D., H. D. Smith and D. T. Scott. 1975. Small mammal estimates using recapture methods with variables partitioned. Acta Theriologica 24:303-318.

Richins, G. H., H. D. Smith and C. D. Jorgensen. 1974. Growth and development of Reithrodontomys megalotis megalotis. Great Basin Nat. 34:105-120.

Smith, H. D. 1974. Small mammal populations in Strawberry Valley, Utah. Proc. Ut. Acad. Sci., Arts and Letters 51:19-44.

Jorgensen, C. D. and H. D. Smith. 1974. Mini-grids and small mammal estimates. Proc. Ut. Acad. Sci., Arts and Letters, 51:12-18.

Garcia, J. R., H. D. Smith and C. D. Jorgensen. 1974. A capture-release method for determining small mammal activity. Proc. Ut. Acad. Sci., Arts and Letters, 51:1-11.

Jorgensen, C. D., N. C. Stenseth and H. D. Smith. 1974. Modeling of the desert rodent population. USIBP Rpt. 47 pp.

Smith, H. D. and C. D. Jorgensen. 1973. Demographic and individual growth studies for Dipodomys ordii and Peromyscus maniculatus. USIBP Desert Biome Rpt. 73-23:38 pp.

Jorgensen, C. D., H. D. Smith and D. T. Scott. 1972. Evaluation of techniques for estimating population size of desert rodents. USIBP Desert Biome Rpt. 72-26:196 pp.

Jorgensen, C. D., D. T. Scott and H. D. Smith. 1972. Small mammal trapping simulator. Proc. Summer Simulation Conf. San Diego.

Smith, H. D., H. D. Tolley and C. D. Jorgensen. 1972. Estimation of small mammal using recapture methods: Partitioning of estimator variables. Acta. Theriologica 17(5):56-66.

Smith, H. D. and C. M. White. 1972. A laboratory study of Vertebrate Zoology. Burgesss. Minneapolis. 129 pp.

Smith, H. D. 1970. Small mammal populations and bioenergetics in the Wasatch Mountains, Utah. Diss. Abs. 491

Smith, H. D. 1968. Temperature tolerance in fish. Anchor 9. 1 p.

Smith, H. D. 1968. Has evolution acted as a tranquilizer? More bark than bite. Anchor 5. 2 pp.

Unpublished Reports:

Smith, H. D., J. T. Flinders, C. D. Jorgensen, and C. M. White. 1978. Ecological relationships of vertebrate wildlife to spruce budworm infestations and control and to forest management practices. 104 pp.

Smith, H. D., and Stan Welsh. 1978. Preliminary biotic assessment of twenty inactive uranium mill tailings in Western United States. 60 pp.

Smith, H. D. 1978. Faunal Overview of Roosevelt KGRA. 21 pp.

Henderson, C. B., H. D. Smith, and C. D. Jorgensen. 1977. Small small responses to experimental pesticide applications in coniferous forests. Submitted to USDA Douglas-Fir Tussock Moth R & D Program. 95 pp.

Smith, H. D., C. L. Pritchett, C. D. Henderson. 1977. Biotic assessments and potential impacts of the proposed West Valley Highway. Submitted to Coon, King, and Knowlton. 32 pp.

Smith, H. D., C. B. Henderson. 1977. Small mammal assessments in manipulated aspen ecosystems. Submitted to U.S.F.S. Experiment Station, Logan, Utah. 7 pp.

Smith, H. D., K. T. Harper. 1975. Biotic assessment of the proposed Crystal Geyser evaporation ponds project. Submitted to U.S. Bureau of Reclamation. 48 pp.

Jorgensen, C. D. and H. D. Smith. 1974. Terrestrial vertebrates of the proposed IPP generator sites: data compilation for site selection. Westinghouse Corporation: 48 pp.

Smith, H. D., C. D. Jorgensen, G. H. Richins and N. C. Stenseth. 1974. Demographic and individual Growth Studies for Dipodomys ordii, peromyscus maniculatus, reithiodontomys megalotis. USIBP Desert Biome Final Rpt. 212 pp. (in press).

Abstracts:

Bowers, M. A., H. D. Smith. 1978. Differential habitat utilization by sexes of the deermouse, Peromyscus maniculatus. Encyclia. In Press.

Morse, E. L., H. D. Smith, and C. D. Jorgensen. 1978. Laboratory breeding of Dipodomys ordii. Encyclia. In Press.

Bowers, M. A., H. D. Smith. 1977. Small mammal population response to burning and clearcutting in aspen ecosystems. Encyclia (In Press).

Deacon, J., H. D. Smith. 1977. Habitat Partitioning by Zapus princeps. Encyclia.

Gardner, P., H. D. Smith. 1977. Mammals of Zions National Park. Encyclia (In press).

Henderson, C. B., C. D. Jorgensen, and H. D. Smith. 1977. Rodent assessments in coniferous forests in eastern Oregon. Encyclia (In press).

Morse, E. L., H. D. Smith, and C. D. Jorgensen. 1978. Reproductive behavior of D. ordii. Encyclia. (In press).

Papers in Review or Journal Requested Revision:

Bowers, M. A., and H. D. Smith. Differential habitat utilization by sexes of the deermouse, Peromyscus maniculatus. Ecology.

Garcia, J. R., C. D. Jorgensen, and H. D. Smith. Activity of Dipodomys ordii population using recapture methods. Great Basin Naturalist.

Teaching Activities, Development Projects:

Established "Biolgoical Principles" for honors (non-majors) that is taught with unique format.

Implemented the synthesis of the ecology programs in botany and zoology into one unified program for both departments general and major students.

Developed new training program in wildlife and range resources for graduates and an option in such for undergraduates - in cooperation with Jerran T. Flinders.

Academic and Professional Honors:

Scholarships: (1) Brigham Young University, 1959-65, Tuition and Fee Award, (2) University of Illinois, 1965-69, Fellowship stipend plus Tuition and Fee Award.

Honors: (1) Graduated with Honors B.S., (2) Graduated with Distinction M.S., (3) President Beta Beta Beta (1965), (4) Member Phi Kappa Phi, Sigma Xi, Beta Beta Beta, (5) Runner-up, Honors Professor of the Year, 1974.

Professional Exposure:

Travel:

Reviewed Research Programs at: University of Arizona; Big Bend National Park; Everglades National Park; Oak Ridge National Laboratory; University of Missouri; University of California, Berkeley; Field Museum, Milwaukee

Museum. Interviewed environmental consultant firms, federal and state agencies and private foundations concerned with environmental problems in the United States.

Professional Meetings:

Meetings attended and participated in during the past five years:

*American Society of Mammalogists
*American Institute of Biological Sciences
Ecological Society of America
*Utah Wildlife Society
American Association for Advancement of Science
*Utah Academy of Arts, Science and Letters
American Medical Association Conference on Solid Waste Management
Small Mammal Symposium - Pymatuning
*North American Wildlife Conference
International Wildlife Congress

*Meetings in which I participated.

Professional Memberships and Positions:

Society	Position
Utah Academy of Arts, Sciences and Letters	Reviewer
American Society of Mammalogists	Reviewer, Chairman Ecology Committe
Ecological Society of America	Membership Committees, Reviewer
American Association for Advancement of Science	None
National Wildlife Society	None
American Museum of Natural History	None
National Geography Society	None
The Wildlife Society	Chairman, Rules and Regulations Committee

University Committee Activities:

College Curriculum Committee, 1969-present
College Research Committee, 1972-75
University Graduate Council, 1972-75
University Departmental Review Committee, 1973-74
University Departmental Review Committee (Chairman,1974-75)
Department Research Coordinator, 1972-77.
Department Graduate Studies Committee, 1969-76
Department Graduate Coordinator, 1974-76
University Collecting Permit Review Committee - 1972-present
Department Coordinator Division Wildlife and Range Resources 1977-present
Advisor Wildlife Society

Numberous Ad Hoc Committees: College Grading Policy Review (Chairman), 1969-70; University Grading Policy Review, 1969-71; College Evolution Committee (Chairman), 1969; University Computer Committee, 1971; College Indian Program Curriculum, 1969; College Ecology Committee (Chairman), 1973-present

PROFESSIONAL DOSSIER

Name: Clyde L. Pritchett

Title: Associate Professor of Zoology

Birthdate: April 4, 1926

Place of Birth: Mt. Pleasant, Utah

Address: Department of Zoology
Brigham Young University
Provo, Utah 84602
(801) 374-1211 Ext. 2419

603 E. 600 South
Orem, Utah 84057
(801) 225-7231

Academic Record:

Institution and Location	Degree	Scientific Field	Dates Attended
Snow College, Ephraim, Utah	A.A. (1959)	Biology	1944-1945
Brigham Young University, Provo, Utah	B.S. (1960)	Zoology	1958-1960
Brigham Young University, Provo, Utah	M.S. (1962)	Zoology	1960-1962
University of Utah, Salt Lake City, Utah	NA	Radiation Biology	Summer, 1963
Arizona State University, Tempee, Arizona	NA	Desert Biology	Summer, 1965
University of Wyoming, Laramie, Wyoming	Ph.D.(1977)	Ecology	1968- 1970-1971

Employment Record:

U.S. Army, Medic, 1945-1946
Asst. Manager, Stringham Feed Mill, 1950-1958
Nebo School District, Biology Teacher, 1962-1964
Ricks College, Instructor, 1964-1967
Brigham Young University, Instructor, 1967-1971
University of Wyoming, Visiting Professor of Ecology, Science Summer Camp, 1969
Brigham Young University, Assistant Professor, 1971-1979
Brigham Young University, Associate Professor, 1979-present

Professional Experience:

Research Associate: (1) Project 10 with D. E. Beck, 1960-1961. (2) Ecological Studies, Nevada Test Site, Mercury, Nevada with D. E. Beck and Clive Jorgensen, summer 1964. (3) National Reactor Testing Station, Idaho Falls, Idaho with D. M. Allred, summer 1966 and 1967. (4) Four Seasons Incorporated 1972-1973, "Impact of Proposed Recreational Construction and Use." (5) Raft River Environmental Studies. Energy Research and Development Administration, Idaho Operations Office, Idaho Falls, Idaho 83401, 1977 to present. (6) Curator of Mammals, M.L. Bean Museum, Brigham Young University, Provo, Utah 1972-present.

Consultant with: (1) Bureau of Reclamation on the Jensen Unit of the Central Utah Project 1972. (2) Navajo - Kaiparowits Project, 1973. (3) Bureau of Reclamation on the Bonneville Unit of the Central Unit Project, 1973 to present. (4) National Science Foundation In-service Institute for High School Biology Teachers. Drs. A. L. Allen and Marden Broadbent, Directors, 1968-1972. (5) Coon, King, and Knowlton Engineering (1975-1978), "Biotic Assessment of the Proposed West Valley (Salt Lake Co.) Highway." (6) Utah Power and Light/Vaughn Hansen Associates, 1979, "Effect of Reservoir Construction on Terrestrial Vertebrates." (7) Coastal States Coal Co./Vaughn Hansen Associates, 1979, "Impact of Coal Mining and Conveyor Construction on Big Game Behavior."

Research Activities:

(1) Brigham Young University, "Vertebrate distribution in relation to certain habitats in Central Kane County Utah," 1960-1962. (2) University of Wyoming, "Variability in populations of the pocket gopher Thomomys talpoides rostralis along an altitudinal transect across the Snowy Range, Wyoming.

Current Research: (1) Cytotxonomic studies of the Tassel-eared squirrel on the north and south rims of the Grand Canyon, Arizona. (2) The impact of selected native rodents on certain plant species in the cool desert biome. (3) Comparative Vascularity of Appendages in Lagomorphs (with Kent Van De Graaff) (4) Ecological studies of the porcupine Erethizon dorsatum.

Publications:

Speth, R. L., C. L. Pritchett and C. D. Jorgensen. 1968. Reproductivity activity of Perognathus parvus. J. Mammal. 49(2): 336-337.

Allred, D. M., and C. L. Pritchett. 1970. A laboratory Guide for Natural History for Elementary Teachers. Brigham Young University Press, Provo, Utah. 56 pp.

Allred, D. M., C. L. Pritchett and B. W. Wood. 1973. An Introduction to Natural History - Laboratory Workbook. Brigham Young University Press, Provo, Utah. 50 pp.

Pritchett, C. L. and D. M. Allred. 1974. A Guide to Field Studies in Natural History. Brigham Young University Press, Provo, Utah. 69 pp.

Allred, D. M. and C. L. Pritchett. 1975. Laboratory Studies in Natural History. Brigham Young University Press, Provo, Utah. 77 pp.

Pritchett, C. L. and J. R. Murdock. 1975. The influence of selected native rodents on certain plant species in a Mormon tea - grass community. p. 146, in Stutz (ed.), Proceedings Symposium and Workshop Woodland Shrubs. U.S.F.S., U.S. Dept. Ag.

Pritchett, C. L. 1977. Karyotypic Analysis of Thomomys talpoides along an altitudinal gradient. Abstracts of papers presented at the 57th Annual Meeting American Society of Mammalogist. Michigan State Univ. East Lansing, Michigan.

Pritchett, C. L., H. H. Frost and W. W. Tanner, in press. Terrestrial Vertebrates in the Environs of Utah Lake. In Utah Lake Monograph, R. L. Heckmann Ed. Mem. series Great Basin Naturalist. In press.

Attwood, N. D., C. L. Pritchett and R. D. Porter, in press. Terrestrial Vertebrates of the Kaiparowitz Plateau. Mem. Series Great Basin Naturalist.

Unpublished Reports:

Allred, D. M. et al. 1973. An Ecological study of the Jensen Unit of the Central Utah Project. A report submitted to the Bureau of Reclamation by C.H.E.S., Brigham Young University. Provo, Utah. 112 pp.

Pritchett, C. L. 1973. Photographic Supplement to the Ecological study of the Central Utah Project. Submitted to the Bureau of Reclamation by C.H.E.S., Brigham Young University. Provo, Utah. 6 pp.

Wood, B. W. et al. 1974. Kaiparowits short-term Report, prepared for: California Edison Company by C.H.E.S. Brigham Young University, Provo, Utah. July 1974. 124 pp.

Pritchett, C. L. 1974. Birds and Mammals in the Diamond Fork - Sevier River regions of the Bonneville Unit or the Central Utah Project. 31 pp. In a special report submitted to The Bureau of Reclamation by C.H.E.S. Brigham Young University. Provo, Utah. July 1974. 224 pp.

Pritchett, C. L. 1974. Birds and Mammals in the Jordanelle, Utah Lake, Jordan River regions of the Bonneville Unit of the Central Utah Project. 48 pp. In a special report to The Bureau of Reclamation by C.H.E.S. Brigham Young University. Provo, Utah. August 1974. 276 pp.

Pritchett, C. L. 1974. Nature Walks for Elementary Students - Nine "experiments" that can be conducted around the school grounds. 12 pp.

Pritchett, C. L. 1976. Vertebrates along the proposed West Valley Highway, Salt Lake County, Utah. In environmental Impact Statement. Koon King Knowlton, Salt Lake City, Utah.

Pritchett C. L. 1977. Wildlife Assessment In Vegetative and Wildlife Assesment of the Jordan River Aqueduct extension. Bonneville Unit, Central Utah Project. Final Draft. Rocky Mountain Research, Provo, Utah.

Jorgensen, C. D., C. M. White and Clyde L. Pritchett 1978. Annual Report-Raft River Environmental Studies, Energy Research and Development Administration. Idaho Operations Office, Idaho Falls, Idaho.

Pritchett, C. L. 1979. "Impact of Proposed Cottonwood Reservoir on Terrestrial Vertebrates," To B.L.M., Utah Power and Light Co. and Vaughn Hansen Associates.

Pritchett, C. L. 1979. "Impact of Proposed Upper San Raphael Reservoir on Terrestrial Vertebrates." To B.L.M., Utah Power and Light and Vaughn Hansen Associates.

Professional Meetings:

1972 International Academy of Cytology - Tutorial on Human Chromosomes and Chromatin. Chicago, Illinois.

1976 American Society of Mammalogy. Texas Tech University. Lubbock, Texas.

1976 Presented Paper at Symposium and Workshop Wildland Shrubs Brigham Young University, Provo, Utah.

1977 Presented Paper at Annual Meeting at American Society of Mammalogy, East Lansing Michigan.

1978 American Society of Mammalogy. Athens, Georgia.

1978 Symposium Elk Management and Control. Laramie, Wyoming.

1978 Symposium Tassel-Eared Squirrels. Flagstaff, Arizona.

Professional Exposure:

1971 - Spent one week in the Laboratory of T.C. Hsu - M.D. Anderson Hospital, Houston, Texas.

Professional Memberships and Positions:

Society	Position
American Society of Mammalogists	Reviewer
American Ornithologists Union	None
The Wildlife Society	None

College Committee Activities:

College Media Committee (Chairman)	1968-1970
College Teaching Assistant Committee	1973-1976
College G.E. Committee	1976-present
College Preprofessional Committee	1977-present
University Pre-Medical (Committee)	1979-
Wildlife Collecting and Importing Committee	1979-

1981 SUPPLEMENT

FEDERAL COAL LEASE NO. U-47080

WILDLIFE

The study area for the Wildlife Report, submitted as a part of the November, 1980, SUFCo Mine Plan, included the area adjacent to the permit area identified as the Emergency Lease Area (Lease No. U-47080) and extended well beyond the lease borders. (See Wildlife Report, Vol. 5, 1980.) Wildlife consultants were asked to provide a specific opinion on the potential for threatened or endangered vertebrate species within Lease No. U-47080. These opinions are included as Exhibits 1 and 2.

EXHIBIT 1

Department of Zoology

Brigham Young University

September 22, 1980

Mr. Keith Welsh
Environmental Coordinator
Costal States Energy Company
411 West 7200 South
Suite 200
Midvale, UT 84047

Dear Keith:

This letter is in response to your request for an evaluation of threatened and/or endangered vertebrate species in the "Emergency Lease Tract to the Northwest."

During our terrestrial vertebrate studies of the SUF Company mining properties, and some adjacent areas this past summer, we spent considerable time in the environs of Duncan Mountain. We all feel we know the area and our respective vertebrate animals well enough to state that there are no threatened or endangered vertebrate species occuring on or utilizing the lands encompassed by the emergency lease tract.

Respectfully submitted,

Clyde L. Pritchett
Associate Professor of Zoology

H. Duane Smith
Associate Professor of Zoology

Clayton M. White
Professor of Zoology

dlm

EXHIBIT 2

Endangered Plant Studies, Inc.
129 North 1000 East
Orem, Utah 84057
(801) 225-7085

Mr. Keith Welch
Coastal States Energy Company
411 West 7200 South
Midvale, Utah 84047

Dear Mr. Welch:

This letter is to confirm the examination of that portion of the Southern Utah Fuel Company property included under conditions of potential lease at the northwest edge of the current lease application area. Specifically, the property in question consists of all of section 25 and the northern half of section 30 in T21S, R4E, and much of section 36 in T21S, R5E. These areas were searched for the presence of plant species listed or proposed as endangered or threatened under terms of the Endangered Species Act of 1973, as ammended in 1978. This letter will serve as a notice of negative review. None of the species currently listed or reviewed were found on the general lease area or in the properties cited herein.

The property was surveyed on a quarter-section by quarter-section basis, with all plant communities within each quarter-section being investigated. The survey was conducted during July and August when plants were at their peak in growth and flowering.

I wish to thank you for the opportunity of serving you in this way. If there are any questions please call me.

Sincerely yours,

Stanley L. Welsh

Stanley L. Welsh
Plant taxonomist