A11---0 to 10 centimeters (0 to 4 inches) grayish brown (10YR 5/2) very stony sandy loam, very dark brown (10YR 2/2 moist; moderate thin platy structure; very friable, nonsticky, nonplastic; many fine and medium roots; many very fine interstitial and tubular pores; 15 percent gravel, 5 percent cobble, 5 percent stones; nonefferves-cent, neutral (pH 7.2); clear wavy boundary. (7 to 15 centimeters thick)

A12---10 to 33 centimeters (4 to 13 inches) grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, slightly sticky, slightly plastic; many fine and medium roots; many very fine interstitial and tubular pores; 25 percent gravel, 5 percent cobble; noneffervescent, neutral (pH 7.2); clear wavy boundary. (16 to 30 centimeters thick)

B2----33 to 51 centimeters (14 to 20 inches) pale brown (10YR 6/3) gravelly loam, brown (10YR 4/3) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; many fine and medium roots; many very fine interstitial and tubular pores; 15 percent gravel, 10 percent cobble, 5 percent stones; weakly effervescent; mildly alkaline (pH 7.8); abrupt smooth boundary. (10 to 20 centimeters thick)

C1ca--51 to 66 centimeters (20 to 26 inches) pale brown (10YR 6/3) very gravelly sandy loam, brown (10YR 4/3) moist; massive; hard, friable, slightly sticky, slightly plastic; many fine and medium roots; many fine interstitial and tubular pores; 30 percent gravel, 5 percent cobble, 5

5 percent stones; strongly effervescent, moderately alkaline (pH 8.2); abrupt smooth boundary. (30 to 45 centimeters thick)

C2ca--66 to 92 centimeters (26 to 36 inches) very pale brown (10YR 7/3) gravelly sandy loam, brown (10YR 4/3) moist; weak fine subangular blocky structure; hard, friable, slightly sticky, slightly plastic; many fine and medium roots; many fine interstitial and tubular pores; 10 percent gravel, 5 percent cobble; strongly effervescent, moderately alkaline (pH 8.2); abrupt smooth boundary. (20 to 30 centimeters thick)

C3ca--92 to 153 centimeters (36 to 60 inches) pale brown (10YR 6/3) very gravelly sandy loam, brown (10YR 4/3) moist; massive; hard, friable, nonsticky, nonplastic; many fine and medium roots; many fine interstitial and tubular pores; 25 percent gravel, 10 percent cobble, 10 percent stones; strongly effervescent; moderately alkaline (pH 8.2). (50 or more centimeters thick)

RO Rock outcrop, 50 to 100 percent slopes

This land type occurs only in the Pinnacle Mine Site extension area. It occurs as a rock face on an extremely steep canyon side facing west. It consists mainly of sandstone with a few thin layers of shale. It is essentially devoid of vegetation; consequently has no associated range site. Permeability is essentially zero. Runoff is very high and erosion hazard is very slight (hard rock). This land type is used for aesthetics and watershed.

It has no taxonomic classification; that is, it is classified as Not Soil; consequently, it has no water or nutrient-holding capacity and no effective rooting depth.

SOIL INTERPRETATIONS

The Brycan and Datino soils were sampled for laboratory testing in the Sunnyside Mine Site area. Also selected for laboratory testing were: one sample from the existing Pinnacle Mine Site topsoil storage pile (not shown on map); one sample of mine spoil material from a small area included in the disturbed Brycan soil in the proposed extension of the Pinnacle Mine Site area; two surface samples of disturbed Brycan soils in the proposed extension of the Pinnacle Mine Site, one designated as southcentral, the other as southwest. The resulting data are shown in the following table, LABORATORY DATA FOR SOIL SAMPLES.

As can be interpreted from the data, all soils tested have very favorable physical and chemical characteristics for plant growth media. All samples were nonsaline, as exhibited by the low electrical conductivities (EC mmhos/cm); they are nonsodic, as evidenced by the very low Sodium Adsorption Ratio (SAR). Excluding the large boulders on the surface of the Brycan soil and the stones, gravel and cobble in the Datino soil, the remaining soil material has very favorable water and nutrient capacities, and have very favorable textures, ranging from sandy loam to light clay loam or sandy clay loam; that is, with 19.2 percent to 31.4 percent clay. The low levels of Boron and Selenium (B and Se) indicate that toxicity from these elements is not a problem. The same is true of the heavy metals, molybdenum (Mo), arsenic (As), and lead (Pb). The micronutrient elements of copper (Cu), iron (Fe), zink (Zn) and manganese (Mn) have sufficient quantities for proper plant growth without creating toxicities. The relatively high amounts of organic matter (OM) enhance the favorability of the soil materials for water and nutrient-supplying capabilities. The amounts of major fertilizer elements of potassium (K) is moderate, phosphorus (P) is low, but adequate, and nitrogen (N) is moderately low, but adequate (estimated from OM). Consequently, no application of fertilizers are recommended with the following exceptions: where mulch is used in the reclamation process, 20 pounds of available nitrogen per ton of mulch should be applied. After plants are established, if they show signs of

LABORATORY DATA FOR SOIL SAMPLES

Series		Sample #	Depth (in.)	mmhos/cm EC 1/	pH 2/	meq/100 gm 3/ Extractable cations Na	Ca	Mg	K	meq/l 4/ soluble cations Na	Ca	Mg	K
Brycan	A11	1	0-11	.499	7.65	.02	14.12	1.40	.37	.11	3.33	1.37	.26
	A12	2	11-26	.464	7 37	.02	9.36	1.20	.33	.09	3.06	1.07	.32
	C1	3	26-40	.464	7.87	.01	9.59	1.67	.31	.11	3.04	1.31	.33
	C2	4	40-54	.486	8.11	.03	11.51	3.14	.40	.07	3.58	1.16	.32
	C3	5	54-68	.546	8.23	.02	7.75	3.24	.37	.24	3.60	1.21	.47
Datino	A1	1	0-11	.509	7.80	.02	8.75	1.66	.49	.12	2.92	1.61	.41
	B2	2	11-18	.410	7.94	.02	6.98	1.60	.48	.16	2.52	1.04	.55
	C1ca	3	18-60	.303	7.98	.02	7.21	1.06	.22	.09	2.05	.64	.26
Pinnacle		South West	0-10	1.24	7.98	.15	7.67	5.38	.25	2.02	7.92	1.18	.26
		Top Soil	0-10	.559	8.07	.02	10.75	1.38	.32	.19	3.83	1.18	.23
		Spoil	0-10	.875	8.20	.05	13.95	7.00	.43	.63	5.34	2.59	.36
		South Central	0-10	1.00	8.18	.06	8.98	5.18	.48	.69	6.72	2.22	.32

Series	Sample #	Depth (in.)	% $CaCO_3$	ppm 5/ Micronutrients Mo	Pb	Cu	Fe	Zn	Mn	6/ % H_2O	7/ % O.M.
Brycan	1	0-11	5.0	<1.0	.4	.62	8.94	1.24	7.04	39.0	3.39
	2	11-26	5.5	<1.0	<.2	.70	4.38	.80	6.50	28.4	1.38
	3	26-40	14.9	<1.0	<.2	.76	2.66	.52	4.60	31.0	1.41
	4	40-54	14.9	<1.0	<.2	.74	2.28	.92	4.34	35.8	2.91
	5	54-68	14.9	<1.0	<.2	.86	2.38	.58	5.14	30.8	1.03
Datino	1	0-11	.4	<1.0	<.2	.38	6.08	1.42	7.32	34.6	2.41
	2	11-18	.4	<1.0	<.2	1.12	3.94	.68	4.60	28.9	1.03
	3	18-60	7.2	<1.0	<.2	.90	2.32	.92	4.26	29.8	.93
Pinnacle	South West	0-10	5.6	<1.0	<.2	.56	4.98	.40	2.26	27.4	2.80
	Top soil	0-10	7.0	<1.0	1.0	.50	6.20	1.22	4.90	33.5	5.06
	Spoil	0-10	7.5	<1.0	.6	.74	7.24	1.76	5.62	31.5	2.37
	South Central	0-10	6.9	<1.0	<.2	.70	5.32	.88	3.52	28.7	1.65

LABORATORY DATA FOR SOIL SAMPLES (Cont'd.)

Series	Sample #	Depth (in.)	% Sand 8/	% Silt 8/	% Clay 8/	Texture 8/	ppm K 9/	mg/l As 10/	ppm P 10/
Brycan	1	0-11	49.4	29.4	21.2	Loam	82	<.2	5.1
	2	11-26	53.2	27.6	19.2	Sandy loam	119	<.2	2.9
	3	26-40	43.2	29.6	27.2	Sandy clay loam	43	<.2	2.6
	4	40-54	33.2	35.4	31.4	Clay loam	133	<.2	4.6
	5	54-68	39.8	37.6	22.6	Loam	86	<.2	2.6
Datino	1	0-11	61.4	21.8	16.8	Sandy loam	123	<.2	7.4
	2	11-18	43.6	33.6	22.8	Loam	168	<.2	2.1
	3	18-60	21.6	55.8	22.6	Silt loam	49	<.2	2.1
Pinnacle	South West	0-10	57.0	21.6	21.4	Sandy clay loam	41	<.2	2.9
	Top Soil	0-10	55.4	25.4	19.2	Sandy loam	96	<.2	4.6
	Spoil	0-10	35.2	35.6	29.2	Loam	90	<.2	5.4
	South Cental	0-10	51.6	25.2	23.2	Sandy clay loam	100	<.2	4.6

LABORATORY DATA FOR SOIL SAMPLES (Cont'd.)

Series		Sample #	Depth (in.)	----mg/l----- B	Se 11/	SAR 12/
Brycan	A11	1	0-11	.54	<.2	.07
	A12	2	11-26	.32	<.2	.06
	C1	3	26-40	.27	<.2	.07
	C2	4	40-54	.35	<.2	.04
	C3	5	54-68	.30	<.2	.15
Datino	A1	1	0-11	.59	<.2	.08
	B2	2	11-18	.35	<.2	.12
	C1ca	3	18-60	.22	<.2	.08
Pinnacle		South West	0-10	.32	<.2	.95
		Top Soil	0-10	.59	<.2	.12
		Spoil	0-10	.80	<.2	.31
		South Central	0-10	.51	<.2	.33

1/ Solution Conductivity

2/ Saturated Paste

3/ Ammonium Acetate Extraction at pH 9.0

4/ Paste Extract

5/ DPTA Extraction

6/ Drying at 105°C.

7/ Walkley-Black

8/ Hydrometer

9/ Ammonium Acetate Extraction

10/ Sodium Bicarbonate Extraction

11/ Hot Water Extraction

12/ $\frac{Na^+}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}}$

Tests conducted by New Mexico State University Soil and Water Testing Laboratory, Las Cruces, New Mexico.

of phosphorus or nitrogen deficiencies, applications can be made at that time, based on plant needs.

Even though all the soil materials are favorable for plant growth, the surface soils of the Brycan and Datino are more favorable than the substratums, due to a higher concentration of calcium carbonate ($CaCO_3$ or lime) in the lower horizons, and a higher concentration of rock fragments in the lower horizons of the Datino soil.

In conclusion, the only major limitations of the soils existing at both sites is the large surface boulders on the Brycan soil, surface stones on the Datino soil, as well as large amounts of rock fragments in the lower horizons of the Datino soil. It is recommended that the large stones and boulders be pushed to the lowest part of the topography and covered with surface soils wherever possible, and that surface soils be replaced to a minimum depth of one foot in disturbed areas, wherever possible, before starting seeding operations.

VEGETATION

The vegetative portion of this inventory includes a map of the range site and condition of the study area. The range sites are the standard range sites (climax ecological plant communities) used by the Soil Conservation Service and the Bureau of Land Management in their range inventory systems. Present vegetation (range condition) was inventoried on July 20, 21, 22, 1981 by Lamar Mason, with the assistance of Allen Emmel and Dellon Cox. The vegetative inventory includes cover, production, species diversity and density of woody species (numbers of plants per acre).

Production data was gathered by use of the double sampling method, supplemented by 1/10-acre transects to get production for trees and large shrubs, including Gambel oak, Utah juniper, pinyon pine, Rockymountain juniper, and bigtooth maple. Randomization in sampling was achieved by selection of line of direction for the belt transects by use of 16 cardinal compass directions. A starting point was selected by going to the farthest north point of the delineation for both range sites. A rock was thrown backwards over the shoulder to determine point of beginning. Samples had previously been drawn from a hat to determine line of direction for the belt transect for the first 100 feet (1/100 acre). The belt transect was 4.356 feet wide and 100 feet long for each sample. At the end of each 100-foot belt transect, a 9.6 square foot plot location was selected at random. A previously drawn direction sample (16 cardinal compass points) was drawn from a hat. To coincide with this, a number (1 to 50 or 1 to 100) was drawn from a hat. The 9.6 square foot plot was located by going the specified line of direction drawn for the number of feet drawn. This same randomized system was used on each of ten, one hundred-foot belt transects and ten-9.6 square foot plots (see TABLES 2 and 2a). Additional 9.6 square foot plots needed (determined by formula) were located by drawing line of direction and numbers for distance from a hat (TABLES 2 and 2a) If a direction and distance was drawn that occurred outside the site, the selection was excluded and the next one was used. These additional plots were located by randomization, as indicated on TABLES 2 and 2a.

PRODUCTION DETERMINATIONS

Procedures for determining production were to take measurements of tree species and large shrubs from the belt transect. The measurements correlated to production have been previously confirmed by computer and use as accurate by Soil Conservation Service and other agencies. These tables are TABLE N, Gambel oakbrush, yield table for Mountain Stony loam range site, TABLE A, Guide for Determining current yield of Utah Juniper in Utah, TABLE B, Pinyon Pine Yields, annual yield per tree, pounds air-dry for pinyon pine, and TABLE J, Gambel oakbrush yield table. TABLE N was used to determine yield of Gambel oak and bigtooth maple, on Mountain Stony loam range site and TABLE J for Gambel oakbrush yield on Upland Stony loam (P-J). Each clump of oak and maple was measured. The foliage width and length were taken and the width multiplied by the length to determine foliage area. The average diameter of stems was measured at the ground line for each clump and the basal area determined by computing the stem area multiplied by the number of stems in the clump. The yield in pounds air-dry was then taken from TABLES N and J by following the foliage area on the left hand column and going across to the applicable basal area column, indicated across the top of the table. Yield of Utah juniper and pinyon pine are correlated with crown diameter of each tree and relative denseness of the foliage. Crown spread was measured on the belt transects and record made of whether the foliage was sparse, medium, or dense. Production was found in TABLES A and B by finding the weight (air-dry) per tree opposite the crown diameter in the sparse, medium, or dense section of the table.

The production of all other species, other than Gambel oak, bigtooth maple, Utah juniper, pinyon pine, and Rockymountain juniper were taken by use of the double sampling method on the 9.6 square foot plots. This was done by taking sample weight units of each species on areas outside the plots. These sample weight units were then used as a base for estimating the gram weights of each species on each plot. After 10 plots were estimated, 2

plots were selected and all species on these plots were weighed in grams. The plot numbers of clipped plots were circled (TABLE 1 and 1a). Species with significant production not found on the clipped plots were clipped from one of the other plots. These are circled in the body of the table. A correction factor was calculated by dividing estimated weight into actual weight. The corrected weights were then computed by multiplying estimated weight by the correction factor.

A sample of each species was weighed green and dried, to air-dry (3 weeks). Percent air-dry was then determined by dividing dry weight by green weight. Dry weight was then determined on TABLE 1 and 1a by multiplying total green weight for each species by percent dry weight (taken from TABLE 20). Average dry weight per plot was then calculated and multiplied by 10 to give pounds per acre air-dry. The 9.6 square foot plot is designed so that weights in grams multiplied by 10 on each plot gives pounds per acre or a total summation of 10 plots converts directly to pounds per acre. The green weight of the 5 tree and large shrub species were included on TABLES 1 and 1a, to give total vegetative yields by converting pounds per acre, taken from the belt transects, to grams per plot and doubling the dry weight to give green weight (most species were found to be near 50 percent dry weight). The first 100 feet transect was included with Plot 1 (on TABLES 1 and 1a), the second 100 feet with Plot 2, etc. For all plots taken on the Upland Stony Loam (P-J) site over the first 10 plots, the average grams per plot from the first 10 were recorded for the 5 species on the extra plots determined as needed by formula. The percent composition by air-dry weight was calculated for each species by dividing dry weight of each by the total dry weight. All data for production is included on TABLE 1 for the Mountain Stony Loam (oak) range site and on TABLE 1a for Upland Stony Loam (pinyon-juniper) range site.

After 10 plots, with supplemental yield data from the belt transects were taken, the number of additional plots needed were calculated. The formula:

$$n = \frac{(\text{t value})^2 S^2}{[(\overline{X})\ (\%\ \text{change})]^2}$$

was used for this calculation. See TABLES 3 and 3a. These calculations indicated the need for only 0.69 plot on the Mountain stony loam (oak) site and 19.45 on the Upland stony loam (Pinyon-juniper) site. So 10 plots of yield data were taken on the former site and 20 on the latter, with 2 additional clipped plots on the latter.

COVER DETERMINATIONS

Vegetative cover by species was determined on the same plots where production data was taken. It was measured by use of a tape measure, graduated in tenths of feet. The crown spread area of each plant was measured on each plot and recorded to the nearest .1 of a square foot. Litter cover, rock surface, and bare ground were also recorded in square feet on each plot on the first 10 plots.

The formula for number of samples needed was calculated and it was thus determined that 20 plots are needed on Mountain stony loam (oak) site (TABLE 8) and 46 (minimum of 40) on the Upland stony loam (Pinyon-Juniper) site (TABLE 16). In addition to the first ten, 10 more plots were taken on the Mountain stony loam (oak) site and 30 more on the Upland stony loam (Pinyon-Juniper). See TABLES 7 and 15.

SPECIES DIVERSITY

Species diversity can be interpreted by weight and by cover. This data will be shown in summary in the interpretations section of this report.

DENSITY

Density of woody species was taken by using the point-quarter method. This information was taken at the locations where the production plots were taken, except where additional plots were needed, and these were taken at locations indicated on TABLES 2 and 2a.

After the distances were recorded in the northeast, northwest, southwest, and southeast quadrats, to the nearest woody species, the mean distance was calculated at each plot location. The formula for the required plots was calculated and determined that 31 (minimum of 40) was needed on the Mountain stony loam (oak) site (TABLE 11) and 27 on the Upland stony loam (Pinyon-Juniper) site (TABLE 18). After the data from these additional locations were taken, the mean distance on the Mountain stony loam (oak) site was determined to be 4.15 feet (see TABLE 9). The total density of woody species was then calculated by use of the formula:

$$\text{Total density} = \frac{\text{Unit Area}}{(\text{mean point-to-plant distance})^2} = \frac{43{,}560}{(4.15)^2} = \frac{43{,}560}{17.22} =$$

2,530 individuals per acre

On the Upland stony loam (P-J) site, the mean distance is 7.8, which calculates to 716 individuals per acre (TABLE 17).

In addition to the total woody species calculations by the point-quarter method, this method was used on individual woody species on the first ten plots of each site. This data is included as TABLE 10 for the Mountain stony loam (oak) site on 8 woody species and as TABLE 21 on 7 woody species on the Upland stony loam (P-J) site.

SPECIES LISTS

Species lists, TABLES 12 and 19, are included for each of the two range sites. This includes the plant code, scientific name, and common name for each plant species. The list is broken down into three groups; grasses, forbs, and shrubs and trees.

INTERPRETATIONS

Two range sites occur in this study area, with very small areas of an additional site making up less than 1/10 of an acre total. These two sites

are Mountain stony loam (oak) and Upland stony loam (pinyon-juniper).

The Mountain stony loam (oak) range site is described as follows:

Mountain Stony Loam (oak)

This site occurs on alluvial fans on the study area, near the Pinnacle Mine site. Elevation is about 2,165 meters (7,100 feet). Slopes are 15 to 25 percent and east facing. Average annual precipitation is 30 to 41 centimeters (12 to 16 inches). Frost-free season is 100 to 110 days.

This range site relates to the Ba, Brycan Soil.

Present Vegetation: The inventory of the Mountain stony loam (oak) range site shows the following plant species and percentage of air-dry weight.

PRESENT PLANT COMMUNITY--MOUNTAIN STONY LOAM (OAK)

Grasses and Grass-Like	Percent
Kentucky bluegrass	4
Sedge	4
Forbs	
Aster	1
Louisiana sagewort	3
Lupine	3
Stansbury phlox	1
Starry-false-Solomons-Seal	1
Goldenrod	5
Trees and Shrubs	
Bigtooth maple	10
Gambel oak	43
Mountain snowberry	9
Rocky mountain juniper	2
Gooseberry currant	3
Woods Rose	1
Douglas fir	T*
Myrtle pachystima	3
Oregon-grape	2
Serviceberry	2

T = trace (less than 1% by weight). The above percent composition by weight, compared with other species in the list, indicates species diversity by weight.

Total annual production is 795 pounds per acre air dry in the 1981 growing season.

POTENTIAL PLANT COMMUNITY--MOUNTAIN STONY LOAM (OAK)

Species	Percent Composition by Weight
Grasses and Grass-Like Plants	
Beardless bluebunch wheatgrass	5
Salina wildrye	15
Muttongrass	10
Carex	5
Western wheatgrass	5
Slender wheatgrass	5
Mountain brome	5
Stipa (3 species)	5
Forbs	
Aster	1
Louisiana sagewort	5
Lupine	5
Phlox	1
Goldenrod	5
Others	5
Shrubs and Trees	
Gambel oak	25
Mountain snowberry	5
Birchleaf mountainmohogany	5
Big sagebrush	5
Antelope bitterbrush	5
Rocky mountain juniper	1
Bigtooth maple	5
Serviceberry	2
Myrtle pachystima	2
Total Potential Yield	1700 pounds per acre favorable 1200 pounds per acre average 650 pounds per acre unfavorable

Considering the above as climax or potential, the present vegetation is 61 percent of potential. This is determined to be good ecological condition.

Upland Stony Loam (Pinyon-Juniper) Woodland Site

This site occurs on alluvial fans and very steep mountain slopes at the study area near the Pinnacle Mine. Elevations range from 2,160 to 2,225

meters (7,100 to 7,300 feet). Slopes are 15 to 65 percent, and east, south, and north facing.

Climate is cold, snowy winters, and warm dry summers. Average annual precipitation is from 30 to 41 centimeters (12 to 16 inches), with approximately 20 to 40 percent occurring during the plant growth period, April to October. Plant growth begins from March 15 to April 15, and grasses and forbs mature June 15 to July 1. Frost-free period is 100 to 110 days.

This woodland site relates to the Da, Datino Soil.

Present Vegetation: An inventory of the Upland stony loam (pinyon-juniper) woodland site recorded the following plant species and percentage of air-dry weight.

PRESENT PLANT COMMUNITY--UPLAND STONY LOAM (P-J)

Grass and Grass-Like	Percent
Blue grama	2
Indian ricegrass	2
Salina wildrye	12
Forbs	
Louisiana sagewort	2
Hairy goldaster	2
Trees and Shrubs	
Big sagebrush	5
Black sagebrush	1
Plains pricklypear	1
Green Mormontea	1
Pinyon pine	20
Utah juniper	39
Mountain snowberry	1
Fineleaf yucca	2
Douglas rabbitbrush	1
Gambel oak	9

Total annual production is 1,252 pounds per acre air dry. The above percent for each species, compared with all the other plants, indicates plant diversity by weight.

Potential Vegetation: Potential vegetation is an overstory of Utah juniper and pinyon pine, with an overstory density of 20 to 25 percent. Composition by annual weight is 25 percent juniper pinyon, 45 percent grasses, about 10 percent forbs, and 20 percent shrubs.

The following table lists the potential plant community for the Upland stony loam (pinyon-juniper) woodland site. Those species occurring at higher percentages of air-dry weight constitute more important species for the site.

POTENTIAL PLANT COMMUNITY--UPLAND STONY LOAM (P-J)

Species	Canopy Class Sparse 10-25% %/wt.
Grasses and Grass-Like	
Bluebunch wheatgrass	40
Bottlebrush squirreltail	1
Indian ricegrass	8
Muttongrass	10
Needleandthread	5
Nevada bluegrass	10
Sandberg bluegrass	1
Western wheatgrass	1
Forbs	
Aster	1
Daisy	1
Eriogonum	1
Blue flax	1
Goldenrod	3
Mustard	1
Phlox	2
Sego lily	1
Tapertip hawksbeard	5
Shrubs and Trees	
Antelope bitterbrush	2
Big sagebrush	15
Birchleaf mountainmahogany	1
Black sagebrush	10
Eriogonum	1
Mormontea	1

POTENTIAL PLANT COMMUNITY--UPLAND STONY LOAM (P-J) (Cont'd.)

Species	Canopy Class Sparse 10-25% %/wt
Pinyon pine	*2 10
Pricklypear	1
Rock goldenrod	2
Utah juniper	*4 15

* Production below 1.37 meters (4.5 feet) in height

Potential yields for a sparse canopy class of the Upland stony loam (pinyon-juniper) woodland site are shown in the following table. This yield data is based on 10 plots in excellent condition, 111 plots in good, 75 plots in fair, and 73 plots in poor condition.

TOTAL POTENTIAL ANNUAL PRODUCTION OF VEGETATION

For Sparse Canopy Class
Upland Stony Loam (P-J)

	Total All Vegetation Kg/Ha	Total All Vegetation Lbs/Ac	Total Below 1.37m(4.5 ft.) Kg/Ha	Total Below 1.37m(4.5 ft.) Lbs/Ac
Favorable Years	1,800	1,600	1,650	1,475
Average Years	1,200	1,075	1,125	1,000
Unfavorable Years	825	725	750	675

On the basis of the above potential, the present vegetation is 32 percent of the potential for the site. This is determined to be fair ecological condition.

Interpretations of the cover on these two sites indicate that in present condition, the Mountain stony loam (oak) site has a total vegetation cover of 58 percent, with 26 percent litter, 7 percent bare rock, and 9 percent bare ground.

TABLE 1

MOUNTAIN STONY LOAM (OAK) PRODUCTION DETERMINATIONS

Species	Plots 1	2	3	4	5	6	7	8	9	10	Total Estimated Weight	Actual Weight Clipped Plots	Correction Factor	Corrected Green Weights	Percent Dry Weight	Total Dry Weight	Average Dry Weight/Plot	Pounds Per Acre	Percent Composition
AGTR		2									2		100	2	50	1	T	1	T
CAREX			7			3	7	33			50	44	110	55	53	29	3	29	4
KOCR								2			2	2	100	2	48	1	T	1	T
POFE						17		24			41	27	112	46	56	26	3	26	3
POPR		1	2		20				22	1	46	28	117	54	57	30	3	30	4
POSE							1				1		100	1	100	1	T	1	T
TOTAL GRASSES																88		88	11
ASTER			10	6							16	9	90	14	50	7	1	7	1
ARLU						5	12	30		4	51	27	90	46	53	24	2	24	3
ERIGE2			3								3	3	100	3	50	2	T	2	T
LUPIN									35		35	37	106	37	54	20	2	20	3
PHST2			1	1		5					7	1	100	7	100	4	T	4	1
SMST	10										10	10	100	10	70	7	1	7	1
SOLID				24	10		12	34	13		93	30	88	82	48	39	4	39	5
TRDU									2		2		100	2	57	1	T	1	T
TOTAL FORBS																104		104	14
ACGR3	72	54	T	T	12			8			146	*8	100	146	50	83	8	83	10
AMAL2			34								34	31	91	31	55	17	2	17	2
BERE						42					42	39	93	39	49	19	2	19	2
JUOS								4	1		5	**4	100	5	50	2	T	2	T
JUSC2	5		5	10		4		8			32	**8	100	32	50	16	2	16	2
PAMY	30	15									45	14	93	42	57	24	2	24	3
PIED									6		6	6	100	6	50	3	T	3	T
QUGA	10	43	82	90	107	64	88	15	38	134	671	*97	100	671	50	336	34	336	43
RIMO2		44									44	40	91	40	50	20	2	20	3
ROWOU	15	5									20	14	93	19	43	8	1	8	1
SYOR2			8	40		25	40		52	6	171	7	88	150	50	75	8	75	9
TOTAL SHRUBS																603		603	75
TOTAL	142	164	152	171	149.	165	160	158	169	145						795		795	100

*COMPUTED FROM TABLES FOR OAKBRUSH (GAMBEL OAK)

**COMPUTED FROM TABLES FOR UTAH JUNIPER

TABLE 1A

UPLAND STONY LOAM (PINYON - JUNIPER) RANGE SITE

PRODUCTION DETERMINATIONS

Species	Plots 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total Estimated Weight	Actual Weight Clipped Plots	Correction Factor	Corrected Green Weights	Percent Dry Weight	Total Dry Weight	Average Dry Weight/Plot	Pounds Per Acre	Percent Composition
ELSA	60		45	32		40	28	30	62		14	110	75	2	20	12	20		16	26	592	17	91	538	59	317	16	160	12
ORHY	5	3			42	1		17			18							30	2		118	63	105	124	47	58	3	30	2
BOGR2						4			4	3				33	2		14				60	45	112	68	67	46	2	20	2
CAREX															17						17	20	118	20	53	11	0.5	5	T
TOTAL GRASSES																												215	16
ARLU	4		8	45					2		7	3						48		7	124	11	82	102	53	54	3	30	2
CHVI6		7						1				2		22	27			2			61	34	117	72	50	36	2	20	2
ASDI5				5						1											6	1	100	6	47	3	20	2	T
ARABI2						2													1		3		100	3	47	1	0.1	1	T
TOTAL FORBS																												52	4
JUOS*	76	92	76		126	230	88	104	144	46	98	98	98	98	98	98	98	98	98	98	1,962	*	100	1,962	50	981	49	490	39
PIED*	2	80	2		10	44	196	28	44	92	50	50	50	50	50	50	50	50	50	50	998	*	100	998	50	499	25	250	20
QUGA*			30	76	5		88	20			22	22	22	22	22	22	22	22	22	22	439	*	100	439	50	219	11	110	9
EPVI																15					15	17	113	17	47	8	0.4	4	T
SYO2	36					12										10					58	32	89	52	50	26	1	10	1
O[illegible]				7						12											19	12	100	19	100**	19	1	10	1
[illegible]			35					34							5						74	34	91	67	100**	67	3	30	2
AR[illegible]2	3	70	2			7	5		1	35			25			4	70		34	24	280	31	89	249	47	117	6	60	5
ARARN														40							40	35	88	35	47	16	1	10	1
CHVI8			8		22				1	18								1			50	13	68	34	50	17	1	10	1
CHNAZ																			4		4		100	4	47	2	0.1	1	T
TOTAL SHRUBS																												985	79
TOTAL	186	252	206	165	295	340	405	234	258	207	211	287	272	269	243	213	276	253	229	229								1,252	99

*Taken on belt transects from measurements and tables J, A and B.
**Reasearch shows annual weight air dry as 15% of green weight of leaves and pads.
This was computed in the field and dry weight recorded directly.

TABLE 2

RANDOMIZATION - MOUNTAIN STONY LOAM (OAK)

	Transect Direction	Plot No.	Plot Direction	Distance
ACGR2 JUSC JUOS Taken on 1/100 acre plots 4.356 wide & 100' long on this transect	SSW	1	NE	72
	S	2	W	48
	SW	3	WSW	63
	SW	4	ESE	29
	SSW	5	SW	4
	SW	6	WNW	42
	WSW	7	NE	25
	WSW	8	E	11
	SE	9	NNW	9
No info. taken on trees and shrubs but transect run to help locate and randomize 9.6 sq. ft. plots	SSW	10	NW	37
	SSE	11	ENE	34
	SW	12	W	23
	SE	13	N	45
	SSW	14	WSW	36
	SW	15	NNW	8
	SSW	16	WSW	40
	SW	17	WNW	3
	S	18	WSW	18
	ESE	19	S	33
	SW	20	NNE	14
		21	ESE	7
		22	NW	19
		23	WNW	44
		24	SE	32
		25	SW	26
		26	N	99
Starting for 31 to 35, 17 ft. SSE of station 18		27	NNE	27
		28	N	41
		29	NW	77
		30	NE	37
		31	WNW	18
		32	ENE	43
		33	W	96
		34	WSW	21
		35	NE	73
Start 36 to 40, 40' ft. SE station 12		36	NW	31
		37	SSE	66
		38	WNW	46
		39	ESE	28
		40	NNW	93

Starting point for plots 21 to 30 drawn by distance & cardinal direction & from station #7 on transect drawn from hat. Direction NNW distance 87 ft.

TABLE 2a

RANDOMIZATION-UPLAND STONY LOAM (P-J)

Transect Direction	Plot No.	Plot Direction	Distance
SW	1	E	17
SSE	2	NNE	43
WSW	3	N	11
SSW	4	S	27
SE	5	SSW	19
SSW	6	ENE	34
WSW	7	ESE	30
S	8	WSW	3
ENE	9	SW	12
NNE	10	NE	44
Start 11 NE station 4, 43 ft. -	11	ENE	29
	12	W	18
	13	N	49
	14	NNE	15
	15	SE	35
Start 16, WNW from station 2, 27 ft.-	16	NW	22
	17	ESE	9
	18	NNE	22
	19	NE	38
	20	S	5
Start 21, S from station 8, 16 ft. -	21	SSW	27
	22	WSW	17
	23	NNW	33
	24	SE	7
	25	WNW	46
Start 26 SW from station 6, 9 ft. -	26	E	24
	27	NNW	6
	28	ENE	14
	29	N	40
	30	NW	7
Start 31 48 ft. ENE, station 1 --	31	SSE	14
	32	SW	28
	33	NNE	46
Start 36 34 ft. NW, station 9 -	34	SW	9
	35	SSW	46
	36	NE	18
	37	N	41
	38	WNW	20
	39	S	34
	40	NE	16

TABLE 3

MOUNTAIN STONY LOAM (OAK) PRODUCTION DATA

Calculation of Number of Plots Needed

$$n = \frac{(\text{t value})^2 \, s^2}{[\bar{x} \, (\% \text{ change})]^2}$$

$$n = \frac{1.81^2 \times 171\text{-}142 = \frac{29}{4} = 7.25^2}{[157.5 \, (.1)]^2}$$

$$n = \frac{3.27 \times 52.56}{248.06}$$

$$n = 0.69$$

So 10 plots are adequate

NOTE: Information received from Susan Linner (by telephone) after this table was completed, indicated that it was not necessary to complete the formula for numbers of plots on production data.

TABLE 3A

UPLAND STONY LOAM (PINYON-JUNIPER) PRODUCTION DATA

Calculation of Number of Samples Needed

$$n = \frac{(\text{t value})^2 \; S^2}{[\bar{x} \; (\% \text{ change})]^2}$$

$$n = \frac{(1.81)^2 \; (60.0)^2}{[\; 246 \; (.1)]^2}$$

$$n = \frac{3.27 \;\; x \;\; 3600.00}{605.16}$$

$$n = \frac{11772.00}{605.16}$$

$$n = 19.45$$

NOTE: Information received from Susan Linner (by telephone) after this table was completed, that it was not necessary to complete the formula for numbers of plots on production data. We ran production on 10 more plots than needed.

TABLE 4

MOUNTAIN STONY LOAM (OAK)

BIG TOOTH MAPLE

Station	Foliage Area W. ft.	Foliage Area L. ft.	Foliage Area (ft.^{2})	Average Diameter (in.)	Average Area	Number of Stems	Basal Area (in.^{2})	Pounds Air-Dry	Height (ft.)
1+00 (SSW)	8.0	10.0	80	6.0	28.26	1	28.26	2.38	17.0
	3.0	5.0	15	0.5	.196	3	.57	.24	3.0
	1.5	4.0	6	0.7	.385	1	.38	.15	3.5
	4.0	5.0	20	0.3	.07	3	.21	.10	3.5
	3.0	3.0	9	7.0	69.86	1	69.86	2.07	10.0
	4.0	5.0	20	3.0	7.07	1	7.07	.69	19.0
	2.0	3.0	6	0.4	.12	2	.24	.07	2.0
	2.0	3.0	6	1.3	1.33	1	1.33	.19	6.0
	3.0	5.0	15	0.3	.07	6	.42	.24	2.0
	3.0	4.0	12	3.5	9.62	1	9.62	.62	11.0
	3.0	3.0	9	0.3	.07	7	.49	.19	3.0
	5.0	8.0	40	1.5	1.77	6	10.62	.34	12.0
TOTAL								7.28	
2+00 (WSW)	3.0	4.0	12	0.4	.12	4	.48	.22	4.0
	5.0	5.0	25	1.8	2.54	3	7.62	.77	15.0
	2.0	3.0	6	0.5	.19	4	.76	.19	2.0
	4.0	4.0	16	2.5	4.91	6	29.46	1.57	17.0
	2.0	3.0	6	3.2	8.04	1	8.04	.39	15.0
	2.0	4.0	8	0.5	.19	6	1.14	.22	3.5
	3.0	5.0	15	3.7	10.75	1	10.75	.70	20.0
	2.0	2.0	4	2.8	6.16	1	6.16	.28	12.0
	2.0	3.0	6	4.2	13.5	1	13.5	.48	13.0
	1.0	1.0	1	2.5	4.91	1	4.91	.14	10.0
	2.0	5.0	10	0.2	.03	12	.36	.20	1.0
	1.0	3.0	3	1.8	2.54	4	10.16	.29	12.0
TOTAL								5.45	
3+00 (SW)								0	
4+00 (SW)	1.0	2.0	2	0.2	.03	5	.15	.02	1.0
5+00 (SSW)	2.0	6.0	10	1.6	2.0	8	16.0	.66	8.0
	3.0	3.0	9	2.2	3.8	1	3.8	.37	12.0
	3.0	3.0	9	0.3	.07	10	.7	.19	3.0
TOTAL								1.22	
6+00 (SW)								0	
7+00 (WSW)								0	
8+00	3.0	3.0	9	.1	.008	11	.09	.02	1.0
	2.0	4.0	8	1.2	1.13	5	5.65	.41	9.0
	2.0	3.0	6	0.2	.03	8	.24	.07	2.0
	1.0	1.0	1	1.0	.78	1	.78	.08	5.0
	1.0	3.0	3	1.3	1.33	2	2.66	.18	7.0
TOTAL								.76	
9+00								0	
10+00								0	

TABLE 4a

UPLAND STONY LOAM (PINYON-JUNIPER)

Dry Weight-Utah Juniper

Station	Crown Spread	Denseness	Height	Pounds	Total/100'
1 + 00 (SW)	7.0 6.0	S M	7.5 8.0	1.9 1.9	3.8
2 + 00(WSW)	10.0	M	12.0	4.6	4.6
3 + 00(WSW)	9.0	M	11.0	3.8	3.8
4 + 00(SSW)					0
5 + 00 (NNE)	6.0 4.0 2.0 10.0	M D M S	5.0 6.0 6.0 11.00	1.9 1.2 0.3 2.9	6.3
6 + 00 (NE)	13.0 11.0 4.0	M S M	12.0 9.0 8.0	7.2 3.3 1.0	11.5
7 + 00(ENE)	14.0	S	12.0	4.4	4.4
8 + 00 (SW)	5.0 9.0	M M	5.0 11.0	1.4 3.8	5.2
9 + 00(NNW)	13.0	M	12.0	7.2	7.2
10 + 88 (W)	7.0 4.0 4.0	D M M	4.0 7.0 4.0	0.3 1.0 1.0	2.3

4.8 Average

48.1 Total

TABLE 5

MOUNTAIN STONY LOAM (OAK)

YIELD OF GAMBEL OAK

Station	Foliage Area W. ft.	L. ft.	(ft.^{2})	Average Diameter (in.)	Average Area	Number of Stems	Basal Area (in.^{2})	Pounds Air-Dry	Height (ft.)
1+00 (SSW)	1	2	2	.3	.07	1	.07	.02	4
	2	5	10	2.5	4.91	1	4.91	.44	7
	1	4	4	.2	.03	5	.15	--	3
TOTAL								.46	
2+00 (WSW)	3	4	12	3.5	9.62	1	9.62	.60	22
	2	4	8	3.7	10.75	1	10.75	.51	23
	3	3	9	3.0	7.07	1	7.07	.46	12
	3	5	15	0.4	.125	10	1.25	.31	3
	1	1	1	0.7	.385	1	.385	.07	5
	2	2	4	2.2	3.8	1	3.8	.24	10
TOTAL								2.19	
3+00 (SW)	1	2	2	0.3	.07	5	.35	.08	3.5
	2	3	6	0.3	.07	7	.49	.15	1.5
	1	2	2	3.5	9.62	1	9.62	.24	20
	4	7	28	3.5	9.62	3	19.24	1.18	22
	2	3	6	0.1	.008	15	.12	.05	1
	1	1	1	2.5	4.91	1	4.91	.14	8
	4	5	20	4.0	12.57	1	12.57	.88	26
	2	3	6	0.2	.03	12	.36	.13	2
	3	3	9	4.0	12.57	1	12.57	.56	24
	3	3	9	3.7	10.75	1	10.75	.55	14
	1	5	5	0.3	.07	8	.56	.14	3.5
TOTAL								4.10	
4+00 (SW)	4	5	20	5.0	19.63	1	19.63	1.02	15
	4	5	20	5.5	25.55	1	25.55	1.30	13
	3	5	15	4.3	14.52	1	14.52	.78	9
	3	7	21	0.2	.03	17	.51	.29	1
	2	3	6	1.5	1.77	1	1.77	.23	6
	2	8	16	0.3	.07	13	.91	.31	2
	1	3	3	1.3	1.33	1	1.33	.13	5
	2	5	10	1.8	2.54	2	5.08	.44	6
TOTAL								4.50	
5+00 (SW)	2	2	4	2.6	5.31	1	5.31	.27	10
	3	3	9	0.5	.196	1	.196	.28	3
	2	2	4	0.7	.385	4	1.54	.15	4
	2	4	6	3.2	8.04	1	8.04	.39	14
	2	2	4	0.3	.07	7	.49	.12	3
	1	4	4	1.3	1.33	1	1.33	.16	5
	1	3	3	0.5	.07	4	.28	.05	3
	1	3	3	1.5	1.77	1	1.77	.16	7
	1	6	6	0.1	.008	16	.128	.04	1
	3	3	9	3.7	10.75	1	10.75	.55	12
	2	3	6	2.8	6.16	1	6.16	.36	10
	1	2	2	0.7	.385	3	1.15	.10	6
	3	4	12	3.8	11.34	1	11.34	.63	12
	2	4	8	3.0	7.07	1	7.07	.43	12
	3	3	9	3.0	7.07	1	7.07	.46	12
	2	3	5	2.5	4.91	1	4.91	.31	10
	2	2	4	2.0	3.14	1	3.14	.21	9
	1	3	3	0.8	.503	6	3.02	.18	5
	2	3	6	1.0	.785	6	4.71	.34	6
	1	1	1	1.3	1.33	1	1.33	.08	9
TOTAL								5.27	

TABLE 5 (CONT'D.)

MOUNTAIN STONY LOAM (OAK)

YIELD OF GAMBEL OAK

Station	Foliage Area W. ft.	Foliage Area L. ft.	Foliage Area (ft.^{2})	Average Diameter (in.)	Average Area	Number of Stems	Basal Area (in.^{2})	Pounds Air-Dry	Height (ft.)
6+00 (SW)	1	2	2	1.5	1.77	1	1.77	.13	10
	1	3	3	0.9	.636	4	2.54	.17	7
	1	3	3	0.3	.07	6	.42	.10	2
	1	3	3	0.3	.07	5	.35	.07	3
	1	2	2	1.2	1.13	1	1.13	.10	8
	2	3	6	1.0	.785	3	2.35	.24	8
	1	2	2	0.2	.03	8	.24	.05	1
	3	3	9	3.5	9.62	1	9.62	.53	11
	3	3	9	3.8	11.34	1	11.34	.55	12
	3	3	9	3.4	9.07	1	9.07	.53	9
	1	2	2	1.0	.785	1	.785	.10	6
	3	15	15	1.5	1.77	5	8.85	.65	9
	1	2	2	0.2	.03	7	.21	.03	1
	1	1	2	0.7	.385	1	.385	.07	5
TOTAL								3.32	
7+00 (WSW)	1	4	4	0.3	.07	8	.56	.12	3
	2	4	8	0.8	.503	5	2.65	.30	6
	1	2	2	0.7	.385	1	.385	.07	5
	1	2	2	0.2	.03	5	.15	.02	1
	2	5	10	1.5	1.77	4	7.08	.49	8
	1	2	2	0.2	.03	7	.21	.05	3.5
	1	4	4	1.5	1.77	2	3.54	.24	8
	2	3	6	2.7	5.71	1	5.71	.36	9
	3	5	15	0.2	.03	18	.54	.24	2
	1	2	2	2.6	4.91	1	4.91	.18	8
	2	4	8	0.3	.07	8	.56	.18	3.5
	1	1	1	1.2	1.13	1	1.13	.08	6
	2	3	6	0.4	.12	9	1.08	.19	3.5
	3	4	12	2.3	4.2	4	16.8	.73	9
	2	4	8	0.6	.283	7	1.98	.26	4
	2	2	4	1.5	1.77	1	1.77	.18	7
	2	4	8	0.7	.385	9	3.46	.30	4
	3	3	9	0.2	.03	13	0.39	.19	2
	2	3	6	1.6	1.9	1	1.90	.23	4
TOTAL								4.41	
8+00 (WSW)	2	3	6	0.2	.03	6	.18	.05	2
	1	3	3	2.3	4.2	1	4.2	.20	8
	2	5	10	0.3	.07	12	.84	.25	2
	2	2	4	0.9	.64	1	.64	.16	6
	1	3	3	0.2	.03	5	.15	.02	2
	1	2	2	0.2	.03	6	.18	.01	2.5
	1	1	1	0.8	.50	1	.50	.07	4
TOTAL								0.76	
9+00 (SW)	1	1	1	0.3	.07	3	.21	.03	2.5
	1	4	4	0.7	.385	6	2.31	.18	3
	2	3	6	1.3	1.33	4	5.32	.34	6
	1	4	4	0.6	.28	5	1.4	.17	4
	2	3	6	0.7	.385	7	2.69	.26	3
	2	4	8	3.8	11.34	1	11.34	.51	12
	2	5	10	0.3	.07	14	.98	.25	2
	1	7	7	0.2	.03	12	.36	.16	3
TOTAL								1.90	

TABLE 5 (CONT'D.)

MOUNTAIN STONY LOAM (OAK)

YIELD OF GAMBEL OAK

Station	Foliage Area W. ft.	L. ft.	(ft.^{2})	Average Diameter (in.)	Average Area	Number of Stems	Basal Area (in.^{2})	Pounds Air-Dry	Height (ft.)
10+00	2	4	8	0.5	.196	10	1.96	.26	3.5
	1	1	1	1.2	1.13	1	1.13	.08	7
	1	4	4	0.6	.28	4	1.12	.16	3
	1	3	3	2.1	3.49	1	3.49	.20	8
	2	3	6	2.7	5.71	1	5.71	.36	9
	1	6	6	0.2	.03	10	.3	.15	2
	2	2	4	1.8	2.54	1	2.54	.21	6
	3	4	12	0.8	.5	7	3.5	.42	4
	2	7	14	0.3	.07	23	1.61	.35	2
	3	6	18	1.8	2.54	9	22.86	1.20	9
	2	6	12	3.1	7.57	4	30.28	1.07	14
	3	8	24	3.5	9.62	4	38.00	2.20	17
	1	2	2	0.3	.07	6	.42	.09	2
TOTAL								6.75	

TABLE 6

YIELD OF ROCKY MOUNTAIN JUNIPER

MOUNTAIN STONY LOAM (OAK)

Station	Crown Diameter	Denseness		Pounds		
1 + 100	5.5	S		1.4		
SSW	4.0	D		1.2		2.6
3 + 00						
SW	8.0	S		2.3		2.3
4 + 00	11.0	S		3.3		
SW	7.0	S		1.9		5.2
6 + 00	3.0	M		0.6		
SW	5.0	S		1.3		1.9
7 + 00						
WSW						
8 + 00	7.0	S	JUOS	1.9		
	8.0	M				3.8
9 + 00	3.0	S	JUOS	0.6		
SW	6.0	M	PIED		1.9	
	5.0	S	PIED		1.3	3.2

TABLE 7

VEGETATIVE COVER - MOUNTAIN STONY LOAM (OAK) Sq. Ft./Plot

Species	1	2	3	4	5	6	7	8	9	10	TOTAL 20 PLOTS	AVERAGE PER PLOT	PERCENT OF TOTAL VEGETATION	PERCENT OF TOTAL COVER
CAREX	--	--	.2	--	--	--	0.2	0.7	--	--	1.6	.08	1	1
POPR	--	--	T	--	0.2	--	--	--	0.3	T	4.5	.22	4	2
POFE	--	--	--	--	--	0.5	--	0.2	--	--	0.7	.04	1	T
AGTR	--	--	--	--	--	--	--	--	--	--	0.1	.01	T	T
AGSU	--	--	--	--	--	--	--	--	--	--	0.1	.01	T	T
TOTAL GRASSES												.36	6	3
ARLU	--	--	--	--	--	T	0.1	--	--	T	0.4	.02	T	T
SMST	0.2	--	--	--	--	--	--	--	--	--	0.3	.02	T	T
ASTER	--	--	.1	0.1	--	--	--	--	--	--	0.2	.01	T	T
SOLID	--	--	--	0.2	0.3	--	--	--	0.1	0.2	1.2	.06	1	1
LUPIN	--	--	--	--	0.2	--	--	--	--	--	0.2	.01	T	T
TOTAL FORBS												.12	1	1
JVSU	--	--	--	--	--	--	--	--	--	--	0.5	.02	T	T
CHNA2	--	--	--	--	--	--	--	--	--	--	0.3	.02	T	T
CELE3	--	--	--	--	--	1.3	--	--	--	--	3.8	.19	3	2

TABLE 7 (Cont'd.)

VEGETATIVE COVER - MOUNTAIN STONY LOAM (OAK) Sq. Ft./Plot

Species	11	12	13	14	15	16	17	18	19	20
POPR	1.5	--	--	--	--	0.8	0.5	--	1.2	--
CAREX	--	0.1	--	0.3	--	--	--	--	--	0.1
AGTR	--	--	--	--	0.1	--	--	--	--	--
AGSU	--	--	--	--	0.1	--	--	--	--	--
SOLID	--	--	--	--	--	0.1	--	--	--	0.3
LUPIN	0.1	0.3	--	--	--	--	--	--	--	--
ARLU	--	--	--	0.2	--	--	--	--	--	0.1
SMST	--	--	--	--	0.1	--	--	--	--	--
QUGA	4.5	2.7	--	--	3.7	3.2	2.7	3.0	4.2	3.7
JUSC	--	0.5	--	--	--	--	--	--	--	--
ACGR3	--	1.5	7.0	5.5	--	--	--	--	--	--
PAMY	--	--	0.2	--	0.2	--	--	--	--	--
SYOR2	--	--	--	--	1.2	--	3.0	2.5	--	--
CHNA2	--	--	--	--	--	--	0.3	--	--	--
CELE3	--	--	--	--	--	--	2.5	--	--	--
TOTAL VEGETATIVE COVER	6.1	5.1	7.2	6.0	5.4	4.1	9.0	5.5	6.4	4.2

TABLE 7 (Cont'd.)

VEGETATIVE COVER - MOUNTAIN STONY LOAM (OAK) Sq. Ft./Plot

Species	1	2	3	4	5	6	7	8	9	10	TOTAL 20 PLOTS	AVERAGE PER PLOT	PERCENT OF TOTAL VEGETATION	PERCENT OF TOTAL COVER
JUSC	--	--	--	--	1.8	--	--	--	--	--	2.3	.12	2	1
BERE	--	--	--	--	0.5	--	--	--	--	--	0.5	.02	T	T
SYOR2	--	--	.1	--	0.5	1.1	1.3	--	1.5	--	11.2	.56	11	6
ACGR3	--	5.5	--	--	--	--	1.0	--	--	--	20.5	1.02	19	11
QUGA	2.2	2.5	5.2	5.2	1.2	2.3	0.9	2.0	3.4	4.7	57.3	2.86	52	30
AMAL2	0.6	--	--	--	--	--	--	--	--	--	0.6	.03	1	T
ROWOV	0.7	T	--	--	--	--	--	--	--	--	0.7	.04	1	T
PAMY	1.1	0.1	--	--	--	--	--	--	--	--	1.6	.08	1	T
RIMO2	2.8 ft.^{2}	--	--	--	--	--	--	--	--	--	2.8	.14	3	1
LITTER	2.0	1.5	3.0	.9	4.9	3.9	1.5	1.0	3.2	4.7	26.6	2.41*	-	26
BARE	--	--	1.0	1.2	--	0.5	1.1	1.7	1.1	--	7.6	.71*		7
ROCK	—	—	—	2.0	--	--	3.5	4.0	--	--	9.5	.90*	-	9
TOTAL SHRUBS												5.09	93	54
TOTAL VEGETATIVE COVER	7.6	8.1	5.6	5.5	4.7	5.2	3.5	2.9	5.3	4.9	112.3	5.58	100	58

* Adjusted average to total 9.6 sq.ft.

TABLE 8

MOUNTAIN STONY LOAM (OAK)

COVER DETERMINATIONS

Computations for 10 Plots

$$S^2 = \frac{\Sigma(X - \bar{X})^2}{n-1}$$

	X	$\bar{X}$	$(X-\bar{X})$	$(X-\bar{X})^2$
1.	7.6	5.33	2.3	5.29
2.	8.1		2.8	7.84
3.	5.6		0.3	.09
4.	5.5		0.2	.04
5.	4.7		-0.6	.24
6.	5.2		-0.1	.01
7.	3.5		-1.8	3.24
8.	2.9		-2.4	5.76
9.	5.3		0	0
10.	4.9		-0.4	.16
	53.3			22.67

$$S^2 = \frac{22.67}{9} = 2.52$$

$$S = 1.58$$

$$n = \frac{(1.64)^2(1.58)^2}{[5.33\ (0.1)]^2} = \frac{2.69 \times 2.50}{0.28} = \frac{6.7}{0.28} = 23.9$$

Computations for 20 Plots

1.	7.6	5.62	1.98	3.92
2.	8.1		2.48	6.15
3.	5.6		0	0
4.	5.5		-0.10	0.01
5.	4.7		-0.92	0.84
6.	5.2		-0.42	0.18
7.	3.5		-2.12	4.49
8.	2.9		-2.72	7.40
9.	5.3		-0.32	0.10
10.	4.9		-0.72	0.52
11.	6.1		0.48	0.23
12.	5.1		-0.52	0.27
13.	7.2		1.58	2.50
14.	6.0		0.38	0.14
15.	5.4		-0.22	0.05
16.	4.1		-1.52	2.31
17.	9.0		3.38	11.42
18.	5.5		-0.12	0.01
19.	6.4		0.78	0.61
20.	4.2		-1.42	2.02
				43.17

$$S^2 = \frac{43.17}{19} = 2.27$$

$$S = 1.51$$

$$n = \frac{(1.64)^2(1.51)^2}{[5.62 \times 0.1]^2} = \frac{2.69 \times 2.28}{0.31} = \frac{6.13}{0.31} = 19.8$$

so, 20 plots are adequate.

TABLE 9

POINT-QUARTER DETERMINATIONS

MOUNTAIN STONY LOAM (OAK)

		DISTANCE/FT.									
	QUADRAT	1	2	3	4	5	6	7	8	9	10
	NE	1	5	3	3	3	6	2	6	1	3
	NW	1	3	4	6	1	3	10	10	2	8
	SW	1	1	7	10	8	4	5	8	2	1
	SE	2	1	4	5	6	7	1	8	7	7
MEAN		1.25	2.5	4.5	6.0	4.5	5.0	4.5	8.0	3.0	4.75
		11	12	13	14	15	16	17	18	19	20
	NE	2	3	2	4	5	10	4	3	4	4
	NW	4	3	1	6	3	5	1	3	4	6
	SW	5	6	2	7	4	7	2	4	1	3
	SE	7	9	2	9	6	3	3	6	2	4
MEAN		4.5	5.25	1.75	6.5	4.5	6.25	2.5	4.0	2.75	4.25
		21	22	23	24	25	26	27	28	29	30
	NE	6	2	3	5	5	1	2	2	5	3
	NW	5	4	1	4	3	1	8	1	3	4
	SW	8	4	1	2	8	1	5	1	2	6
	SE	9	5	2	1	16	3	1	2	4	4
MEAN		7.0	3.75	1.75	3.0	8.00	1.5	4.0	1.5	3.5	4.25
		31									
	NE	4									
	NW	3									
	SW	5									
	SE	4									
MEAN		4.0									

MEAN OF 31 PLOTS = 4.15

TOTAL DENSITY OF WOODY SPECIES = $\frac{43560}{(4.15)^2} = \frac{43560}{17.22}$ = 2,530 INDIVIDUALS PER ACRE

TABLE 10

MOUNTAIN STONY LOAM (OAK)

SPECIES	QUADRAT	DISTANCE/FT. 1	2	3	4	5	6	7	8	9	10
RIMO2	NE	0.5	35.0					41.0	00	00	00
	NW	2.0	75.0					00	00	00	00
	SW	3.0	25.0					00	00	00	00
	SE	5.0	47.0					00	00	00	00
AMAL2	NE	4.0	75.0		45.0	45.0	00	00	75	32	47.0
	NW	5.0	80.0		75.0	50.0	00	00	80	77	00
	SW	3.0	27.0		00	50.0	55.0	00	00	00	00
	SE	8.0	33.0		80.0	65.0	00	00	47	00	00
ROWOU	NE	20.0	16.0				00	00	00	00	00
	NW	11.0	77.0				00	00	00	00	00
	SW	2.0	2.0				00	00	00	00	00
	SE	7.0	15.0				00	00	00	00	00
PAMY	NE	3.0	30.0		60.0	25.0	00	00	00	00	00
	NW	1.0	55.0		00	32.0	00	00	00	00	00
	SW	1.0	0.5		45.0	00	00	00	00	00	00
	SE	2.0	1.0		120.0	45.0	00	00	00	00	00
QUGA	NE	4.0	21.0	3.0	3.0	3.0	22.0	2.0	6	7	3
	NW	1.0	3.0	4.0	6.0	10.0	3.0	10.0	13	5	8
	SW	12.0	9.0	7.0	20.0	8.0	4.0	10.0	15	2	4
	SE	5.0	3.0	5.0	5.0	15.0	15.0	15.0	10	8	9
(Arithm. Avg.)		5.5	9.0	4.8	8.5	9.0	11.0	9.25	11.0	5.5	6.0
ACGR3	NE	5.0	5.0	50.0	75.0	35.0	17.0	30.0	57	73	77
	NW	17.0	15.0	00	55.0	75.0	8.0	00	00	00	00
	SW	4.0	1.0	40.0	20.0	43.0	00	5.0	00	00	00
	SE	9.0	2.0	12.0	35.0	80.0	12.0	8.0	00	22	28
SYOR2	NE			3.0	5.0	3.0	6.0	12.0	27	1	34
	NW			10.0	35.0	1.0	3.0	23.0	10	2	42
	SW			25.0	10.0	20.0	12.0	31.0	32	24	1
	SE			4.0	22.0	17.0	7.0	1.0	9	7	7
VUSC2	NE			15.0	15.0	22.0	18.0	35.0	00	31	62
	NW			00	20.0	11.0	00	32.0	00	00	00
	SW			17.0	70.0	30.0	9.0	00	39	12	37
	SE			27.0	120.0	00	45.0	00	3.7	46	66
PSME	NE	9.0					00				00
	NW	-					00	00	00	00	00
	SW	100.0					00	00	00	00	00
	SE	50.0					00	00	--	00	00
ABCO	NE	--					00	00	00	00	00
	NW	--					00	00	00	00	00
	SW	6.0					00	00	00	00	00
	SE	--					00	00	00	00	00
ARTR	NE			15.0		35.0	72.0	00	00	00	00
	NW			00		70.0	00	23.0	00	00	00
	SW			18.0		9.0	00	00	00	00	00
	SE			5.0		6.0	47.0	00	8	00	46
CELE	NE				60.0	00	7.0	56.0	14	32	63
	NW				90.0	00	36.0	68.0	00	00	73
	SW				15.0	00	15.0	37.0	00	00	00
	SE				17.0	00	00	00	78	33	00
PLED	NE					55.0	00	42.0	17	00	85
	NW					40.0	00	21.0	36	46	00
	SW					43.0	20.0	13.0	28	00	00
	SE					00	00	00	67	52	42

TABLE 11

MOUNTAIN STONY LOAM (OAK)

POINT-QUARTER TOTAL DENSITY WOODY SPECIES

Computation for 10 Plots

$$S^2 = \frac{\Sigma(X - \bar{X})^2}{n-1}$$

	X	$\bar{X}$	$(X-\bar{X})$	$(X-\bar{X})^2$
1.	1.25	4.4	-3.15	9.92
2.	2.5		-1.9	3.61
3.	4.5		0.1	.01
4.	6.0		1.6	2.56
5.	4.5		0.1	.01
6.	5.0		0.6	0.36
7.	4.5		0.1	.01
8.	8.0		3.6	12.96
9.	3.0		-1.4	1.96
10.	4.75		0.35	0.12
	44.00			31.52

$$S^2 = \frac{31.5}{9} = 3.5$$

$$S = 1.87$$

$$n = \frac{(1.28)^2\,(1.87)^2}{[(4.4 \times 0.1)]^2} = \frac{1.63 \times 3.50}{.19} = 30.0$$

Computation for 30 Plots

1.	1.25	4.15	-2.9	8.41
2.	2.5		-1.65	2.72
3.	4.5		0.35	0.12
4.	6.0		1.85	3.42
5.	4.5		0.35	0.12
6.	5.0		0.85	0.72
7.	4.5		0.35	0.12
8.	8.0		3.85	14.82
9.	3.0		-1.15	1.32
10.	4.75		0.60	0.36
11.	4.5		0.35	0.12
12.	5.25		1.10	1.21
13.	1.75		-2.4	5.76
14.	6.5		2.35	5.52
15.	4.5		0.35	0.12
16.	6.25		2.10	4.41
17.	2.5		-1.65	2.72
18.	4.0		-0.15	0.02
19.	2.75		-1.4	1.96
20.	4.25		0.1	0.01
21.	7.0		2.85	8.12
22.	3.75		-0.40	0.16
23.	1.75		-2.4	5.76
24.	3.0		-1.15	1.32
25	8.0		3.85	14.82
26.	1.5		-2.65	7.02
27.	4.0		-0.15	0.02
28.	1.5		-2.65	7.02
29.	3.5		-0.65	0.42
30.	4.25		0.10	0.01
	124.50			98.65

$$S^2 = \frac{98.65}{29} = 3.4$$

$$S = 1.84$$

$$n = \frac{(1.28)^2\,(1.84)^2}{(4.15 \times .1)^2} = \frac{1.64 \times 3.39}{0.18} = \frac{5.56}{.18} = 30.8 \text{ or } 31$$

So use Plot 31

$\bar{X}$ is still 4.15 $S^2 = \frac{98.67}{30} = 3.29$ $S = 1.81$

$$n = \frac{(1.28)^2\,(1.81)^2}{(4.15 \times .1)^2} = \frac{1.64 \times 3.29}{0.18} = \frac{5.4}{.18} = 30.0$$

So, 31 Plots are enough.

TABLE 12

SPECIES LIST

MOUNTAIN STONY LOAM (OAK) RANGE SITE

CODE	SCIENTIFIC NAME	COMMON NAME
	Grasses	
*AGCR	Agropyron cristatum	crested wheatgrass
AGSM	Agropyron smithii	western wheatgrass
AGSU	Agropyron subsecundum	bearded wheatgrass
AGTR	Agropyron trachycaulum	slender wheatgrass
BRCA5	Bromus carinatus	mountain brome
*BRTE	Bromus tectorum	cheatgrass
CAREX	Carex spp.	sedge
KOCR	Koeleria cristata	prairie junegrass
POFE	Poa fendleriana	muttongrass
*POPR	Poa pratensis	Kentucky bluegrass
PORE	Poa reflexa	nodding bluegrass
STCO3	Stipa columbiana	Columbia needlegrass
	Forbs	
ACMIL	Achillea millefolium lanulosa	Western yarrow
ANTEN	Antennaria spp.	pussytoes
ARDR4	Artemisia dracunculus	tarragon
ARLU	Artemisia ludoviciana	Louisiana sagewort
ASTER	Aster spp.	aster
CIFO	Cirsium foliosum	elk thistle
ERIGE2	Erigeron spp.	daisy
GIAG	Gilia aggregata	skyrocket gilia
GRSQ	Grindelia squarrosa	curlycup gumweed
LIPEL	Linum perenne lewisii	Lewis flax
LUPIN	Lupinus spp.	lupine
PENST	Penstemon spp.	penstemon
PHST2	Phlox standburyi	stansbury phlox
PODO4	Polygonum douglasii	Douglas knotweed
SMST	Smilacina stellata	starry false-Solomons-seal
SOLID	Solidago spp.	goldenrod
*TRDU	Tragopogon dubius	yellow salsify
VIMU	Viguiera multiflora	showy goldeneye

TABLE 12 (CONT'd.)

SPECIES LIST

MOUNTAIN STONY LOAM (OAK) RANGE SITE

CODE	SCIENTIFIC NAME	COMMON NAME
	Shrubs and Trees	
ACGR3	Acer grandidentatum	bigtooth maple
AMAL2	Amelanchier alnifolia	saskatoon serviceberry
BERE	Berberis repens	Oregon-grape
CELE3	Cercocarpus ledifolius	curlleaf mountainmahogany
CHNA2	Chrysothamnus nauseosus	rubber rabbitbrush
CHVI8	Chrysothamnus viscidiflorus	Douglas rabbitbrush
FAPA	Fallugia paradoxa	apacheplume
HODU	Holodiscus dumosus	bush oceanspray
*JUOS	Juniperus osteosperma	Utah juniper
JUSC2	Juniperus scopulorum	Rocky Mountain juniper
PAMY	Pachystima myrsinites	Myrtle pachystima
PIED	Pinus edulis	pinyon pine
PIPO	Pinus ponderosa	ponderosa pine
PRVI	Prunus virginiana	common chokecherry
PSME	Pseudotsuga menziesii	Douglas-fir
QUGA	Quercus gambelii	gambel oak
RIMO2	Ribes montigenum	gooseberry currant
ROWOU	Rosa Woodsii ultramontana	woods rose
SACA10	Sambucus caerulea	blue elderberry
SYOR2	Symphoricarpus oreophilus	mountain snowberry

*NOT NATIVE TO THE SITE

TABLE 13

UPLAND STONY LOAM (PINYON-JUNIPER)

Dry Weight-Pinyon Pine

Station	Crown Spread	Denseness	Height	Pounds	Total/100'
1 + 00(SW)	1.0	S	2.0	0.01	0.01
2 + 00 (WSW)	1.0	S	1.0	0.01	
	11.0	M	14.0	4.00	
	1.5	M	2.0	0.04	4.5
3 + 00(WSW)	3.0	S	4.0	0.1	0.1
4 + 00					0
5 + 00(NNE)	2.0	S	4.0	0.05	0.5
6 + 00 (NE)	5.0	M	8.0	0.6	
	5.0	S	8.0	0.5	1.1
7 + 00 (ENE)	16.0	S	21.0	8.0	
	7.0	S	11.0	1.1	
	3.0	S	5.0	0.1	
	2.0	M	4.0	0.06	
	5.0	S	9.0	0.5	9.8
8 + 00(SW)	7.0	M	10.0	1.4	1.4
9 + 00 (WNW	2.0	S	5.0	0.05	
	7.0	S	11.0	1.1	1.15
10 + 00 (W)	1.0	M	2.0	0.01	
	6.0	S	8.0	0.8	
	5.0	M	6.0	0.6	
	10.0	M	11.0	3.2	4.61
					5.0

TABLE 14

UPLAND STONY LOAM (P-J)

DRY WEIGHT GAMBEL OAK

Station	Foliage Area W. ft.	Foliage Area L. ft.	Foliage Area (ft.^{2})	Average Diameter (in.)	Average Area	Number of Stems	Basal Area (in.^{2})	Pounds Air-Dry	Height (ft.)
3+00 (WSW)	2	4	8	0.4	.126	8	1.0	.26	4.0
	1	2	2	1.4	1.54	1	1.54	.08	5.0
	2	4	8	1.2	1.13	7	7.92	.47	5.0
	2	4	8	0.8	.50	4	2.01	.32	6.0
	1	3	3	1.1	.95	2	1.9	.08	4.0
	2	4	8	0.5	.2	8	1.6	.31	3.0
TOTAL								1.52	
4+00 (ENE)	3	4	12	0.7	.38	9	3.46	.49	4.0
	2	5	10	1.0	.78	8	6.3	.50	5.0
	1	4	4	0.2	.03	7	.22	.08	2.0
	2	4	8	1.2	1.13	5	5.65	.43	6.0
	1	3	3	0.7	.38	3	1.14	.13	5.0
	2	2	4	2.0	3.14	1	3.14	.22	6.0
	2	6	12	0.8	.50	8	4.00	.51	5.0
	2	5	10	0.2	.03	16	.48	.31	1.0
	2	5	10	1.4	1.53	6	9.2	.55	6.0
	3	4	12	1.4	1.53	4	6.16	.56	6.0
TOTAL								3.78	
5+00 (NNE)	1	3	3	0.4	.13	5	.62	.13	3.0
	3	2	6	0.3	.07	4	.28	.10	10.0
TOTAL								.23	
6+00								0	
7+00 (ENE)	2	4	8	0.2	.03	12	.38	.18	2.0
	1	4	4	2.5	4.91	1	4.91	.26	6.0
	2	6	12	0.3	.07	20	1.4	.41	3.0
	1	2	2	0.3	.07	3	.21	.05	4.0
	1	4	4	1.7	1.33	1	1.33	.18	5.0
	2	2	4	1.5	1.77	1	1.77	.19	8.0
	1	4	4	0.5	.20	3	.60	.16	3.0
	2	3	6	1.8	2.54	1	2.54	.28	5.0
	2	2	4	0.6	.28	2	.56	.16	3.0
	2	5	10	0.8	.50	4	2.0	.38	4.0
TOTAL								2.25	
8+00 (SW)	2	4	8	1.2	1.13	2	2.26	.32	6.0
	1	4	4	0.3	.07	4	.28	.08	2.0
	1	4	4	1.0	.79	6	4.74	.26	3.0
	2	5	10	0.5	.97	5	.98	.35	4.0
TOTAL								1.01	
9+00 (WNW)								0	

TABLE 15

VEGETATIVE COVER - UPLAND STONY LOAM (P-J) Sq. Ft./Plot

Species	1	2	3	4	5	6	7	8	9	10	11	12	13
ELSA	0.1	1.5	0.9	T	0.2	-	0.2	-	.2	0.3	--	--	--
ORHY	0.4	-	-	-	-	.5	-	0.6	.1	-	0.4	0.6	0.2
BOGR2	-	-	-	2.2	0.1	-	0.8	-	-	-	-	-	-
CAREX	-	-	-	-	0.5	-	-	-	-	-	-	-	-
ARLU	-	T	-	-	-	.2	-	0.3	-	-	-	-	-
CHVI6	-	T	-	0.2	0.5	-	-	-	-	-	-	-	-
ARABI2	-	-	-	-	-	-	-	-	.1	-	-	-	-
CHVI8	-	-	-	-	-	-	-	-	-	-	0.5	-	-
CHNA2	-	-	-	-	-	-	-	-	0.1	-	-	-	-
CELE3	-	-	-	-	-	-	-	2.0	-	-	-	-	-
JUOS	-	-	-	-	-	-	-	-	-	1.5	-	-	3.0
EPVI	-	-	-	-	-	-	-	-	-	-	-	-	-
SYOR2	-	-	-	-	-	-	-	-	-	-	0.7	0.2	-
PIED	-	-	-	-	1.2	-	-	-	-	0.5	-	-	-
YUANZ	0.4	-	-	-	T	-	-	-	-	-	-	-	-
ARTR2	-	-	1.1	-	-	-	1.0	-	1.0	0.2	-	-	-
ARARN	-	-	-	.8	-	-	-	-	-	-	-	-	-
QUGA	-	-	-	-	-	.5	-	-	-	-	-	-	-
TOTAL VEGETATIVE COVER	0.9	1.5	2.0	3.2	2.5	1.2	2.0	2.9	1.5	2.5	1.6	0.8	3.2
BARE	5.0	4.6	4.1	3.2	5.3	3.6	4.2	1.0	2.2	0	3.2	5.3	0.5
LITTER	.5	.8	2.0	.5	0.3	2.5	0.7	3.2	2.2	3.9	2.5	0.3	3.9
ROCK	3.6	2.7	1.5	2.7	1.5	2.3	2.7	1.5	3.7	3.2	2.3	3.4	1.5

TABLE 15 (Cont'd.)

VEGETATIVE COVER - UPLAND STONY LOAM (P-J) Sq. Ft./Plot

Species	14	15	16	17	18	19	20	21	22	23
ELSA	0.2	--	0.6	0.2	0.3	--	0.2	0.2	--	0.6
ORHY	--	0.5	--	0.4	0.2	--	0.1	--	1.3	--
BOGR2	--	--	--	--	--	0.8	0.5	0.3	--	0.8
ARLU	0.3	0.2	--	--	0.4	0.1	--	--	--	--
CHVI8	--	--	--	--	--	--	--	0.1	--	--
OPPO	--	--	0.5	0.3	--	--	--	1.0	--	0.7
ARTR2	--	--	0.8	--	0.5	--	--	--	--	0.2
SYOR2	1.2	--	--	--	--	--	--	--	--	--
PIED	1.0	--	--	--	--	1.0	--	--	--	--
JUOS	--	--	0.3	0.5	--	--	--	0.5	--	0.3
TOTAL VEGETATIVE COVER	2.7	0.7	2.2	1.4	1.4	1.9	0.8	2.1	1.3	2.6

TABLE 15 (Cont'd.)

VEGETATIVE COVER - UPLAND STONY LOAM (P-J) Sq. Ft./Plot

Species	24	25	26	27	28	29	30
ORHY	0.3	--	--	--	--	--	--
ELSA	0.1	--	0.3	0.5	--	--	0.3
STCO4	--	0.5	0.8	--	--	--	--
BOGR2	--	--	--	--	1.2	0.5	--
CAREX	--	--	--	--	--	--	--
ARABI2	--	--	--	--	--	--	--
CHVI6	--	--	--	--	--	--	--
ARLU	0.2	--	--	--	--	--	--
ARARN	--	--	--	--	--	--	--
YUAN2	--	--	--	--	--	--	--
SYOR2	--	--	--	--	--	--	--
CELE3	--	--	--	--	--	--	--
ARTR2	--	--	--	--	--	--	0.1
OPPO	--	--	--	--	0.1	0.6	--
CHVI8	--	--	0.1	0.3	--	--	0.1
EPVI	1.2	--	--	--	--	0.6	--
QUGA	0.8	--	--	--	--	--	--
PIED	--	--	--	--	0.6	--	--
JUOS	--	--	--	--	--	--	0.5
CHNA2	--	--	--	--	--	--	--
TOTAL VEGETATIVE COVER	1.4	1.7	1.2	0.8	1.9	1.7	1.0

TABLE 15 (Cont'd.)

VEGETATIVE COVER - UPLAND STONY LOAM (P-J) Sq. Ft./Plot

Species	31	32	33	34	35	36	37	38	39	40	TOTAL 40 PLOTS	AVERAGE PER PLOT	* PERCENT OF TOTAL VEGETATION	PERCENT OF TOTAL COVER
ELSA	0.9	--	0.3	0.3	--	0.5	0.2	0.2	0.4	--	9.9	.25	13	3
ORHY	T	0.1	--	--	0.6	--	--	0.2	--	--	6.8	.17	9	2
BOGR2	--	--	--	--	--	0.6	--	--	0.1	0.5	8.4	.21	12	2
STCO4	--	--	--	--	--	--	--	--	--	--	1.3	.03	2	T
TOTAL GRASSES												.66	36	7
ARABI2	--	--	--	--	--	--	--	--	--	--	0.1	T	T	T
ARLU	T	--	--	0.3	--	--	--	--	T	--	2.0	.05	3	1
CHVI6	--	0.2	--	--	--	--	--	T	--	--	0.9	.02	1	T
ASDI5	--	--	--	T	--	--	--	--	--	--	T	T		
TOTAL FORBS												.07	4	1
QUGA	--	--	--	--	--	--	--	--	--	--	1.8	.04	2	T
ARARN	--	--	--	--	--	--	--	--	--	--	0.8	.02	1	T
CELE3	--	--	--	--	--	--	--	--	--	--	2.0	.05	3	1
OPPO	--	--	--	--	--	--	--	--	--	0.3	3.5	.09	5	1
EPVI	--	--	--	--	--	--	0.3	--	--	--	2.1	.05	3	1
SYOR2	--	--	--	--	--	0.2	--	--	--	--	2.3	.06	3	1
PIED	--	--	--	2.1	--	--	1.0	--	--	--	6.4	.16	9	2
YUAN2	--	--	0.2	--	--	--	0.2	--	--	--	0.8	.02	1	T
CHVI8	--	--	0.1	--	0.5	--	--	--	T	0.2	1.9	.05	3	1
JUOS	.5	--	--	--	--	0.9	3.0	0.8	--	--	13.2	.33	18	3
ARTR2	0.4	1.4	T	--	--	0.3	0.1	--	T	1.0	8.4	.21	12	2
CHNA2	--	--	--	--	--	--	--	--	--	--	0.1	T	T	T
TOTAL SHRUBS												1.08	60	12
TOTAL VEGETATION	1.8	1.7	0.6	2.7	1.1	2.2	1.5	1.4	0.5	1.3		1.81	100	20
BARE	2.6	3.7	3.8	1.5	2.4	2.3	1.3	3.0	4.4	4.3		3.2	-	32
LITTER	4.0	--	.7	3.7	1.3	1.5	1.6	2.5	1.2	1.5		1.8	-	19
ROCK	1.2	4.2	4.5	1.7	4.8	2.3	2.1	2.7	3.5	1.8		2.8	-	29

*The percent of total vegetation column shows species diversity by vegetation cover when compared with all other species.

TABLE 16

UPLAND STONY LOAM (PINYON-JUNIPER)

VEGETATIVE COVER DETERMINATIONS

Computation for 10 Plots

$$S^2 = \frac{\Sigma(X - \bar{X})^2}{n-1}$$

	X	$\bar{X}$	$(X-\bar{X})$	$(X-\bar{X})^2$
1.	0.9	2.02	-1.12	1.25
2.	1.5		-0.52	0.27
3.	2.0		0	0
4.	3.2		1.18	1.39
5.	2.5		0.48	.23
6.	1.2		-0.82	.67
7.	2.0		0	0
8.	2.9		.88	0.77
9.	1.5		-0.52	0.27
10.	2.5		0.48	.23
	20.2			5.08

$$S^2 = \frac{5.08}{9} = 0.56$$

$$n = \frac{(1.64)^2\ (0.74)^2}{[(2.02)\ 0.1]^2} = \frac{2.69 \times 0.55}{.04} = \frac{1.48}{.04} = 36.9 \text{ or } 37$$

Computation for 37 Plots

	X	$\bar{X}$	$(X-\bar{X})$	$(X-\bar{X})^2$
1.	.9	1.7	-0.80	0.64
2.	1.5		-0.20	0.04
3.	2.0		0.30	0.09
4.	3.2		1.5	2.25
5.	2.5		0.8	0.64
6.	1.2		-0.5	0.25
7.	2.0		0.3	0.09
8.	2.9		1.2	1.44
9.	1.5		-0.2	0.04
10.	2.5		0.8	0.64
11.	1.6		-0.1	0.01
12.	0.8		-0.9	0.81
13.	3.2		1.5	2.25
14.	2.7		1.00	1.00
15.	0.7		-1.00	1.00
16.	2.2		0.5	0.25
17.	1.4		-0.3	0.09
18.	1.4		-0.3	0.09
19.	1.9		0.2	0.04
20.	0.8		-0.9	0.81
21.	2.1		0.4	0.16
22.	1.3		-0.4	0.16
23.	2.6		0.9	0.81
24.	1.4		-0.3	0.09
25.	1.7		0	0

(Cont'd. in Upper Right Column)

	X	$\bar{X}$	$(X-\bar{X})$	$(X-\bar{X})^2$
26.	1.2	1.7	-0.5	0.25
27.	0.8		-0.9	0.81
28.	1.9		0.2	0.04
29.	1.7		0	0
30.	1.0		-0.7	0.49
31.	1.8		0.1	0.01
32.	1.7		0	0
33.	0.6		-1.1	1.21
34.	2.7		1.00	1.00
35.	1.1		-0.6	0.36
36.	2.2		0.5	0.25
37.	1.5		-0.2	0.04
	64.2			18.15

$$S^2 = \frac{18.15}{36} = 0.50 \qquad S = 0.71$$

$$n = \frac{(1.64)^2\ (0.71)^2}{(1.7 \times .1)^2} = \frac{2.69 \times .50}{.03} = 44.8 \text{ or } 45$$

So, maximum of 40

Computation for 40 Plots

	X	$\bar{X}$	$(X-\bar{X})$	$(X-\bar{X})^2$
1.	.9	1.7	-0.80	0.64
2.	1.5		-0.20	0.04
3.	2.0		.3	0.09
4.	3.2		1.5	2.25
5.	2.5		0.8	0.64
6.	1.2		-0.5	0.25
7.	2.0		0.3	0.09
8.	2.9		1.2	1.44
9.	1.5		-0.2	0.04
10.	2.5		0.8	0.64
11.	1.6		-0.1	0.01
12.	0.8		-0.9	0.81
13.	3.2		1.5	2.25
14.	2.7		1.00	1.00
15.	0.7		-1.00	1.00
16.	2.2		0.5	0.25
17.	1.4		-0.3	0.09
18.	1.4		-0.3	0.09
19.	1.9		0.2	0.04
20.	0.8		-0.9	0.81
21.	2.1		0.4	0.16
22.	1.3		-0.4	0.16

TABLE 16 (Cont'd.)

Computation for 40 Plots

	X	$\overline{X}$	$(X-\overline{X})$	$(X-\overline{X})^2$
23.	2.6	1.7	0.9	0.81
24.	1.4		-0.3	0.09
25.	1.7		0	0
26.	1.2		-0.5	0.25
27.	0.8		-0.9	0.81
28.	1.9		0.2	0.04
29.	1.7		0	0
30.	1.0		-0.7	0.49
31.	1.8		0.1	0.01
32.	1.7		0	0
33.	0.6		-1.1	1.21
34.	2.7		1.0	1.0
35.	1.1		-0.6	0.36
36.	2.2		0.5	0.25
37.	1.5		-0.2	0.04
38.	1.4		-0.3	0.09
39.	0.5		-1.2	1.44
40.	1.3		-0.4	0.16
	67.4			19.84

$$S^2 = \frac{19.84}{39} = 0.51$$

$$n = \frac{(1.64)^2\ (0.71)^2}{(1.7 \times .1)^2} = \frac{2.69 \times .51}{.03} = 45.73 \text{ or } 46$$

But maximum of 40 was used.

TABLE 17

POINT QUARTER DETERMINATIONS FOR WOODY PLANTS

UPLAND STONY LOAM (P-J)

QUADRATS	1	2	3	4	5	6	7	8	9	10	11	12	13	14
NE	6	1	5	7	11	3	8	9	12	7	1	1	1	5
NW	1	14	8	6	15	6	3	6	17	8	3	4	5	7
SW	16	6	19	14	16	10	9	23	21	6	4	3	9	8
SE	1	7	16	9	10	8	17	4	7	19	4	6	5	7
AVE	6	7	12	9	13	7	9	10	14	10	3	4	5	7

MEAN OF 14 PLOTS = 8.28

QUADRATS	15	16	17	18	19	20	21	22	23	24	25	26	27
NE	9	6	8	12	11	12	7	11	8	14	17	13	3
NW	10	7	7	11	3	5	10	12	3	12	3	2	13
SW	8	10	7	6	5	7	4	5	10	9	6	7	4
SE	6	10	5	9	7	7	12	6	12	4	2	13	7
AVE	8	8	7	10	6	8	8	8	8	10	7	9	7

MEAN OF 27 PLOTS = 7.8

TOTAL DENSITY OF ALL WOODY SPECIES = $\frac{43560}{(7.8)^2} = \frac{43560}{60.84}$ = 716 INDIVIDUALS PER ACRE

TABLE 18

POINT QUARTER - TOTAL DENSITY WOODY SPECIES

UPLAND STONY LOAM (P-J)

	X	$\bar{X}$	$(X-\bar{X})$	$(X-\bar{X})^2$
1.	6	8.28	-2.28	5.20
2.	7		-1.28	1.64
3.	12		3.72	13.84
4.	9		.72	.52
5.	13		4.72	22.28
6.	7		-1.28	1.64
7.	9		.72	.52
8.	10		1.72	2.96
9.	14		5.72	32.72
10.	10		1.72	2.96
11.	3		-5.28	27.88
12.	4		-4.28	18.32
13.	5		-3.28	10.76
14.	7		-1.28	1.64
	116			142.88

$$S2 = \frac{142.88}{13} = 10.99$$

$$S = 3.31$$

$$\frac{(1.28)^2\ (3.31)^2}{[(8.28)\ .1]^2} = \frac{1.638 \times 10.96}{0.68} = \frac{17.95}{0.68} = 26.4 \text{ or 27 Plots}$$

	X	$\bar{X}$	$(X-\bar{X})$	$(X-X)^2$
15.	8	7.8	0.2	0.04
16.	8		0.2	0.04
17.	7		-0.8	0.64
18.	10		2.2	4.84
19.	6		-1.8	3.24
20.	8		0.2	0.04
21.	8		0.2	0.04
22.	8		0.2	0.04
23.	8		0.2	0.04
24.	10		2.2	4.84
25.	7		-0.8	0.64
26.	9		1.2	1.44
27.	7		-0.8	0.64
	211			161.24

$$S^2 = \frac{161.24}{26} = 6.20 \qquad S = 2.49$$

$$\frac{(1.28)^2\ (2.49)^2}{(7.8 \times .1)^2} = \frac{1.638 \times 6.2}{.61} = \frac{10.15}{.61} = 16.6 \text{ or } 17$$

So, 27 are more than adequate.

Computations for 27 Plots

	X	$\bar{X}$	$(X-\bar{X})$	$(X-\bar{X})^2$
1.	6	7.8	-1.8	3.24
2.	7		-0.8	0.64
3.	12		4.2	17.64
4.	9		1.2	1.44
5.	13		5.2	27.04
6.	7		-0.8	0.64
8.	10		2.2	4.84
9.	14		6.2	38.44
10.	10		2.2	4.84
11.	3		-4.8	23.04
12.	4		-3.8	14.44
13.	5		-2.8	7.84
14.	7		-0.8	0.64

TABLE 19

SPECIES LIST

UPLAND STONY LOAM (PINYON-JUNIPER) RANGE SITE

CODE	SCIENTIFIC NAME	COMMON NAME
	Grasses	
AGIN	Agropyron inerme	Beardless bluebunch wheatgrass
BOGR2	Bouteloua gracilis	Blue grama
BRTE	Bromus tectorum	Cheatgrass
CAREX	Carex spp	Sedge
ELSA	Elymus salinus	Salina wildrye
KOCR	Koeleria cristata	Prairie junegrass
ORHY	Oryzopsis hymenoides	Indian ricegrass
POFE	Poa fendleriana	Mutton grass
POPR	Poe pratensis	Kentucky bluegrass
STCO4	Stipa comata	Needle andthread
	Forbs	
ANTEN	Antennaria spp	Pussytoes
ARABI2	Arabis spp	Rockcress
ARLU	Artemisia ludoviciana	Lousiana sagewort
ASDI5	Astragalus diversifolius	Meadow milkvetch
CHVI6	Chrysopsis villosa	Hairy goldaster
PHACE	Phacelia spp	Phacelia
	Shrubs and Trees	
ARARN	Artemisia arbuscula nova	Black sagebrush
ARTR2	Artemisia tridentata	Big sagebrush
CELE3	Cercocarpus ledifolius	Curlleaf mountainmahogany
CEMO2	Cercocarpus montanus	Birchleaf mountainmahogany
CHNA2	Chrysothamnus nauseosus	Rubber rabbitbrush
CHVI8	Chrysothamnus viscidiflorus	Douglas rabbitbrush
EPYI	Ephedra viridis	Green mormontea
JUOS	Juniperus osteosperma	Utah juniper
MAMMI	Mammillaria spp	Mammillaria
OPPO	Opuntia polyacantha	Plains pricklypear
PIED	Pinus edulis	Pinyon pine
QUGA	Quercus gambelii	Gambel oak
SYOR2	Symphoricarpos oreophilus	Mountain snowberry
YUAN2	Yucca angustissima	Fineleaf yucca

TABLE 20

DRY WEIGHT DETERMINATIONS

	Green	Dry	Percent Dry Weight
ELSA	59	35	59
LUPINE	11	6	54
POPR	7	4	57
SYOR2	14	7	50
ARLUD	17	9	53
CHVI6	10	5	50
ARTR2	36	17	47
SOLID	54	26	48
BOGR2	5	4	67
CHVI8	12	6	50
ORHY	30	14	47
CAREX	17	9	53
EPVI	15	7	47
AGTR	10	5	50
KOCR	25	12	48
POFE	18	10	56
POSE	8	8	100
ASTER	20	10	50
ERIGE2	12	6	50
PHST2	5	5	100
SMST	10	7	70
TRDU	7	4	57
AMAL2	31	17	55
BERE	39	19	49
PAMY	14	8	57
RIMO2	14	7	50
ROWOV	14	6	43

TABLE 21

POINT-QUARTER DETERMINATIONS
(BY SPECIES)

UPLAND STONY LOAM (P-J)

		DISTANCE/FT.													
SPECIES	QUADRATS	1	2	3	4	5	6	7	8	9	10	11	12	13	14
JUUS	NE	15	11	17	11	19	9	8	9	12	32				
	NW	9	21	8	27	24	6	75	13	23	47				
	SW	34	34	19	--*	33	11	23	24	21	6				
	SE	26	57	31	10	12		43	4		34				
PIED	NE	18	12	36	7	13	24	14	22	43	7				
	NW	27	34	32	6	15	16	3	14	17	43				
	SW	19	6	23	--	16	10	9	31	35	8				
	SE	24	9	55	17	27	19		4	7	24				
ARTR2	NE	6	1	16	9	18	3		13	13	14				
	NW	1	14	22	42	20	6	4	6	33	8				
	SW	16	11	17	14	20	14	21	23	24	11				
	SE	21	7	16	16	10	13	26	4	12	27				
PUTR2	NE	9	00	00											
	NW	45	00	00		24									
	SW	00	00	00											
	SE	00	00												
EPVI	NE	26	14	5	36	44				17	22				
	NW	22	21	12	57	21				24	34				
	SW	26	13	32	--		53		24	32					
	SE	1	00	62	--			28		37	26				
CELE3	NE		36	00		57					34				
	NW		62	00				38							
	SW		00	00		44		37		41					
	SE		00	00											
QUGA	NE			22	28	11	12	21		75	68				
	NW			28	24	48	18	17		47	35				
	SW			32	14	38	72	32	37	54	6				
					9	23	8	17		7	19				

TABLE A

GUIDE FOR DETERMINING CURRENT YIELD OF UTAH JUNIPER IN UTAH

UPLAND STONY LOAM (JUNIPER) SITE

CURRENT YIELD AIR DRY POUNDS

Crown Diameter Feet	Weight Per Tree	10 Trees	50 Trees	100 Trees	200 Trees	300 Trees	400 Trees	500 Trees
				Sparse Foliage				
1	0.1	1	5	10	20	30	40	50
2	0.3	3	15	30	60	90	120	150
3	0.6	6	30	60	120	180	240	300
4	1.0	10	50	100	200	300	400	500
5	1.3	13	65	130	260	390	520	650
6	1.6	16	80	160	320	480	640	800
7	1.9	19	95	190	380	570	760	950
8	2.3	23	115	230	460	690	920	1150
9	2.6	26	130	260	520	780	1040	1300
10	2.9	29	145	290	580	870	1160	1450
11	3.3	33	165	330	660	990	1320	1650
12	3.6	36	180	360	720	1080	1440	1800
13	4.0	40	200	400	800	1200	1600	2000
14	4.4	44	220	440	880	1320	1760	2200
15	4.7	47	235	470	940	1410	1880	2350
16	5.1	51	255	510	1020	1530	2040	2550
17	5.5	55	275	550	1100	1650	2200	
18	5.8	58	290	580	1160	1740	2320	
19	6.2	62	310	620	1240	1860	2480	
20	6.6	66	330	660	1320	1980	2640	
				Medium Foliage				
1	0.1	1	5	10	20	30	40	50
2	0.3	3	15	30	60	90	120	150
3	0.6	6	30	60	120	180	240	300
4	1.0	10	50	100	200	300	400	500
5	1.4	14	70	140	280	420	560	700
6	1.9	19	95	190	380	570	760	950
7	2.5	25	125	250	500	750	1000	1250
8	3.1	31	155	310	620	930	1240	1550
9	3.8	38	190	380	760	1140	1520	1900
10	4.6	46	230	460	920	1380	1840	2300
11	5.4	54	270	540	1080	1620	2160	2700
12	6.2	62	310	620	1240	1860	2480	
13	7.2	72	360	720	1440	2160		
14	8.1	81	405	810	1620	2430		
15	9.1	91	455	910	1820	2730		
16	10.2	102	510	1020	2040			
17	11.3	113	565	1130	2260			
18	12.4	124	620	1240	2480			
19	13.6	136	680	1360				
20	14.8	148	740	1480				
				Dense Foliage				
1	0.1	1	5	10	20	30	40	50
2	0.3	3	15	30	60	90	120	150
3	0.7	7	35	70	140	210	280	350
4	1.2	12	60	120	240	360	480	600
5	1.9	19	95	190	380	570	760	950
6	2.7	27	135	270	540	810	1080	1350
7	3.6	36	180	360	720	1080	1440	1800
8	4.7	47	235	470	940	1410	1880	2350
9	5.9	59	295	590	1180	1770	2360	
10	7.2	72	360	720	1440	2160		
11	8.6	86	430	860	1720	2580		
12	10.2	102	510	1020	2040			
13	11.9	119	595	1190	2380			
14	13.7	137	685	1370	2740			
15	15.6	156	780	1560				
16	17.7	177	885	1770				
17	19.9	199	995	1990				
18	22.2	222	1110	2220				
19	24.6	246	1230	2460				
20	27.2	272	1360	2720				

TABLE B

PINYON PINE YIELDS

ANNUAL YIELD PER TREE POUNDS AIR DRY

Crown Diameter	Semidesert Stony Loam (J-P)			Upland Stony Loam (J-P)		
	S	M	D	S	M	D
1	0.01	0.02	0.04	0.01	0.01	0.02
2	0.06	0.09	0.1	0.05	0.06	0.09
3	0.1	0.2	0.3	0.1	0.2	0.2
4	0.3	0.4	0.6	0.3	0.4	0.5
5	0.4	0.6	0.9	0.5	0.6	0.8
6	0.6	0.9	1.3	0.8	0.9	1.2
7	0.9	1.2	1.8	1.1	1.4	1.7
8	1.1	1.5	2.4	1.5	1.9	2.4
9	1.5	2.0	3.0	2.0	2.5	3.0
10	1.9	2.5	3.8	2.6	3.2	4.0
11	2.2	3.0	4.5	3.4	4.0	5.0
12	2.7	3.6	5.4	4.1	5.0	6.0
13	3.2	4.3	6.4	5.0	6.0	7.0
14	3.7	5.0	7.2	6.0	7.0	8.4
15	4.3	5.7	8.4	7.0	8.2	9.8
16	5.0	6.6	9.8	8.0	9.8	
17	5.6	8.0	11.2	9.4		
18	6.4	8.4	12.6			
19	7.0	9.4	14.0			
20	8.0	10.5	15.4			

S = Sparse foliage M = Medium foliage D = Dense foliage

Above based on 55 trees on Semidesert stony loam (J-P) site and 37 trees on Upland stony loam (J-P) site. Not enough data for reliable correlation analyses.

TABLE H

GAMBEL OAKBRUSH YIELD TABLE

MOUNTAIN STONY LOAM RANGE SITE - FAIR CONDITION
Pounds Air Dry

Foliage Area Sq. Ft.	Basal Area Sq. In. 22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00	31.00	32.00	33.00	34.00	35.00	36.00	37.00	38.00	39.00	40.00	50.00	60.00
.50	.17	.17	.17	.18	.18	.18	.18	.19	.19	.19	.19	.20	.20	.20	.20	.20	.21	.21	.21	.23	.26
1	.24	.24	.25	.25	.25	.26	.26	.27	.27	.27	.28	.28	.28	.28	.29	.29	.29	.30	.30	.32	.34
2	.31	.32	.32	.32	.33	.34	.34	.35	.35	.35	.36	.36	.36	.36	.38	.38	.38	.39	.39	.42	.44
3	.38	.39	.40	.40	.40	.41	.42	.42	.43	.44	.44	.44	.45	.45	.46	.46	.47	.48	.48	.52	.54
4	.44	.46	.47	.48	.48	.48	.50	.50	.51	.52	.52	.53	.53	.53	.54	.55	.56	.56	.57	.61	.63
5	.53	.54	.54	.55	.56	.56	.58	.58	.59	.60	.60	.61	.62	.62	.63	.64	.65	.65	.66	.71	.73
6	.57	.58	.59	.60	.61	.61	.63	.63	.64	.65	.65	.66	.67	.67	.68	.69	.70	.70	.71	.77	.81
7	.61	.63	.63	.64	.65	.66	.68	.68	.69	.70	.70	.71	.72	.72	.73	.74	.75	.76	.77	.83	.86
8	.66	.67	.68	.69	.70	.70	.72	.73	.74	.75	.76	.77	.78	.78	.79	.80	.81	.81	.82	.88	.94
9	.70	.72	.72	.73	.74	.75	.77	.78	.79	.80	.81	.82	.83	.83	.84	.85	.86	.87	.88	.94	1.01
10	.74	.76	.77	.78	.79	.80	.82	.83	.84	.85	.86	.87	.88	.88	.89	.90	.91	.92	.93	1.00	1.07
11	.77	.79	.80	.81	.82	.83	.85	.86	.87	.88	.89	.90	.91	.92	.93	.94	.95	.96	.97	1.04	1.11
12	.80	.82	.83	.84	.85	.86	.88	.90	.91	.92	.93	.94	.95	.95	.96	.97	.98	.99	1.00	1.08	1.16
13	.83	.85	.86	.88	.89	.90	.92	.93	.94	.95	.96	.97	.98	.99	1.00	1.01	1.02	1.03	1.04	1.12	1.20
14	.86	.88	.89	.91	.92	.93	.95	.96	.97	.98	1.00	1.01	1.02	1.02	1.03	1.04	1.05	1.07	1.08	1.16	1.24
15	.90	.91	.92	.94	.95	.96	.98	1.00	1.00	1.02	1.03	1.04	1.05	1.06	1.07	1.08	1.09	1.10	1.12	1.20	1.28
16	.93	.94	.96	.97	.98	.99	1.01	1.03	1.04	1.05	1.06	1.07	1.08	1.10	1.11	1.12	1.13	1.14	1.15	1.25	1.33
17	.96	.97	.99	1.00	1.01	1.02	1.04	1.06	1.07	1.08	1.10	1.11	1.12	1.13	1.14	1.15	1.16	1.18	1.19	1.29	1.37
18	.99	1.00	1.02	1.04	1.05	1.06	1.08	1.09	1.10	1.11	1.13	1.14	1.15	1.17	1.18	1.19	1.20	1.22	1.23	1.33	1.41
19	1.02	1.03	1.05	1.07	1.08	1.09	1.11	1.13	1.14	1.15	1.17	1.18	1.19	1.20	1.21	1.22	1.23	1.25	1.26	1.37	1.48
20	1.05	1.06	1.08	1.10	1.11	1.12	1.14	1.16	1.17	1.18	1.20	1.21	1.22	1.24	1.25	1.26	1.27	1.29	1.30	1.41	1.50
21	1.07	1.08	1.10	1.12	1.14	1.15	1.17	1.19	1.20	1.21	1.23	1.24	1.25	1.27	1.28	1.29	1.30	1.32	1.33	1.44	1.53
22	1.10	1.11	1.13	1.15	1.16	1.17	1.19	1.21	1.22	1.24	1.25	1.26	1.28	1.30	1.31	1.32	1.33	1.35	1.36	1.47	1.57
23	1.12	1.14	1.16	1.17	1.18	1.20	1.22	1.24	1.25	1.26	1.28	1.29	1.30	1.32	1.33	1.34	1.36	1.38	1.39	1.50	1.60
24	1.15	1.16	1.18	1.20	1.21	1.22	1.24	1.26	1.28	1.29	1.31	1.32	1.33	1.35	1.36	1.37	1.39	1.41	1.42	1.53	1.63
25	1.17	1.18	1.20	1.22	1.24	1.25	1.27	1.29	1.30	1.32	1.34	1.34	1.36	1.38	1.39	1.40	1.42	1.44	1.44	1.56	1.66
26	1.19	1.21	1.23	1.24	1.26	1.28	1.30	1.32	1.33	1.35	1.36	1.37	1.39	1.41	1.42	1.43	1.44	1.46	1.47	1.60	1.70
27	1.22	1.24	1.26	1.27	1.28	1.30	1.32	1.34	1.36	1.38	1.39	1.40	1.42	1.44	1.45	1.46	1.47	1.49	1.50	1.63	1.73
28	1.24	1.26	1.28	1.29	1.31	1.33	1.35	1.37	1.39	1.40	1.42	1.43	1.44	1.46	1.47	1.48	1.50	1.52	1.53	1.66	1.76
29	1.27	1.28	1.30	1.32	1.34	1.35	1.37	1.39	1.41	1.43	1.44	1.45	1.47	1.49	1.50	1.51	1.53	1.55	1.56	1.69	1.80
30	1.29	1.31	1.33	1.34	1.36	1.38	1.40	1.42	1.44	1.46	1.47	1.48	1.50	1.52	1.53	1.54	1.56	1.58	1.59	1.72	1.83
31	1.31	1.33	1.35	1.36	1.38	1.40	1.42	1.44	1.46	1.48	1.49	1.50	1.52	1.54	1.55	1.56	1.58	1.60	1.62	1.75	1.86
32	1.33	1.35	1.37	1.38	1.40	1.42	1.44	1.46	1.48	1.50	1.52	1.53	1.55	1.57	1.58	1.59	1.61	1.63	1.64	1.77	1.89
33	1.35	1.37	1.39	1.40	1.42	1.44	1.47	1.49	1.51	1.53	1.54	1.55	1.57	1.59	1.60	1.62	1.63	1.65	1.66	1.80	1.92
34	1.37	1.39	1.41	1.42	1.44	1.46	1.49	1.51	1.53	1.55	1.56	1.57	1.59	1.61	1.62	1.64	1.66	1.68	1.69	1.82	1.95
35	1.38	1.41	1.43	1.44	1.46	1.48	1.51	1.53	1.55	1.57	1.58	1.60	1.62	1.64	1.65	1.66	1.68	1.70	1.72	1.85	1.98
36	1.40	1.43	1.45	1.47	1.49	1.49	1.53	1.55	1.57	1.59	1.61	1.62	1.64	1.66	1.67	1.69	1.70	1.72	1.74	1.88	2.00
37	1.42	1.45	1.47	1.49	1.51	1.51	1.55	1.57	1.59	1.61	1.63	1.64	1.66	1.68	1.70	1.72	1.73	1.75	1.76	1.90	2.03
38	1.44	1.47	1.49	1.51	1.53	1.53	1.58	1.60	1.62	1.64	1.65	1.66	1.68	1.70	1.72	1.74	1.75	1.77	1.79	1.93	2.06
39	1.46	1.49	1.51	1.53	1.55	1.55	1.60	1.62	1.64	1.66	1.68	1.69	1.71	1.73	1.75	1.76	1.78	1.80	1.82	1.95	2.09
40	1.48	1.51	1.53	1.55	1.57	1.57	1.62	1.64	1.66	1.68	1.70	1.71	1.73	1.75	1.77	1.79	1.80	1.82	1.84	1.98	2.12
50	1.66	1.68	1.71	1.73	1.75	1.78	1.80	1.83	1.85	1.87	1.89	1.91	1.93	1.95	1.97	1.99	2.01	2.03	2.05	2.21	2.36
60	1.81	1.83	1.86	1.89	1.92	1.95	1.97	2.00	2.03	2.05	2.07	2.10	2.12	2.14	2.16	2.18	2.21	2.23	2.25	2.43	2.59

GAMBEL OAKBRUSH YIELD TABLE
UPLAND LOAM RANGE SITE - FAIR CONDITION
Pounds Air Dry

TABLE J

Foliage Area Sq. Ft.	Basal Area Sq. In. .50	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00
.50	.04	.05	.06	.06	.06	.07	.07	.07	.08	.08	.08	.08	.08	.08	.08	.08	.09	.09	.09	.09	.09	.09
1	.07	.08	.08	.09	.10	.10	.10	.11	.12	.12	.12	.12	.12	.13	.13	.13	.13	.13	.14	.14	.14	.14
2	.10	.12	.12	.13	.15	.15	.16	.16	.17	.18	.18	.18	.18	.19	.19	.19	.19	.19	.20	.20	.20	.20
3	.13	.15	.16	.18	.20	.20	.21	.22	.22	.23	.24	.24	.24	.25	.25	.26	.26	.26	.26	.27	.27	.27
4	.16	.18	.20	.22	.24	.26	.26	.28	.28	.28	.29	.30	.30	.31	.31	.32	.32	.32	.33	.34	.34	.34
5	.19	.22	.24	.26	.29	.31	.32	.33	.33	.34	.35	.36	.36	.37	.37	.38	.38	.38	.39	.40	.40	.40
6	.21	.25	.27	.29	.32	.35	.36	.37	.37	.38	.39	.40	.40	.41	.41	.42	.43	.43	.44	.45	.45	.45
7	.24	.27	.30	.32	.36	.38	.39	.41	.41	.42	.43	.44	.45	.45	.46	.47	.47	.48	.48	.49	.50	.50
8	.26	.30	.32	.36	.39	.42	.43	.44	.45	.47	.48	.49	.49	.50	.50	.51	.52	.52	.53	.54	.55	.55
9	.29	.32	.35	.39	.43	.45	.46	.48	.49	.51	.52	.53	.54	.54	.55	.56	.56	.57	.57	.58	.60	.60
10	.31	.35	.38	.42	.46	.49	.50	.52	.53	.55	.56	.57	.58	.58	.59	.60	.61	.62	.62	.63	.64	.64
11	.33	.37	.40	.44	.48	.52	.53	.55	.56	.58	.59	.60	.61	.62	.62	.64	.65	.66	.66	.67	.68	.68
12	.35	.39	.43	.47	.51	.54	.56	.58	.59	.61	.63	.64	.65	.65	.66	.67	.68	.69	.69	.71	.72	.72
13	.36	.41	.45	.49	.54	.57	.59	.61	.62	.64	.66	.67	.68	.68	.70	.71	.72	.73	.73	.75	.76	.76
14	.38	.43	.47	.52	.56	.60	.62	.64	.65	.67	.69	.70	.72	.72	.73	.74	.75	.76	.77	.79	.80	.80
15	.40	.46	.50	.54	.58	.62	.64	.66	.68	.70	.72	.74	.75	.76	.76	.78	.79	.80	.80	.82	.82	.83
16	.42	.48	.52	.56	.61	.65	.67	.69	.72	.74	.76	.77	.78	.79	.80	.82	.83	.84	.84	.86	.86	.87
17	.44	.50	.54	.59	.64	.68	.70	.72	.75	.77	.79	.80	.82	.82	.84	.85	.86	.87	.88	.90	.90	.91
18	.45	.52	.56	.61	.66	.71	.73	.75	.78	.80	.82	.83	.85	.86	.87	.89	.90	.91	.92	.94	.94	.95
19	.47	.54	.59	.64	.68	.73	.76	.78	.81	.83	.86	.87	.89	.90	.90	.92	.93	.94	.95	.98	.98	.99
20	.49	.56	.61	.66	.71	.76	.79	.81	.84	.86	.89	.90	.92	.93	.94	.96	.97	.98	.99	1.01	1.02	1.03
21	.51	.58	.63	.68	.73	.79	.82	.84	.87	.89	.92	.93	.95	.96	.97	.99	1.00	1.01	1.02	1.05	1.06	1.06
22	.52	.60	.65	.70	.76	.81	.84	.86	.90	.92	.95	.96	.98	.99	1.00	1.02	1.03	1.04	1.05	1.08	1.08	1.09
23	.54	.61	.67	.73	.78	.84	.87	.89	.92	.95	.98	.99	1.01	1.02	1.03	1.05	1.06	1.07	1.09	1.12	1.12	1.13
24	.55	.63	.69	.75	.81	.86	.89	.92	.95	.98	1.01	1.02	1.04	1.05	1.06	1.08	1.09	1.10	1.12	1.15	1.16	1.16
25	.57	.65	.71	.77	.83	.89	.92	.94	.98	1.00	1.04	1.05	1.06	1.08	1.09	1.11	1.12	1.14	1.15	1.18	1.18	1.19
26	.59	.67	.73	.79	.85	.92	.95	.97	1.01	1.03	1.06	1.08	1.09	1.11	1.12	1.14	1.16	1.17	1.18	1.21	1.22	1.22
27	.60	.69	.75	.81	.88	.94	.97	1.00	1.04	1.06	1.09	1.11	1.12	1.14	1.15	1.17	1.19	1.20	1.21	1.24	1.24	1.25
28	.62	.70	.77	.84	.90	.97	1.00	1.03	1.06	1.09	1.12	1.14	1.15	1.17	1.18	1.20	1.22	1.23	1.25	1.28	1.28	1.29
29	.63	.72	.79	.86	.93	.99	1.02	1.05	1.09	1.12	1.15	1.17	1.18	1.20	1.21	1.23	1.24	1.26	1.28	1.31	1.32	1.32
30	.65	.74	.81	.88	.95	1.02	1.05	1.08	1.12	1.15	1.18	1.20	1.21	1.23	1.24	1.26	1.28	1.29	1.31	1.32	1.34	1.35
31	.68	.76	.83	.90	.97	1.04	1.07	1.10	1.14	1.17	1.20	1.22	1.24	1.26	1.27	1.29	1.31	1.32	1.34	1.37	1.38	1.38
32	.68	.77	.84	.92	.99	1.06	1.09	1.13	1.16	1.20	1.23	1.25	1.26	1.28	1.29	1.31	1.33	1.34	1.36	1.40	1.40	1.41
33	.69	.79	.86	.93	1.01	1.08	1.12	1.15	1.19	1.22	1.25	1.27	1.28	1.30	1.32	1.34	1.36	1.37	1.39	1.42	1.42	1.43
34	.71	.80	.88	.95	1.03	1.10	1.14	1.17	1.21	1.24	1.28	1.30	1.31	1.33	1.34	1.36	1.38	1.40	1.42	1.45	1.46	1.46
35	.72	.82	.90	.97	1.05	1.12	1.16	1.20	1.23	1.26	1.30	1.32	1.34	1.36	1.37	1.39	1.41	1.42	1.44	1.48	1.48	1.49
36	.73	.84	.91	.99	1.07	1.15	1.18	1.22	1.25	1.29	1.32	1.34	1.36	1.38	1.40	1.42	1.44	1.45	1.47	1.51	1.52	1.52
37	.75	.85	.93	1.01	1.09	1.17	1.20	1.24	1.27	1.31	1.35	1.37	1.38	1.40	1.42	1.44	1.46	1.48	1.50	1.54	1.54	1.55
38	.76	.87	.95	1.02	1.11	1.19	1.23	1.26	1.30	1.33	1.37	1.39	1.41	1.43	1.45	1.47	1.49	1.51	1.53	1.56	1.56	1.57
39	.78	.88	.96	1.04	1.13	1.21	1.25	1.29	1.32	1.36	1.40	1.42	1.44	1.46	1.47	1.49	1.51	1.53	1.55	1.59	1.60	1.60
40	.79	.90	.98	1.06	1.15	1.23	1.27	1.31	1.34	1.38	1.42	1.44	1.46	1.48	1.50	1.52	1.54	1.56	1.58	1.60	1.62	1.63
50	.91	1.04	1.13	1.24	1.34	1.43	1.47	1.51	1.56	1.60	1.64	1.66	1.69	1.71	1.74	1.76	1.78	1.81	1.83	1.86	1.88	1.90
60	1.03	1.18	1.29	1.40	1.51	1.62	1.66	1.70	1.73	1.77	1.81	1.84	1.87	1.91	1.94	1.97	2.00	2.03	2.07	2.10	2.13	2.15

CANYEL OAKBRUSH YIELD TABLE
UPLAND LOAM RANGE SITE - FAIR CONDITION
Pounds Air Dry

TABLE J (Cont'd.)

Foliage Area Sq. Ft.	Basal Area Sq. In. 22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00	31.00	32.00	33.00	34.00	35.00	36.00	37.00	38.00	39.00	40.00	50.00	60.00
.50	.09	.09	.09	.09	.09	.09	.09	.09	.09	.09	.09	.09	.09	.10	.10	.10	.10	.10	.10	.10	.11
1	.14	.14	.14	.14	.15	.15	.15	.15	.15	.15	.15	.15	.15	.16	.16	.16	.16	.16	.16	.16	.17
2	.21	.21	.21	.21	.22	.22	.22	.22	.22	.22	.22	.22	.22	.23	.23	.23	.24	.24	.24	.24	.25
3	.28	.28	.28	.28	.28	.29	.29	.30	.30	.30	.30	.30	.30	.30	.30	.30	.31	.31	.31	.32	.34
4	.34	.34	.35	.35	.35	.36	.36	.37	.37	.37	.37	.38	.38	.38	.38	.38	.38	.38	.38	.40	.42
5	.41	.41	.42	.42	.42	.43	.43	.44	.44	.44	.44	.45	.45	.45	.45	.45	.46	.46	.46	.48	.50
6	.46	.46	.47	.47	.47	.48	.48	.49	.49	.49	.50	.50	.50	.50	.50	.50	.51	.51	.51	.54	.56
7	.51	.51	.52	.52	.52	.53	.53	.54	.54	.54	.54	.55	.55	.55	.55	.56	.56	.57	.57	.60	.62
8	.55	.56	.56	.56	.57	.58	.58	.58	.59	.59	.60	.60	.61	.61	.61	.61	.62	.62	.62	.65	.68
9	.60	.61	.61	.61	.62	.63	.63	.63	.64	.64	.64	.65	.66	.66	.66	.67	.67	.68	.68	.71	.74
10	.65	.66	.66	.66	.67	.68	.68	.68	.69	.69	.70	.70	.71	.71	.71	.72	.72	.73	.73	.77	.80
11	.69	.70	.70	.70	.71	.72	.72	.72	.73	.73	.74	.74	.75	.75	.75	.76	.76	.77	.77	.82	.85
12	.73	.74	.74	.74	.75	.76	.76	.76	.77	.77	.78	.78	.79	.80	.80	.80	.81	.82	.82	.86	.89
13	.77	.77	.78	.78	.79	.80	.80	.80	.81	.82	.82	.83	.84	.84	.84	.84	.85	.86	.86	.90	.94
14	.81	.81	.82	.82	.83	.84	.84	.84	.85	.86	.86	.87	.88	.88	.88	.89	.90	.90	.91	.95	.98
15	.84	.85	.86	.86	.87	.88	.88	.88	.90	.90	.90	.91	.92	.92	.92	.93	.94	.94	.95	1.00	1.03
16	.88	.89	.89	.90	.91	.92	.92	.93	.94	.94	.95	.95	.96	.97	.97	.98	.98	.99	.99	1.04	1.08
17	.92	.93	.93	.94	.95	.96	.96	.97	.98	.98	.99	.99	1.00	1.01	1.01	1.02	1.03	1.03	1.04	1.08	1.12
18	.96	.96	.97	.98	.99	1.00	1.00	1.01	1.02	1.03	1.03	1.04	1.05	1.05	1.05	1.06	1.07	1.07	1.08	1.13	1.17
19	1.00	1.00	1.01	1.02	1.03	1.04	1.04	1.05	1.06	1.07	1.07	1.08	1.09	1.10	1.10	1.11	1.12	1.12	1.13	1.18	1.21
20	1.04	1.04	1.05	1.06	1.07	1.08	1.08	1.09	1.10	1.11	1.12	1.12	1.13	1.14	1.14	1.15	1.16	1.16	1.17	1.22	1.26
21	1.07	1.07	1.08	1.09	1.10	1.11	1.12	1.12	1.14	1.14	1.15	1.16	1.16	1.18	1.18	1.19	1.20	1.20	1.21	1.26	1.30
22	1.10	1.11	1.12	1.13	1.14	1.15	1.15	1.16	1.17	1.18	1.18	1.19	1.20	1.21	1.21	1.22	1.23	1.23	1.24	1.30	1.34
23	1.14	1.14	1.15	1.16	1.17	1.18	1.18	1.20	1.20	1.22	1.22	1.22	1.24	1.24	1.25	1.26	1.26	1.27	1.28	1.33	1.38
24	1.17	1.17	1.18	1.20	1.21	1.22	1.22	1.23	1.24	1.25	1.25	1.26	1.27	1.28	1.28	1.29	1.30	1.30	1.31	1.37	1.42
25	1.20	1.20	1.22	1.23	1.24	1.25	1.26	1.26	1.28	1.28	1.29	1.30	1.30	1.32	1.32	1.33	1.34	1.34	1.35	1.41	1.46
26	1.23	1.24	1.25	1.26	1.27	1.28	1.29	1.30	1.31	1.32	1.33	1.33	1.34	1.35	1.36	1.36	1.37	1.38	1.39	1.45	1.50
27	1.26	1.26	1.28	1.30	1.31	1.32	1.32	1.34	1.34	1.36	1.36	1.36	1.38	1.38	1.39	1.40	1.40	1.41	1.42	1.49	1.54
28	1.30	1.30	1.31	1.33	1.34	1.35	1.36	1.37	1.38	1.39	1.40	1.40	1.41	1.42	1.43	1.44	1.44	1.45	1.46	1.52	1.58
29	1.33	1.34	1.35	1.37	1.38	1.39	1.40	1.40	1.42	1.42	1.43	1.44	1.44	1.46	1.46	1.47	1.48	1.48	1.49	1.56	1.62
30	1.36	1.37	1.38	1.40	1.41	1.42	1.43	1.44	1.45	1.46	1.47	1.47	1.48	1.49	1.50	1.51	1.51	1.52	1.53	1.60	1.66
31	1.39	1.40	1.41	1.43	1.44	1.45	1.46	1.47	1.48	1.49	1.50	1.50	1.51	1.52	1.53	1.54	1.54	1.55	1.56	1.63	1.70
32	1.42	1.43	1.44	1.46	1.47	1.48	1.49	1.50	1.51	1.52	1.53	1.53	1.54	1.55	1.56	1.57	1.58	1.59	1.60	1.67	1.73
33	1.45	1.46	1.47	1.49	1.50	1.51	1.52	1.53	1.54	1.55	1.56	1.57	1.58	1.59	1.60	1.61	1.61	1.62	1.63	1.70	1.77
34	1.48	1.49	1.50	1.52	1.53	1.54	1.55	1.56	1.57	1.58	1.59	1.60	1.61	1.62	1.63	1.64	1.64	1.65	1.66	1.74	1.80
35	1.50	1.52	1.53	1.54	1.56	1.57	1.58	1.60	1.60	1.62	1.62	1.63	1.64	1.65	1.66	1.67	1.68	1.68	1.70	1.77	1.84
36	1.53	1.54	1.56	1.57	1.58	1.60	1.61	1.63	1.64	1.65	1.66	1.66	1.67	1.68	1.69	1.70	1.71	1.72	1.73	1.80	1.88
37	1.56	1.57	1.59	1.60	1.61	1.63	1.64	1.66	1.67	1.68	1.69	1.69	1.70	1.71	1.72	1.73	1.74	1.75	1.76	1.84	1.91
38	1.59	1.60	1.62	1.63	1.64	1.66	1.67	1.69	1.70	1.71	1.72	1.73	1.74	1.75	1.76	1.77	1.77	1.78	1.79	1.87	1.95
39	1.62	1.63	1.64	1.66	1.67	1.69	1.70	1.72	1.73	1.74	1.75	1.76	1.77	1.78	1.79	1.80	1.81	1.82	1.83	1.91	1.98
40	1.65	1.66	1.68	1.69	1.70	1.72	1.73	1.75	1.76	1.77	1.78	1.79	1.80	1.81	1.82	1.83	1.84	1.85	1.86	1.94	2.02
50	1.91	1.93	1.94	1.96	1.98	1.99	2.01	2.02	2.04	2.05	2.06	2.08	2.09	2.10	2.11	2.12	2.14	2.15	2.16	2.26	2.31
60	2.17	2.18	2.20	2.22	2.24	2.26	2.27	2.29	2.31	2.32	2.34	2.35	2.36	2.38	2.39	2.40	2.41	2.43	2.44	2.55	2.65

E. Fish and Wildlife Resources and Plan

1. Introduction

The mine plan area is located in the West Tavaputs Plateau, a region which supports about 360 vertebrate wildlife species. The abundance and distribution of wildlife in the lease area is directly related to present land use activities and capabilities. Use of this area by certain species is limited to lack of perennial water. Wildlife species possibly occurring in the lease area are listed in Table IV-11.
Please refer to plate 34

2. Source of Data

Department of the Interior, 1979. Final Environmental Statement - Development of Coal Resources in Central Utah, Parts 1 and 2.

Utah Department of Natural Resources, Division of Fish and Wildlife.

3. Habitats

Previously described vegetation provides fair to excellent habitat for a variety of wildlife species.

4. Species (See Table IV-11).

4.1 Mammals

Mammals occurring in the area can be divided into two groups, game species and non-game species.

The main game species include mule deer, mountain lion, black bear, elk, and cottontail rabbits. Mule deer, however, are the most important wildlife resource in the area. Mountain lion are present but little information is available due to their ranging habits. Generally, their movement coincides with the migration of deer. Black bear may occasionally be found in the vegetated canyons, usually along the cliff face. They normally inhabit the Book Cliffs to the north but little data is available on their populations. The permit area is within the lower limits of the elk range, however, elk are generally found north of the mine plan area at higher elevations. Cottontail rabbits are distributed throughout the area.

Non-game mammals include several species of small animals inhabiting the area. Predator species such as coyote and bobcat occasionally are found in the area and depend on small rodents and rabbits for their source of food. Information on non-game species is generally unavailable.

TABLE IV-11

List of Animals Possibly Occurring in Lease Area

Common Name	Scientific Name
Mammals	
Badger	Taxidea taxus
Black Bear	Ursus americanus
Bobcat	Lynx rufus
Coyote	Canis latrans
Deer mouse	Peromyscus maniculatus
Desert Cottontail	Sylvilagus audubonni
Elk	Cervus elaphus
Ground Squirrel	Spermophillus tridecelineatus
Least Chipmunk	Eutomias minimus
Mountain Lion	Felis concolor
Mule Deer	Odocoileus hemionus
Porcupine	Evethizon dorsatum
Striped skunk	Mephitus mephitus
White-tailed Jackrabbit	Lepus townsendii
Birds	
Brewers Sparrow	Spizella breweri
Blue Grouse	Dendragapus obscurus
Common Nighthawk	Chordeiles minor
House Sparrow	Passer Domesticus
Lark Sparrow	Chondestes grammacus
Magpie	Pica pica
Mourning Dove	Zenaidura macroura
Pinyon Jay	Gymnorhinus cyanocephala
Red-tailed Hawk	Buteo jamaicenis
Robin	Turdus migratorius
Ruffed Grouse	Bonasa umbellus
Sage Grouse	Centrocercus urophasianus
Sparrow Hawk	Falco sparverius
Turkey Vulture	Cathartes aura
Vesper Sparrow	Pooecetes gromineus

4.2 Birds

4.2-1 Raptors

The turkey vulture and red-tailed hawk frequent the area. A variety of other raptors breed in the Price area, however, there is a poor density of raptors throughout the mine plan area. A raptor survey performed for Tower Resources of the proposed permit area by Clayton M. White of Brigham Young University is attached as Exhibit IV-D. See plate 34

4.2-2 Other

Sage grouse inhabit the sagebrush flats at the foot of the cliffs. Blue and ruffed grouse may occasionally be found in the vegetated canyons of the area. Chukars can be found around the cliffs. Mourning doves are generally distributed throughout the area, however, the lack of perennial water limits dove nesting habitat in the area. Other representative birds include the magpie, bluebird, robin, and several species of sparrow.

4.3 Reptiles and Amphibians

The most prominent species of reptiles include the rattlesnake and sagebrush lizard. No aquatic fauna are present in the area.

4.4 Fish

There are no active fisheries as there are no permanent bodies of water or perennial streams in the area. No aquatic fauna are found.

4.5 Threatened or Endangered Species

There have been no known threatened or endangered species on or near the lease area according to a survey conducted by the Utah Division of Wildlife Resources (Boner 1977).

5. Impacts of Operations

Construction of all roads, powerlines, and surface facilities has been completed and mining operations have commenced. Therefore, no additional impact of operations on wildlife is anticipated.

6. Fish and Wildlife Plan (See plan following page 96).

State of Utah

DIVISION OF WILDLIFE RESOURCES

DOUGLAS F. DAY
Director

EQUAL OPPORTUNITY EMPLOYER
1596 West North Temple/Salt Lake City, Utah 84116/801-533-9333

April 13, 1981

Reply To SOUTHEASTERN REGIONAL OFFICE
455 West Railroad Avenue, Box 840, Price, Utah 84501
(801) 637-3310

Mr. Sam Quigley
Tower Resources Inc.
Centenial Mining Project
82 West Main
Price, Utah 84501

Attention: Mike Glasson

Dear Sam:

I want to take this opportunity to extend thanks for the assistance you and Mike have provided our staff in becoming familiar with existing and planned surface facilities on the area encompassed by Tower Resources Inc.'s Centenial Mining Project. I believe that you will find the enclosed information helpful at filing a mine and reclamation plan.

In response to your request for wildlife resource information (UMC 783.20) the attached map, data and comments are provided. The wildlife resource information is consistent with the formal guidelines for acquisition of fish, wildlife and habitat information that will be provided your Company by Utah's Division of Oil, Gas and Mining. In instances where your Company was or will be required to provide for study beyond existing information, such findings need be appended to this report.

Please note that the enclosed wildlife plan (UMC 784.21) represents our recommendations; Utah's Division of Oil, Gas and Mining is the regulatory authority for approval of the mining and reclamation plan. Implementation of the recommended wildlife plan should assist the Company in compliance with performance standards UMC 817.97.

Thank you for an opportunity to assist your Company in complying with the State's permanent program for coal mining and reclamation and the resultant protection of Utah's wildlife resources. If the Division can be of any further service, please coordinate with our Regional Resource Analyst (Larry Dalton, phone 801-637-3310) as appropriate.

Sincerely,

John Livesay

John Livesay, Supervisor
Southeastern Region

JL:LBD:gp

Enclosure

cc: Darrell Nish
Cleon B. Feight
Clark Johnson
Leon Berggren

GOVERNOR
DEPT. OF NATURAL RESOURCES
Gordon E. Harmston
Exec. Director

WILDLIFE BOARD
Roy L. Young — Chairman

UMC 784.21; FISH AND WILDLIFE PLAN
TOWER RESOURCES INC., CENTENIAL MINING PROJECT

Mitigation and Impact Avoidance Procedures General to all Wildlife

Utah Division of Wildlife Resources provides the following recommendations in order to minimize disturbances and impacts on wildlife and their habitats that could be impacted during developmental, operational and reclamation operations at the Company's mining project. The recommendations address how enhancement of the wildlife resource and their habitats as discussed in UMC 783.20 can be achieved. They are also consistent with the performance standards of UMC 817.97. In instances where it would be necessary to restore or could be beneficial to enhance or develop high value habitats for fish and wildlife, recommended plant materials and rates of application are provided as "Appendix B" (UMC 817.97 and UMC 817.111 through 817.117). This list should prove useful in meeting the additional requirements to be imposed upon the operator if the primary or secondary land use will be for wildlife habitats (UMC 817.97 d 9). Additionally, "Appendix C" represents a list of commercial sources for plant materials.

The project and adjacent areas are represented by seven basic wildlife habitats which are inhabited on occasion and during different seasons of the year by about 184 species of vertebrate wildlife. The wildlife habitats and use areas for the "high interest" species from this group of wildlife have been ranked into four levels of importance. The most valuable to an individual species or ecological assemblage are the critical sites followed in respective importance by high-priority, substantial value and limited value sites. Each type of use area requires various and specific levels of protection from man's activities. Additionally, due to the variability of vegetation communities in each use area, various and specific technologies in site development will need to be evaluated for possible mitigations, enhancements of wildland habitats or the required level of reclama-

tion. It is recommended that all land clearing impacts be designed so that irregular shaped openings are created in contrast to openings that would have straight edges.

It is recommended that the Company make significant efforts to educate all employees associated with their coal handling operation of the intricate values of the wildlife resource associated with the project and adjacent areas and the local area. Each employee should be advised not to unnecessarily or without proper permits harass or take any wildlife. (Apprehension of wildlife violators has increased by nearly 250 percent during recent years in the region). It is especially important that wildlife not be harassed during winter periods, breeding seasons and early in the rearing process. Exploration should be limited as much as possible during these crucial periods.

During winter wildlife are always in a depleted condition. Unnecessary disturbance by man causes them to use up critical and limited energy reserves which, often times, results in mortality. In less severe cases, the fetus being carried by mammals may be aborted or absorbed by the animal, thus reducing reproductive success of a population.

During breeding seasons, disturbance by man can negatively affect the number of breeding territories for some species of wildlife. Disturbance can also interrupt courtship displays and preclude timely interactions between breeding animals. This could result in reduced reproductive success and ultimate reductions in population levels.

Early in the rearing process, young animals need the peace and tranquillity normally afforded by remote wildlands. It is also during this crucial period that young animals gain the strength and ability to elude man and other predators. This allows the young animal to develop in relatively unstressed situations and to utilize habitats that are secure from predators. Disturbance by man can compromise this situation and result in abandonment of the young by the female, increased accidents that result in mortality to young animals or increased natural predation.

It is recommended that employees be cautioned against disturbing young animals or females with young if accidentally located.

Employees associated with coal handling operations should be instructed that when wildlife are encountered during routine work that they not stop vehicles for viewing purposes. Moving traffic is less disturbing to wildlife than traffic that stops or results in out-of-the-vehicle activities. If viewing is desirable, the vehicle should only be slowed, but not stopped.

Hunting and other state and federal wildlife regulations must be adhered to by sportsmen utilizing the project area.

Mitigation and Impact Avoidance Procedures for Aquatic Wildlife

There are no recommendations for a wildlife plan that would enhance any perennial water or fishery since none are associated with the Company's proposed operation.

Mitigation and Impact Avoidance Procedures for Terrestrial Habitats

It is recommended that all habitats associated with dry washes be maintained. Roads and other facility developments should not destroy or degrade these limited and highly productive habitats. Roads crossing through those areas should do so in a manner that is least damaging to the habitat. Wetlands and riparian habitats associated with dry washes are of similar character to riparian habitats in other areas. They are ranked as being of critical value and are the most productive sites in terms of herbage and biota produced as compared to other local habitat types. It is probable that a majority of the vertebrate wildlife that inhabit the project area make some use of such sites.

It is important to note that roads and other surface facilities to be constructed should as far as practicable be placed at sites where they will not compromise wildlife or their use areas. Also, surface facilities, including roads, should be screened if possible from wildlife use areas by vegetation or terrain.

In situations where wildland habitats have been or will be disturbed, reclamation is required. Also, there are sites where development or enhancement of

wildland habitats through vegetation treatments and/or seedings and transplants of seedlings could benefit wildlife. "Appendix B" depicts the Division's recommendation for plant materials to be utilized for various wildlife habitats on wildland treatments that are intended to benefit wildlife. If circumstances arise where seed or seedling transplants for a recommended plant species are not available, suitable alternates are also recommended.

Seedling transplants from nursery stock as well as nearby rangelands would also be acceptable for some wildland treatments.

Appendix C represents an exhaustive list of commercial sources for plant materials for use in wildland treatments.

Temporary control of rodents may be required to ensure a successful rangeland treatment. It is recommended that the county agent be consulted in this area of concern. Poisoned oats are the most common and acceptable method for rodent control; however, only licensed persons may apply the treatment.

Currently, there are some new concepts in methodology for revegetation that are being successfully implemented in other parts of the nation and world. One promising method is a procedure where a large scoop removes, from a natural and stabilized site, a small area of earth intact with vegetation and subsurface soils for placement on a site to be restored. This same procedure can be utilized when disturbing pristine sites, except that the native vegetation is stored for use in latent reclamation. Another meritorius method for stimulating natural revegetation, in combination with other reclamation techniques, is to plan facility developments so that islands of natural, native vegetation remain. This will allow for natural vegetation to spread from the islands. These techniques can also be useful for enhancement of poor quality sites that currently exist on the mine plan area.

Encapsulation of seed and fertilizer for several releases over a period of years after a single application is a new and possibly advantageous procedure. This technique along with soil stabilizing structures has been successfully used in South Africa. Dr. J. Van Wyk in the Department of Botany at Potchetstroom

University in South Africa could provide additional information on this new technique.

There are also new specialized techniques coming to the forefront for stabilization of problem sites such as roadbanks and steep slopes. It is important that these sites be promptly and permanently revegetated in order to reduce siltation into local riverine systems. This will mitigate for damage to aquatic wildlife populations and habitats from siltation. Enhancement of existing problem sites or reclamation of disturbed sites can mitigate for salt loading of local river systems. It is believed that natural, nonpoint sources represent 50 percent of the salinity in the upper basin of the Colorado River system into which this mine plan area drains.

It is recommended the Company make numerous contacts with appropriate agencies, institutions and persons to ensure that enhancement or reclamation projects achieve the required degree of permanency, plant diversity, extent of cover and capability of regeneration to ensure plant succession. Generally speaking, seeding should be accomplished as late in the fall as possible. Seedling transplants need to be coordinated with local soil moisture conditions which are usually at optimum in the early spring just as the snow melts.

It is paramount that suitable vegetation be maintained and/or re-established if the life requirements of wildlife are to be satisfied in the postmining period. Success in this area of concern along with cessation of man's disturbances will likely result in a natural reinvasion and the resultant inhabitation by most wildlife species of an impacted site.

It is important to note that enhancement or reclamation projects that are to benefit wildlife must be properly designed so that all the life requirements of the target species are considered in conjunction with forage. Water must be provided or be present and thermal cover along with escape and hiding cover has to be in abundance. Loafing areas and travelways between the many types of use areas must also be provided. In order to meet these goals, a considerable degree of consul-

tation will be required between the Company and Utah Division of Wildlife Resources.

As a service and also to ensure that the needs of wildlife are met, the various expertism within the Division of Wildlife Resources are available to the Company for consultation. For the most part, Larry Dalton, Resource Analyst, for the Southeastern Regional Office at 455 West Railroad Avenue in Price, Utah 84501 (phone 637-3310) will coordinate any needed contacts. Richard Stevens, Wildlife Biologist, at the Great Basin Research Center, Box 704, in Ephraim, Utah 84627 (phone 283-4441) is available for consultation and site specific analysis concerning species for vegetation plantings, timing and techniques to achieve the best results.

In instances where revegetation projects are to be planned over coal waste areas, heavy metal uptake by the plants must be evaluated. It is recommended that the Company initiate an appropriate long-term monitoring program to determine the magnitude and resolutions, if needed, for this problem.

It is recommended that persistent pesticides not be utilized on the project area. Other alternate pesticides or forms of control should be utilized.

All hazards associated with the project operation should be fenced or covered to preclude use by wildlife; of special concern would be sites having potential to entrap animals or toxic materials.

Mitigation and Impact Avoidance Procedures for Amphibians and Reptiles

Enhancement or development of habitats that provides a diversity of vegetation will benefit amphibians and reptiles. It is important to note that all of these species are protected by Utah law. Due to the myriad of myths that surround these animals, it is urged that individual specimens not be destroyed. This is especially true for snakes since they are a valuable component of the ecosystem.

Snake dens are ranked as being of critical value to the population and are protected by law. If a den is located, it should be reported to the Utah Division of Wildlife Resources. Snake dens can be moved, but only with intensive efforts that may take a year or more (snakes are caught and removed in the spring and fall).

Thus, construction of facility developments may take place in denning locations if there is sufficient lead time to relocate the occupants.

Mitigation and Impact Avoidance Procedures for Avifauna

It is recognizable that development and operation of a mining project will in some cases negatively impact many avian species through physical destruction of habitats and continual disturbance that makes other habitats unavailable or less desirable to an individual bird. It is also true that impacts that are negative to one species may be beneficial to another species. It is recommended that the Company plant native and/or ornamental berry producing shrubs around surface facilities. When mourning doves are a target species, sunflowers or blazing star should be planted. This will provide food and cover for many of the smaller species of birds, resulting in enhancement of their substantial value and high-priority habitats. This action would also mitigate for disturbances and destruction of avifauna habitats at other sites associated with project operations.

It is important to note that the nests of all avifauna (except the house sparrow, starling and ferral pigeon) when active and their eggs are protected by federal (Federal Migratory Bird Treaty Act) or state laws (Utah Code 23-17-1 and 23-17-2). All avifauna utilize a nest during their reproductive process. Dependent upon the species, some nests are well developed while others may be represented by only a scrape on the ground. These sites when being utilized are critical to maintenance of individual bird populations; each species has a specific crucial time period in which the nest is occupied. It is during this crucial period that the nest must be protected from disturbance.

Several species of raptors frequent the project area. Their nests when active should not be disturbed and abandoned stick nests are never to be damaged. Every effort should be made to eliminate man's disturbance within visual sight or one-half kilometer radius of an active raptor nest. This distance would have to be increased to a one-kilometer radius if the cause for disturbance were to originate within view and from above the nest. This effort is demanded in the instance of

golden eagles and cliff nesting falcons since they are sensitive to disturbance and could abandon the nest. Termination of man's use of a site would not be required if eagles or falcons constructed their nest after mining had been initiated, since it would demonstrate the individual bird's willingness to tolerate mining activities and the associated disturbance by man.

Roost trees for eagles, if located, must not be disturbed or destroyed. Similarly, activities planned for high-priority concentration areas of eagles must be designed and implemented so that they are not of significant disturbance to the birds.

As a general comment, whenever active raptor nests are observed or roost trees for eagles located, they need to be reported to the Utah Division of Wildlife Resources and the U.S. Fish and Wildlife Service.

Design and construction of all electrical power lines and other transmission facilities shall be designed in accordance with guidelines set forth in "Environmental Criteria for Electric Transmission System" published by the USDA and USDI in 1970 and/or the REA Bulletin 61-10 "Powerline Contacts by Eagles and Other Large Birds". It is also recommended that placement of utility poles over flat or rolling terrain be planned so that they are out of view of roads or at least 300 meters away from any roads. This will lessen opportunity for illegal killing of these valuable birds, since the poles can serve as suitable hunting perches for raptors. In some instances poles can result in an extension of raptor hunting territories, which would represent a beneficial impact.

During the crucial period of December through February spruce-fir forests and aspen forests need to be protected from man's disturbance so that blue grouse will not be impacted. Destruction of these wildlife habitats at any time of the year need be minimized due to their value to wildlife.

During the spring period (mid-March through mid-June) care needs to be taken that male blue grouse are not disturbed or precluded from establishing breeding territories.

Mature trees with natural cavities and dead snags need to be protected for use by cavity nesting birds. Trees with such a character are ranked as being of critical value to cavity nesting birds. The project should be planned so that three such trees are left standing per acre within 500 feet of forest openings and two such trees per acre in dense forested areas.

Mitigation and Impact Avoidance Procedures for Mammals

The lodges, nests and dens of all mammals or roosts in the instance of bat like mammals represent a critical use area for maintenance of their individual populations. The crucial period for any species is when the lodge, den, nest or roost is occupied. Therefore, such sites for any mammal must be protected from disturbance during that period when it is being utilized.

Many species of mammals develop food caches in order to carry individual animals or family groups through periods when they cannot forage. Such sites are of critical value to maintenance of their populations and if located should not be destroyed or subjected to regular disturbance by man.

It is important to realize that within natural ecosystems there exists a predator-prey relationship. One species of animal may represent a prey source for other species. Therefore, it is important that project operations be designed and implemented so as to not unnecessarily disturb or destroy any wildlife or their habitats.

Big game ungulates--mule deer and elk--each have seasonal use areas ranked as being of critical value to an individual herd. Such sites need to be protected from any of man's activities or developments that could result in destruction, loss or permanent occupancy of the site by man or has facility developments. If these types of impacts cannot be avoided the site must ultimately be reclaimed and revegetated. Also, critical valued areas need protection from disturbance during their appropriate crucial period.

High-priority valued use areas for all wildlife and particularly big game ungulates need to be protected from man's activities or facility developments.

Actions that would result in loss or permanent occupancy of significant acreages (25 or more acres) of habitat are of special concern. In any event impacts to high-priority valued areas should be limited and ultimate reclamation planned. Many impacts can be avoided simply by precluding exploration, developmental or other activities during the period of time when a high interest specie is present.

Haulage of coal between the various mine projects and distribution points should be planned so that impacts to wildlife are lessened; of special concern is haulage of coal through wintering areas for big game. It is recommended that the Company, when hauling coal with motor vehicles, develop coal haulage contracts that require personnel involved with coal haulage to use extreme caution so that accidental collisions between motor vehicles and big game are reduced. Without doubt, a reduction in speed across winter ranges would aleviate this problem during the period between November 1 and May 15 each year.

At present the most successful and cost effective technique for reducing deer-highway mortality is a system of warning reflectors. This system (manufactured by Strieter Corporation, 2100 Eighteenth Avenue, Rock Island, Illinois 61201 and known as "Swareflex") is only of value at night time, but it is during darkness that most deer-highway mortality occurs. Strieter Corporation describes the effect of the reflector system as follows: "The headlights of approaching vehicles strike the wildlife reflectors which are installed on both sides of the road. Unnoticeable to the driver, these reflect red lights into the adjoining terrain and an optical warning fence is produced. Any approaching wildlife is [are] alerted and stops or returns to the safety of the countryside. Immediately after the vehicle has passed, the reflectors become inactive, thereby permitting the animals to cross safely".

Installation of a wildlife warning reflector system, a reduction in speed of coal-haulage trucks and other mine related traffic and increased awareness of wildlife values by mine associated employees should result in a reduction of deer-highway mortality problems. Such a reduction would represent satisfactory miti-

gation.

In instances where conveyors, slurry lines or any other structure having potential to be a barrier to big game movement is to be developed, passage structures must be provided. Generally speaking overpass and underpass type structures are recommended in order to allow passage of big game to habitats either side of any barrier. These crossings should be placed at the points to be identified from intensive study of big game movements in relation to the mine plan area. Such study would not be required if the structure was adequately elevated to allow uninhibited passage of big game along its entire length.

Underpasses should have a minimum clearance of three meters maintained across a span of at least five meters. Overpasses should be designed as a circular earthen ramp with the barrier bisecting the ramp into two equal halves as follows:

> On either side of the conveyor a half-round ramp with a slope no greater than 3:1 on a five meters wide path placed at an angle 90 degrees to the conveyor and tapering around to a slope of 5:1 at paths adjacent and parallel to the conveyor. The platform over the conveyor should be concrete or some other material that would not echo when being crossed by big game and should be of character similar to rock or natural earth.

Soils associated with either crossing style should be of the A or B horizons to allow for development of vegetation. Vegetative cover must be established in association with all crossing sites. This will lessen anxiety of individual animals using the site through development of a natural appearing environment.

Mature pinion or juniper trees and an abundance of browse plants need to be placed proximal to crossing points in order to provide a safe travelway. The browse plants will also serve as a permanent attraction for big game to crossing points. Additionally, a mixture of grass and forb seeds should be broadcast over each crossing point to stabilize the soil and enhance the forage situation.

Appropriately sized boulders may need to be placed at crossing sites in order to control off-road vehicles utilized in outdoor recreation.

Industrial developments are encouraged on habitat use areas that are ranked as being of limited value to wildlife. It should be noted, however, that reclamation is [illegible] on any wildlife use area, regardless of its value to

Table 1. Ranking of value per ecological association for wildlife habitats [illegible] the state of Utah. Crucial-critical (C) habitats [illegible] the highest valued followed in respective order [illegible] high-priority (H), substantial value (S) and limited va[illegible]d (L) habitats.

Ecological Association	Wildlife Habitats											
	Riparian and Wetland	Desert Scrub	Pasture and Fields	Urban or Parks	Cliffs and Tallus	Sagebrush	P-J Forest	Shrubland	Aspen Forest	Ponderosa Forest	Parkland	Spruce-fir Forest
			LOWER SONORAN LIFE ZONE									
Warm Desert	This ecological association does not exist in the Southeastern Region											
			UPPER SONORAN LIFE ZONE									
Cold Desert	C(H[1], S[2])	S	S	S	H							
			TRANSITION LIFE ZONE									
Submontane	C(H[1], S[2])		S	S	H	S	S	S				
			CANADIAN LIFE ZONE									
Montane	C(H[1]L[2])		S	L	S				S	S	S	S
			HUDSONIAN LIFE ZONE									
Montane	H(S[1]; L[2])				S							S
			ALPINE LIFE ZONE									
Montane	This ecological association does not exist in the Southeastern Region											

This Table represents a summation of effort where by numerical values were assigned as a ranking per high interest specie to each wildlife habitat. The numerical values were as follows: critical, 1; high-priority, 2; substantial, 3; and limited, 4. Once the individual values were assigned they were then summed and a mean calculated, for each wildlife habitat. A mean value lying between 1.0 and 1.8 was ranked as critical; a value between 1.9 and 2.3 was ranked as high-priority; a value between 2.4 and 3.4 was ranked as substantial; and a value between 3.5 and 4.0 was ranked as limited.

1. Habitat ranking value for species associated with the riparian-wetland type that represents just the wet meadow situation.
2. Habitat ranking value for species associated with the riparian-wetland type that represents just the dirt bank situation.

in Utah. Crucial-critical (1), sections are the highest valued followed in respective order by high-priority (2), substantial value (3) and limited valued (4) sections.

BOOK CLIFFS

T.	R.	Section	Rank
12	8	1-36	1
12	9	2,4-12,14,16-18,31-35	1
		1,3,13,15,19-30,36	2
12	10	2-11,13-17,19-27	1
		1,12,18,28-36	2
12	11	16-28,33-35	1
		1-15,29-32,36	2
12	12	19,27-30,32-34	1
		1-18,20-26,31,35,36	2
13	8	1-3,5-16,19,20,22-24,28-31	1
		4,17,18,21,25-27,32-36	2
13	9	1-11,14,15,17,18,28,29,31-35	1
		12,13,16,19-27,30,36	2
13	10	1,2,6	1
		3-5,7-36	2
13	11	14-16,21-28,34-36	1
		1-13,17-20,29-33	2
13	12	4,19,30,31,36	1
		1-3,5-18,20-29,32-35	2
13	13	1-36	2
14	13	1-36	2
14	14	33	1
		1-32,34-36	2
15	14	1-21,23-26,28-36	2
		22,27	3
16	14	24-26,35,36	1
		1-23,27-34	2
16	15	3,10,11,14,23-25,29-33	1
		1,2,4-9,12,13,15-22,26-28,34-36	2
17	14	1,12,13,24,25,36	1
		2,3,10,11,14,15,22,23,26,27,34, 35	2
17	15	4-9,16-22,27-34	1
		1-3,10-15,23-26,35,36	2
18	14	1,27	1
		2,3,10-15,22-26,34-36	2
18	15	4-10,15-18	1
		1-2,11-14,19,21-25,30-32	2
		3,20,26-29,33-36	3

HENRY MOUNTAINS

T.	R.	Section	Rank
27	9	1-36	1
30	9	25,32-36	3
		19-24,26-31	4
30	10	20-29,32-36	1
		19,30,31	3
31	8	1,7,12,13,18,19,24,25,30,31,36	3
		2-6,8-11,14-17,20-23,26-29,32-35	4
31	9	4-9,16-21,28-33	3
32	8	30,31	2
		1,6,7,10-15,18,20-29,33-36	3
		2-5,8,9,16,17,19,32	4
32	9	1,12,13,24,25,35,36	1
		2-11,14-23,26-34	3
33	8	6-8,12-14,17-20,22-36	2
		1-4,9-11,15,16	3
		5,21	4
33	9	1-3,9-17,20-28,34-36	1
		7,18,19,29-32	2
		4-6,8,33	3
34	8	1-3,10-13,15	2
		14	3
34	9	3	1
		2,5-11,13,14,16-19	2
		1,4,12,15,20-24,26-28	3
		25,29-36	4
34	10	1-23,26-30,32-34,36	2
		24,25,35	3
		31	4

KAIPAROWITS PLATEAU

T.	R.	Section	Rank
33	1	26,27,34-36	1
		25,33	2
		19-25,29-32	3
33	2	28,31-33	1
		19-21,29-30	3
34	1	1-3,10-14,24	1
		4-9,15-23,25-36	2
34	2	4-7,17,18,20,21,28,29	1
		8,9,16,19,30-33	2
35	2W	3-10,16-19	1

KAIPAROWITS PLATEAU (CONTINUED)

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

WASATCH PLATEAU NORTH

T.	R.	Section	Rank
12	6	1-26,29,31,34-36	1
		27,28,30,32,33	2
12	7	1-15,17-36	1
		16	3
12	8	1-36	1
13	6	1,2,5-8,10,13,17-20	1
		3,4,9,11,12,14-16,21-36	2
13	7	1-4,9-17,19,22-26,31,32,35,36	1
		5-8,18,20,21,27-30,33,34	2

WASATCH PLATEAU NORTH (CONTINUED)

T.	R.	Section	Rank
14	6	28-33	1
		1-27,34-36	2
14	7	1,4-6,9,12,13,16	1
		2,3,7,8,10,11,14,15,17-36	2
15	6	4-6,10-15,22-24	1
		1-3,7-9,16-21,25-36	2
15	7	32-36	1
		1-31	2
15	8	9,15,20-22,27-29,32,33	1
		1-8,10-14,16-19,23-26,30,31,34-36	2
16	6	11,13,14,16,20-26,28,29,31-33,35, 36	1
		1-10,12,15,17-19,27,30,34	2
16	7	1-5,9-16,21-28,34-36	1
		6-8,17-20,29-33	2
16	8	4,7,9,17-21,28-31	1
		1-3,5,6,8,10-16,22-27,32-36	2
17	6	4-9,11-14,16-22,24-35	1
		1-3,10,15,23,36	2
17	7	1,2,7,12,18,19,25,30	1
		3-6,8-11,13-17,20-24,26-29,31-36	2
17	8	5,6,16,19	1
		4,7-9,17,18,20,21,28-33	2
18	6	1-3,10,11,13-15,22-27,34-36	1
		12	2
18	7	4,5,7-11,13-17,19-27,29-32,34-36	1
		1-3,6,12,18,28,33	2
19	6	1-3,10-15,22-27,34-36	1
19	7	1-3,5,23,27-34	1
		4,24-26,35,36	2

WASATCH PLATEAU SOUTH

T.	R.	Section	Rank
20	5	20-29,31-36	1
		19,30	2
20	6	19-36	1
21	4	1-3,10-15,19-36	1
		4-9,16-18	2
21	5	1-36	1
21	6	4-9,16-21,28-33	1
22	3	1-3,10-15,22-27,34-36	1
22	4	1-4,9-16,21-28,33-36	1
		5-8,17-20,29-32	2
22	5	1-20,22-24,29-30	1
		21,25-28,31-36	2
23	3	1,12,13	1
		2,3,10,11,14,15,22-27	2
		34-36	3
23	4	2-4,6-11,14-18,20-29,31-36	1
		1,5,12,13,19,30	2
24	4	2,4-9,16-18	1
		1,3,10-15	2

This Table represents a summation of work published in 1977 as a "Ranking of Wildlife Values on Federal Coal Lands". Robert W. Scott performed the work as a Division of Wildlife Resources employee under contract (No. 14-16-006-3125) for the U.S. Fish and Wildlife Service. Scott's procedure ranked habitat use areas as critical, high-priority, substantial and limited value for select individual species of high interest. Afterwhich the individual values were evaluated per legal section of land and a cummulative value was determined.

UMC 783.20; FISH AND WILDLIFE RESOURCE INFORMATION
TOWER RESOURCES INC., CENTENIAL MINING PROJECT

General Wildlife Resource Information--All Species of Vertebrate Wildlife

The mine plan area encompasses a portion of the West Tavaputs Plateau in Carbon County, Utah. This area drains into Hayes Wash which is tributary of the Price River, which flows into the Green River and ultimately into the Colorado River at a point upstream from Lake Powell. Generally speaking, the West Tavaputs Plateau is encompassed by cold desert (upper Sonoran life zone), submontane (Transition life zone) and montane (Canadian life zone) ecological associations. These life zones could be inhabited on occasion and during different seasons of the year by about 364 species of vertebrate wildlife--20 fish species, 5 amphibian species, 15 reptile species, 244 bird species and 80 mammal species. It is interesting to note that 84 percent of these species are protected.

The mine plan area itself is represented by the Transition and Canadian life zones and provides habitat for approximately 184 species of wildlife--no fish species, 3 amphibian species, 15 reptile species, 106 bird species and 60 mammal species. Forty-seven of these species are of high interest to the State of Utah.

The Division Publication No. 78-16 "Species List of Vertebrate Wildlife that Inhabit Southeastern Utah" is appended (Appendix A) to this report since it represents a low level of study for the wildlife species listed. It identifies those species having potential to inhabit the region as well as those inhabiting the environs of the mine plan area. Appendix A also identifies which species are considered to be of high interest for the habitats and local area represented.

High interest wildlife are defined as all game species; any economically important species; and any species of special aesthetic, scientific or educational

significance. This definition would include all federally listed, threatened and endangered species of wildlife.

A ranking and display of wildlife habitats and use areas relative to high interest species of vertebrate wildlife has been developed (Table 1 and 2 and the attached map). Critical wildlife use areas followed in respective importance by high-priority, substantial value and limited value wildlife use areas require various levels of protection from man's activities and developments. Wildlife habitats and use areas ranked as being of critical or high-priority value to wildlife should be protected from surface disturbance, subsidence impacts and human or industrial disturbance. This can be accomplished through development and implementation of a wildlife plan.

For purposes of clarification the classification of waters in Utah that will be referenced in the following narrative represents a Division of Wildlife Resources system developed and applied to all of the State's waters in 1970. The classification system determined a numerical rating for each of the stream sections or lakes within Utah. (Insofar as possible, each stream section represents an ecologically and physically uniform stream segment.) The numerical values were developed through an evaluation at each water of esthetics, availability of the water to sportsmen and production of fish. Class 1 waters are the best and Class 6 are the poorest.

Critical wildlife use areas are "sensitive use areas" necessary to sustain the existence and perpetuation of one or more species of wildlife during crucial periods in their life cycles. These areas are restricted in area and lie within high-priority wildlife use areas. All stream sections, reservoirs, lakes and ponds identified by Utah Division of Wildlife Resources as Class 1 or 2 are classified as being critical. Biological intricacies dictate that significant disturbances cannot be tolerated by the members of an ecological assemblage on critical sites. Professional opinion is that disturbance to critical use areas or habitats will result in irreversible changes in species composition and/or

biological productivity of an area.

High-priority wildlife use areas are "intensive use areas" for one or more species of wildlife. "Intensive use areas" are not restricted in area and in conjunction with limited value use areas form the substantial value distribution for a wildlife species. All stream sections, reservoirs, lakes and ponds identified by Utah Division of Wildlife Resources as Class 3 are classified as being of high-priority. In addition, wildlife use areas where surface disturbance or underground activities may result in subsidence that could interrupt underground aquifers and result in a potential for local loss of ground water and decreased flows in seeps and springs should be considered as being of high-priority to wildlife.

Substantial value wildlife use areas are "existence areas" for one or more species of wildlife. "Existence areas" represent a herd or population distribution and are formed by the merging of high-priority and limited value wildlife use areas for a species. All stream sections, reservoirs, lakes and ponds identified by Utah Division of Wildlife Resources as Class 4 are classified as being of substantial value.

Limited value wildlife use areas are "occasional use areas" for one or more species of wildlife. "Occasional use areas" are part of the substantial value wildlife use area for a species. All stream sections, reservoirs, lakes and ponds identified by Utah Division of Wildlife Resources as Class 5 or 6 are classified as being of limited value.

MAPPING

Vegetation and Wildlife Habitats

It is recommended that the Company's primary effort be placed on identifying species of vegetation in each wildlife habitat within the various wildlife use areas for purposes of reclamation. The Division does not have site specific information relative to vegetation types at the mine plan area. However, there are

seven wildlife habitats present--riparian wetlands, cliffs and tallus, sagebrush, pinion-juniper forest, shrubland, ponderosa forest (limited to just scattered trees) and spruce-fir forest. The Company should identify each of these habitat associations on appropriately scaled maps.

It is believed that if satisfactory reclamation is achieved and man's disturbance does not continue or become a factor, that most species of wildlife displaced from the mine plan area will return. Without doubt, the key to success for enhancing or restoring wildlands will be development of habitats so that the postmining condition as compared to the premining condition will have similar species, frequency and distribution of permanent plants in each vegetative type. This will allow for natural plant succession. Additionally, other habitat features that represent the various life requirements for local wildlife must be provided.

Wildlife Use Areas

The enclosed map displays mapable, high value use areas for high interest wildlife on or adjacent to the mine plan area. This display includes stream sections and bodies of water, if any, utilized by high interest fish species. Also displayed are known seeps, springs, wetlands and riparian zones. Note that there are high interest wildlife distributions that are so broad that they cover the entire map and therefore are not illustrated. However, all vertebrate species of high interest wildlife and their distributions are discussed in the following narrative.

Water

Due to demands of state and federal coal mining regulations, the Company will probably be required to identify and appropriately monitor all surface waters for potential impacts from subsidence. This information should be correlated with the wildlife use area information due to the value of water to wildlife.

FISH AND WILDLIFE INVENTORY

Aquatic Use Areas

Macrophytes, Macroinvertebrates and Fish

No perennial streams are associated with the project, thus data relative to aquatic wildlife would not be practicable for presentation in the permit application.

It is important to note that no species of fish having relative abundances so low as to have caused them to be federally listed as threatened or endangered inhabit the mine plan or adjacent areas. The endangered humpback chub, bonytail chub and Colorado squawfish inhabit the Green and Colorado Rivers. Additionally, the humpback (razorback) sucker also inhabits those rivers; it is likely that this species will one day be federally listed as threatened. It is not believed that implementation and operation of the Company's project will impact any of these species.

Terrestrial Use Areas

Wildlife Habitat Types

Of the seven wildlife habitat types present on the mine plan area wetlands and riparian habitats are ranked as being of critical value to all wildlife. These critical valued habitats are normally assoicated with drainage bottoms (ephemeral or intermittent), or perennial streams (UMC 700.5), seeps and springs within the upper Sonoran, Transition and Canadian life zones. Cliffs and their associated tallus areas that lie within the upper Sonoran or Transition life zones are ranked as being of high-priority value to all wildlife. When compared to all other wildlife habitats the aforementioned situations are considered to represent unique habitat associations (Table 1).

Riparian and wetland areas are highly productive in terms of herbage produced and use by wildlife as compared to surrounding areas. Experience has shown that as much as 70 percent of a local wildlife population are dependent upon riparian zones. Cliffs and tallus are of special importance to many high interest wildlife.

These unique habitat types must be identified in the permit application and protected due to their high value for all wildlife.

Quantitative (acreage) and qualitative (condition, successional stage and trend) data concerning the wildlife habitats in each ecological association should be included as part of the mine permit application. It is important to note that each legal section of land represented by the mine plan and adjacent areas has been ranked as to its value for the total wildlife resource. Sections 5, 6, 7, 8, 9, 12, 17 and 18 of Township 13 South Range 11 East have each been ranked as being of high-priority value to wildlife. These rankings were developed through an analysis of cumulative values for use areas of individual wildlife species inhabiting each legal section of land (Table 2).

Amphibians--Species Occurrence and Use Areas

Five species of amphibians, all of which are protected, are known to inhabit the biogeographic area in which the mine plan and adjacent areas are located. It is probable that three of these species inhabit the project area. Only one specie of the amphibians inhabiting the project area has been determined to be of high interest to the State of Utah (Appendix A).

The tiger salamander is a yearlong resident animal that may inhabit the project area. The substantial value use area for the adult form is represented by any moist underground site or any similar habitat such as inside rotten logs, cellars or animal burrows. Such sites can be found within any wildlife habitat extending from the cold desert (upper Sonoran life zone) through the submontane (Transition life zone) and into the montane (Canadian life zone) ecological association. The larva form, often referred to as a mud-puppy, is a gilled animal that must remain in water within the above described ecological associations. It is interesting to note that the larva may fail to transform into an adult, even after their second season, and they can breed in the larva condition.

Once the larva is transformed into the adult form the animal is primarily terrestrial. Salamanders do migrate to water in the spring for breeding and

may remain there during much of the summer. Such an intensive use area would be ranked as being of high-priority value to the animal. In September the newly transformed animals leave the water to find suitable places to spend the winter.

The tiger salamander breeds from March through June and is sexually mature after one year. The male deposits a small tent-shaped structure containing a myriad of sperm on the pool bottom. During courtship the female picks up this structure in her cloaca; then the eggs are fertilized internally before or just at the time they are laid. The eggs, singly or in small clusters, adhere to submerged vegetation; after 10 to 12 days they hatch. Obviously, a critical period for maintenance of the population is when breeding salamanders, eggs or their larva are inhabiting a water.

Post-embryonic development of a salamander's larval form progresses at a pace somewhat controlled by water temperature; in some cold waters the larva may not transform into an adult and drying up of a pool may hasten the process.

Migration to or from water usually occurs at night, during or just after a rain storm. When inhabiting terrestrial sites the tiger salamander is most active at night, particularly on rainy nights, from March through September.

Larva, when small feed on aquatic invertebrates and become predacious to the point of cannibalism when they are larger. Food items for adults include insects, earthworms and occasionally small vertebrates.

No amphibians have relative abundances that are so low to have caused the animal to be federally listed as a threatened or endangered species.

Reptiles--Species Occurrence and Use Areas

Fifteen species of reptiles, all of which are protected, are known to inhabit the biogeographic area in which the mine plan and adjacent areas are located. It is probable that all of these species inhabit the project area. Only one specie of the reptiles inhabiting the project area have been determined to be of high interest to the State of Utah (Appendix A).

The Utah milk snake is a yearlong resident animal of the project area. Its

substantial value use area encompasses all wildlife habitats extending from the upper Sonoran (cold desert life zone) through the submontane (Transition life zone) and into the montane (Canadian and possibly Hudsonian life zone) ecological associations. Although its use area spans a multitude of habitats, the animal is extremely secretive, mostly nocturnal and is often found inside or under rotten logs, stumps, boards, rocks or within other hiding places. At night they can be found in the open where they hunt for small rodents, lizards and other small snakes. Occasionally, the milk snake may take small birds or bird eggs.

The milk snake may live beyond twenty years and it becomes sexually mature during its third spring season. After mating, which occurs during spring or early summer when they are leaving the den, female milk snakes produce clutches which average seven eggs. The eggs are secreted in a moist warm environ and then abandoned; incubation lasts 65 to 85 days. The site where an individual snake has deposited its clutch of eggs is of critical value to maintenance of the species.

To date snake dens, which are protected and of critical value to snake populations, have not been identified on or adjacent to the project area. It is important to note that inventory for such has not been attempted. If the Company at some later time discovers a den it should be reported to the Utah Division of Wildlife Resources. If a den(s) is currently known, its location must be included with the permit application.

No reptiles have relative abundances that are so low to have caused the animal to be federally listed as a threatened or endangered species.

Birds--Species Occurrence and Use Areas

Two hundred forty-four species of birds, all of which are protected, are known to inhabit the biogeographic area in which the mine plan and adjacent areas are located. It is probable that one hundred six of these species inhabit the project area. Twenty-eight species of the birds inhabiting the project area

have been determined to be of high interest to the State of Utah (Appendix A).

The project and adjacent areas provides substantial valued habitat for a multitude of raptors--turkey vulture, bald and golden eagles, four species of falcons (prairie, American peregrine and arctic peregrine falcon and American kestrel), five species of hawks (goshawk, sharp-shinned, Cooper's, red-tailed and Swainson's hawks) and seven species of owls (barn, screech, flammulated, great horned, pygmy, long-eared and saw-whet owls). Many of these species are of high federal interest pursuant to 43 CFR, 3461.1 (n-1). All of these species are of high interest to the State of Utah (Appendix A).

Realistically, nesting habitat does not exist on the project or adjacent areas for most, if not all, of these species. However, if a species were to nest on or adjacent to the project area, it would have a specific crucial period during which the aerie would need protection from disturbance; this period of time lies between February 1 and August 15. Generally speaking, aerie represent a critical valued site and need protection from significant or continual disturbance within a one-half kilometer radius of the nest. This consideration need only be implemented during the period of time that the nest is occupied. Species specific protective stipulations for aeries are available from the Utah Division of Wildlife Resources and the U.S. Fish and Wildlife Service.

The current level of data relative to site specific use of the area by raptors is unsatisfactory. Likely, there are aeries that have not been identified. Many of these species are highly sensitive to man's disturbances. Therefore, it is recommended that intensive surveys be initiated on the mine plan and adjacent areas for determination of locations for raptor aerie territories. Such data needs to be merged with information provided within this report.

Golden eagles are a common yearlong resident of the mine plan area. To date no active aerie territories are known. (Note, an aerie territory is utilized by one pair of eagles but may contain several nest sites.) It is believed that aerie territories may exist on the project area. This belief is based upon

the fact that suitable nesting habitat is widespread on the mine plan area and throughout the local area.

An active golden eagle nest site is extremely sensitive to disturbance within a one-half kilometer radius. This buffer zone is ranked as being of critical value to maintenance of the eagle population when the bird is actually utilizing the aerie; that period of time is normally between April 15 and June 15. The radius for a buffer zone may need to be increased to one kilometer if a disturbance were to originate from above and within direct line of sight to the eagle aerie.

To date there are no known high-priority concentration areas or critical roost trees for golden eagles on the project area. The mine plan and adjacent areas have been ranked as being of substantial value to golden eagles.

The northern bald eagle is an endangered winter resident (November 15 to March 15) of the local area. To date there are no known high-priority concentration areas or critical roost trees for this species on or adjacent to the project. The mine plan area has been ranked as being of substantial value to wintering bald eagles. Note that no bald eagles are known to nest in Utah, however, historic data documents nesting activity by these birds in the State. There is no known historic evidence of the northern bald eagle nesting on the mine plan or adjacent areas.

The American peregrine falcon (status is endangered) and the prairie falcon (status is common) are yearlong residents of the mine plan and adjacent areas. Each of these species utilizes cliff nesting sites. To date there are no known aerie sites for cliff nesting falcons on the project area. However, suitable nesting habitat for the prairie falcon is widespread. Suitable nesting habitat for the American peregrine falcon cannot be found on the mine plan and adjacent areas. The project area has been ranked as being of substantial value to these two cliff nesting falcons.

For each falcon their aerie site while being utilized and a one-half kilo-

meter radius would be ranked as being of critical value to maintenance of their populations. The falcon's period of use at the aerie site spans the spring and early summer period--prairie falcon, April 15 to June 30; peregrine falcon, March 1 to June 30.

The level of data relative to site specific use of the project area by cliff nesting falcons (not including the kestrel) is unsatisfactory and there could be aeries that have not been identified. Therefore, it is recommended that intensive surveys be initiated on the area for determination of locations for cliff falcon aerie sites.

The endangered arctic peregrine falcon is a winter resident (November 15 through March 15) of the local area. This species has not been observed to utilize the environs on or adjacent to the mine plan area, however, its occasional presence would not be unlikely. Therefore, the project area is ranked as being of limited value to this species.

The blue grouse is a yearlong resident of the project area. Adult birds prefer open stands of conifers. During winter the blue grouse feeds exclusively upon needles and buds of douglas-fir and spruce trees. Thus, this wildlife habitat (spruce-fir forest) is ranked as being of critical value to over-winter survival of the population during the crucial period of December through February.

Blue grouse annually exhibit what has been termed a reverse vertical migration. That is, during the spring months, they migrate from the high elevation spruce-fir habitat to lower elevation sagebrush, pinion-juniper or shrubland habitats. This movement is caused by a need of the birds to feed on early developing vegetation. Such movement also facilitates successful breeding, nesting and brooding of their young. Then as the year progresses, they move to the higher elevations.

The males are polygamous and will set up and defend territories for booming and breeding activities against other breeding males. Such territories are critical to maintenance of the population during the crucial period of mid-March through mid-June.

After breeding the female develops a nest site which is secreted on the ground; the nest is of critical value to maintenance of the blue grouse population. Upon hatching, which occurs in late May and early June, the young accompanied by the hen immediately leave the nest. The young blue grouse while being brooded rely heavily on insects for their protein needs during the first several months of development. The adult bird also shifts its diet during this period to include a high proportion of insects. Brooding areas are ranked as being of high-priority value to blue grouse. The crucial period extends from hatching into mid-August.

As summer progresses into the fall season the grouse consumes large quantities of berries.

The chukar is a yearlong resident of the project area. It is important to note that they are an exotic species introduced from Asia during the 1950's. These birds prefer open rocky areas in the cold desert and submontane ecological associations. During summer chukars feed on grass shoots and insects, but during winter their diet is primarily seeds. Their substantial valued habitats are the cliff and tallus type and the associated desert scrub or shrubland types.

The winter season is a crucial period (early December through mid-February) for chukars; the birds concentrate on selected areas. Winter range has been ranked as being of critical value to over-winter survival of the chukar populations. Disturbance on winter range must be avoided when chukars are present.

Chukars are monogamous; the pairs nest between early April and late May. Nest sites are critical to maintenance of the population during the crucial nesting period.

It is important to note that all sources of water within the substantial valued use area for chukars are critical to maintenance of their populations on a yearlong basis.

Mourning doves normally inhabit the project and adjacent areas, which represents a substantial valued use area for these birds, between May 1 and September

15 each year. They nest throughout most of this period and each pair produces two clutches. The pinion-juniper and riparian habitats are ranked as being of high-priority value for nesting. Locally, mourning doves show two peaks in on-nest activity--early July and early August. Successful nesting activities and any water sources are critical to maintenance of the mourning dove population.

The black swift is a summer resident of the West Tavaputs Plateau. The montane ecological association represents the swift's substantial valued use area. Normally, the bird is associated with a small flock that represents a colony. Black swifts are usually observed soaring as pairs and they feed upon flying insects. A colony's nests are scattered along percipitous terrain where the nest is often secreted behind a waterfall. Such a moist habitat is not known to exist on the project area. Cliff and tallus wildlife habitats are ranked as being of high-priority value to the black swift. There is evidence that pair bonds are long lasting and that a nest may be utilized in successive years.

The pileated woodpecker is a species having high federal interest pursuant to 43 CFR 3461.1 (n-1). The spruce-fir and aspen wildlife habitats of the montane ecological association represent this birds substantial valued use area. It is important to note that the pileated woodpecker has never been documented to utilize the environs of the biogeographic area that surrounds the project site. In areas of the State where the bird is known to exist, it is a yearlong resident with a relative abundance considered to be rare.

The Williamson's sapsucker is another species having high federal interest pursuant to 43 CFR 3461.1 (n-1). Typically, the substantial valued use area for this species is the spruce-fir habitat of the Hudsonian life zone in the montane ecological association. Therefore, the spruce-fir habitat of the Canadian life zone on the project site would only represent the substantial valued use area for the yellow-bellied sapsucker. The yellow-bellied sapsucker is a yearlong resident of the environs associated with the project area and it has a relative abundance considered to be common. Where as the Williamson's sapsucker has never

been documented to utilize the environs of the biogeographic area that surrounds the project site. In areas of the State where the Williamson's sapsucker is known to exist, it is a summer resident with a relative abundance considered to be uncommon.

The Lewis woodpecker is also another species having high federal interest pursuant to 43 CFR 3461.1 (n-1). Its substantial valued use area is represented by riparian habitats characterized by cottonwood stands and ponderosa forests. These habitats do not exist on the project site. It is important to note that the Lewis woodpecker has never been documented to utilize the environs of the biogeographic area that surrounds the project site. In areas of the State where the bird is known to exist, it is a summer resident or only a transient. Its relative abundance is unknown.

The western bluebird is an uncommon summer resident known to inhabit the environs of the biogeographic area that surrounds the project site. Where as the mountain bluebird is a common yearlong resident of the area. Both birds are cavity nesting species. The western bluebird nests from the pinion-juniper habitat of the submontane ecological association up into the lower forest habitats within the Canadian life zone of the montane ecological association. The mountain bluebird utilizes the same continum of habitats for nesting, but also extends its nesting use across the Canadian and Hudsonian life zones and into the Alpine life zone. During winter both species show elevational and longitudinal migrations; they then utilize all habitats associated with the cold desert ecological association. Therefore, the substantial valued use area for each species spans a broad continum of habitats. It is important to note that trees with cavities located on the project area can be of critical value to bluebirds.

Grace's warbler is a species having high federal interest pursuant to 43 CFR 3461.1 (n-1). Its substantial valued use area is shrublands and associated ponderosa forest habitats of the submontane and montane ecological associations. This bird's nest is built twenty or more feet above ground in a ponderosa tree.

It is important to note that the Grace's warbler has never been documented to utilize the environs of the biogeographic area that surrounds the project site. In areas of the State where it is known to exist, it is a summer resident with a relative abundance considered to be uncommon.

Scott's oriole is also a species having high federal interest pursuant to 43 CFR 3461.1 (n-1). Its substantial valued use areas are riparian habitats characterized by cottonwood stands and the continum of habitats extending from the pinion-juniper forest into shrublands of the submontane ecological association. The oriole's nest is characterized as a grassy pouch and is hung in a tree. It is important to note that the Scott's oriole has never been documented to utilize the environs of the biogeographic area that surrounds the project site. In areas of the State where it is known to exist, it is a summer resident with a relative abundance considered to be uncommon.

The grasshopper sparrow is a rare transient species known to inhabit the environs of the biogeographic area that surrounds the project site. It only frequents dry grassland areas in the desert scrub habitat of the cold desert ecological association during spring and fall migration periods; the project borders such areas. Since its use of such sites is best described as "occasional", those habitats in the region are only ranked as being of limited value to the bird.

Mammals--Species Occurrence and Use Areas

Eighty species of mammals, of which 22 percent are protected, are known to inhabit the biogeographic area in which the project and adjacent areas are located. It is probable that sixty of these species inhabit the project area. Seventeen species of the mammals inhabiting the project area have been determined to be of high interest to the State of Utah (Appendix A).

The dwarf (least) shrew is a yearlong inhabitant of the biogeographic area that surrounds the project site. This animal's substantial valued use area is characterized as open grass covered areas of any wildlife habitat in the submontane and montane (Canadian life zone) ecological associations. Since this

shrew has a relative abundance determined to be limited, its use areas should be ranked as being of high-priority value to the animal.

The red bat is a summer resident of the biogeographic area that surrounds the project site. The animal roosts in wooded areas (riparian woods and pinion-juniper forests) of the submontane ecological association. Such areas represent this animals substantial valued use area. An occasional individual has been known to utilize caves; those individuals could hibernate and remain over winter.

The western big-eared bat is a yearlong resident of the biogeographic area that surrounds the project site. This animal roosts and hibernates within caves, mine tunnels or suitable buildings located in the pinion-juniper, shrubland and low elevation spruce-fir habitats of the submontane and montane (Canadian life zone) ecological association. Such areas represent this bats substantial valued use area.

The cottontail rabbit (mountain cottontail inhabits sites lying between 7,000 and 9,000 feet in elevation and the desert cottontail inhabits sites lower than 7,000 feet in elevation) is a yearlong resident of the biogeographic area that surrounds the project site. The entire project area represents a substantial valued use area for cottontails. Their young are born between April and July. This is a crucial period for maintenance of the cottontail population.

The red fox and kit fox are yearlong inhabitants of the biogeographic area that surrounds the project site. The substantial valued use area for the red fox would include all wildlife habitats extending from the cold desert through the montane (Canadian life zone) ecological associations. The substantial valued use area for the kit fox is restricted to all of the habitats of the cold desert ecological association and extends into the sagebrush and pinion-juniper habitats of the submontane ecological association. Almost nothing is known of their population dynamics. Without doubt a crucial period for both species is when they are caring for young in the den. Dens while being inhabited are a critical use area.

The gray wolf is a historic inhabitant of the biogeographic area that surrounds the project site. Currently its relative abundance is so low that the animal is listed as endangered with extinction. The wolf's substantial valued use area would be represented by any remote habitat in any ecological association.

Black bears are inhabitants of the biogeographic area that surrounds the project site. Their substantial valued use area is represented by all natural wildlife habitats (excluding the pasture and fields and urban or park types) extending from the submontane into the montane (Canadian and Hudsonian life zones) ecological associations. These animals go into a semi-hibernation during winter. During this crucial period, which may last from December through March, the animal secrets itself in a den in order to conserve body energy reserves. The young are born in the den during January or February. Dens while being inhabited represent a critical valued use area for bears.

The wolverine and badger are the only members of the family mustelidae having potential to inhabit the biogeographic area that surrounds the project site. They are protected and classified as furbearers.

The substantial valued use area for wolverine is the montane ecological association. This specie may be found in the environs of the project site.

The substantial valued use area for badger spans all wildlife habitats other than dense forests in the cold desert, submontane and montane (Canadian life zone) ecological associations. They are dependent upon a suitable prey source.

A crucial period for maintenance of all furbearer populations is when they have young in a den. Such sites are critical for reproductive success.

Bobcat and cougar are known to inhabit the biogeographic area that surrounds the project site. For both of these species a crucial period for maintenance of their population is when the female has her young secreted at a den site. Such sites are of critical value when being utilized. It is also crucial to their survival that a female accompanied by young not be killed or harassed.

The substantial valued use area for bobcats extends from the cold desert through the submontane and into the montane (Canadian life zone) ecological association. The bobcat is normally associated with percipitous terrain, but has been observed in every wildlife habitat within the aforementioned ecological associations. Their primary prey source is represented by small mammals and birds or any other small animal they can catch. It is important to note that bobcats occasionally do kill the young of big game animals.

The substantial valued use area for the cougar (locally known as mountain lion) extends from the submontane into the montane (Canadian and Hudsonian life zone) ecological association. Due to the dependency of the cougar upon mule deer as a prey source, a ranking of the lion's seasonal distribution parallels that of the deer.

Mule deer are inhabitants of the biogeographic area that surrounds the project site. Their substantial valued use area spans all wildlife habitats extending from the cold desert through the submontane and montane ecological associations. In some situations deer show altitudinal migrations in response to winter conditions. There are, however, habitats where deer reside on a yearlong basis.

Migration of mule deer from summer range to winter range is initiated during late October; probably, the annual disturbance of the fall hunting season coupled with changing weather conditions is the initial stimulus. The onset of winter weather reinforces the deer's urge to migrate and continued adverse weather keeps the deer on the winter range.

The project site represents winter range for mule deer herd unit 27b. Winter ranges for mule deer are all ranked as being of high-priority value to the animal; these areas are usually inhabited between November 1 and May 15 each year. During winters with severe conditions the higher elevation portion of the winter range becomes unavailable to deer due to snow depth. Traditionally, some restricted portions of the winter range have shown concentrated use by the deer; these sites are ranked as being of critical value. Critical valued sites must be protected from man's disturbance when the deer are physically present on the

range (see attached map).

Deer begin their migration back to summer range during mid-May and remain there throughout October. There are no summer ranges on the project area.

Mule deer fawn during the month of June. The continum of wildlife habitats extending from the pinion-juniper through the shrubland and into the aspen type probably represents the fawning area. All riparian areas are of critical value for fawning and maintenance of the deer population. To date no specific areas showing annual use for fawning are known. It is probable that such areas exist; they would be ranked as being of critical value to deer. It is important to note that June represents a crucial period for maintenance of deer populations.

Rocky mountain elk are inhabitants of the biogeographic area that surrounds the project site. Their substantial valued use area spans all wildlife habitats extending from the submontane through the montane ecological association. Elk do not show as strong of altitudinal migration as mule deer do in response to winter conditions, but they do migrate to wintering areas.

Migration of elk from summer range to winter range is initiated during late October; probably, the annual disturbance of the fall hunting seasons coupled with changing weather conditions is the initial stimulus. The onset of winter weather reinforces the elk's urge to migrate and continued adverse weather keeps elk on the winter range.

The project site represents winter range for the Avintiquin elk herd. Winter ranges for elk are ranked as being of either high-priority or limited value to the animal; these areas are usually inhabited between November 1 and May 15 each year (see attached map).

During winters with severe conditions some portions of the winter range becomes unavailable to elk due to snow depth. High-priority valued sites need to be protected from man's disturbance when the elk are physically present on the range.

Elk begin their migration back to summer range during mid-May and remain

there throughout October. There are no summer ranges for elk on the project area.

Elk calf during the month of June, but no animals would be expected to calf on the project area.

Currently, there are no other known high interest wildlife species or their habitat use areas on or adjacent to the project area. It is not unreasonable to suspect that in the future, some additional species of wildlife may become of high interest to the local area, Utah or the Nation. If such is the case, the required periodic updates of project permits and reclamation plans can be adjusted and appropriate recommendations made.

4.2 Productivity

Only topsoil will be used, according to the reclamation plan outlined in Chapter III, Part E re Reclamation.

5. Topsoil Handling During Operations

5.1 Removal

The area from which topsoil was removed is approximately 30 acres and includes poorly developed soils. Using dozers and front end loaders, the soil was scraped from the surface and dumped at a site near the facility location. The topsoil was removed as a separate operation from areas to be disturbed by surface installations such as roads and areas upon which support facilities are sited.

5.2 Storage

The topsoil storage area is shown on Plate VI . The topsoil has been segregated, stockpiled, and protected from wind and water erosion and contaminants through revegetation and the use of berms.

6. Reclamation of Topsoil and Substitute

Disturbed areas no longer required for the conduct of mining operations have been revegetated. Upon completion of mining activities, topsoil will be distributed and reclamation will commence as outlined in Chapter III, Part E re Reclamation. Andalex will adhere to all UDOGM guidelines

G. Alluvial Valley Floors

The permit area is not located in the presence of an alluvial valley floor.

H. Land Use Information and Post-Mining Land Use

1. Introduction

Due to the rugged topography and sparse rainfall, the land area is presently used only for grazing, wildlife habitat, and outdoor recreation. Historically, the land has also been used for coal mining.

2. Condition, Capability, and Productivity of the Land

Livestock grazing has been the most intense use of the lease area. However, due to the expansive cliff formations and the roughness of the canyon walls, grazing has been principally limited to the canyon bottoms and extreme tops to the north of the lease boundary.

Mule deer are found within the lease area as well as the usual small mammals, predators, and passerine and raptorial birds.

Outdoor recreation in the lease area is limited and usually related to enjoyment of the open space and associated scenic facilities and hunting for wild animals. The number of people using the area is small due to the rough terrain, poor roads, and lack of water.

3. Past Mining

The initial development of the Book Cliffs Coal Field was started in the early 1890's. By the early 1900's practically the entire field had been prospected. Mines in the lease area were not active until the 1920's because the cliffs were less accessible and the coal beds were thinner.

The Knight-Ideal mines, now held by Eureka Energy Corp., are located approximately two miles east of the lease area. Initial prospecting took place at this location in 1906 and extensive mining began in 1948 and ceased in 1958. During this period, 1,680,000 tons of coal were produced from the Gilson seam.

Three mines on or adjacent to the lease area in Deadman Canyon were the Zion, Olsen, and Sutton (Blue Flame) mines. The Zion was located on the Zion's fee lease and the Olsen and Sutton were on SL-027304. The first two produced from the Gilson seam and the last produced from the Aberdeen or Castlegate "A" seam. Production figures are not reliable but it is estimated that between 216,000 tons and 720,000 tons may have been produced from the Sutton mines. The Olsen mines produced about 18,000 tons and the Zion mine around 240,000 tons, between 1924 and 1944.

There was also a prospect entry driven in the Lower Sunnyside Seam (the Hileman) on lease U-010581 from which production was insignificant, approximately 1,400 tons. Mining ceased in the area in 1964.

4. Existing Use

The Deadman Canyon area would fall into two land use categories: 1) Fish and Wildlife habitat and recreation lands, and 2) Range lands. County zoning regulations (1974) indicate all lands involved in the lease application area are within zone M and G1 which is for mining and grazing. Current land use consists of grazing and deer hunting. For recreational purposes the land is suitable only for deer hunting. The snow cover is too light and slopes too steep for snowmobiling, cross-country skiing, and snow shoeing. The lack of water prevents the establishment of a chukkar/partridge population. Usually there are no elk in the area although an animal or two may occasionally wander onto the area.

There are no oil and gas wells or water wells other than those water wells drilled by Tower for use in mining activities, on the lease area.

The area is eight air miles from Price, but the unavailability of water precludes any development for residential or summer homes.

5. Impacts of Operations

5.1 Socioeconomic Impacts

The proposed project is located in an area where coal mining is the major industry, therefore, the community is geared for coal operations. The labor supply is excellent, well-trained, and available. Most people in this area have a very favorable attitude towards the increased coal activity. They look forward to growth in the area which will increase population, home construction, and provide other facilities for community use.

The need for development of additional housing, school space, and changes in present community services would be among the greatest impacts, due to the increase in population. Positive effects of the project will be to increase the number of jobs, payroll, and taxes thus helping to build the community.

5.2 Land Use Changes

The nature of an underground mine of this type and size requires minimal surface disturbance. The limited resources both physical and scenic will dictate no future change in land status. Considering the extent and nature of similar lands in the Book Cliffs, no uses other than those previously discussed can be forecast.

Deadman Canyon has been unsightly since the earliest mining began in the 1920's the new mine surface facility and portal site will be in the same area as the old mine tipples and waste dumps. These waste dumps are numerous and located throughout the canyon bottom and consist of coal fines which were unmarketable during the earlier mining history. This coal waste has been recovered, reprocessed, and cleaned up during the new operation. This new operation will actually be a significant reclamation phase to the canyon area.

During and after completion of mining operations, the land will continue to be used for grazing and hunting. No future change is dictated in the land status. Surface disturbances will be very minimal and all disturbed land will be restored in a timely manner, according to the Reclamation Plan outlined in Chapter III, to conditions that are capable of supporting the uses they were capable of supporting before mining.

6. Post-Mining Land Use

6.1 Comments of Owners of Surface Disturbed Areas and State and Local Agencies

As there are no proposed land use changes and minimal surface disturbance, there have been no negative comments from legal or equitable owners of record of surface areas to be affected or from any state or local agencies.

6.2 Consideration given to Comments

The proposed mining activities are consistent with surface owner plans and state and local land use plans. However, full consideraiton will be given to any future comments concerning this mining activity.

6.3 Methods to Achieve Post-Mining Land Use

As previously discussed, there will be minimal surface disturbances and no change in land use. As discussed in Part H, Section 5.2 of this Chapter re Land Use Changes, this operation will be a significant reclamation phase in the Deadman Canyon area. All disturbed areas shall be reclaimed and revegetated as described in Chapter III, Part E re Reclamation and Chapter IV, Part D, Section 5 re Revegetation Plan.

I. Cultural and Historic Resources

1. Identification and Description of Resources

1.1 Archaeology

To assure that no archaeological or historical sites existed in the proposed permit area, which would be impacted by the development of the coal resources, two reconnaissance surveys have been conducted.

The Department of Anthropology and Archaeology of Brigham Young University was employed to conduct a survey of the Deadman Canyon Area. A report of this survey by Terry Walker, prepared under the direction of Professor Ray T. Matheny of Brigham Young University is attached as Exhibit IV-E. A survey of Fiasco Canyon, Starpoint Canyon, and Straight Canyon was conducted by the Consulting Services Branch of the Antiquities Section, Division of State History, Salt Lake City, Utah. A report of this survey was prepared by Bruce Hawkins and Gregory S. Seward under the supervision of Asa S. Nielson and is also attached as Exhibit IV-E.

Authorization to conduct these surveys was granted by the Bureau of Land Management, as the majority of the surface described above is under the jurisdiction of the B.L.M.

Prior to these investigations, no recorded archaeological studies of any kind had ever been done in the survey area.

In the Deadman Canyon area study by Walker, no archaeological or historical sites were found. In the Fiasco-Straight Canyon study by Hawkins and Seward, six historic sites were encountered, early 20th century construction associated with mining, and a seventh site was historic graffiti. All were lacking National Register qualifications. In the opinion of the Archaeologists performing the studies, none of the sites encountered should impede development.

1.2 Paleontology

The project area has not been surveyed for paleontological resources. However, the mine plan area is located in a potential fossil-bearing area of slight value according to the United States Department of the Interior, Final Environmental Statement, Development of Coal Resources in Central Utah, Regional Analysis Part 1, Figure II-7 (Map of central Utah vertebrate and plant fossil bearing area.)

1.3 Public Parks

There are no public parks in the proposed permit area or nearby vicinity.

1.4 Other

No other cultural or historic resources are known to exist in the area.

2. Protection

Since there are no public parks or archaeological or historic sites which will be adversely affected by the proposed operation, no specific protection plan is deemed necessary.

VOLUME II

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Plate #	Plate Title
1.	General Location Map
2.	Surface Ownership
3.	Book Cliffs Mineral Ownership
4.	Leases
5.	Surface Area Boundry
6.	As Constructed Surface Facilities - Deadman Canyon
7.	As Proposed Surface Facilities - Deadman Canyon
8.	Support Facilities - Surface Area Drainage
9.	Watershed & Culvert Sizing
10.	Sediment Pond A - As Constructed
11.	Sediment Pond B - As Constructed
12.	Sediment Pond C - As Constructed
13.	Sediment Pond E - Proposed Aberdeen Surface
14.	Cut & Fill Cross Section Reference Sheets A & B
15.	Cut & Fill Cross Sections
16.	Final Reclamation Contours
17.	Final Reclamation - Cut & Fill Cross Sections
18.	Soil Survey Map - Deadman Canyon
19.	Vegetation Survey Map - Deadman Canyon
20.	Revegetation Map
21.	Surface Geology of the Andalex Resources Mine Plan Area
22.	Cross Section Reference (Geologic)
23.	Cross Section A-A'
24.	Cross Section B-B'
25.	Subsidence Monitoring Plan
26.	Lower Sunnyside Seam Isopach
27.	Gilson Seam Isopach
28.	Aberdeen Seam Isopach
29.	Proposed Mine Plan Lower Sunnyside Seam
30.	Proposed Mine Plan Gilson Seam
31.	Proposed Mine Plan A Seam
32.	Pinnacle Mine Current Mine Plan
33.	Apex Mine Current Mine Plan
34.	Wildlife Distribution Map
35.	Typical Road Cross Section

VI. Preparation of Application

A. Persons and Consultants Involved

The following persons and/or organizations were involved in collection and analysis of the technical data set forth in this application.

1. In House Consulting Services

a) Andalex Resources, Inc. - AMCA Coal Leasing, Inc.
Samuel C. Quigley - Western Project Manager
Michael W. Glasson - Senior Geologist
Allen D. Emmel - Environmental Planning Coordinator

2. Outside Consulting Services

a) Dan W. Guy - Registered Professional Engineer
(State of Utah No. 4548)
Price, Utah
-Sedimentation and Drainage Control Plan (April 1980)
-Wastewater Disposal System; Pinnacle Mine (April 1980), Office Building (September 1980)

b) Bruce T.S. Ware - Registered Land Surveyor
Price, Utah

c) A and W Surveying
Price, Utah

d) Commercial Testing and Engineering Co.
Denver, Colorado

e) Standard Laboratories
Huntington, Utah

f) Western Testing and Engineering
Helper, Utah

g) VanCott, Bagely, Cornwall and McCarthy
Attorneys at Law
Salt Lake City, Utah

h) Rollins, Brown, and Gunnel
Provo, Utah

i) Brigham Young University
Provo, Utah
Department of Zoology
Clayton M. White
(Raptor Study)
Department of Anthropology/Archaeology
Dr. Ray T. Matheny
(Archaeological Survey)

j.) Earth Environmental Consultants
Albuquerque, New Mexico.

K \ Vaughn Hansen Associates
Salt Lake City, Utah
(Hydrology Study)

B. Coordination and Consultation with Governmental Agencies

The following governmental agencies were consulted in the preparation of information set forth in this application.

U.S. Department of Agriculture
Soil Conservation Service
Price, Utah
(Soil and Vegetation Survey)

U.S. Department of the Interior
Bureau of Land Management
Price, Utah
Salt Lake City, Utah

Office of Surface Mining, Reclamation and Enforcement
Denver, Colorado

U.S. Geological Survey
Salt Lake City, Utah

State of Utah
Department of Natural Resources
Division of Oil, Gas, and Mining
Salt Lake City, Utah

Antiquities Section (Consulting Services Branch)
Salt Lake City, Utah
(Archaeological Survey)

Department of Natural Resources
Division of Fish and Wildlife
Salt Lake City, Utah

C. References

AMCA Coal Leasing, Inc., 1978. Mining and Reclamation Plan, Zion's Fee. Submitted to the State of Utah, Department of Natural Resources, D.O.G.M.

Centennial Coal Associates, 1976. Mining Application. Submitted to the U.S. Geological Survey.

Doelling, H.H., 1972. Central Utah Coal Fields. U.G.M.S. Monograph Series No. 3.

U.S.D.A., 1978. Soil Survey and Interpretations of the Coal Creek Emery Portion of the Price River and Emery County Areas, Carbon and Emery Counties, Utah. S.C.S.

U.S.D.I., 1979. Final Environmental Statement, Development of Coal Resources in Central Utah, Parts 1 and 2.

U.G.M.S., 1966. Central Utah Coals. U.G.M.S. Bulletin No. 80.

VII. Cross Reference Table - Regulation in 30 CFR, Chapter VII.

The cross reference tables appearing here are included to provide a rapid completeness check of this application by the reviewer.

A. Subchapter G

1. Part 782 - Legal, Financial, Compliance, and Related Information.

Regulatory Paragraph	Text Reference
782.13	II A (1-3)
782.14	II B (1-3)
782.15	II C (1-3)
	II D
782.16	II E (1-6)
782.17	II F
782.18	II G
782.19	II H
782.20	II I
782.21	II J

2. Part 783 - Environmental Resources

Regulatory Paragraph	Text Reference
783.12	IV I
783.13	IV A (1-3)
	IV B (1-2)
	II D (1)
783.14	IV A (1-3)
783.15	IV B (1-2)
783.16	IV B (1-2)
783.17	IV B (2)
783.18	IV C
783.19	IV D (1-3)
783.20	IV E (1-4)
783.21	IV F (1,2,4)
783.22	IV H (1-4)
783.24	V
783.25	V
783.27	IV F (3)

3. Part 784 - Reclamation and Operation Plan

Regulatory Paragraph	Text Reference
784.11	III A
	III B (1-12)
	III C
	III E (3)
784.12	III A
	III B (1-2)
784.13	III A
	III B (2,4,5)
	III E (2,3,4)

Regulatory Paragraph	Text Reference
	IV D (5)
	IV F (2,5,6)
784.14	III D (1)
	IV B (3,4)
784.15	III E (1)
	IV H (6)
784.16	II B (8)
784.17	II D (6)
	IV I
784.18	II E (4)
	III D (7)
784.19	III B (10)
	III D (5)
784.20	III B (14)
	III D (2)
	IV B (2,4)
784.21	III D (3)
	IV E (5)
784.22	III B (12)
784.23	V
784.24	III B (7)
784.25	III B (10)
	III C (2)
784.26	III D (4)

4. Part 785 - Special Mining Categories

Regulatory Paragraph	Text Reference
785.11-16	Not Applicable
785.17	III D (8)
	IV F (3)
785.18	Not Applicable
785.19	III D (9)
	IV G
785.20	Not Applicable
785.21	III B (6)
785.22	Not Applicable

B. Subchapter J (Parts 800-806) - Bonding and Insurance

Regulatory Paragraph	Text Reference
800	III E (4)
	II G
805	III E (4)
806	III E (4)
	II G

C. Subchapter K (Parts 817-828) - Performance Standards

Regulatory Paragraph	Text Reference
817.11	III B (16)
817.13-15	III E (3)
817.21	III B (3)
	IV F (5,6)
817.22	III B (4)
	IV F (5)
817.23	III B (4)
	IV B (5)
817.24	III E (3)
	IV D (5)
	IV F (4,6)
817.41-50	III B (8,12,14)
	III D (1,2)
	IV B (3,4)
	IV D (5)
817.52	III B (14)
	III D (1)
	IV B (3,4)
817.53-55	Not Applicable
817.56	III E (2,3)
817.57	Not Applicable
817.59	III C (2)
817.61-68	III B (3)
817.71	III B (10)
817.72-93	Not Applicable
817.95	III D (4)
817.97	III D (3)
	IV E (5)
817.99	
817.100-117	III E
	IV D (5)
817.121-126	III B (14)
	III D (2)
817.131-132	III E (3,4)
817.133	III E (1)
	IV H
817.150-180	III B (7)
817.181	IV B (1-10)
818-825	Not Applicable
826	
827	III B (6)
828	Not Applicable

Attachment 1

	UMC	Section*	Page
(1) 211.10 (c)(1) Names, addresses, and telephone numbers of persons responsible for operations under the plan to whom notices and orders are to be delivered, and the names and addresses of surface owners of record, and owners of record of subsurface minerals, if other than the United States.	782.13 (a)	2.2	Vol. I: pp. 7-8, 11-12 Vol. II: Plates III, IV Addendum B: pp. 1-2
211.10 (c)(2) A description of geologic conditions, with maps and tables where appropriate, within the area where mining is to be conducted and including any Logical Mining Unit. Such description shall include, as a minimum, potential geologic hazards; and a description of the structural features of the coal and overlying strata, including faults, cleats, joints and fractures and any other information which would affect the orientation of the mine or production methods.	783.14	3.3 6.0	Vol. I: pp. 49-63 Vol II: Plates II, XV, XVI, XVII, XVIII Addendum A: Part II, Laboratory Analysis Addendum B: p. 3 Plate XXII
211.10 (c)(6)(i) The nature and extent of the coal deposit in terms of Btu content, ash, water, sulphur, volatile matter and carbon content, and any other available information that may affect blending or combustion and including estimated recoverable reserves. The recoverable reserves shall be reported for all coal seams of mineable thickness, considering the type of mining and the value of the coal. (This information must conform with the requirements of General Mining Order No 1.)	783.25 (c), (d)	3.3.1 6.5.5.2	Vol. I: pp. 4, 25, 33, 38, Exhibit IV-B
211.10 (c)(6)(ii) The method of mining, including mining sequence and proposed production rate; the plan for any lease issued or readjusted after August 4, 1976, must provide for the mining of all the reserves of the logical mining unit of which the lease is a part in a period of not more than forty years; that period shall begin on the date of approval of the first mining plan for that logical mining unit.	784.11 (a)	3.3.1.3	Vol. I: pp. 24, 25, 32-40 Addendum B: Plates V-R, VI-R, VII-R Roof Control & Ventilation Submittal
The plan must include planned sequence of mining by year for the first 5 years and by number in 5-year increments for remainder of mine life.	783.12 (a)	3.3.1.4 3.3.7 & 3.3.8	Addendum B: Plates V-R, VI-R, VII-R

*Suggested sections listed in Utah DOGM "Permit Application Guidelines"

	UMC	Section	Page
211.10 (c)(6)(iv) The engineering techniques proposed to be used in mining. The plan shall describe the method of mining and present justifications for the method selected. The selected mining system shall conform to sound mining practices and be based on current technology and economics.	784.11 (a)	3.3.1.3 -	Vol. I: pp. 24-40 Addendum B: pp. 6, 9 Plates V-R, VI-R, VII-R
211.10 (c)(6)(v) A list of all major equipment.	784.11 (a)	3.3.4	Vol. I: pp. 37, 38-39
211.10 (c)(6)(vii) The method of operation and measures by which the operator plans to comply with the obligations and requirements set forth in 211.4 and 211.40 of this Part and any special terms and conditions of the lease, permit, or license. (This can be by a narrative statement and must include only those items related to resource recovery.)	784.13 (a)(2)	3.3.3	Vol. I: pp. 37, 38, 42-45
211.10 (c)(6)(viii) The anticipated starting and termination dates of each phase of the mining operation and number of acres of land to be affected.	782.17 (a) 784.13 (b)(1)	3.36	Vol. I: pp. 25, 26, 34, 37, 40 Addendum B: pp. 2, 6 Plates V-R, VI-R, VII-R
211.10 (c)(6)(x) The measures for ensuring the maximum practicable recovery of the mineral resource. (Sufficient data should be submitted to substantiate the anticipated recovery factor of the resource for the coal reserve base. Data includes sufficient information in the form of narrative, cross-sections, coal thickness isopachs, overburdern isopachs and quality and quantity data (Btu content, ash, moisture, sulfur, volatile matter, and fixed carbon and any other available information thay may affect blending or combustion) of all known potentially minable seams on the lands involved. The areal extent of mining of each seam to be mined should be delineated. This information must conform with the requirements of General Mining Order No. 1.)	784.13 (b)(6)	3.3.3.1	Vol. I: pp. 25, 33, 34, 37, 38 Exhibit IV-B Addendum B: Plates V-R, VI-R, VII-R
211.10 (c)(6)(xi) The method of abandonment of coal mine operations including protection of unmined coal and other mineral ressources.	784.13 (b)(8) 784.14 (d)		Vol. I: pp. 38, 46-48 Addendum B: pp. 6-7, 8, 10

	UMC	Section	Page
211.10(c)(6)(xii) Furnish complete logs of all exploration drill holes (both surface and underground) in Federal leases.	783.14 (a)(1) (ii)	6.5	Vol. I: pp. 56-59 Exhibit IV-A
211.10 (c)(6)(xiv) Plans for protecting oil, gas, and water wells as well as oil, gas, and underground water resources, when encountered.	783.25 (5)	3.3.2.1	Vol. I: pp. 12, 42, 72, 73 Addendum A: Part IV-Hydrologic Inventory
211.10 (c)(6)(xv) Any justification for not recovering any coal deposits that may be detrimentally affected in terms of future recovery by the coal developent operations proposed.	784.13 (b)(6)	3.3.3.2	Not Applicable
(If no coal preparation plant is planned and if the operator plans not to mine coal beds or portions of coal beds because of high sulfur, high ash, or other chemical or physical properties, the operator shall submit a narrative and analyses of the rationale for not mining such beds or portions of seams.)			
211.10 (c)(7) Suitable topographic maps or aerial photographs showing:			
(i) Topographic and natural drainage features, roads and vehicular trails.	783.25 (k)		Vol II: Plates I, II, XI Addendum A: Part IV-Hydrologic Inventory
(ii) The name of the watershed and location of the surface stream or tributary into which mine waters will be discharged, if applicable.	783.16 (a) 783.25 (y)		Addendum B: Plate XIX Not Applicable
(iii) Cross sections and plan views of the land to be affected, including the actual area to be mined, showing elevation and location of drill holes and depicting the following information: the nature and depth of the various strata of overburden; the nature and thickness and extent of any coal, or if rider seams above the specific coal proposed to be mined; the nature of the strata beneath the coal to be mined for a vertical distance of at least 20 meters beneath the base of the coal seam; the location of the next known deeper coal seam below the deepest seam to be mined and representative characteristics thereof; the location of any	783.25 (a) 783.25 (j)		Vol. I: pp. 53, 54, 55 Vol. II: Plates V, VI, VII, XV, XVI, XVII, XVIII Addendum A: Part IV-Hydrologic Inventory Addendum B: pp. 11, Plates XIX, XXII

	UMC	Section	Page
other mineral values encountered within the logical mining unit; hydrologic data and other information relevant to the mining plan; all mineral crop lines and the strike and dip of the coal to be mined within the area of land to be affected; location and extent of known surface and underground mine workings (active and abandoned), oil or gas wells, and water wells within 1/4 mile of the affected lands. (Hydrologic information is required only as relevant to resource recovery.)			
Plan maps of the area to be mined on a suitable topographic base showing: lease boundaries and numbers, boundaries of nonfederal coal, LMU boundaries, and surface ownership boundaries.		4.3.1 4.3.2	Vol. I: pp. 3, 15 Vol. II: Plates I, II, III, IV
(iv) Locations of surface structures and facilities, including loading facilities.	784.23 (b)(1)	3.2.3 3.2.4	Vol. II: Plates I, II, VIII, VIII-A, IX, X, X-A Addendum B: Plate XIV
(v) For an underground mine, in addition, the planned mine layout, including location and dimensions of shafts, slopes, drifts, crosscuts, rooms, haulageways, aircourses, entries, and barrier pillars; show typical panel recovery, sequence of development and retreat.		3.3.1.2	Vol. I: pp. 32-40 Roof Control & Ventilation Plan Vol.
Submit the Roof Control and Ventilation System and Methane and Dust Control Plans approved by Mine Safety and Health Administration (MSHA) as a part of the mining and reclamation plan.		3.3.1.6	Vol. I: Exhibit II-A - Roof Control & Ventilation Plan Vol.
Include a structural coutour map of bed(s) to be mined.		6.4.2	Vol. I: pp. 53-55 Vol. II: Plates XV, XVI, XVII, XVIII
If several seams are involved, include interburdern isopach map(s) on 10-foot intervals.		6.5.5	Vol. I: pp. 53-55 Vol. II: Plates XV, XVI, XVII, XVIII
Include an isopach map of overburden of surface mines on 20-foot intervals.		6.5.5	Not Applicable
Include an isopach map of overlying strata over underground mines on 250-foot intervals.		6.5.5	Vol. I: pp. 53-55 Vol. II: Plates XV, XVI, XVII, XVIII
Furnish a copy of any subsidence control plan required by 30 UMC 784.20.		3.4.2	Vol. I: pp. 42-43 Addendum B: pp. 9

	UMC (SMC)	Section	Page
(vi) If auger mining is proposed, the location and diameter of auger holes, the depth to be drilled, and the estimated percentage of recovery. In determining whether or not to recommend approval of proposed auger mining, the Regional Director and mining supervisor shall take into account the percentage of recovery, which shall in general exceed 30 percent, and probable adverse effects upon water quality.	785.20		Not Applicable
If surface mining is proposed, include a general layout of the proposal including location and width of box cut(s), location of main haulroads, and location and width of coal fenders.			Not Applicable
211.10 (c)(8) Any requests for variances from the performance standards of 30 CFR Part 211.			Not Applicable

APPENDIX A

(EXHIBITS II-A, B, AND C)

EXHIBIT II-A

B.L.M. RIGHT-OF-WAY GRANTS
APPROVAL OF PLANS AND PROGRAMS
PERMIT GRANTS

SCOTT M. MATHESON
Governor

GORDON E. HARMSTON
Executive Director,
NATURAL RESOURCES

CLEON B. FEIGHT
Director

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS, AND MINING
1588 West North Temple
Salt Lake City, Utah 84116
(801) 533-5771

OIL, GAS, AND MINING BOARD

CHARLES R. HENDERSON
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THADIS W. BOX
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EDWARD T. BECK
E. STEELE McINTYRE

September 5, 1980

RECEIVED
9-10-80

Mr. Sam Quigley
Tower Resources, Inc.
P.O. Box 1027
Price, Utah 84501

RE: Final Approval
Pinnacle Mine
ACT/007/019
Carbon County, Utah

Dear Mr. Quigley:

The Board of Oil, Gas and Mining, at its May, 1980 Executive Session, fully executed the Mined Lands Reclamation Escrow Agreement submitted by Tower Resources, Inc. for the Pinnacle Mine. A copy of this agreement is enclosed for your records.

Tower Resources, Inc. has now fulfilled all of the requirements under the Utah Mined Land Reclamation Act as well as the Interim Program Regulations for Coal Mining and Reclamation Operations for the Pinnacle Mine. Further, during the 30 day public comment period subsequent to publication of the Division's tentative approval of the Mining and Reclamation Plan for this operation, no adverse comments were received.

The Division therefore issues Final Approval to Tower Resources, Inc. for the Pinnacle Mine and operations may now lawfully commence. Please note however, that this approval is issued under the Interim Program Regulations only and that a Permanent Program Mining and Reclamation Plan will be required for the Pinnacle Mine within two months of the State's regulatory program approval.

Please notify the Division within 30 days of commencement of operations as required under Rule 40-8-15 of the Utah Mined Land Reclamation Act. Also under this Rule it is required that an annual Operations and Progress Report be submitted at the end of each calander year for all active operations.

Also, please be reminded that any modifications in Tower Resources, Inc.'s mining and reclamation plan as presently approved, must be submitted to the Division for approval prior to initiating the modification.

Should you have any questions relative to this Final Approval, please feel free to contact the Division.

Sincerely,

James W. Smith Jr.

JAMES W. SMITH, JR.
COORDINATOR OF MINED LAND DEVELOPMENT

JWS/te
cc: Don Crane, O.S.M.

Scott M. Matheson
Governor

DEPARTMENT OF HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
150 West North Temple, P.O. Box 2500, Salt Lake City, Utah 84110

Alvin E. Rickers, Acting Director
Room 426 801-533-6121

James O. Mason, M.D., Dr.P.H.
Executive Director
801-533-6111

DIVISIONS
Community Health Services
Environmental Health
Family Health Services
Health Care Financing and Standards

OFFICES
Administrative Services
Health Planning and Policy Development
Medical Examiner
State Health Laboratory

533-6108
June 13, 1980

Michael W. Glasson
Tower Resources, Inc.
P.O. Box 1027
Price, UT 84501

Re: Air Quality Approval Order for Construction and Operation of the Centennial Coal Mine and Loadout Operation near Price, Carbon County

Dear Mr. Glasson:

On May 6, 1980 the Executive Secretary published a notice of intent to approve your proposed coal mine and loadout operation. The 30-day public comment period expired June 5, 1980 and no comments were received.

This air quality approval order authorizes the construction and operation of the Centennial Coal Mine and loadout operation in Carbon County as proposed in your notice of intent dated 2/15/80 and 4/22/80, with the following conditions:

1. Production shall be limited to 960,000 tons/year. Production proposed above this limit shall require a notice of intent, per Utah Air Conservation Regulations, Section 3, be submitted by the owner/operator.

2. All air pollution control facilities shall be installed and operated as proposed.

3. Primary crushing operation shall be enclosed underground with spraying (water and wetting agent) required on material entering the crusher and on exiting the crusher via the exit conveyor.

4. Storage piles shall be chemically stabilized to minimize fugitive dust emissions.

5. Conveyors shall be covered to minimize fugitive emissions.

6. Railroad car loadout area shall be sprayed to minimize fugitive dusts.

7. Visible emissions from all controlled process and fugitive emission sources shall not exceed 20% opacity.

8. Haul roads: 5.82 miles section from mine to paved Coal Creek Road and 2.69 miles section from U.S. 6/50 to loadout at Farnham Siding shall be chemically stabilized upon initial operation and be re-treated routinely as required by dry weather conditions or as determined necessary by the Executive Secretary to minimize fugitive dusts. Speed on these sections of road shall be limited to 35 mph.

9. Commuter road: 7 miles from Price to Mine site shall be chemically stabilized upon initial operation and be re-treated routinely as required by dry weather conditions or as determined necessary by the Executive Secretary to minimize fugitive dusts. Speed on this section of road shall be limited to 35 mph.

10. A record shall be kept of the spraying/stabilizing done on storage areas, loadout area, and haul/commuter roads, i.e., dates, time, type, amount and locations, and be available to the Executive Secretary.

An initial compliance inspection will be required. Please notify us when your construction is completed and you are operational, so an inspection can be performed.

Sincerely,

Brent C. Bradford
Executive Secretary
Utah Air Conservation Committee

MRK:js

cc: Southeastern District Health Dept.
EPA/Region VIII (Norman Huey)

Governor

DEPARTMENT OF HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
150 West North Temple, P.O. Box 2500, Salt Lake City, Utah 84110

Alvin E. Rickers, Acting Director
Room 426 801-533-6121

James O. Mason, M.D., Dr.P.H.
Executive Director
801-533-6111

DIVISIONS
Community Health Services
Environmental Health
Family Health Services
Health Care Financing and Standards

OFFICES
Administrative Services
Health Planning and Policy Development
Medical Examiner
State Health Laboratory

533-6146
May 14, 1980

Samuel C. Quigley
Western Project Manager
Tower Resources, Inc.
P.O. Box 1027
Price, UT 84501

RE: Sediment ponds

Dear Mr. Quigley:

We have reviewed the April 3, 1980 sedimentation and drainage control plan and supporting information for the Pinnacle Mine of Tower Resources. These two ponds are to provide for the runoff from a ten year 24 hour 1.8 inch rainfall on the mine disturbed area.

As a result of our review, the plans for the Tower Resources Pinnacle mine sedimentation control ponds are approved and a construction permit as constituted by this letter is hereby issued provided:

1. Sufficient riprap is provided on the outside toe of the pond dike to protect against erosion by the stream.
2. The sediment level is maintained at least 3 feet below the outlet.

The two ponds are to have a design capacity of 1 and 0.2 acre feet of sediment and runoff storage. The dikes are to have a top width of 10 feet with a side slope of 2 horizontal to 1 vertical. The outlet pipes are to have an inverted inlet one foot below the water level.

Additional treatment must be provided if the discharge from these ponds fails to meet state or federal discharge requirements.

Sincerely,

UTAH WATER POLLUTION COMMITTEE

Calvin K. Sudweeks
Executive Secretary

cc: Oil, Gas & Mining
EPA Salt Lake
Southeast 208
Southeastern District Health Dept.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VIII
1860 LINCOLN STREET
DENVER, COLORADO 80295

Ref: 8E-WE

June 20, 1980

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Samuel C. Quigley
Manager, AMCA Coal Leasing, Inc.
P. O. Box 1027
Price, Utah 84501

Dear Mr. Quigley:

Herewith enclosed is the NPDES permit for AMCA Coal Leasing, Inc., UT-0023507. This permit shall become effective and issued thirty (30) days following your receipt of this letter, unless within thirty (30) days following the date of receipt you submit a request for an evidentiary hearing in accordance with the provisions of 40 CFR Section 124.74. Such request must be addressed to:

Roger L. Williams (8E-WE)
Regional Administrator
U.S. Environmental Protection Agency
Region VIII, Suite 103
1860 Lincoln Street
Denver, Colorado 80295

If you have any legal questions with regard to this matter, please contact Mr. John J. Lepley of this Agency at (303) 837-4812. Questions regarding monitoring requirements should be directed to Mr. Doug Skie of this office at (303) 837-4335.

Sincerely yours,

Roger E. Frenette
Acting Director
Enforcement Division

Enclosures

(1) NPDES Discharge Permit
(2) EPA Form 3320-1 for reporting of self-monitoring

MI

Permit No.: UT-0023607

AUTHORIZATION TO DISCHARGE UNDER THE

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Clean Water Act, as amended (33 U.S.C. 1251 et. seq.)(hereinafter referred to as "the Act"),

AMCA Coal Leasing, Inc.,

is authorized to discharge from a facility located at Section 7, Township 13 South, Range 11 East, Carbon County, Utah,

to receiving waters named Deadman Creek which is a tributary to the Price River,

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, and III hereof.

This permit shall become effective on the date of issuance.*

This permit and the authorization to discharge shall expire at midnight, December 31, 1980.

Signed this 30th day of May, 1980.

Lance C. Vinson
Director, Enforcement Division

*Thirty (30) days after the date of receipt of this permit by the Applicant.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
1860 LINCOLN STREET
DENVER, COLORADO 80295

DEC 1 1980

Ref: 8E-WE

Mr. Samuel C. Quigley
AMAC Coal Leasing, Inc.
P. O. Box 1027
Price, Utah 84501

Re: NPDES No. UT-0023507

Dear Mr. Quigley:

As you are aware, the NPDES permit previously issued to you by EPA expires by its own terms on December 31, 1980. Although you have applied for permit renewal, we will be unable to reissue the permit by that date. Consequently, there is an interim period between the expiration date contained in the previous permit and the time any renewal permit will be issued. Because you made a timely and sufficient application for permit renewal, under the provisions of EPA's May 19, 1980, Consolidated Permit Regulations (45 FR 33425, 40 CFR 122.5), there is an automatic continuation of the permit during the interim between expiration and renewal. You should be aware that, under the terms of this regulation, all of the requirements and conditions of your current permit will remain fully effective until the renewal permit is issued.

Any violations of the permit during the interim period are subject to enforcement action by the Agency. Additionally, at the discretion of the permit issuing official, your request for permit renewal can be denied on the basis of any failure to comply during the interim period. The denial would terminate the permit continuation and subject you to an enforcement action for discharge without a permit.

After we have completed an evaluation of the necessary information, including application Form 2C where applicable, a permit will be drafted and we will publish notice of our intent to reissue the permit. The draft permit will contain effluent limitations and other provisions reflecting the various requirements of the Clean Water Act. The public notice and related information will summarize the proposed permit and will allow thirty (30) days for public comments. A final permit will be issued sometime after the close of the public comment period.

The permit continuation, provided under the terms of 5 U.S.C. 558(c) and 40 CFR 122.5, Will terminate upon issuance of the renewal permit.

Sincerely yours,

Lance C. Vinson
Director
Enforcement Division

cc: Utah Dept. of Health

EPA, Utah State Engineer

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

MAR 21 1980

REGION VIII
1860 LINCOLN STREET
DENVER, COLORADO 80295

RECEIVED 3-24-80

REF: 8AH-A

Mr. Michael Glasson
Geologist
Tower Resources, Inc.
Post Office Box 1027
Price, Utah 84501

Dear Mr. Glasson:

This office has received your February 13, 1980, PSD emission inventory of the proposed Pinnacle Mine near Price, Utah.

Because of the recent court decision in the case of Alabama Power Co. vs. Douglas M. Costle (D. C. Circuit 78-1006 and consolidated cases), EPA implemented a partial stay of its regulations (February 5, 1980, Federal Register, 45 FR 7800). In light of this stay, we have determined that your proposed mine does not need a PSD air quality permit. We believe your proposed mine is not now subject to the PSD regulations because of the new definition of a major source and the accompanying exclusion of fugitive emissions (including fugitive dust) as announced in the proposed PSD regulations of September 5, 1979 (44 FR 51924).

Nevertheless, you are advised that the decision in Alabama Power will have further significant impacts on EPA's PSD regulations and may affect permit actions taken under existing regulations.

It is our intent to work with OSM and the State to incorporate in their programs measures to control particulate emissions at mines. I have forwarded copies of your emission inventory to the Denver OSM office and the Utah Bureau of Air Quality. I have also included a copy of the Region VIII guideline document on air quality review of surface mining operations. This document was the basis for our determinations as to what constitutes acceptable control measures.

If you have any questions, please contact David Joseph of my staff at (303) 837-3763.

Sincerely yours,

Robert L. Duprey, Director
Air and Hazardous Materials Division

Enclosures

cc: F. Johnson, OSM, with enclosures
B. Bradford, Utah Bureau of Air Quality, with enclosures

IN REPLY REFER TO
2810
U-45966
(U-060)

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Moab District
P. O. Box 970
Moab, Utah 84532

RECEIVED
SEP 11 1980

CERTIFIED MAIL--RETURN RECEIPT REQUESTED
Certification No. 661144

DECISION

Tower Resources Incorporated P. O. Box 1027 Price, Utah 84501	: : :	Right-of-Way U-45966

Right-of-Way Granted

Details of Grant

Serial number of grant:	U-45966
Name of Grantee:	Tower Resources Incorporated P. O. Box 1027 Price, Utah 84501
Map showing the location and dimensions of grant	
Map designations:	Right-of-way location map Tower Resources Incorporated access road.
Date filed:	June 13, 1980
Right-of-way width:	50 feet
Permitted use:	Construction, use and maintenance of access road.
Authority:	Section 501 (a)(6) of the Federal Land Policy and Management Act of 1976, (90 Stat. 2776; 43 USC 1761).
Effective Date:	Effective the date of this decision
Termination Date:	30 years from the date of this decision

United States Department of the Interior

2800
F017
U-36739
(U-942)

BUREAU OF LAND MANAGEMENT
UTAH STATE OFFICE
University Club Building
136 East South Temple
Salt Lake City, Utah 84111

DECISION

NOV 20 1978

Right-of-Way Granted

Details of Grant

Serial number of grant:	Utah 36739
Name of Grantee:	AMCA Coal Leasing, Inc. Post Office Box 1027 Price, Utah 84501
Map showing the location and dimensions of grant	
Map designations:	Meiji Resource Consultants Telephone Line Survey S.N. U-36739 AMCA Coal Leasing, Inc.
Date filed:	March 31, 1978
Permitted use by grantee:	Buried Telephone Cable 15 Feet in Width
Authority for grant:	Title V of the Federal Land Policy and Management Act of October 21, 1976 (90 Stat. 2776; 43 U.S.C. 1761)
Date of grant:	NOV 20, 1978
Expiration date of grant:	NOV 19, 2008
Rental	
Amount:	$25.00
When payable by grantee:	At the beginning of each 5-year rental period

Terms and conditions of the grant are set forth on the following pages.

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
UTAH STATE OFFICE
University Club Building
136 East South Temple
Salt Lake City, Utah 84111

2800
FJ17
U-36741
(U-942)

DECISION NOV 20 1978

Right-of-Way Granted

Details of Grant

Serial number of grant:	Utah 36741
Name of Grantee:	AMCA Coal Leasing, Inc. Post Office Box 1027 Price, Utah 84501
Map showing the location and dimensions of grant	
Map designations:	A & W Surveying Powerline Survey S.N. U-36741 AMCA Coal Leasing, Inc.
Date filed:	August 15, 1978
Permitted use by grantee:	46 KV Electric Power Transmission Line 100 feet in width
Authority for grant:	Title V of the Federal Land Policy and Management Act of October 21, 1976 (90 Stat. 2776; 43 U.S.C. 1761)
Date of grant:	NOV 20, 1978
Expiration date of grant:	NOV 19, 2008
Rental	
Amount:	$100.00 rental deposit
When payable by grantee:	Rental amount not yet determined

Terms and conditions of the grant are set forth on the following pages.

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

USO 2800-1 (March 1976)

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Moab District
P. O. Box 970
Moab, Utah 84532

IN REPLY REFER TO
2890
U-45965
(U-060)

RECEIVED
SEP 11 1980

CERTIFIED MAIL--RETURN RECEIPT REQUESTED
Certification No. 661143

DECISION

Tower Resources Incorporated P. O. Box 1027 Price, Utah 84501	: : :	Right-of-Way U-45965

Right-of-Way Granted

Details of Grant

Serial number of grant:	U-45965
Name of Grantee:	Tower Resources Incorporated P. O. Box 1027 Price, Utah 84501
Map showing the location and dimensions of grant	
Map designations:	Right-of-Way location map Tower Resources Incorporated Material Storage Site
Right-of-way area:	10 acres
Date filed:	June 13, 1980
Permitted use:	Material Storage
Authority:	Section 501 (a)(7) of the Federal Land Policy and Management Act of 1976, (90 Stat. 2776; 43 USC 1761).
Effective Date:	Effective the date of this decision
Termination Date:	30 years from the date of this decision

IN REPLY REFER TO

2890
U-45965
(U-601)

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Moab District
Price River Resource Area
P. O. Drawer AB
Price, Utah 84501

RECEIVED
8-28-80

August 27, 1980

Mr. Mike Glasson
Tower Resources Incorporated
P. O. Box 1027
Price, Utah 84501

Dear Mr. Glasson:

We have made the necessary changes in your right-of-way (U-45965), authorizing you to construct an office, shop or warehouse on the site should the need arise. We were able to make the adjustment without any additional information from you since the right-of-way had not been issued.

If you have any questions, please feel free to call.

Sincerely yours,

Leon E. Berggren

Leon E. Berggren
Area Manager

U. S. Department of Labor

Mine Safety and Health Administration
P.O. Box 25367
Denver, Colorado 80225

Coal Mine Safety & Health
District 9

December 24, 1980

Mr. Samuel C. Quigley
Western Project Manager
Tower Resources, Inc.
P.O. Box 1027
Price, UT 84501

Re: Roof Control Plan
Pinnacle Mine
I.D. No. 42-01474

Dear Mr. Quigley:

The roof control plan consisting of 18 pages, received at this office on December 22, 1980, has been reviewed and is approved. This is a minimum roof control plan and will supercede all previously approved plans, supplements and addendums. As required by 30 CFR, 75.200, the plan must be reviewed by MSHA every six months.

Sincerely,

for John Brake

John W. Barton
District Manager

Enclosure

U. S. Department of Labor

P O Box 25367
Denver, Colorado 80225
Coal Mine Safety and Health
District 9

RECEIVED
7-14-80

July 9, 1980

Samuel C. Quigley
Manager
Tower Resources, Inc.
PO Box 1027
Price UT 84501

Re: Pinnacle Mine
I.D. No. 42-01474
Ventilation System and Methane
and Dust Control Plan

Dear Mr. Quigley:

The ventilation system and methane and dust control plan dated June 26, 1980, for the subject mine has been approved in accordance with Section 75.316, 30 CFR 75. The plan is subject to revision at any time and shall be reviewed by the operator and MSHA at least once every six months. Before any changes are made in the approved ventilation system, they shall be submitted to and approved by MSHA prior to implementation.

This plan supersedes any previously approved plans and a copy of this plan shall be made available to the miners.

Sincerely yours,

John W. Barton
District Manager

Enclosure

U. S. Department of Labor

Mine Safety and Health Administration
P O Box 25367
Denver, Colorado 80225

Coal Mine Safety and Health
District 9

RECEIVED
7-3-80

June 30, 1980

Samuel C. Quigley
Western Project Manager
Tower Resources, Incorporated
P. O. Box 1027
Price, Utah 84501

Re: Pinnacle Mine
I. D. No. 42-01474
Roof Control Plan

Dear Mr. Quigley:

The roof control plan for the subject mine, dated June 24, 1980, has been reviewed and is approved. This plan supercedes all previously approved plans, supplements and addendums. As required by 30 CFR, 75.200, the plan must be reviewed by MSHA every six months.

Sincerely,

for Donald E. Dalton
John W. Barton
District Manager

Enclosures

U.S. DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
Mailing Address:
P.O. Box 25367, DFC
Denver, Colorado 80225
Street Address:
730 Simms
Lakewood, Colorado
Coal Mine Health and Safety
District 9

September 21, 1978

Samuel C. Quigley
Manager
A.M.C.A. Coal Leasing, Inc.
PO Box 1027
Price, Utah 84501

Re: Pinnacle Mine
I.D. No. 42-01474
Smoking Prohibition Plan

Dear Mr. Quigley:

This is to acknowledge receipt of the Smoking Prohibition Plan for the subject mine. It has been reviewed for compliance with Section 75.1702, 30 CFR 75, and is hereby approved.

Sincerely yours,

John W. Barton
District Manager

Enclosure

U. S. Department of Labor

Mine Safety and Health Administration
P O Box 25367
Denver, Colorado 80225

EDUCATION AND TRAINING
DENVER TRAINING CENTER

RECEIVED
8-25-80

August 19, 1980

S. C. Quigley
Manager
Tower Resources, Inc.
P.O. Box 1027
Price, UT 84501

RE: 42-01474 Pinnacle
UNDERGROUND

Dear Mr. Quigley:

Your training plan submitted under the requirements of CFR Title 30, Part 48 is approved as of the date of this letter.

Any proposed revisions or changes to your approved plan must be submitted to the miner's representative and approved by the Training Center Chief.

Included is an initial supply of the 5000-23 form on which training must be recorded. A copy of this record must be given the employee at the completion of the training received (i.e. New Miner Training, Refresher Training, etc.) The other copy must be retained at the mine site. A copy of the 5000-23 should not be sent to this or any other MSHA office. Additional 5000-23 forms may be obtained from this office as needed.

Please do not record Part 48 training on the 5000-1 forms.

Sincerely,

Walter R. Schell
Chief, Denver Training Center

cc: Representative of Miners

U. S. Department of Labor

Mine Safety and Health Administration
P O Box 25367
Denver, Colorado 80225
Coal Mine Safety and Health
District 9

November 5, 1980

Thomas R. May
Safety Director
Tower Resources, Inc.
PO Box 1027
Price, UT 84501

Re: Pinnacle Mine
I.D. No. 42-01474
Firefighting & Evacuation Plan

Dear Mr. May:

The firefighting and evacuation plan for the subject mine has been approved in accordance with Section 75.1101-23, 30 CFR 75. The plan is subject to review and possible revision at any time and any changes proposed to the plan shall be approved by MSHA prior to implementation.

Sincerely yours,

John W. Barton
District Manager

Enclosure

U.S. DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
Mailing Address:
P.O. Box 25367, DFC
Denver, Colorado 80225
Street Address:
750 Simms
Lakewood, Colorado

Coal Mine Health & Safety
District 9

September 6, 1978

Mr. Samuel C. Quigley
AMCA Coal Leasing, Inc.
P.O. Box 1027
Price, Utah 84501

Re: Pinnacle Mine
I.D. #42-01474
Emergency Medical

Dear Mr. Quigley:

The information submitted to this office, required by Section 75.1713-1 of the Regulations, CFR 30, has been placed on file at the District Office.

Sincerely,

for John W. Barton
District Manager

Enclosure

U.S. DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
Mailing Address:
P.O. Box 25367, DFC
Denver, Colorado 80225
Street Address:
730 Simms
Lakewood, Colorado
Coal Mine Health & Safety
District 9

September 6, 1978

Mr. Samuel C. Quigley
AMCA Coal Leasing, Inc.
P.O. Box 1027
Price, Utah 84501

Re: Pinnacle Mine
I.D. #42-01474
Section 109(d)

Dear Mr. Quigley:

The information submitted to this office, required by Section 109(d) of the Act, has been placed on file at the District Office.

Sincerely,

for John A. Barton
District Manager

Enclosure

APPENDIX B

(EXHIBITS III-A, B, C, D, E, AND F)

EXHIBIT III-A

SEDIMENTATION AND DRAINAGE CONTROL PLAN

SEDIMENTATION
AND
DRAINAGE CONTROL PLAN
FOR THE
CENTENNIAL PROJECT
(Revised 3/12/87)

PREPARED FOR:

ANDALEX RESOURCES, INC.

BY

DAN W. GUY

REGISTERED PROFESSIONAL ENGINEER

STATE OF UTAH NO. 4548

PLAN FOR CONSTRUCTION AND MAINTENANCE OF SEDIMENTATION PONDS

General Description

The Andalex Deadman Canyon Project will be comprised of three mines located closely together in Deadman Canyon. The Pinnacle Mine and Apex Mines are presently in operation mining the Gilson and Lower Sunnyside Seams. The other mine will be the Aberdeen Mine in the A Seam. Surface runoff from the Pinnacle Mine and Apex Mine is controlled by Ponds A, B and C. Engineering design for these ponds have been presented to the Division of Oil, Gas and Mining on 4-3-80 and 8-21-81. Surface runoff from the Aberdeen Mine will be controlled by Pond E. Designs for these ponds are shown on Plates 10, 11, 12 and 13 included herein.

The Mines are located in the Right Fork of Deadman Canyon. This is an ephemeral drainage flowing only from direct runoff and eventually reaches the Price River some 12 miles to the south. The major drainages in the minesite area will be routed under the site through large culverts. The projected minesite will have a disturbed area of approximately 24.25 acres. In order to minimize additional sediment loading to the main drainage, it is proposed to collect the runoff from this disturbed area and pass it into 4 separate sedimentation ponds. Berms will be placed on the lower edge of all disturbed areas to prevent runoff from reaching natural drainages before it has passed through the sedimentation ponds.

Sedimentation Pond Specifications

Location

The proposed ponds are to be located superimposed over the main drainage of the Right Fork of Deadman Canyon. The main canyon drainage will be routed through a 42" culvert located under the ponds. The sites are located downslope of the disturbed areas to simplify collection of runoff water. (See attached maps)

Design

The proposed ponds are designed to fully contain the expected run-off and sediment load from a 10 year - 24 hour precipitation event in this area. The design has been certified by a registered professional engineer.

long term load?

Construction

The construction of the ponds will be as per the specifications set forth in the Construction Specifications sheet attached to this plan.

Capacity

Each pond is designed to contain the runoff and sediment load from a 10 year - 24 hour precipitation event in the area of drainage. In addition, each pond has an overflow capacity in excess of that required for a 25 year - 6 hour event.

25yr - 24hr

Safety Precautions

The ponds will be built as per specifications and under supervision of a qualified, registered professional engineer. The structures will be regularly inspected by a licensed individual as required by law. Ponds will be cleaned at minimum when sediment reaches 20% of volume. Measuring devices will be installed in the ponds to show when the ponds have filled with sediment to the clean-out level.

how regular?

what volume pond sediment?

Monitoring

Water monitoring stations will be established at the outlet of the ponds. Sample parameters and frequencies shall be as per specification of the NPDES permit.

Maintenance

The ponds shall be inspected after each storm and the sediment cleaned as necessary. In no event shall sediment be allowed to build beyond 20% of pond capacity. Sediment removed shall be disposed of at the Carbon County sanitary landfill.

Seeding

An approved seed mix will be applied to all feasible disturbed areas in an effort to minimize erosion and sediment loading to the ponds. The proper seed mixture for this area has been obtained through the local BLM.

Culverts

All culverts are shown on the attached maps. Calculations for sizing are also included. It should be noted that all culvert sizes were arrived at and approved through consultation with the DOGM hydrologic engineer.

Calculations

The following sheets reflect the calculations for sizing and details of each separate pond. Attached maps show pond locations and volumes as well as watershed areas.

Construction Specifications

for Sedimentation Ponds

1. All construction of sedimentation ponds will be performed under the direction of a qualified registered professional engineer.
2. Dams shall be constructed with primary overflows 3 ft. from the top, and emergency overflows 2 ft. from the top.
3. The areas of pond construction shall be examined for topsoil, and if present in removable quantities such soil shall be removed separately and stored in an approved topsoil storage location.
4. In areas where fill is to be placed, natural ground shall be removed for at least 12" below the base of the structure.
5. Native materials will be used where practical. Fill will be placed in lifts not to exceed 15" and compacted prior to placement of next lift. Compaction of all fill materials shall be at least 95%.
6. Rip-rap will be placed at all inlets and outlets to prevent scouring. Rip-rap will consist of substantial (non-slaking) rock material of 6" or greater size.
7. Each pond shall be fitted with an inverted inlet to the primary overflow, to prevent the passage of oil into the discharge.
8. Slopes of the dams shall not be steeper than 2.0:1, inside and outside, with a total of the inslope and outslope not less than 5:1.
9. Tops and external slopes of the dams shall be planted with an approved seed mix to prevent erosion and promote stability. Compaction of the slopes shall be at least 95%.
10. Top width of dams shall be not less than (H + 35)/5.

Pond C

1. Use 1.82" for 10 year - 24 hour event

2. Disturbed Watershed - 10.50 acres

3. Runoff Curve No. = CN = 1 — CN ≈ 90, by back calc.

4. Area Runoff = Q (in.) = $(P-0.25)^2/(P+0.85)$; Where:

   $S = (1{,}000/CN) - 10$

   $P = 1.82"$

   $Q\ (in.) = [1.82-0.2(1.11)]^2/[1.82+0.8(1.11)] =$

   $\frac{2.553}{2.709} = .94$ in. = 0.0785 ft.

   Volume = 10.50 acres x 0.0785 ft. = 0.824 acre-ft.

5. Sediment Storage Volume

   10.50 acres x 0.1 acre-ft./acre = 1.05 acre-ft. ok

6. Direct Precipitation into Pond

   Area of Ponds = .39 acres

   .39 acres x 1.82 in. x 1/12 ft./in. = 0.059 acre-ft. good

7. Total Required Pond Volume

   0.824 + 1.05 + 0.059 = 1.933 ok

8. Pond Volume @ Outlet

   Total Pond Volume = 2.418 acre-ft. → reference map

   At 20% cleaning point - Volume = 1.934 acre-ft. — wrong this is 80% no approval

9. Conclusion: Pond size is adequate to contain the runoff and sediment load from a 10 year - 24 hour precipitation event in the area of drainage to the pond.

POND D?

Pond E

1. Use 1.82" for 10 year - 24 hour event

2. Disturbed Watershed - 6.02 acres

3. Runoff Curve No. = CN = 90

4. Area Runoff = Q (in.) = $(P-0.25)^2/(P+0.85)$; Where:

   $S = (1{,}000/CN) - 10$

   $P = 1.82"$

   $Q\ (in.) = [1.82-0.2(1.11)]^2/[1.82+0.8(1.11)] =$

   $\frac{2.553}{2.709} = .94$ in. = .0785 ft.

   Volume = 6.02 acres x 0.0785 ft. = 0.472 acre-ft.

5. Sediment Storage Volume

   6.02 x 0.075 acre-ft./acre = 0.451 acre-ft.

   Note: 0.075 sediment loading factor used because much of the disturbed area (Aberdeen Mine storage yard and truck turn around) is level and will contribute little if any sediment during a 10 year - 24 hour precipitation event. validate w/ USLE

6. Direct Precipitation into Ponds

   Area of Ponds = 0.165 acres

   0.165 acres x 1.82 in. x 1/12 ft./in. = 0.025 acre-ft.

7. Total Required Pond Volume

   0.472 + 0.451 + 0.025 = 0.948

8. Pond Volume @ Outlet = 1.205 acre-ft.

   at 20% Cleaning Point = 0.964 volume @ cleanout or volume left at full cleanout

9. Conclusion: Pond size is adequate to contain the runoff and sediment load from a 10 year - 24 hour precipitation event in the area of drainage to the pond.

Pond Discharge Structures

Principle Spillways - These will consist of an 18" culvert, fitted with an inverted inlet to provide for oil skimming. The inlet will be approximately 1' below water level. The culvert will be located 3' below the top of the dam, and will discharge directly onto a rip-rapped channel leading to the main drainage. These spillways will provide for the normal dewatering of the pond at base capacity.

Emergency Spillways - The emergency spillway for proposed Pond E will be the open notch type with a trapezoidal cross section. The spillway dimensions will be as shown on the attached sheet. This will be located 12" above the principal spillway and 2' below the top of the dam. This structure will be rip-rapped through the point of discharge and into the main channel. This spillway will provide an added safety factor to protect the dam in the event of overload on the culvert discharge.

The emergency spillway for Pond C will consist of an open 36" culvert which empties directly into the main 42" culvert which drains the main canyon. This emergency spillway will be open at the top and will extend to within 2' of the top of the dam. At right angle to this emergency spillway culvert will be an 18" culvert to handle non-emergency overflow conditions. This 18" pipe will have an inverted inlet to skim oil and grease and flotsum from the water.

Calculations

Source of Formulae

B.L.M. State Engineer

Rational Formula

QP = Cia

QP = Peak Discharge (C.f.s.)

C = Runoff Coefficient (@ 90% runoff, C = .9)

i = Rainfall intensity (in./hr.) for a 10 year - 24 hour storm } i = what duration of Tc

in Price, i = .3024

a = Area (acres)

Manning Equation

$$D = \left[\frac{(2.16Qn)}{\sqrt{s}}\right]^{0.375}$$

D = Diameter (feet)

Q = QP = Peak Discharge (cfs)

n = Roughness factor (0.02 for steel culvert)

s = Slope (0.0556% = 1 foot for 18 feet)

Pond C (Principle Spillway)

1. QP = Cia; C-1, i=.3024, a=10.96 acres

   QP = (0.9) (0.3024) (10.96)

   QP = 2.983 cfs

2. $D = \left[\frac{(2.16Qn)}{\sqrt{s}}\right]^{.375}$; Q = 2.983, n = 0.02, $\sqrt{s}$ = .2357

   $$D = \left[\frac{(2.16)(2.983)(0.02)}{0.2357}\right]^{.375}$$

Req. D = .797 ft. = 9.57 inches

Actual D = 36 inches

Culverts

General

Culverts will be sized as per the designations on the attached maps, and will be placed to drain on a minimum of .0556% slope (1 ft./18ft.). Each culvert will be fitted with a trash rack on the inlet to help prevent plugging from washed-in debris. Each culvert shall discharge onto a protected surface (i.e. rip-rap, conveyor belting, flexible downspouts, or other) to prevent scouring and erosion. The use of energy dissapators shall be employed as necessary to reduce velocities and prevent erosion from culvert discharges.

Maintenance

Culverts shall be inspected regularly, and cleaned as necessary to provide for passage of designed flows. Inlets and outlets shall also be maintained so as to prevent plugging or undue restriction of water flow.

CULVERT SIZE DETERMINATION

SOURCE:

"Applied Hydrology and Sedimentology for Disturbed Areas", Barfield, Warner and Haan, 1983.

PEAK FLOW - SCS-TR-55 METHOD FOR TYPE II STORMS:

$qp = qp^1AQ;$

A = Watershed in square miles;

Q = Runoff volume in inches;

qp^1 = Discharge from Fig. 2.40

qp = Peak Discharge in cfs.

MANNING EQUATION

$$D = \left[\frac{2.16Qn}{\sqrt{s}}\right]^{0.375}$$

D = Diameter (feet)

Q = QP = Peak discharge (cfs)

n = roughness factor (0.02 for steel culvert)

s = slope (0.0556% = 1 foot for 18 feet)

Using the above formulas minimum culvert sizes were calculated based on 100% runoff from a 10 year - 24 hour storm:

WATERSHED AND CULVERT SIZING MAP

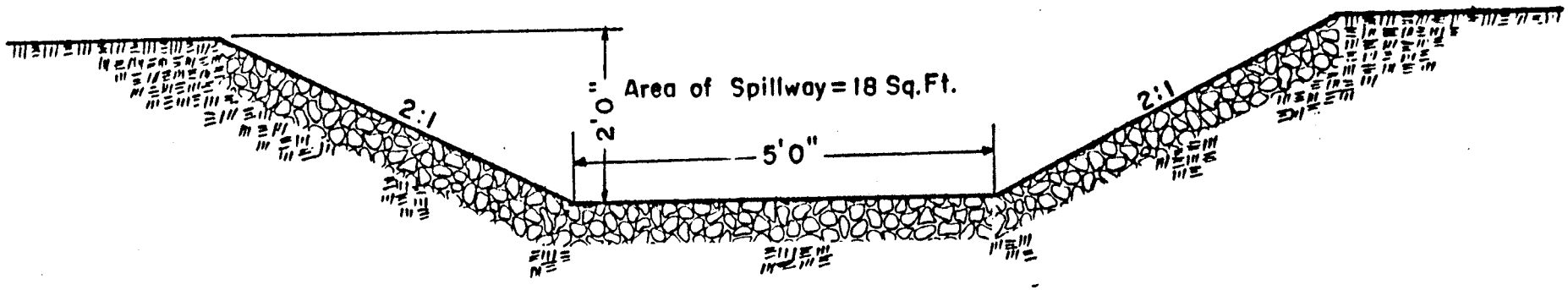
Culvert	Watershed Area (acres)	Culvert Needed (in.)	Culvert Used (in.)
C1	467.58	27.7	30
C2	25.71	16.1	18
C3	493.29	29.6	36
* C4	87.78	19.2	18
C5	581.07	33.8	36
C6	40.04	17.2	18
C7	621.11	35.5	36
* C8	53.63	20.3	18
C9	674.74	37.9	42
C10	29.38	16.6	18
C11	704.12	39.2	42
* C12	74.20	18.4	18
C13	778.32	41.7	42
C14	27.18	15.9	18
C15	805.50	42.7	42

* Adequate Headwater Available to allow flow.

ANDALEX RESOURCES, INC.

Price, Utah

Centennial Project



Typical Section of Emergency Spillways

Scale: 1" = 2'0"

Date: 8-20-81

Diversion Structures

General

Diversion ditch locations are shown on the enclosed Surface Facilities Map. The direction of flow is also shown. All diversions are classed as temporary, and will be removed upon final reclamation.

Specifications

Diversions along the upslope side of the road will be as per specifications on the haul road design. At a minimum, these, and any other diversions shown, will meet the minimum size specifications on the attached Diversion Ditch Typical sheet. Diversions are sized to carry the runoff from a 10 year - 24 hour precipitation event in the area.

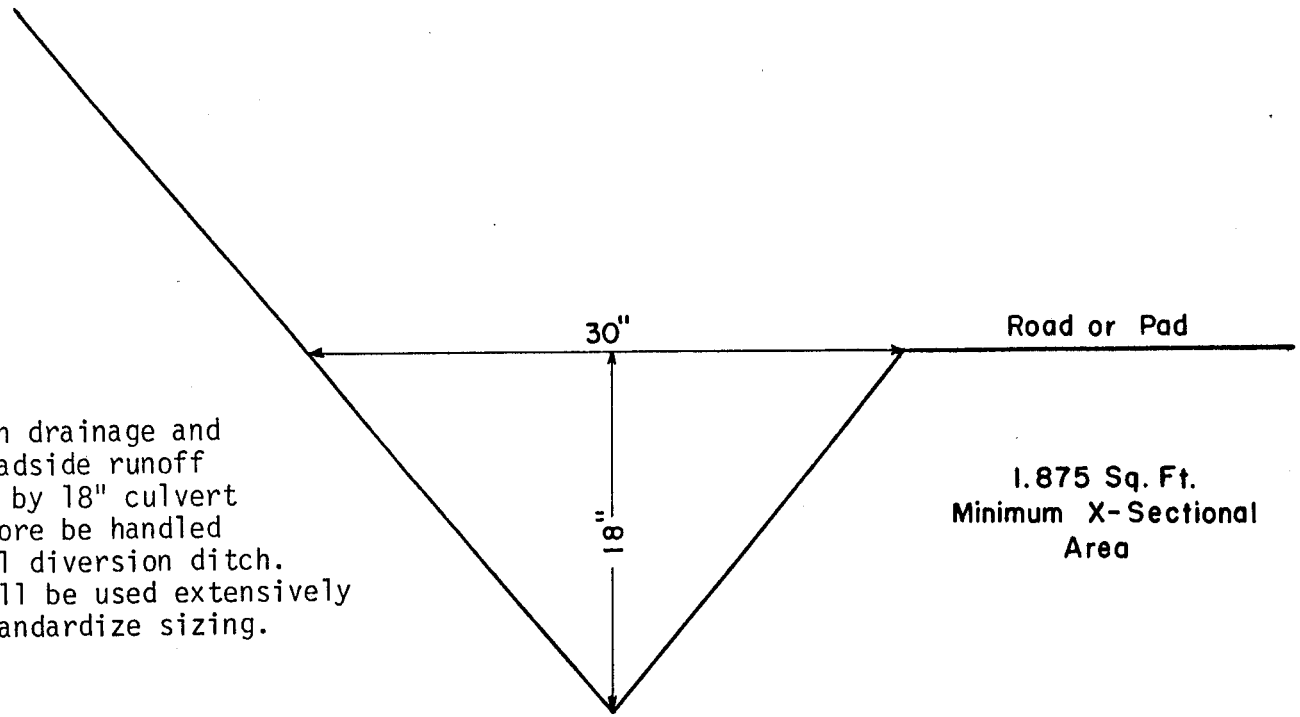
Maintenance

All diversions will be maintained so as to pass the volumes of water for which they were designed. Sluffage will be cleaned out along with regular road maintenance procedures, and any blockage will be removed as soon as practicable after occurrence. Velocities will be controlled as needed to prevent excessive scouring.

Tower Resources, Inc.

Price, Utah

Centennial Project



Note: All side canyon drainage and all pad and roadside runoff can be handled by 18" culvert and can therefore be handled by this typical diversion ditch. 18" culvert will be used extensively in order to standardize sizing.

Diversion Ditch Typical

Scale: 1" = 10"

Date: 8-20-81 J.B.

Comment 817.43 Hydrologic Balance: Diversions and Conveyance of Overland Flow-DC

Response:

There are 2 types of diversions at this property- undisturbed and disturbed. The undisturbed diversions are labeled UD-1, UD-2, and C-1 through C-15, and carry undisturbed drainage around and under the disturbed area. All undisturbed diversions are in place, and are shown on Plate 9, along with respective drainage areas. Cross sections of the undisturbed diversions are shown on the attached "Undisturbed Diversion Ditch Typical." Design calculations are shown on the attached tables entitled "Diversion Design", "Main Channel Culvert Design", and "Side Drainage Culvert Design".

The disturbed diversions carry disturbed drainage to the sediment ponds. The existing disturbed diversions are labled DD-1 and DD-2, and are shown on Plate 6 "Support Facilities- As Constructed." The proposed diversions DD-3 and DD-4 are shown on Plate 7 "Support Facilities- As Proposed". Cross sections of the disturbed diversions are shown on the attached "Diversion Ditch Typical". Disign calculations are shown on the attached table entitled "Diversion Design".

Peak flows for all undisturbed diversions were calculated by the SCS-TR55 Method for Type II storms, as described in "Applied Hydrology and Sedimentology for Disturbed Areas", by Barfield, Warner and Haan, 1983. The Rationale Method was used to calculate peak flows for small, disturbed area diversions, since it is more applicable to the extremely short times of concentration calculated for the pad and road areas.

A runoff curve number of 70 was used for undisturbed areas, and a CN of 90 was used for the disturbed area.

The outlet of C-15 (Main Channel Culvert) shows a velocity of 7.28 fps, which could be slightly erosive in this area; therefore, erosion protection is planned for this outlet. The calculations and design of the protection are shown on the Table entitled "Erosion Protection". Erosive velocities for all other culverts are not applicable, since they all drain to the main culvert C-15.

Velocities on the undisturbed diversions UD-1 and UD-2 and the disturbed diversion DD-1 thru DD-4 are less than 6.5 fps, and are not considered erosive as shown in the Manning's N chart in Exhibit I attached.

Comment UMC 817.44:
Stream Channel Diversions-DC

Response:

Stream channel diversions are covered under the response to UMC 817.44.

The reclamation plans for the drainage in the area consist of replacing each of the culverts C-1 through C-15 with restored channels. The undisturbed diversions UD-1 and UD-2 will also be removed and replaced with appropriate sized channels, corressponding to the channels at culverts C-4 and C-12 respectively. The restored channels are all sized to carry the runoff from a 100 year- 24 hour precipitation event. Cross sections of the restored channels are shown in the attached "Restored Channel Typicals". Design calculations are summarized in the table entitled "Restored Channel Designs".

Culverts C-1, C-3, C-5, C-7, C-9, C-11, C-13, and C-15 will be replaced by the Main Channel RC-1, and culverts C-2, C-4, C-6, C-8, C-10, C-12, and C-14 will be replaced by the Side Channels entitled RC-2, RC-4,.... RC-14, respectively.

The only restored channels with erosive velocities for this area (greater than 6.5 fps) are RC-1, RC-4, and RC-12. Erosion protection is planned for these channels, as shown on the table entitled "Erosion Protection". All other restored channels are expected to have non-erosive velocities, and will not require erosion protection.

Comment UMC 817.46 Hydrologic Balance:
Sedimentation Ponds-JRH and DC

Response:

The sedimentation ponds are shown on Plate 10 through 13. Ponds A, B, and C are constructed as shown on Plate 6- "Support Facilities- As Constructed". There will be no Pond D. Pond E (Plate 13) is a proposed pond, as shown on Plate 7- "Support Facilities- As Proposed". The plans and profiles shown on Plates 10, 11 and 12 are for Ponds A, B, and C respectively, as- constructed. Plate 13 (Pond E) is a design plate only.

All elevations of inflow and discharge are shown on the plates. Also, the embankment slopes are shown not to exeed 5:1 as required. The embankment widths are greater than the required width of "height of embankment plus 35 feet divided by 5" as required. (Please note the different horizontal and vertical scales used on the section views of the ponds.)

Sediment Pond A is currently used only for waste disposal, and will be removed at a later date. This is a presently approved amendment to the M.R.P.

Comment UMC 817.47 Hydrologic Balance: Discharge Structures-DC

Response:

Discharge structures from the sediment ponds have been included in the response to UMC 817.46.

Comment UMC 817.48 Hydrologic Balance:
Acid-Forming and Toxic Forming Material-JSL

Response:

See Appendix IVF of approved plan.

Comment UMC 817.49 Hydrologic Balance:
Permanent and Temporary Impoundments-DC

Response:

The sedimentation ponds and disturbed diversions will remain in place after reclamation, until adequate revegetation is established on the reseeded areas. At this time, the ponds and disturbed diversions will be removed and reclaimed according to UMC 817.46 (U).

DIVERSION DESIGN

Structure	UD-1	UD-2	*DD-1	*DD-2	*DD-3	*DD-4
Drainage Area (acres)	87.78	74.20	0.735	3.72	10.5	6.02
10 yr. - 24 hr. Event (in)	1.82	1.82	1.82	1.82	1.82	1.82
Time of Conc. (hrs.)	0.24	0.21	0.04	0.04	0.04	0.04
Curve number	70	70	90	90	90	90
Manning's Number	.038	.040	.040	.040	.040	.040
Ditch Slope (%)	6.75	8.33	6.25	6.25	6.25	6.25
Peak Flow	20.57	18.32	0.22	1.13	2.86	1.64
Min. Structure Area (ft^2)	6.25	6.25	1.875	1.875	1.875	1.875
Req'd Area (ft^2)	3.38	3.10	0.06	0.28	0.72	0.41
Depth of Flow (ft)	1.35	1.24	0.03	0.15	0.58	0.33
Velocity (fps)	6.08	5.92	3.97	3.97	3.97	3.97
Hydraulic Length	2850'	2800'	200	200	200	200
Land Slope (%)	47.22	58.33	6.25	6.25	6.25	6.25

*Rationale Method Used
q=CiA; q=peak flow in cfs
c=.9 (90% runoff); i=0.3024 in/hr. for Price, Utah
A=Drainage Area

Note: The Rationale Method was used to calculate peak flows for small, disturbed areas, since it is more applicable to extremely short times of concentration such as those experienced on the pads and road areas.

MAIN CHANNEL CULVERT DESIGN

Structure	C1	C3	C5	C7	C9	C11	C13	C15
Drainage Area	467.58	493.29	581.07	621.11	674.74	704.12	778.32	805.50
10 yr. - 24 hr. Event	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82
Time of Conc. (hrs.)	1.02	-	-	-	-	-	-	-
Curve number	70	70	70	70	70	70	70	70
Manning's number	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Ditch Slope (%)	5.56	5.56	5.56	5.56	5.56	5.56	5.56	5.56
Peak Flow	40.91	48.94	69.51	79.21	94.29	103.01	121.33	129.19
Min. Structure Area (ft^2)	4.91	7.07	7.07	7.07	9.62	9.62	9.62	9.62
Velocity (fps)	7.28	7.28	7.28	7.28	7.28	7.28	7.28	7.28
Hydraulic Length	10,200	-	-	-	-	-	-	-
Land Slope	19.83	-	-	-	-	-	-	-
Headwater Req'd (ft)	4.50	N/A	-	-	-	-	-	-
D Req'd (ft)	2.31	2.47	2.82	2.96	3.16	3.27	3.48	3.56

SIDE DRAINAGE CULVERT DESIGN

Structure	C-2	C-4	C-6	C-8	C-10	C-12	C-14
Drainage Area	25.71	87.78	40.04	53.63	29.38	74.20	27.18
10 yr. - 24 hr. Event	1.82	1.82	1.82	1.82	1.82	1.82	1.82
Time of Conc. (hrs.)	0.08	0.24	0.22	0.14	0.11	0.21	0.13
Curve Number	70	70	70	70	70	70	70
Manning's Number	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Ditch Slope (%)	4.00	10.00	4.00	4.00	4.00	10.00	4.00
Peak Flow	8.03	20.57	9.70	15.08	8.72	18.32	7.86
Min. Structure Area (ft^2)	1.767	1.767	1.767	1.767	1.767	1.767	1.767
Velocity (fps)	6.18	8.73	6.18	6.18	6.18	9.77	6.18
Hydraulic Length	850	2850	1400	1600	1250	2800	1300
Land Slope	61.54	47.22	56.67	58.62	63.16	58.33	46.82
Headwater Req'd (ft)	1.8	*6.00	2.40	*3.75	2.10	*5.10	2.00
D Req'd. (ft)	1.34	*1.60	1.43	*1.69	1.38	*1.53	1.33
D In Place (ft)	1.5	1.5	1.5	1.5	1.5	1.5	1.5

* Available headwater at culvert inlet is greater than that required to allow for surge storage and passage of flows.

RESTORED CHANNEL DESIGNS

Structure	Main Channel RC-1	Side Channel RC-2	RC-4	RC-6	RC-8	RC-10	RC-12	RC-14
Drainage Area	805.50	25.71	87.78	40.04	53.63	29.38	74.20	27.18
100 yr. - 24 hr. Event	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74
Time of Conc. (hrs.)	1.02	0.08	0.24	0.22	0.14	0.11	0.21	0.13
Curve number	70	70	70	70	70	70	70	70
Manning's Number	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Ditch Slope (%)	5.56	4.00	10.00	4.00	4.00	4.00	10.00	4.00
Peak Flow	193.82	22.09	54.69	26.50	41.48	23.99	49.74	21.61
Min. Structure Area (ft^2)	27.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Req'd Area (ft^2)	22.08	4.23	6.65	5.09	7.96	4.60	6.04	4.15
Depth of Flow (ft)	2.45	1.05	1.66	1.27	1.99	1.15	1.51	1.04
Velocity (fps)	8.78	5.21	8.23	5.21	5.21	5.21	8.23	5.21
Hydraulic Length	10,200	850	2,850	1,400	1,600	1,250	2,800	1,300
Land Slope (%)	19.83	61.54	47.22	56.67	58.62	63.16	58.33	46.82
Erosion Protection (Y/N)	Y	N	Y	N	N	N	Y	N

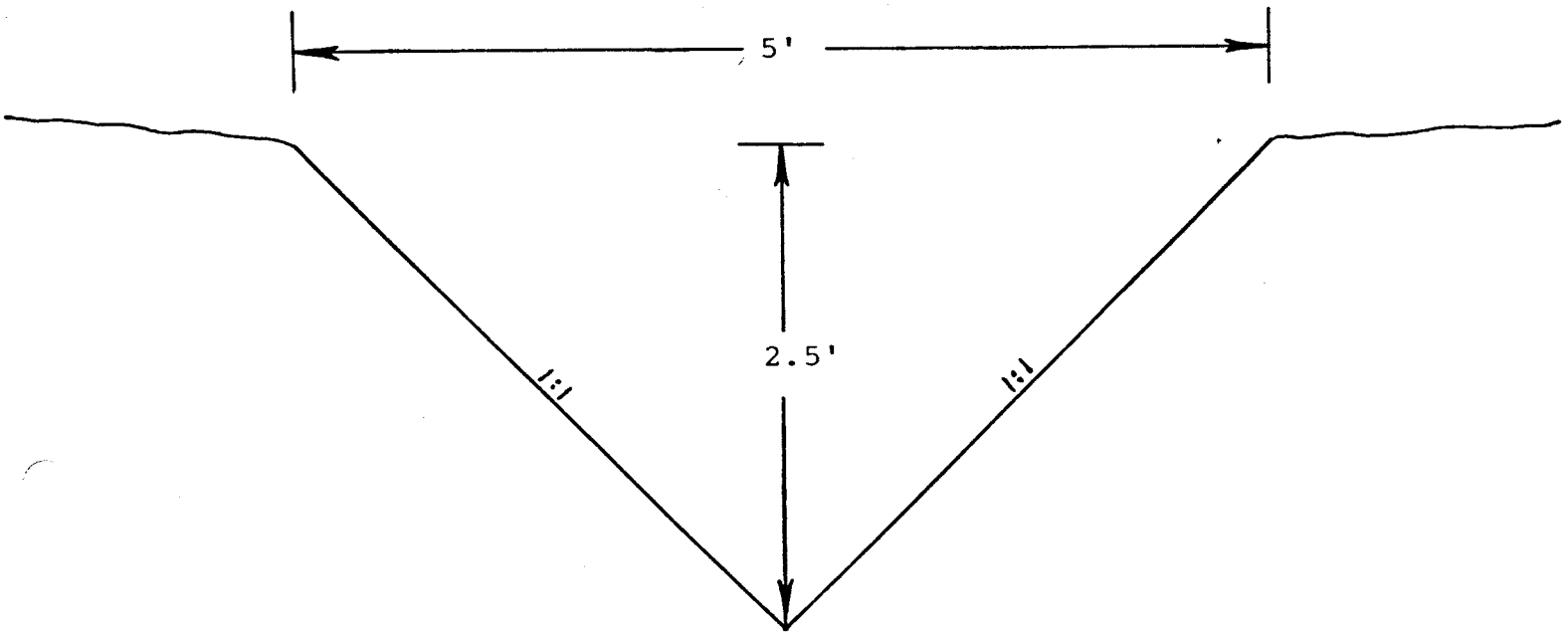
EROSION PROTECTION

Structure	Main Channel C-15	Restored Main Channel RC-1	Restored Side Channel RC-4	Restored Side Channel RC-12
Flow (cfs)		193.82	54.69	49.74
Slope (%)	5.56	5.56	10.00	10.00
Velocity (fps)	7.28	8.78	8.23	8.23
Rip-rap Size (M.D.)	9"	15"	12"	12"
Bedding (3/4" gravel)	3"	4"	3"	3"
Length of Protection (ft)	20'	All	All	All
Width of Protection (ft)	10'	12'	6'	6'

Reference: Attached Exhibit 1.

BY D. Guy DATE 3/15/87 SUBJECT UNDISTURBED DIVERSION TYPICAL Scale: 1"=1' SHEET NO. ..... OF.....

CHKD. BY ..... DATE ..... JOB NO. .....



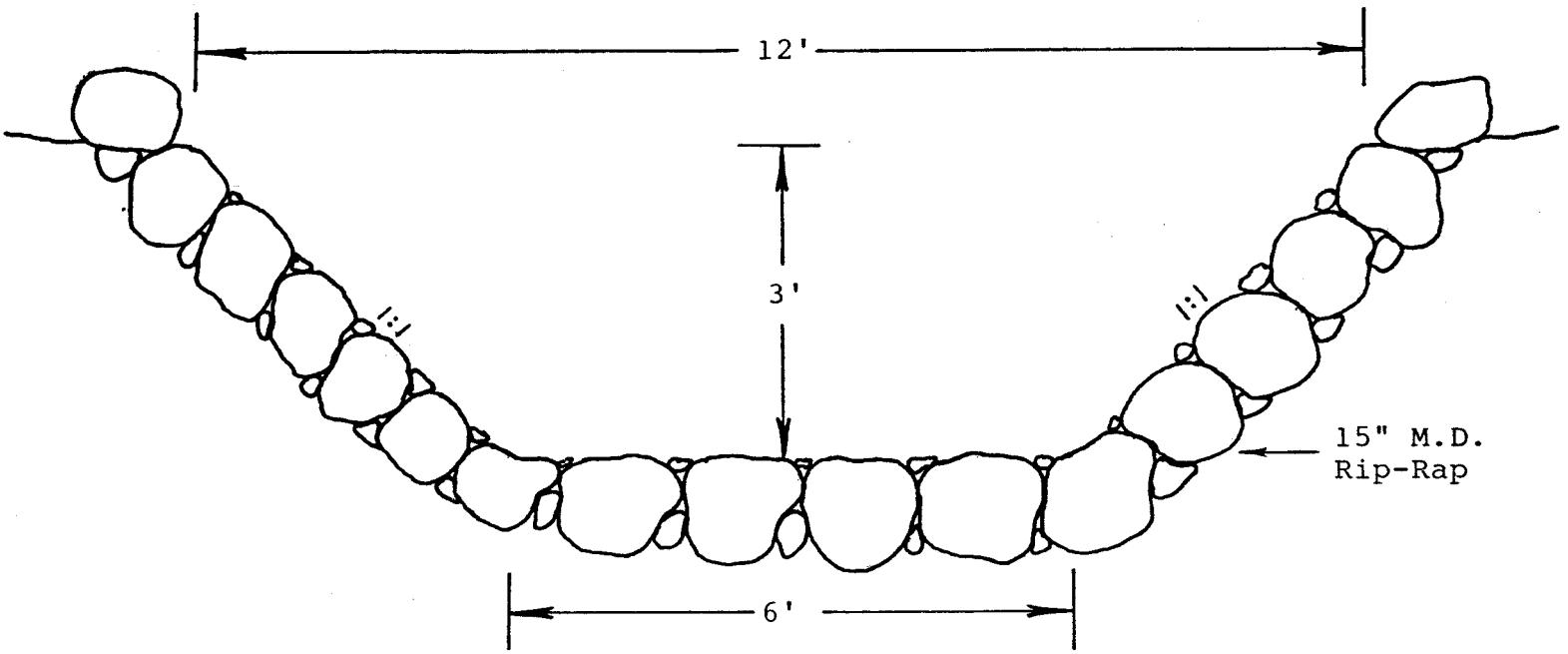
SECTION VIEW

Note: Ditch configuration may vary; however, minimum area will be maintained at 6.25 sq. ft.

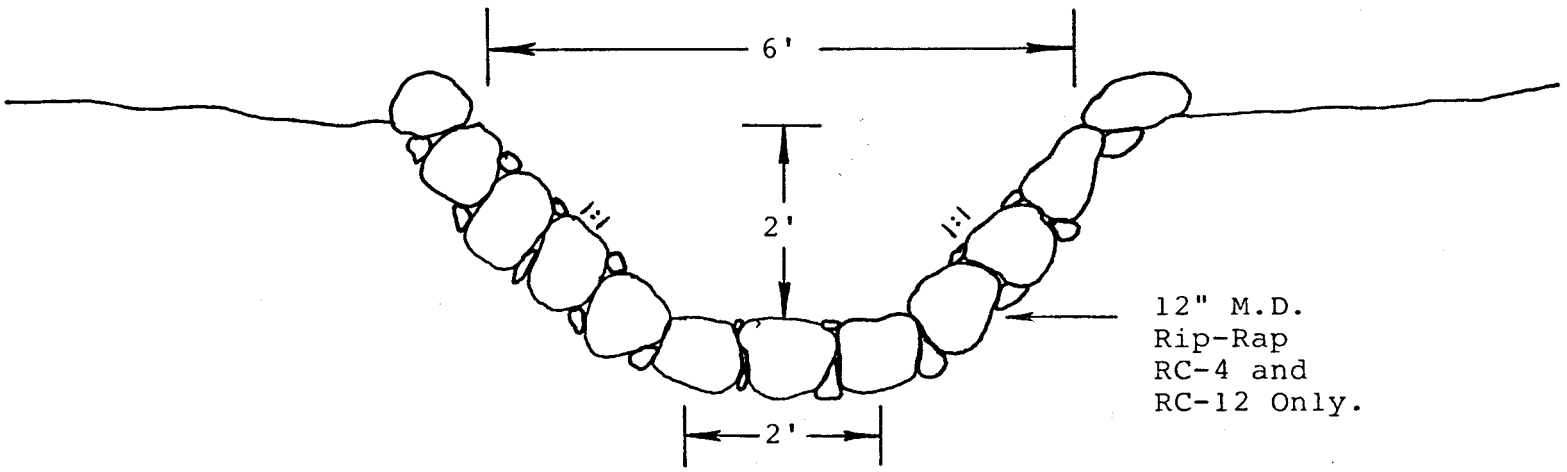
BY D. Guy DATE 3/15/87 SUBJECT RESTORED CHANNEL TYPICALS SHEET NO. ..... OF.....

CHKD. BY ..... DATE ..... JOB NO. .....

Scale: 1"= 2'



MAIN CHANNEL - RC-1



SIDE CHANNELS

Exhibit 1

Erosion Protection Charts

Manning's N-VALUES

Table IV.C.1—Values for Manning's n and maximum permissible velocity of flow in open channels

Ditch lining					Manning's n	V_{max} fps[1]
1. Natural earth						
a. Without vegetation						
(1) Rock						
(a) Smooth and uniform					0.035 - 0.040	20
(b) Jagged & irregular					0.040 - 0.045	15 - 18
(2) Soils						
		Unified	USDA			
Coarse grained	Gravel and gravelly soils	GW	Gravel		0.022 - 0.024	6 - 7
		GP	Gravel		0.023 - 0.026	7 - 8
		GM	Loamy Gravel	d	0.023 - 0.025	3 - 5
				u	0.022 - 0.020	2 - 4
		GC	Gravelly Loam Gravelly Clay		0.024 - 0.026	5 - 7
	Sand and sandy soils	SW	Sand		0.020 - 0.024	1 - 2
		SP	Sand		0.022 - 0.024	1 - 2
		SM	Loamy Sand	d	0.020 - 0.023	2 - 3
				u	0.021 - 0.023	2 - 3
		SC	Sandy Loam		0.023 - 0.025	3 - 4
Fine grained	Silts and clays, LL 50	CL	Clay Loam Sandy Clay Loam Silty Clay		0.022 - 0.024	2 - 3
		ML	Silt Loam Very Fine Sand Silt		0.023 - 0.024	3 - 4
		OL	Mucky Loam		0.022 - 0.024	2 - 3
	Silts and clays, LL 50	CH	Clay		0.022 - 0.023	2 - 3
		MH	Silty Clay		0.023 - 0.024	3 - 5
		OH	Mucky Clay		0.022 - 0.024	2 - 3
Highly Organic		PT	Peat		0.022 - 0.025	2 - 3

[1]Maximum recommended velocities

2.4

A filter layer under all riprap is essential (3) unless the bank material meets the filter requirements. (See section 2.7.)

(1) Dumped riprap is graded stone dumped on a prepared slope in such a manner that segregation will not take place. Dumped stone riprap is the most flexible of the types considered here and will adjust itself to uneven bank settlement. In most areas dumped stone is the least costly type.

(2) Hand-placed riprap is stone laid carefully by hand or by derrick following a more or less definite pattern with the voids between the larger stone filled with smaller stone and the surface kept relatively even. The resulting protection approaches good dry rubble in quality and appearance, but this type of riprap is rigid and lacks the strength necessary to bridge even minor movement of the surface which it protects.

(3) Wire-enclosed riprap is stone placed in wire baskets or in wire covered mats. Wire-enclosed riprap is generally used because rock of suitable size is not available. This riprap is effective until the wire enclosure fails.

(4) Grouted riprap is riprap with the interstices filled with portland cement mortar. The use of grouted riprap is seldom justifiable when stone of suitable size is available.

(5) Concrete riprap in bags is concrete in cement sacks or suitable burlap bags that are hand placed in contact with adjacent bags.

(6) Concrete-slab riprap is plain or reinforced concrete slabs poured or placed on the surface to be protected. The slabs poured or placed on the surface to be protected. The slabs are not connected to each other.

II - DESIGN

2.1 - Design of Dumped-Stone Riprap

The resistance of dumped stone to displacement by moving water depends upon:

(1) Weight, size, shape, and composition of the individual stones

(2) The gradation of the stone

(3) The depth of water over the stone blanket

(4) The steepness and stability of the protected slope

(5) The stability and effectiveness of the filter blanket on which the stone is placed.

(6) The velocity of the flowing water against the stone

(7) The protection of toe and terminals of the stone blanket

The design of a dumped-stone blanket for bank protection is similar to that for a stone-lined channel discussed in section 4.12 of reference 8. The principal difference between stone linings and stone bank protection is that in linings the channel bed is also lined, and the lining is generally continuous throughout the length of channel wherein erosion is imminent. Bank protection is generally limited to problem areas. The toe and terminals of the bank protection are particularly vulnerable to attack by the current. At some locations, wave action may present a more severe form of attack than water flowing parallel to the embankment; such cases may require heavier protection. Protection from wave action is discussed in references 1, 4, 6, and 7.

2.1.1 - Size of Stone

The size of stone needed to protect a streambank or highway embankment from erosion by a current moving parallel to the embankment is determined by the use of figures 1 and 2. Size (k) is the diameter, in feet, of a spherical stone that would have the same weight as the 50 percent size of stone. The size of stone is found by a trial-and-error procedure which consists of first estimating a stone size.

The mean velocity (V_m) of the stream during the design flood must then be converted to velocity against the stone by use of figure 1. The ratio ($\frac{k}{d}$) of the equivalent spherical diameter of the 50 percent stone size to the depth of flow during the design flood is computed by using 0.4 of the total depth when the depth of flow exceeds about 10 feet. The reason for this is that use of the total depth would result in a stone size which would be adequate at the total depth but which might be too light to provide protection near the water surface.

With the velocity against the stone (V_s) enter figure 2 and read the stone size for the embankment slope. The stone size from figure 2 is the 50 percent (median) size, by weight, of a well-graded mass of stone with a unit weight of 165 pounds per cubic foot. If the stone size from figure 2 agrees with the assumed stone size, this is the correct size. If not, the procedure is repeated until the assumed size is in reasonable agreement with the size from figure 2.

When the unit weight of the stone is other than 165 pounds per cubic foot, the size from figure 2 should be corrected by Creager's equation (discussion of in reference 4):

$$k_w = \frac{102.5\ k}{w - 62.5}$$

where k = stone size from figure 2

k_w = stone size for stone of w pounds per cubic feet

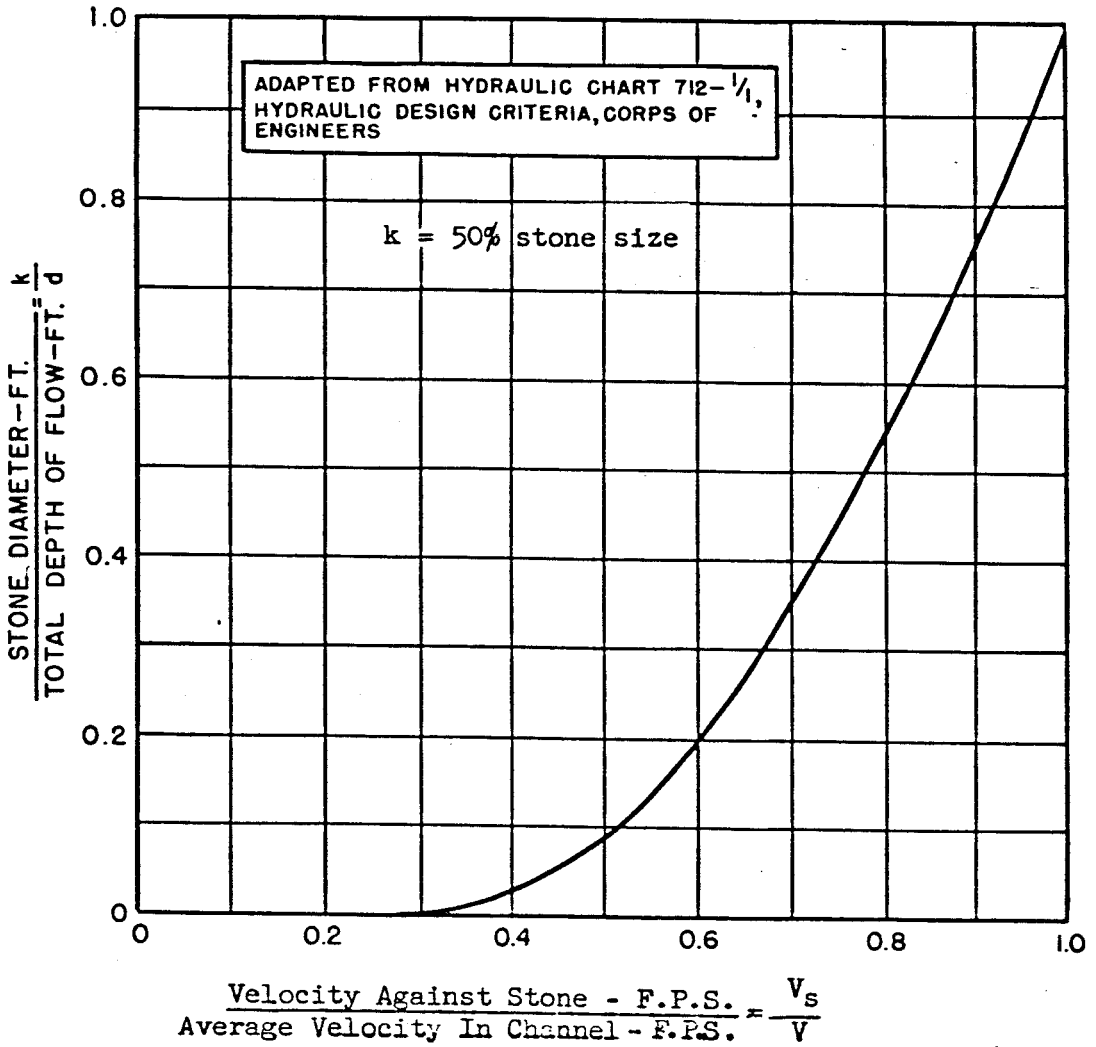


FIG. 1 - VELOCITY AGAINST STONE ON CHANNEL BOTTOM

The size of stone required to resist displacement from direct impingement of the current as might occur with a sharp change in stream alinement is greater than the value obtained from figure 2, although research data is lacking on just how much larger the stone should be. The California Division of Highways (6) recommends doubling the velocity against the stone as determined for straight alinement before entering figure 2 for stone size. Lane (9) recommends reducing the allowable velocity by 22 percent for very sinuous channels; for determining stone size by figure 2, the velocity (V_s) would be increased by 22 percent. Until data are available for determining the stone size at the point of impingement, a factor which would vary from 1 to 2 depending upon the severity of the attack by the current, should be applied to the velocity V_s before entering figure 2.

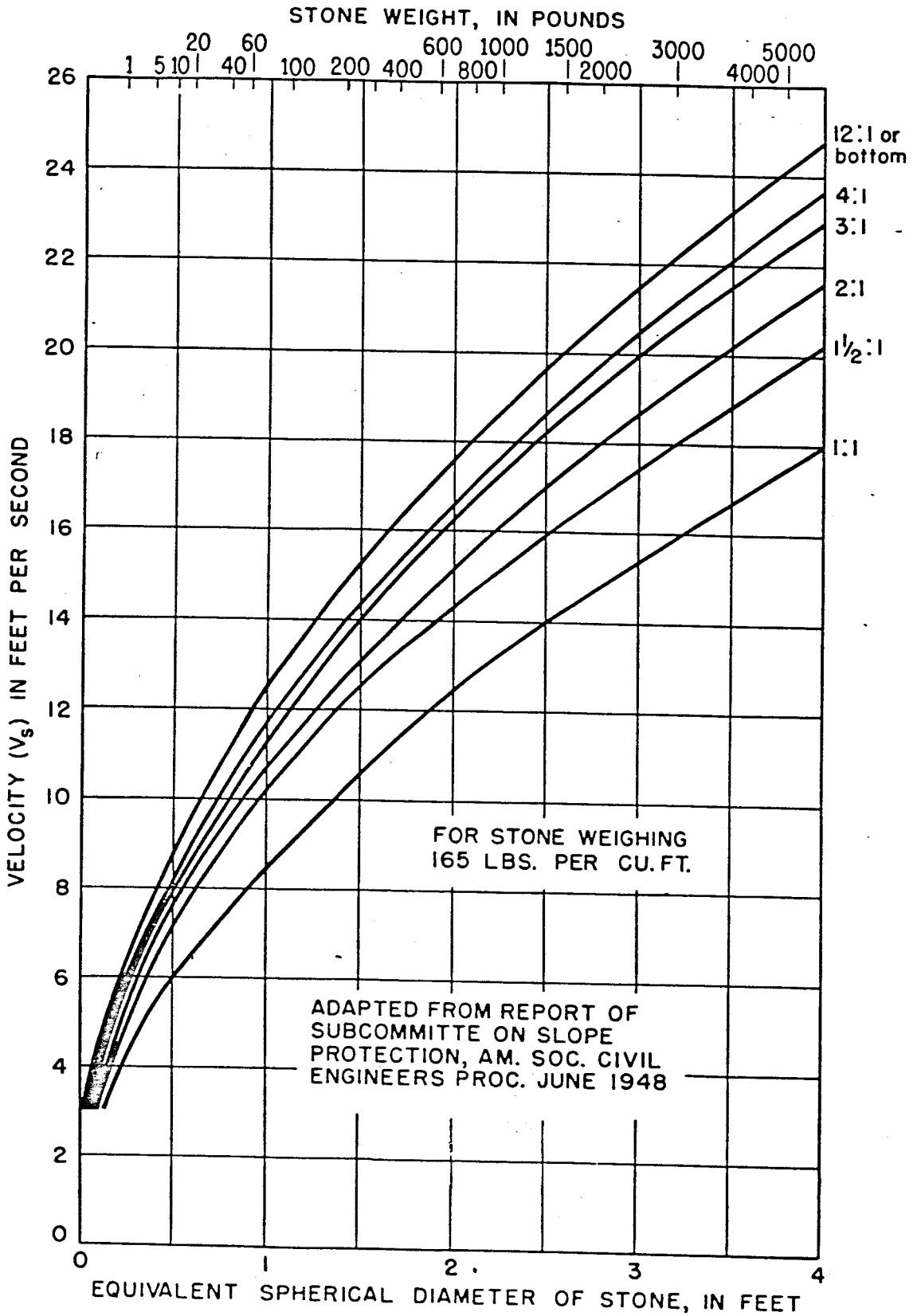


FIG. 2-SIZE OF STONE THAT WILL RESIST DISPLACEMENT FOR VARIOUS VELOCITIES AND SIDE SLOPES

EXHIBIT III-B

ELECTRICAL SPECIFICATIONS

TOWER RESOURCES, INC.

ELECTRICAL SPECIFICATION NO. TR-2

DEADMAN CANYON MINE SUBSTATION

I. General

This specification is for the construction of an outdoor permanent substation. This substation will be used to step-down the incoming 46 KV, 3-phase, 60 Hertz power supply from Utah Power and Light Company to a distribution voltage of 4160 volts, 3-phase, 60 Hertz for supplying power to Tower Resources, Inc.'s Pinnacle Coal Mine and surface facilities at the present time. However, the entire substation secondary and mine power distribution system shall be designed, installed, and insulated in accordance with 8 KV specifications to facilitate the futre conversion to a 7200 volt mine power distribution system. The substation will also contain a section that will step-down the mine primary distribution voltage (4160 or 7200 volts) to 480 volts, 3-phase, 60 Hertz power for surface power distribution purposes.

All work shall be done in strict adherance to the latest National Electrical Code; Part 77, Code of

Federal Regulations; and all applicable local, state, and federal laws, regulations, and codes. In addition, all applicable spacings and clearances shall conform to the recommendations given in Utah Power and Light Company's Drawing C1501, "Outdoor Substation Clearances", which is attached. The general layout is to be as shown on the conceptual drawing TR-2-1.

II. Definitions

A. The term "purchase" shall refer to Tower Resources, Inc.

B. The term "contractor" shall refer to the successful bidder who is constructing the substation.

III. Work By Purchaser

The purchaser will grade and drain substation site; and survey and locate foundations, footers, and pads for the substation structure, power transformers, ground resistor, control transformer, and distribution boxes.

IV. Material Supplied By Purchaser

The purchaser shall supply all major substation components such as power transformers; switchgear; control transformer; grounding resistor; 46 KV load

break switch; 39 KV intermediate type lightning arrestors; 46 KV deadend insulators; S & C SMD-1A, 46 KV fused disconnects and fuse units; 4.5 KV intermediate type lightning arrestors, and 8 KV solid disconnect switches.

V. Material Supplied By Contractor

The contractor shall supply all conduit, conduit fittings, wire and cable, stress cones, terminals, fencing material, steel, and concrete necessary to complete the construction of the substation as specified.

VI. Work By Contractor

A. Grounding

1. A ground field (grid) not exceeding 3 ohms shall be established within the station by means of interconnected driven ground rods. The ground rods shall be copper-clad steel electrodes, 3/4 inch diameter x 12 feet long. A main ground loop shall be constructed by interconnecting the ground rods with stranded, soft-drawn, bare copper wire, size 500 MCM. The main ground loop should follow the fence line as closely as possible with the tops of the ground rods at least 24 inches below finished grade.

2. The main tap from the ground loop to the neutral grounding resistor shall also be stranded, soft-drawn, bare copper wire, size 500 MCM.

3. Taps from the ground loop are to be connected to all columns of the substation metallic structure, to all metallic cases and enclosures within the substation and switchgear house, and to the operating mechanisms and operating handles of all air-break switches within the substation. All of these shall be stranded, soft-drawn, bare copper wire, size 250 MCM.

4. A dual-path ground will be provided for 46 KV and 4.16 KV lightning arrestors, size 2/0 AWG minimum.

5. The fence shall be grounded in accordance with the following specifications and Utah Power and Light Company's Drawing UC-57923-C "Grounding Steel Fence Details" which is attached for reference.

   a. All corner posts and all gate posts shall be grounded.

   b. Ground taps at intervals not exceeding 50 feet in length will be placed between corner posts and between gate posts and corner posts.

c. Gate panels and removable panels will be bonded to ground with flexible straps (shunts).

d. All grounds will be extended up the fabric and bonded to each strand of fence.

e. All ground taps shall be stranded, soft-drawn, bare copper wire, size 250 MCM minimum.

6. A ground tap shall be provided for the grounded mat located at each grounded operating handle of airbreak switches. Each ground tap shall be stranded, soft-drawn, bare copper wire, size 250 MCM minimum.

7. Ground wire connections to the main ground loop, to the electrodes and to the substation structure shall be by thermit weld. Bolted ground clamps shall be used on all electrical equipment within the substation and switchgear house.

8. All conduits shall be bonded to panel boards, wire troughs or other metallic enclosures by means of grounding bushings or ground clamps. Bonding is to be provided across all conduit connections that are not fully threaded.

B. <u>Substation Structure Construction</u>

1. The contractor shall supply all materials, fabricate, and erect the heavy guage steel

structure. Outline drawings and instructions pertaining to the construction of the substation structure shall be furnished by purchaser. Note that the drawings are to be used as guidelines only and are not detailed enough to be used as fabrication specifications. The contractor shall be responsible for design, layout, fabrication, and erection of the substation structure. The structure shall be designed on the basis of 1500 lbs. tension per wire $\pm 15^{\circ}$ from straight and 80 MPH wind. The contractor shall be responsible for locating all necessary anchors and/or fasteners within the concrete footers and pads in order to erect the structure. The contractor shall also be responsible for all concrete work associated with the substation construction.

2. The incoming 46 KV, 3-phase, 60 Hertz power line will dead-end on the incoming end of the substation structure with a slack span from the 2-pole terminal structure that will be centered on the substation. The incoming conductors, which are three, single, bare 266.8 MCM ACSR conductors, shall terminate on the line side of the substation incoming-line, air-break

switch. In addition, 1 3/8" EHS Grade B, 7-strand, galvanized steel static wire carried along the overhead power line shall be solidly grounded to the substation structure. The contractor shall be responsible for terminating the incoming line on strain insulators provided by the purchaser and mounted by the contractor. The contractor shall be responsible for providing a means to solidly ground the static wire to the substation structure and to make the connection. The contractor shall supply and install the jumper wires required between the strain insulators and the line-side of the incoming-line, air-brak switch.

3. The purchaser shall supply and the contractor shall install the incoming line switch on the substation structure. This switch shall be a three-pole, gang operated, air-break, load-break, manually operated switch rated at 46 KV and 600 amperes. The switch operating mechanism will be arranged so that the operating handle is located near ground level enabling the switch to be opened and closed from the ground. The switch operating handle shall be grounded as specified previously. A metal mat, grounded as previously specified, shall be provided by

purchaser and installed by contractor. The switch shall be arranged so that it will automatically ground all three phases on the load-side of the switch when fully in "open" position. The contractor shall install this switch and make all necessary connections; including grounds, bus work and wires. The busing will be supplied by the contractor.

4. Lightning arrestors shall be supplied by the purchaser and installed and connected by the contractor on the load-side of the 46 KV incoming line switch. These lightning arrestors shall be rated for at least 40 KV to ground and one shall be provided for each phase (3). All bus work, wiring and grounding shall be installed by the contractor. The contractor will supply the busing. A dual-path ground shall be provided.

5. Three single-pole fused cut-outs shall be provided for transformer protection on the primary (46 KV) side. These fuse cut-outs shall be S & C Electric Company type SMD-1A or equivalent. They shall be rated for at least 46 KV and 200 amperes. Each fused cut-out will be equipped with a 46 KV, 20 ampere current-limiting fuse. These fuse cut-outs will be supplied by the purchaser.

6. The purchaser shall supply and the contractor shall install the 46 KV insulators that are required.

7. The contractor shall furnish and install all 46 KV bus work that is required. All bus work will be copper and all terminations will be for copper-to-copper connections. All terminations will also be furnished by and installed by contractor. Busing shall be copper tubing (IPS).

8. All clearances and spacings in the substation and on the substation structure shall comply with the 1978 National Electrical Code, AIEE standards, and Utah Power & Light Company's Drawing C1501 "Outdoor Substation Clearances" shall be used as a reference. All energized 46 KV parts are to be at least 120 inches above finished ground level. All energized 4160 volt parts are to be at least 111 inches above finished ground level.

9. All 4160 volt bus work within the substation will be copper and will be furnished by and installed by the contractor. All terminations are to be for copper-to-copper connections and will be furnished by and installed by the contractor.

10. Lightning arrestors will be supplied by the purchaser and installed and connected by the contractor as closely as practical to the load-side (4160 volt) of the main transformer. These lightning arrestors will be rated for at least 4160 volts to ground and one shall be provided for each phase (3). A dual-path ground shall be provided. All bus work, wiring and grounding shall be installed by the contractor. The purchaser will supply all bus work that is required.

11. The purchaser shall supply and the contractor shall install all insulators on the 4160 volt side of the substation. All 4160-volt side insulators will be rated for at least 7.5 KV to ground.

12. The purchaser will supply and the contractor will install a 25 KVA, 4160 volt, 120/240 volt, single-phase control power transformer on the 4160-volt end of the substation. All necessary terminals, mounting brackets and associated hardware required for this installation will also be provided by the purchaser. The contractor shall furnish and install enclosed fuse cut-outs on the primary side (4160 volt) of this control transformer. The

fuse cut-outs shall be rated for at least 8 KV and 100 amperes, with fuse links rated at 8 KV and 9.0 amperes.

13. The contractor shall furnish and install an outdoor, NEMA 3R (raintight), 8 pole-space, 100 ampere rated circuit breaker panel. This circuit breaker panel shall be equipped with circuit breakers with the following ratings:

    1 - 30 ampere, 2 - pole

    2 - 20 ampere, 1 - pole

14. The contractor shall furnish all parts and install a service drop from the 25 KVA control transformer to the circuit breaker panel. This service drop shall consist of a 1½ inch weatherhead; 1½ inch rigid conduit; a 1½ inch weather-tight hub; and the enclosed service conductors which shall be 2 - #2 AWG, type THW, black phase conductors; 1 - #2 AWG, type THW white neutral conductor; and 1 - #6 AWG, bare copper ground wire. Note that the center-tapped neutral shall be grounded to the substation structure ground field.

15. The contractor shall furnish all parts and install a 120 volt, single-phase, auxiliary power outlet on the substation structure column beneath the circuit breaker panel. This

power outlet shall consist of a 20 ampere, 1-pole circuit breaker in the circuit breaker panel; a ½ inch rigid galvanized conduit offset nipple, locknuts, and plastic bushings; the enclosed conductors which shall be 1 - #12 AWG, type THW, black phase conductor; 1 - #12, type THW white neutral conductor; and 1 - #12 AWG, bare copper ground wire; a weather-proof outlet box; a 20-ampere-rated duplex receptacle; a weather-proof cover; and the necessary mounting accessories.

16. The contractor shall supply and install two 200 watt mercury vapor street lights and the power circuits for these lights. The lights shall be mounted on both sides of the 46 KV end of the structure as shown on the attached diagrams. The lights shall be equipped with photocells. The lighting circuit shall consist of a 20 ampere, 1-pole circuit breaker in the circuit breaker panel; ½ inch rigid galvanized conduit; ½ inch weather-proof boxes; and the enclosed conductors which shall be 1 - #12 AWG, type THW, black phase conductor; 1 - #12 AWG, type THW, white neutral conductor; and 1 - #12 AWG, bare copper ground wire.

17. All 120/240 volt control and power circuits, and all 480 volt distribution circuits on the substation structure and located within the substation area shall be enclosed in galvanized rigid conduit and all conductors shall be 600 volt, type THW, copper. All buried conduits shall be coated and sealed with black mastic compound.

18. All 46 KV busing, complete with fittings and terminals, shall be supplied and installed by the contractor. This busing shall be electrical tubing-type copper (IPS) rated at 600 amperes continuous, and braced to withstand the mechanical forces associated with currents up to 10,000 amperes instantaneously. See the attached diagrams.

19. All 8 KV busing, complete with fittings and terminals, shall be supplied and installed by the contractor. This busing shall be 4/0 bare copper, stranded, single-conductor cable suspended from one end of the substation secondary to the other by means of 8 KV strain insulators. See the attached diagrams.

20. The purchaser shall supply and the contractor shall install three (one per phase) non-fused (solid blade) disconnect switches on the

substation structure on the line-side of the mine oil circuit breaker. The contractor shall connect the line-side of these disconnect switches to the secondary busing on the substation and the load-side of the mine oil circuit breaker.

21. The purchaser shall supply and the contractor shall install three (one per phase) fused cut-outs on the substation structure to provide protection and disconnect functions for the surface power transformer bank. The line-side of these fused cut-outs shall be connected to the substation secondary bus work (4160 volts), and the load-side shall be connected to the surface transformer bank. The surface power transformer bank shall provide 480 volt, 3-phase, 60 Hertz power for surface loads. The connections shall be made with 4/0, bare, stranded copper wire. All wire and connectors shall be supplied by the contractor. The voltage rating of the fused cut-outs, insulators, and fuse links shall be at least 8 KV. The current rating of the fused cut-outs shall be 200 amperes and the current rating of the fuse links shall be sized to protect the surface transformer bank and will be specified at a later date.

22. The contractor shall provide mounting brackets at the location shown on the attached diagrams for the installation of the utility company metering cabinet. The contractor shall also provide a beam or other mounting arrangement on the substation structure for installation of the utility company secondary (4160 volt) metering transformers.

23. The contractor shall provide and install a fence that shall completely enclose the substation. The fence shall be in accordance with Utah Power and Light Company specifications, which are attached (page 2 of the attached Utah Power and Light Company "Specifications and Requirements for Customer-Owned Substations- 69,000 Volts and Below"). The most important items of these specifications and additional instructions are listed below.

    a. The fence is to be of galvanized chain link 7 feet in height with 1 foot extension of barbed wire above for an overall height of 8 feet.

    b. The fence shall be grounded in accordance with the specifications

for fence grounding previously described in the section of this specification headed "Grounding".

c. At no point shall the bottom of the fence fabric and bottom of fabric on gates and removable panels be more than 2" above finished grade.

d. The substation fencing shall not be connected or in contact with any other fencing.

e. "Danger-High Voltage" signs shall be prominently displayed on all sides of the fence facing outside.

f. One man gate (3 feet wide) and one equipment gate (10 feet wide overall, consisting of 2 - 5 foot wide gates) shall be provided. The man gate shall be located on the end opposite the high-voltage end of the substation opposite the hillside and near the high-voltage end. These gates shall be constructed of galvanized steel pipe and chain link, and shall be 8 feet high overall. All gates shall be provided with locking provisions to prevent unauthorized entrances.

C. The purchaser shall supply and the contractor shall install the main substation distribution transformer or transformer bank. The substation structure has been outlined to provide the required spacings and clearances for a capacity of up to 5,000 KVA. However, the initial transformers will probably be a bank of three 333 KVA, single-phase transformers (1,000 KVA total capacity). Therefore, the contractor will likely need to provide transformer stands to achieve the required vertical clearance for 46 KV lowest line parts of 120 inches. All transformers shall be equipped with primary and secondary top-mounted bushings for connection to the substation structure equipment and bus work. The contractor shall provide a 4/0 bare copper wire bus extended between 46 KV strain insulators on the substation primary end for connection of the transformer bank primary (46 KV). The contractor shall make all transformer power connections and supply all material except transformer bushing terminals needed to make the connections. The contractor shall install and connect substation ground field taps for each power transformer.

D. The purchaser shall supply and the contractor shall install and wire a neutral current-limiting grounding resistor. The purchaser shall supply and the contractor shall install and wire a neutral current transformer. The neutral current transformer shall be mounted inside the grounding resistor shall be completely enclosed in a galvanized expanded metal enclosure, complete with top-mounted bushings. The contractor shall supply and install a galvanized steel stand that will elevate the grounding resistor such that the height to the exposed terminals above the bushings is at least 111 inches. A ½ inch galvanized rigid conduit shall be provided and installed by the contractor which will initiate at the neutral grounding resistor and terminate at the mine oil circuit breaker. This conduit shall enclose two #12 AWG, type THW conductors that connect to the neutral current transformer and the ground fault relay at the mine oil circuit breaker control panel. The contractor shall connect the line-side of the neutral grounding resistor to the main transformer neutral and the load-side to the mine ground field and mine neutral ground conductor. Refer to the attached diagrams for clarification. The contractor shall also ground the neutral

grounding resistor enclosure to the substation ground field.

E. The purchaser shall supply and the contractor shall install a mine oil circuit breaker complete with control panel and stand. The vertical clearance to the lowest live part above the finished grade on this oil circuit breaker must be at least 111 inches. This oil circuit breaker shall be equipped with line-side and load-side, top-mounted bushings. The line-side of the circuit breaker shall be connected to the disconnect switches provided on the substation structure. The load-side of the oil circuit breaker shall be connected to an overhead power line extending to the mine portal via the appropriate stand-off and strain insulators mounted on the substation structure. For the purposes of this bid, the contractor shall make the line-side connections as described above. In addition, the contractor shall extend a conductor on each phase from the load-side of the circuit breaker to the stand-off insulators and strain insulator provided on the substation structure, leaving an 18 inch pigtail for connection to the overhead lines. All interconnecting conductors used to make the connections described above shall be 4/0 AWG, stranded,

bare copper. The contractor shall furnish all parts and materials and install a control power circuit for the oil circuit breaker. This control power circuit shall consist of a 30 ampere, 2-pole circuit breaker in the circuit breaker panel (240 volt, 1-phase, 60 Hertz); ½ inch galvanized rigid conduit, fittings, and mounting accessories; and the enclosed conductors which shall be 2 - #10 AWG, type THW, black phase conductors; and 1 - #10 AWG, bare copper ground wire. The contractor shall solidly ground the mine oil circuit breaker frame to the substation ground field. A nuetral ground current transformer circuit to be installed by the contractor has already been specified. A mine power feeder ground monitor circuit must also be installed by the contractor. The contractor shall supply all parts and materials to install this circuit as specified. Note that the ground monitor unit shall be equipped by the purchaser and contained in the mine oil circuit breaker control panel. The ground monitor circuit shall originate at the mine oil circuit breaker control panel and terminate at the mine power feeder ground and pilot wires as described below. This ground monitor circuit shall consist of a ½ inch galvanized rigid conduit, fittings, and mounting accessories; and the

enclosed conductors which are 1 - #10 AWG, type THW, yellow pilot wire, and 1 - #10 AWG, type THW, green ground wire. The yellow wire shall be connected to the mine feeder circuit pilot wire at the point where it leaves the substation structure via a strain insulator accessing it to the overhead power line to the mine. The green wire shall be connected to the mine neutral ground wire on the load-side of the neutral grounding resistor. The contractor shall test, calibrate, and set the oil circuit breaker protective relays and current transformers as specified by the purchaser.

F. The purchaser shall supply and the contractor shall install a surface power transformer bank. All transformers shall be equipped with top-mounted bushings. The contractor shall make all transformer connections and shall solidly ground the transformer cases to the substation ground field. The transformer bank will very likely consist of three 150 to 200 KVA, single-phase transformers (450 to 600 KVA total capacity). The contractor shall be responsible for achieving the required vertical clearance of 111 inches to live parts on this transformer bank primary (4.15 or 7.2 KV). The contractor shall supply all material

needed to install and connect the surface power transformer bank. The surface power transformer bank shall supply 480 volts, 3-phase, 60 Hertz power to a distribution box located in the substation enclosure. The specifications for this power feeder circuit and the distribution box are given below.

G. The contractor shall supply all parts, material, and labor to install a 480 volt, 3-phase, 60 Hertz power feeder circuit from the surface power transformer to a 480 volt distribution box that will be specified later. This power feeder circuit shall consist of a 4-inch weatherhead, 4-inch rigid galvanized conduit, necessary 4-inch rigid galvanized conduit fittings, and the enclosed conductors. The conductors are 2-350 MCM, type THW, copper conducters in parallel per phase. This 4-inch conduit shall be solidly grounded to the substation ground field by means of a grounding bushing. This power feeder circuit shall initiate at the surface power transformer secondary terminals and terminate on the line-side of the 600 ampere main breaker at the 480 volt distribution box. The conduit shall be constructed in accordance with acceptable standards for a weatherproof installation. See the attached diagrams for a clarification of the work described above and to determine the relative locations of the transformer bank and distribution box.

H. The contractor shall supply all materials for and construct a 480 volt distribution box located as shown in the substation on the attached

diagrams. This distribution box shall be constructed of heavy guage steel, and shall be weatherproof and weathertight. All conduits entering the distribution box shall be equipped with weathertight hubs. The incoming power feeder circuit for the distribution box shall terminate on the line-side of the 600 ampere main circuit breaker. The load-side of this main circuit breaker shall be connected to three copper buses (one per phase) by means of 2-350 MCM, type THW, copper conductors. The buses shall be rated at least 600 amperes continuous and braced to withstand the magnetic forces associated with 10,000 amperes of fault current momentarily. The distribution box shall be equipped with 3-225 ampere circuit breakers and 1-50 ampere circuit breaker to supply and protect the 480 volt branch circuits. The 225 ampere circuit breakers shall be used to supply the "Fan", "Belt Drive", and "Bath House and Office". The 50 ampere circuit breaker shall be used to supply a yard lighting circuit. The line-sides of the 225 ampere circuit breakers shall be connected to the phase buses by means of 4/0, type THW, copper conductors. The line-side of the 50 ampere circuit breaker shall be connected to the phase buses by means of #6,

type THW, copper conductors. The distribution box shall be equipped with a copper ground bus extending across the bottom of the box for the entire length of the box. This copper ground bus shall be rated at 600 amperes continuous and shall be solidly grounded to the distribution box frame and to the substation ground field. All circuit breakers shall be standard molded-case, 3-pole, thermal-magnetic trip, 600 volt rated. The box shall be constructed such that all circuit breakers can be operated external to the box, all circuit breakers have lock-out provisions, and all circuit breakers are easily accessible by means of hinged doors which also have locking provisions. The box shall be constructed to provide for enough length for the possible future addition of a 400 ampere circuit breaker.

I. The contractor shall supply all parts, material, and labor to install the branch distribution circuits, conduit risers, and initial pole (pole C on attached diagrams) for the 480 volt distribution circuits. Rigid galvanized conduits equipped with weathertight hubs shall originate at the distribution box, extend underground to pole C, and extend up pole C by means of rigid galvanized conduit risers and

weatherheads. All buried conduits shall be coated with black mastic compound. Pole C shall be a 40 ft., butt-treated, Class 2 or 3 pole. The contractor shall supply, set, install all necessary hardware on, and supply all hardware on this pole. The branch distribution circuits for the "Fan", "Belt Drive", and "Bath House and Office" shall be protected by 225 ampere circuit breakers at the distribution box; shall be enclosed by 2½-inch rigid galvanized conduits; and shall be fed by 3 - 4/0, type THW, copper phase conductors, and 1 - 4/0, type THW copper ground conductor for each distribution circuit. The 50 ampere lighting circuit shall consist of 2 - #6, type THW, copper phase conductors; and 1 - #6, type THW, copper ground conductor enclosed in 1 inch rigid galvanized conduit. All ground conductors shall originate and be solidly connected to the distribution box ground bus. The conduit risers on the poles shall all terminate with weatherheads and 18-inch pigtails for all conductors shall extend from the weatherheads for connection to future overhead powerlines. The contractor shall supply and install stand-offs, unistrut, and unistrut clamps for attaching the conduit risers to the pole.

J. The contractor shall supply all parts, material, and labor to install the necessary hardware and insulators to facilitate the connection of the future mine 4160 volt overhead powerline drop into the substation. The contractor shall extend 4/0, bare, copper conductors for each phase from the mine oil circuit breaker to stand-off insulators provided on the substation structure. A 24-inch pigtail for each phase shall extend from these stand-off insulators for connection to the power drop. Strain insulators shall also be provided on the substation structure for each phase for termination of the future overhead powerline at the substation. A splice shall be made between the stand-off insulator and strain insulator for each phase for final connection of the overhead power line to the mine oil circuit breaker. Similarly, the necessary strain and stand-off insulators shall be provided on the substation structure to facilitate the transition from the substation to the overhead power line for the mine ground conductor and ground monitor (pilot) conductor.

K. The contractor shall supply all parts, material, and labor to install a mine neutral ground field. This ground field shall at no point be

located less than 25 feet from the substation ground field or structure. In addition, the neutral ground conductor connected to this ground field shall be insulated from the substation structure, substation ground field, and all lightning arrestor grounds. The ground field shall be constructed in accordance with the following guidelines.

1. The mine neutral ground field (grid) shall not exceed 3 ohms and shall be established by means of interconnected driven ground rods. The ground rods shall be copper-clad steel electrodes, 3/4-inch diameter x 12 feet long.

2. A main ground loop shall be constructed by interconnecting the ground rods with stranded, soft-drawn, bare copper wire, size 500 MCM. This main ground loop shall be connected to the tops of the ground rods which shall be located at least 24 inches below finished grade.

3. The main tap from the ground loop shall also be stranded, soft-drawn, bare copper wire, size 500 MCM. This main tap shall extend up a 30 ft. pole provided to extend the neutral ground field conductor into the substation. A 4/0 ACSR

conductor shall extend from this pole to the substation. The necessary strain and stand-off insulators shall be provided on the substation structure to facilitate the connection of this conductor to the mine neutral ground bus in the substation. Note that approved copper-to-aluminum connectors shall be used to make all copper-to-aluminum connections. The contractor shall make all connections required to connect the mine neutral ground field to the substation neutral ground bus. The contractor shall supply all necessary parts, materials, connectors, conductors, insulators, pole, and labor to complete this phase of the project.

4. The initial ground field construction shall consist of digging a 24-inch deep, square trench that is centered on a 30 ft. square. A total of 12 - 3/4-inch x 12 ft. ground rods shall be driven around the square trench on 10 ft. centers. The ground rods shall then be interconnected with wire as previously specified to establish the main ground loop. The connections between the ground rods and wire shall be by thermit

weld. The main tap from the ground loop as previously specified, shall be connected to the ground loop by means of thermit weld. The contractor shall measure the resistance of the ground field upon completion of the above steps. If the resistance of the ground field is 3 ohms or less, the construction is complete and the trenches may be filled and the ground wire connections to the substation completed. However, if the resistance is greater than 3 ohms, additional ground rods must be driven until a measured resistance not exceeding 3 ohms is obtained. Refer to Drawing No. TR-2-2 for a layout of the initial ground field construction and the location of additional ground rods if necessary.

L. The contractor shall furnish and spread gravel throughout the entire area enclosed by the substation to an average depth of at least 6 inches.

Insert

46KV Transmission
Line Specifications

AMCA COAL LEASING, INC.
P. O. BOX 1027
PRICE, UTAH 84501
801-637-5385

RLG 12078-1
Rev. 1/18/79

A M C A C O A L L E A S I N G, I N C.

46 KV POWER TRANSMISSION LINE

SPECIFICATIONS

1. GENERAL

All construction work shall be done in a thorough and workmanlike manner in accordance with the Plans, Specifications, and Construction Drawings, and shall be subject to the acceptance of the Owner.

Deviation from the Plans, Specifications, and Construction Drawings shall not be permitted except upon the written permission of the Owner.

If any construction problem arises that is not covered by these Specifications, the Contractor shall consult with the Owner for approval on material, type of construction, reclamation, or procedure to be followed.

2. DRAWINGS AND MAPS

The Vicinity Map is presented to show the general route of the transmission line. Each Plan and Profile sheet, as listed seperately hereinafter, becomes part of these Plans and Specifications. The Construction Drawings and the Pole Data sheets showing the type of construction to be used, where indicated on the Plan and Profile, are also listed and are part of these Plans and Specifications. No deviation from the Plan and Profile drawings or Specifications shall be made without the written approval of the Owner.

3. LOCATIONS OF STRUCTURE

Structure, guys, etc., shall be placed in locations determined by the Engineer and staked by the Engineer as shown on the Plan and Profile sheets and structure lists. Structures, guys, etc., shall not be erected in any other location without prior approval of the Owner.

Survey stakes established by the Owner shall be preserved by the Contractor. Any stakes destroyed or ruined by the Contractor without the Owner's approval shall be replaced at the Contractor's expense.

4. RIGHT-OF-WAY CLEARING

The Contractor shall clear the right-of-way of all trees, brush and other obstructions as required for stringing conductors and as specified hereinafter or as otherwise specified by Owner.

The Contractor shall clear all trees, brush, stumps, and large boulders from around each pole and anchor location for a radius of fifteen (15) feet and as close to the ground as possible.

Trees, brush or other vegetation which has grown to within ten (10) feet of the nearest conductor, or if when turned in an arc from it's base would strike within ten (10) feet of the nearest conductor, shall be removed by the Contractor.

Any hazard to the transmission line shall be removed by the Contractor as specified by the Owner. A hazard to the transmission line shall include any tree, boulder, stump, or other object within the right-of-way, which may, at some future time, fall or roll onto, or come in contact with the transmission line causing damage. Any hazard apparent outside the right-of-way shall be noted and a request for removal shall be made to the Bureau of Land Management.

All areas cleared along the right-of-way shall be vegetated, as dictated by the Owner, to prevent erosion and unnecessary damage.

5. CONSTRUCTION & ACCESS ROADS

The Contractor shall use the right-of-way furnished by the Owner for construction where practical. Access to the right-of-way shall be from intersecting or adjacent public or private roads.

No access or construction road shall be built by the Contractor, whether on or off the right-of-way, without the Owner's consent. Such roads, as approved by the Owner, shall be built and maintained by the Contractor. Upon completion of the job, access roads which have been built shall be obliterated, the soil shall be reseeded with vegetation and the terrain returned to it's original form, as dictated by the Owner.

Any existing access roads used by the Contractor shall be left in as good or better condition than when the Contractor's use commenced.

6. POLES

A. All poles shall conform to American National Standard Institute (ANSI) 05.1-1972 standards with respect to fiber stresses, class, dimensions, and defect limitations.

B. All poles shall be fully treated Douglas Fir conforming to EEI standard TD-100.

C. All poles are to possess a low conductivity. The measured resistance over a twenty (20) foot length of pole must be greater than 1,000,000 ohms.

D. All poles are to be new and free of splits, splinters, and other signs of visable abuse.

E. Poles shall not be dropped in unloading or handling.

F. All poles are to be set and buried at not less than their standard depths; the minimum setting depths shall be as follows:

Pole Length (feet)	Setting Depth (feet)
45	6.5
50	7.0
55	7.5
60	8.0
65	8.5
70	9.0

G. For multiple pole structures, holes shall be carefully dug to the setting depth specified by the Engineer, except that the distance from the butt to the gain shall be measured for each pole and the depth of holes adjusted as required. If necessary, the top of one pole of a multiple pole structure shall be cut and reframed to bring crossarms level.

On sloping ground, the depth of the hole shall always be measured from the low side of the hole.

Holes shall be approximately eight (8) inches larger than the butt diameter of the pole, and shall be at least as large at the bottom as at the top.

H. All poles shall be set in alignment, except on line angles, and plumb. At line angles, where suspension construction is used, poles shall be offset on the bisector of the angle so that conductors will hang directly over the point of intersection or in line with the tangent in both directions. All poles shall be plumb after conductors are strung.

6. POLES (Continued)

I. In backfilling, holes shall be thoroughly tamped in layers of six inches or less for the full depth. Earth shall be banked up around each pole. After completion of the job, holes shall be inspected and any settlement refilled.

Frozen earth or any material subject to decay shall not be used in backfilling. Holes shall be dewatered before any backfilling is attempted. Gravel shall be used in backfilling holes under muddy conditions.

J. The tops of full length treated poles shall not be cut except under very exceptional conditions and upon the approval of the Owner. If cutting is deemed necessary, the pole top shall be painted with creosote compound and covered completely with a copper or aluminum cap plate or other approved method.

K. Under no circumstances shall the butt on any pole be cut.

L. All unused holes in poles shall be plugged prior to line completion using treated cedar wood dowel pins.

7. TIMBERS AND ARMS

A. All timbers are to be high-grade structural timbers conforming to the specifications of the Timber Manufacturer's Associations.

B. All arms are to be treated Douglas fir conforming to structural specifications and EEI specifications TD-90 and TD-92.

C. The maximum crushing strength of each timber and arm shall not be less than that set forth by ASTM specifications.

D. All timbers and arms shall be new and free of splits, splinters, and other signs of visible defects.

E. Any field bored holes which are not used shall be plugged with tight-fitting treated cedar plugs.

F. Any timber or arm shall only be cut upon approval of Owner, and when cut shall receive at least two applications of preservative.

G. Timbers and arms shall be installed level to horizontal and perpendicular to the center line except as noted for certain structure types. Timbers or arms used on angle structures shall be set on the bisection of the angle.

8. CONDUCTORS AND OVERHEAD GROUND WIRE

A. Care shall be exercised to avoid kinking, twisting, or abrading the conductor or overhead ground wire in any manner. Conductors or overhead ground wires shall not be tramped on, run over by vehicles, or dragged over sharp rocks. The wire on each reel shall be inspected for cuts, kinks, or other injuries. Injured portions or crooked or imperfect splices in either the conductor or overhead ground wire shall be cut out and the wire respliced. Badly nicked conductors shall not be acceptable.

B. Conductors and overhead ground wires shall be pulled over suitable rollers or stringing blocks properly mounted on the pole or crossarm, to prevent binding while stringing.

C. Installation of conductors and accessories shall be done in accordance with manufacturers' recommendations.

D. Phase conductors shall be 266.8 MCM ACSR (Partridge) throughout. The ground conductors (static) shall be 3/8" EHS Grade B 7 strand galvanized steel.

E. The conductor SAG design shall be set at 40 percent of ultimate (4520 pounds maximum design tension) and for medium loading. Stock bridge dampers shall be installed on the 266.8 MCM ACSR so that they hang directly under the phase conductors. Dampers shall be carefully attached to the conductor in accordance with the wire manufacturers recommendations with regards to the damper spacing, weights, and quantity. Contractor shall ascertain that drain holes in weights are open after dampers are installed.

Included with these specifications are the ALCOA SAG-tension data for 266.8 MCM ACSR based on 40 percent of ultimate. This data lists the final and initial SAGS for 50 foot increments from 100 to 900 foot spans. Also included is ALCOA's recommendations for the damper applications.

This information from ALCOA is intended as a guide for the contractor to follow in determining the damper cost. The actual application shall depend on the specific recommendations by the manufacturer of the cable. It shall be the responsibility of the Contractor to obtain and follow these recommendations based on the brand of conductor purchased.

F. The sag of all conductors after stringing shall be in accordance with the Manufacturers' recommendations, except that a maximum increase of three (3) inches of the specified

8. CONDUCTORS AND OVERHEAD GROUND WIRES (Continued)

sag in any span will be acceptable. Under no circumstances will a decrease in the specified sag be allowed. Sagging by sighting between targets is recommended.

The minimum allowable ground clearance should be no less than twenty-five (25) feet at any point along the line.

The air temperature at the time and place of stringing shall be determined by a certified etched-glass thermometer. The temperature at which the conductor is sagged in and the spans in which sags are measured shall be recorded and the information given to the Owner.

G. There shall not be more than one splice per conductor in any span, and no splice shall be located within fifteen (15) feet of the conductor support. There shall be no splices in spans over 1200 feet. Splices shall be limited to not more than one every 2,000 feet. Where splices are necessary, they shall be made with high quality, compression-type sleeves suitable for the application and they shall be approved by the Owner.

All splicing sleeves shall be carefully installed so that the completed splice is as straight as possible and presents no undue twisting or kinks to the conductor.

After the compression sleeve has been installed, it shall be finished in a workmanlike manner with all the corners and sharp projections tapered or rounded.

H. Utmost care shall be exercised in installing parallel grove clamps. The contact surface of the clamp and the wire shall be clean and bright. A steel brush shall be the principal cleaning medium. These same precautions for cleaning shall apply to the conductor before splicing.

9. INSULATORS

A. Care shall be exercised in handling and erecting insulators and in assembling suspension units to insure that all cotter keys are in place.

B. String and suspension insulators shall be ball and socket type, 5 3/4" x 10", 15,000 pound M&E, ANSI Class 52-3, Light Gray Glaze.

C. Dead end strings will be made up of six (6) insulators having an overall length of 34½ ±.

9. INSULATORS (Continued)

D. Angle string will be made up of five (5) insulators for an overall length of 28 3/4" ±.

E. Tangent strings will be made up of four (4) insulators for an overall length of 23" ±.

F. Post insulators shall be clamp type, Lapp No. 4766.

G. Any insulation type with broken or chipped glass shall not be acceptable.

10. GUYS AND ANCHORS

A. Guys shall be installed in locations specified by the Engineer. Points of attachment to poles shall be via Pole Bands as shown on construction drawings. Guys shall be installed before conductors or overhead ground wires are strung. Down Guys shall be installed at a 1 to 1 slope.

B. Holes for anchors shall be dug in locations staked by the Engineer. Anchor rods shall be in line with the strain and so installed that approximately eight (8) inches of the rod shall remain out of the ground. Under no circumstances shall the eye of the rod be covered. Holes shall be backfilled and tamped in the same manner as for pole holes. The setting of each anchor, in regards to depth and position, shall be inspected by the Engineer and his approval given before the anchor hole is backfilled.

C. Anchors are to be set against undisturbed earth with the rod trenched upward at an angle equal to the guy wire.

D. All guy wire shall be one common size of ½" Grade B galvanized extra high strength steel throughout.

E. All guy attachments shall be as near as possible to the conductor they are supporting.

F. All guys shall be of the insulated type with fiberglass strains used where insulation from energized conductors is required.

G. All anchors shall be rated in the 20,000 pound class.

H. Colored fiberglass guy guards shall be installed on all down guys.

I. Adjustable grip deadends shall be installed for down guy tension adjustments.

11. LINE ACCESSORIES AND HARDWARE

A. All hardware shall be hot dipped galvanized.

B. All hardware shall be new equipment.

C. All bolts, angle brackets, etc., shall be at least 3/4" in diameter unless specified otherwise.

D. All accessories and hardware shall conform to pole structure specifications or accepted standard requirements.

E. Where practical, locknuts shall be used on all bolts.

12. GROUNDS

A. Pole grounds shall be run on every pole with a 12" "Bayonet" brought above the pole.

B. All ground wire shall be #6 AWG Copper Weld.

C. Copper butt plates shall be used on all poles.

D. In addition to the butt plates, 3/4" x 8' ground rods shall be driven between poles on the three (3) pole "H" structures and tied to the pole grounds.

E. On two (2) and three (3) pole structures, where more than one static wire is pulled, the static shall be tied together.

F. The #6 AWG pole ground conductor shall be stapled to the pole approximately every two (2) feet using ground wire clips.

G. The pole ground conductor and the overhead static conductor shall be tied together at every pole using compatible connectors.

H. All pole grounds shall be meggered for ground resistance. If the ground resistance of any structure measures greater than 20 ohms ground rods will be driven, but not to exceed two (2) rods per structure. Contractor will notify Owner if less than 20 ohms cannot be achieved.

13. MISCELLANEOUS

These specifications are intended as minimum acceptable standards. The following pole data sheets, comprised of the specific pole type and material list, along with the reference drawings, are intended to pinpoint the construction as much as

13. MISCELLANEOUS (Continued)

practical. However, the material lists are in no way conclusive. The responsibility for the correct quantities will fall on the successful Contractor who is solely responsible for providing a complete 46 KV transmission line ready to be energized. The quality of the material shall be no less than that specified. For particular items showing no manufacturer, the material selected shall be of comparable grade to the specified components. In such cases, the Owner reserves the right to refuse certain materials considered below grade or inferior.

POLE DATA SHEETS

Pole Number	Constr. type	Pole Size Height/Class	Span (from Preceding Pole)
0.	SPECIAL	50ft/3 40ft/3	Disconnect-Meter Structure (Str.)
1.	P1TS	55ft/3	256 ft.
2.	P1TS	60ft/3	400 ft.
3.	P1TS	55ft/3	400 ft.
4.	P1TS	60ft/3	400 ft.
5.	P1TS	55ft/3	400 ft.
6.	P1TS	55ft/3	400 ft.
7.	P1TS	60ft/3	400 ft.
8.	P1TS	65ft/3	400 ft.
9.	P1TS	65ft/3	400 ft.
10.	P1TS	65ft/3	400 ft.
11.	P1TS	60ft/3	400 ft.
12.	P1TS	65ft/3	400 ft.
13.	P1DE	60ft/2	400 ft.
14.	P1TS	60ft/3	375 ft.
15.	P1TS	60ft/3	375 ft.
16.	P1TS	55ft/3	375 ft.
17.	P1TS	60ft/3	375 ft.
18.	P1TS	60ft/3	375 ft.
19.	P1TS	55ft/3	375 ft.
20.	P1TS	60ft/3	375 ft.
21.	P1TS	55ft/3	375 ft.
22.	P1TS	55ft/3	400 ft.
23.	P1TS	55ft/3	375 ft.
24.	P1TS	55ft/3	375 ft.
25.	P1TS	55ft/3	375 ft.
26.	P1TS	60ft/3	375 ft.
27.	P1TS	60ft/3	375 ft.
28.	P1DE	60ft/2	390 ft.
29.	P1TS	55ft/3	390 ft.
30.	P1TS	55ft/3	390 ft.

POLE DATA SHEETS

(Page 2)

Pole Number	Constr. type	Pole Size Height/Class	Span (from Preceding Pole)
31.	P1TS	55ft/3	390 ft.
32.	P1TS	60ft/3	390 ft.
33.	P1TS	55ft/3	390 ft.
34.	PIMA	60ft/2	400 ft.
35.	P1TS	55ft/3	400 ft.
36.	P1TS	55ft/3	400 ft.
37.	P1TS	55ft/3	400 ft.
38.	P1TS	55ft/3	400 ft.
39.	P1TS	60ft/3	400 ft.
40.	P1TS	55ft/3	400 ft.
41.	P1TS	60ft/3	400 ft.
42.	P1DE	65ft/2	400 ft.
43.	P1TS	55ft/3	400 ft.
44.	P1TS	60ft/3	400 ft.
45.	P1TS	55ft/3	400 ft.
46.	PIMA	60ft/2	400 ft.
47.	P1TS	55ft/3	400 ft.
48.	P1TS	60ft/3	400 ft.
49.	P1TS	55ft/3	400 ft.
50.	P1TS	65ft/3	400 ft.
51.	P1TS	55ft/3	400 ft.
52.	P1TS	55ft/3	400 ft.
53.	P1TS	55ft/3	400 ft.
54.	P1TS	60ft/3	400 ft.
55.	P1TS	55ft/3	400 ft.
56.	H3/LA	55ft/3 55ft/3 55ft/3	400 ft.
57.	H3/LA	55ft/3 55ft/3 55ft/3	705 ft.
58.	P1YS	60ft/3	455 ft.
59.	P1YS	60ft/3	455 ft.
60.	P1YS	60ft/3	455 ft.

POLE DATA SHEETS

(Page 3)

Pole Number	Constr. type	Pole Size Height/Class	Span (from Preceding Pole)
61.	P1YS	60ft/3	442 ft.
62.	P1YS	60ft/3	438 ft.
63.	P1DE	55ft/2	525 ft.
64.	PIMA	55ft/2	400 ft.
65.	P1TS	55ft/3	350 ft.
66.	P1TS	55ft/3	350 ft.
67.	P1DE	60ft/2	350 ft.
68.	P1TS	55ft/3	383 ft.
69.	P1TS	65ft/3	275 ft.
70.	P1TS	60ft/3	385 ft.
71.	PIMA	55ft/2	385 ft.
72.	P1TS	60ft/3	341 ft.
73.	H3/LA	60ft/3 60ft/3 60ft/3	331 ft.
74.	H2TS	60ft/2 65ft/2	645 ft.
75.	H3/LA	55ft/3 55ft/3 60ft/3	694 ft.

APPENDIX L

EXHIBIT III-C

WATER WELLS

Zimmerman Well Service

4081 Sunnydale Drive ○ Moab, Utah 84532

Sept. 25, 1980

Tower Resources
Box 1027
Price, Utah 84501

Pump Test on Wells drilled for Tower Resources

Well #1
Depth 130' Static water level 58' Drawdown to
67' after 4 Hrs. at 50 GPM.

Well #2

Depth 155' Static water level 57' Drawdown to 88'
after 2 Hrs. at 30 GPM.

Depth 280' Static water level 57' Drawdown 100' after
1 Hr. at 30 GPM.
Was pumping 25 GPM at end of test.

1140 HUNTINGTON, UTAH 84528 (801) 653-2314

For Tower Resources
P.O. Box 1027
Price, Utah 84501

RECEIVED 9-24-80

Lab. No. 1319

Sample ID: Well #1 Pinnacle Mine

Date Rec'd. 08-29-80

Date Sampled 08-29-80

PARAMETER	VALUE	
pH	7.5	
Total Alkalinity	452.6	mg/l $CaCo_3$
Acidity	0	mg/l $CaCo_3$
Chloride	26.4	mg/l
Conductivity	1290	umhos/cm
Hardness (Ca&Mg)	2.54	mg/l $CaCo_3$
Cyanide	*	
Flouride	*	
Nitrogen, Ammonia	*	
Nitrogen, Nitrate	*	
Nitrogen, Nitrite	*	
Phenol	*	
Phosphorus, Ortho	Less than 0.1	mg/l
Phosphorus, Total	Less than 0.1	mg/l
Total Dissolved Solids	846	mg/l
Total Suspended Solids	4.0	mg/l
Sulfate	251.4	mg/l
Turbidity	1.1	NTU
Aluminum	Less than 0.5	mg/l
Antimony	Less than 0.5	mg/l
Barium	Less than 0.2	mg/l
Boron	2680	ug/l
Cadnium	Less than 0.02	mg/l
Calcium	1.0	mg/l
Chromium	0.08	mg/l
Cobalt	Less than 0.05	mg/l
Copper	Less than 0.02	mg/l
Iron, Total	0.04	mg/l
Lead	Less than 0.1	mg/l
Magnesium	14.08	mg/l
Manganese	0.01	mg/l
Molybdenum	*	
Nickel	Less than 0.06	mg/l
Potassium	5.8	mg/l
Silica	8.56	mg/l
Sodium	22.8	mg/l

Respectfully Submitted

STANDARD LABORATORIES, INC.
BOX 1140 HUNTINGTON, UTAH 84528 (801) 653-2314

For Tower Resources
P.O. Box 1027
Price, Utah 84501

Lab. No. 1319 (cont'd)

Sample ID: Well #1 Pinnacle Mine

Date Rec'd. 08/29/80

Date Sampled 08/29/80

PARAMETER		VALUE	
Cyanide	Less than	0.50	mg/l
Flouride		0.30	mg/l
Nitrogen, Ammonia		0.10	mg/l
Nitrogen, Nitrate		0.36	mg/l
Phenol	Less than	0.10	mg/l
Arsenic		0.7	µg/l
Mercury		3.5	µg/l
Selenium	Less than	0.2	µg/l

Respectfully Submitted

X 1140 HUNTINGTON, UTAH 84528 (801) 653-2314

For Tower Resources
P.O. Box 1027
Price, Utah 84501

Lab. No. 1319 (cont'd)

Sample ID: Well #1 Pinnacle Mine

Date Rec'd.

Date Sampled

PARAMETER	VALUE		
Vanadium	Less than	0.6	mg/l
Zinc	Less than	0.01	mg/l
Silver	Less than	0.03	mg/l
Arsenic		*	
Mercury		*	
Selenium		*	
Bicarb. Alkalinity		452.6	mg/l $CaCo_3$
Carbinate Alkalinity		0	mg/l $CaCo_3$

Respectfully Submitted

OX 1140 HUNTINGTON, UTAH 84528 (801) 653-2314

For Tower Resources
P.O. Box 1027
Price, Utah 84501

Lab. No. 1327 (cont'd)

Sample ID: Well #2 Pinnacle Mine

Date Rec'd.

Date Sampled

PARAMETER		VALUE	
Aluminum	less than	0.06	mg/l
Antimony	less than	0.35	mg/l
Barium	less than	0.20	mg/l
Boron		700	µg/l
Cadnium	less than	0.02	mg/l
Calcium		54.50	mg/l
Chromium	less than	0.05	mg/l
Cobalt	less than	0.05	mg/l
Copper	less than	0.03	mg/l
Total Iron	less than	0.05	mg/l
Lead	less than	0.05	mg/l
Magnesium		27.6	mg/l
Manganese	less than	0.01	mg/l
Molybdenum	less than	0.1	mg/l
Nickle	less than	0.04	mg/l
Potassium		12.8	mg/l
Silica		7.49	mg/l
Sodium		39.8	mg/l
Vanadium	less than	0.02	mg/l
Zinc	less than	0.01	mg/l
Silver	less than	0.01	mg/l
Arsenic		1.3	µg/l
Mercury	less than	0.2	µg/l
Selenium	less than	0.2	µg/l
Bicarb. Alkalinity		461.2	mg/l
Carb. Alkalinity		0	

Respectfully Submitted

OX 1140 HUNTINGTON, UTAH 84528 (801) 653-2314

For Tower Resources
P.O. Box 1027
Price, Utah 84501

Lab. No. 1327

Sample ID: Well #2 Pinnacle Mine

Date Rec'd. 09/11/80

Date Sampled 09/07/80

PARAMETER		VALUE	
pH		7.7	
Total Alkalinity		461.2	mgCaCo3/L
Acidity		-0-	
Chloride		41.0	mg/l
Conductivity		1690	µmhos/cm
Cyanide	less than	0.5	mg/l
Flouride		.219	mg/l
Nitrogen, Ammonia		0.50	mg/l
Nitrogen, Nitrate		0.37	mg/l
Phenol	less than	0.1	mg/l
Phosphorus, Ortho	less than	0.1	mg/l
Phosphorus, Total	less than	0.1	mg/l
Total Dissolved Solids		1164	mg/l
Total Suspended Solids		105	mg/l
Sulfate		483.9	mg/l
Turbidity		7.4	NTU

Respectfully Submitted

STANDARD LABORATORIES, INC.
BOX 1140 HUNTINGTON, UTAH 84528 (801) 653-2314

For Tower Resources
P.O. Box 1027
Price, Utah 84501

RECEIVED 10-20-80

Lab. No. 1340

Sample ID: Pinnacle Mine Well #3

Date Rec'd. 10/02/80

Date Sampled 09/29/80

PARAMETER		VALUE	
pH		8.2	
Total Alkalinity		315.8	mgCaCo3/L
Acidity		0	
Chloride		58.6	mg/l
Conductivity		2150	umhos/cm
Cyanide	less than	0.5	mg/l
Flouride		0.304	mg/l
Nitrogen, Ammonia		0.18	mg/l
Nitrogen, Nitrate		0.71	mg/l
Nitrogen, Nitrite		*	
Phenol	less than	0.1	mg/l
Phosphorus, Ortho		0.42	mg/l
Phosphorus, Total		0.62	mg/l
Total Dissolved Solids		1791	mg/l
Total Suspended Solids		4.5	mg/l
Sulfate		818.9	mg/l
Turbidity		2.6	NTU
Aluminum	less than	0.06	mg/l
Antimony	less than	0.35	mg/l
Barium	less than	0.2	mg/l
Boron		240	mg/l
Cadnium	less than	0.02	mg/l
Calcium		303.8	mg/l
Chromium	less than	0.05	mg/l
Cobalt	less than	0.05	mg/l
Copper		0.23	mg/l
Total Iron		0.68	mg/l
Lead		0.05	mg/l
Magnesium		41.0	mg/l
Manganese		0.18	mg/l
Molybdenum	less than	0.1	mg/l
Nickle	less than	0.04	mg/l
Potassium		12.9	mg/l
Silica		10.5	mg/l

Respectfully Submitted

OX 1140 HUNTINGTON, UTAH 84528 (801) 653-2314

For Tower Resources
P.O. Box 1027
Price, Utah 84501

Lab. No. 1340 (cont'd)

Sample ID: Pinnacle Mine Well #3

Date Rec'd.

Date Sampled

PARAMETER		VALUE	
Sodium		58.0	mg/l
Vanadium	less than	0.2	mg/l
Zinc	less than	0.01	mg/l
Silver	less than	0.05	mg/l
Arsenic		*	
Mercury		*	
Selenium		*	
Bicarb. Alkalinity		315.8	mg/l
Carb. Alkalinity		0	

* To be reported at a later date.

Respectfully Submitted

EXHIBIT III-D

WASTEWATER DISPOSAL SYSTEM (OFFICE BUILDING)
WASTEWATER DISPOSAL SYSTEM (PINNACLE MINE)

WASTEWATER DISPOSAL SYSTEM

FOR THE

PINNACLE MINE

OFFICE BUILDING

PREPARED FOR:

TOWER RESOURCES, INC.

BY

DAN W. GUY

REGISTERED PROFESSIONAL ENGINEER

STATE OF UTAH NO. 4548

APPROVAL
Date Sept 17, 1980

REGISTERED PROFESSIONAL ENGINEER
No. 4548
DAN W. GUY
STATE OF UTAH

PLAN FOR CONSTRUCTION AND MAINTENANCE

OF

WASTEWATER DISPOSAL SYSTEM

General Description

The Pinnacle Mine is to be located in the Right Fork of Deadman Canyon, in Carbon County, some 10 miles northeast of Price, Utah. Due to the remote location, no existing sewage disposal facilities are available; therefore, this submittal encompasses a complete design for wastewater disposal from the office building on site.

Pinnacle Mine

Wastewater Disposal System Specifications

Criteria

The following criteria have been used in the design of this system:

1) Office facilities, complete with toilets and drinking fountains will be available.
2) Facilities designed for 20 men/day.
3) Disposal system designed for 15 gallon/day/man. (Based on average of "day workers at offices" use in Table V-2, of Part V, Small Underground Wastewater Disposal Systems).
4) Percolation rate of 17 inches/minute.
5) Design is based to comply with standards set forth in the Utah State Division of Health, Code of Waste Disposal Regulations, Part V, Small Underground Wastewater Disposal Systems.
6) Design is certified by a registered professional engineer, State of Utah.

Design

The system herein proposed is a septic tank/drainfield type, using proven and approved materials and techniques. It will consist of a wastewater discharge line, a septic tank, and an absorption field.

Location and Installation

Location and installation of the system shall be such that, with reasonable maintenance, it will function in a sanitary manner and will not create a nuisance, health hazard or endanger the quality of any waters of the state. The proposed location of the system is shown on the attached map.

Construction Materials

All materials used in the construction of the system shall be durable, sound and not unduly subject to corrosion. Pipe, pipe fittings and similar materials shall comply with the requirements of the Utah Plumbing Code.

Wastewater Drainage Line

This line will convey wastewater from the office to the septic tank. The following criteria will be followed in the installation of this line:

1) It shall be of suitable, approved material and will have watertight and root-proof joints.
2) It will have an inside diameter of 4 inches, and will be laid on a minimum grade of 15 inches per 100 feet.
3) Cleanouts will be installed every 50 feet and at all changes in direction. Cleanouts will consist of 2-45° bends with cleanout.
4) Lines will not be closer than 10 feet horizontally to any water service pipes.

Wastewater Quantity Estimate

Estimates are based on Table V-2, "Estimated Quantity of Domestic Wastewater", Part V, Small Underground Wastewater Disposal Systems, which shows an average of 15 gal/day/person for office day workers. Using the projected manning of 20 people, the estimated daily wastewater will be:

20 men x 15 gallon/man/day = 300 gallons/day.

Septic Tank

The septic tank shall be constructed of durable material designed to withstand expected physical loads and corrosive forces. It shall be designed to provide settling of solids, accumulation of sludge and scum, and access for cleaning.

The septic tank herein proposed is a standard, approved concrete type, sold commercially under the name of Duracrete. This tank will meet all requirements of Parts V-13 through V-20 of Part V, Small Underground Wastewater Disposal Systems. A detailed drawing of this proposed tank is attached.

Septic tank sizing is based on the requirements of V-15, a., which requires a 750 gallon septic tank for flows less than 500 gallons per day. Since Q is expected to be 300 gallons per day, V=750 gallons. The proposed tank is therefore sized at a 1,000 gallon capacity to allow for an added safety factor.

Discharge Line

The effluent from the septic tank will be conducted to the absorption field, through a watertight line meeting the requirements for house sewers. Outlet inverts will be at least 1 inch below the inlet invert.

Absorption Field

1) Soil Exploration: The attached drawing shows a 10' deep soil exploration test in the proposed drainfield area. This test assures at least 4' of soil between the base of the proposed absorption system and bedrock.

2) Installation: The field is proposed to be placed level, with all trenches interconnected.

3) Sizing: The percolation rate for this area is found to be 17 minutes per inch. A copy of the percolation test report is attached. Based on this rate, an allowable rate of application to the field will be 1.2 gallons per square foot per day, requiring a minimum of 250 square feet of absorption area for the expected wastewater discharge of 300 gallons per day. The proposed field will consist of 2-50' long x 36" wide trenches, separated by a minimum of 7.5' of undistrubed earth (wall to wall). This will provide an absorption area of 345 square feet, including side trenches, slightly

more than required.

4) Criteria: The absorption field will consist of gravel filled trenches provided with perforated pipes to distribute septic tank effluent in the gravel fill, from which it will percolate through the trench walls and bottom into the surrounding sub-surface soil.

a) The portion of the trenches below the distribution lines shall be in natural or acceptably stabilized earth.

b) The proposed system will be level, with all trench bottoms constructed at the same elevation. Distribution lines and trenches will be level and interconnected.

c) Effluent distribution lines shall be 4" diameter, perforated pipe of suitable material.

d) The gravel fill in the trench shall be of ½" to 2½" drain rock, and will completely encase the distribution pipe. The gravel will be covered with untreated building paper or straw prior to backfill.

e) Heavy equipment will not be driven over the trenches during backfilling or after completion of the absorption field.

Percolation Test

for

Pinnacle Mine

Office Building

The following percolation test was run at 2 points within the proposed drainfield site for the Pinnacle Mine Office Building on Sept. 2, 1980. The test was performed by Mr. Mike Glasson, under the direction of Dan W. Guy, a registered professional engineer, State of Utah.

The test was performed as follows:

1) 2 holes were dug in the area of the proposed absorption field. Each hole was 6 inches in diameter, with vertical sides, and dug to the depth of the bottom of the proposed field. Hole locations are shown on the enclosed map.

2) The sides and bottom of each hole was roughened, and all loose materials were removed. Two inches of coarse sand were placed in the bottom of each hole to prevent scouring.

3) The holes were filled with water greater than 12 inches above the sand, and each hole was kept filled for 4 hours.

4) The water level was adjusted to 6 inches over the sand. The drop in water level was then measured from a fixed reference point, at 30 minute intervals for a period of 4 hours. The water level was brought back to a depth of 6 inches after each measurement.

5) The drop during the final 30 minute period was used to calculate the percolation rate.

6) The following table is a tabulation of all measurements:

WEST HOLE #1

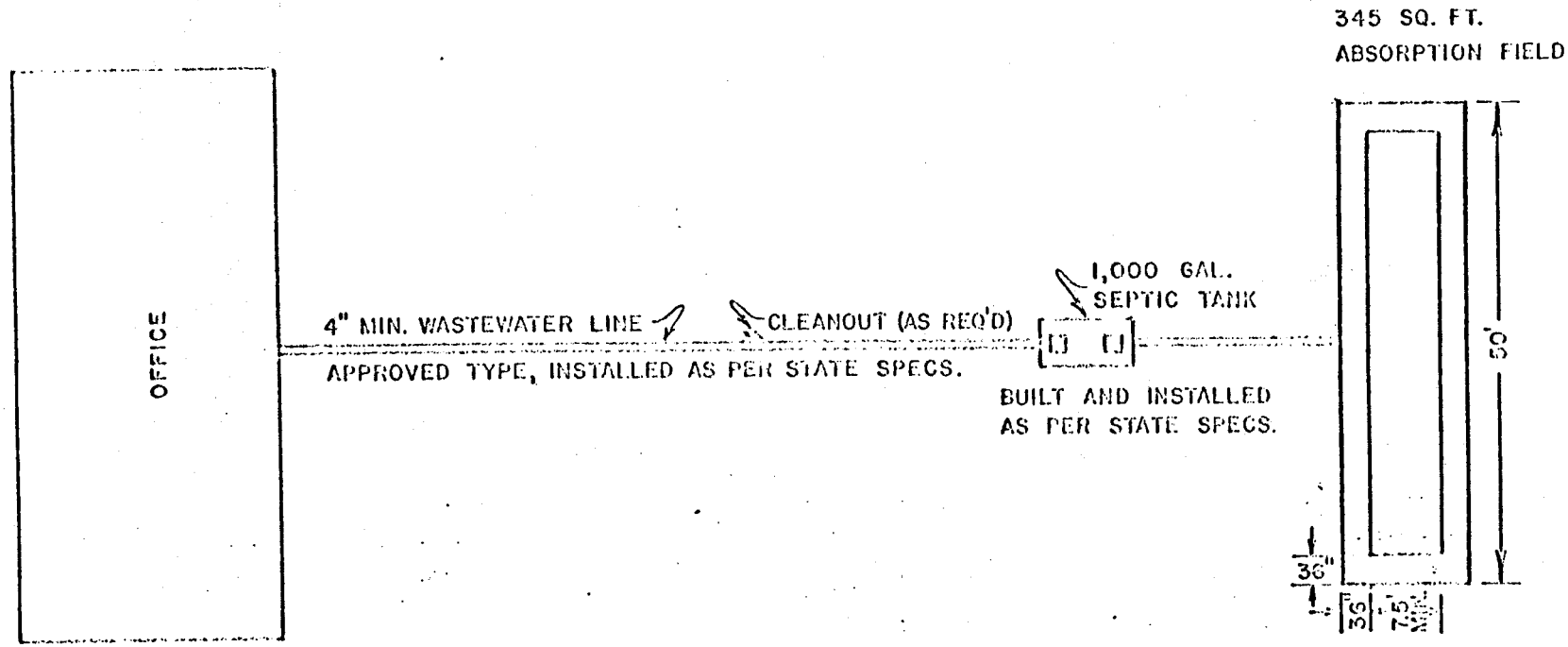
Measurement No.	Time (start 10:15)	Water Level Drop
1	10:45	3-3/8"
2	11:15	3-1/8"
3	11:45	2-5/8"
4	12:15	2-1/8"
5	12:45	1-7/8"
6	1:15	1-3/4"
7	1:45	1-3/4"
8	2:15	1-3/4"

EAST HOLE #2

Measurement No.	Time (start 10:25)	Water Level Drop
1	10:55	3-1/4"
2	11:25	2-3/8"
3	11:55	2-1/4"
4	12:25	2-1/8"
5	12:55	1-7/8"
6	1:25	1-7/8"
7	1:55	1-3/4"
8	2:25	1-3/4"

TOWER RESOURCES, INC.

PINNACLE MINE
OFFICE BUILDING

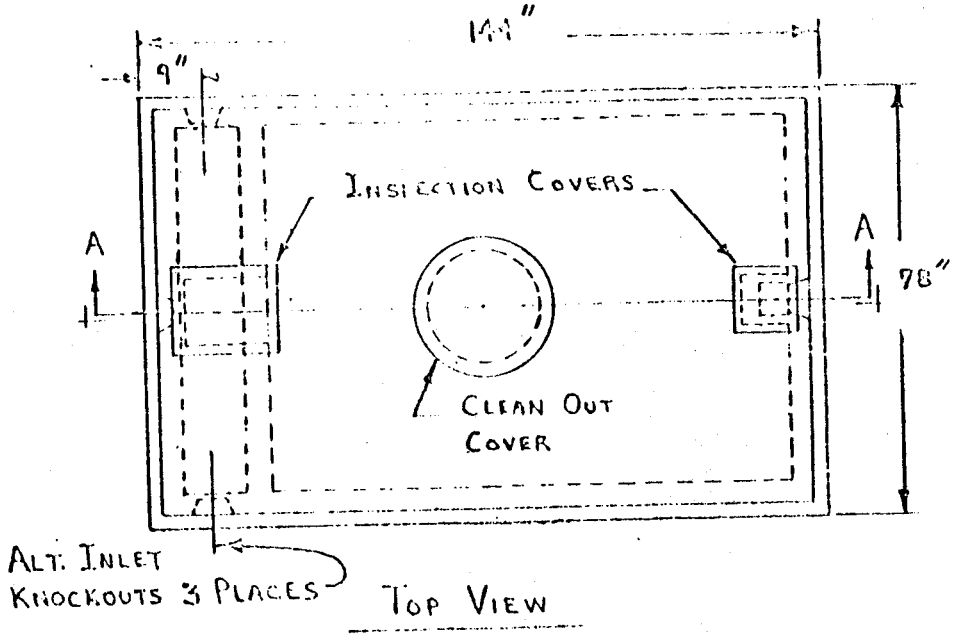


WATER DISPOSAL SYSTEM

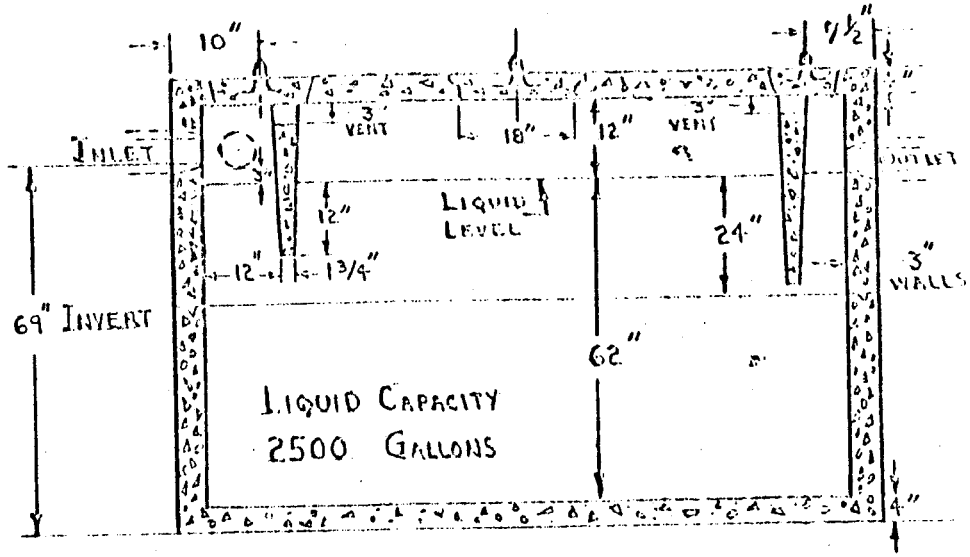
DATE: 9-1-80

SCALE: AS SHOWN

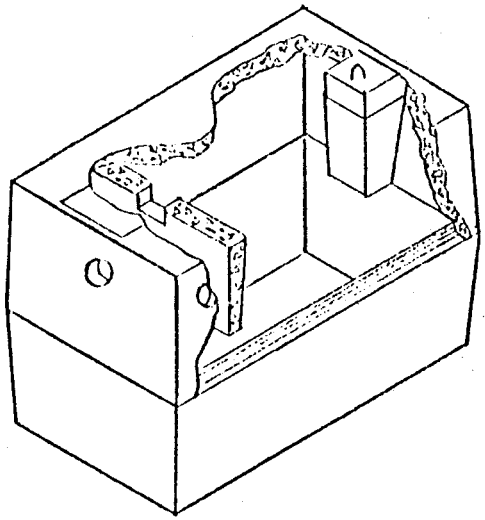
Sept 17, 1980 Gerald Stang



TOP VIEW



SECTION A-A



CUTAWAY ISOMETRIC

NOTE:

CAPACITY - 2500 GALLONS
WEIGHT - 28000 POUNDS
EXCAVATION DIMENSIONS - 9'X 15'
FLOW LINE - 5'-9"

SEALED WITH ASPHALT ROPE AND REINFORCED WITH 4"X 4" - 4 X 4 WELDED FABRIC

2500 GALLON - TWO PEICE SEPTIC TAN

SCALE: NONE	APPROVED BY:	DRAWN BY
DATE: 4-29-74		REVISED

DURA - CRETE, INC.

1475 W. 3500 S. SALT LAKE CITY, U

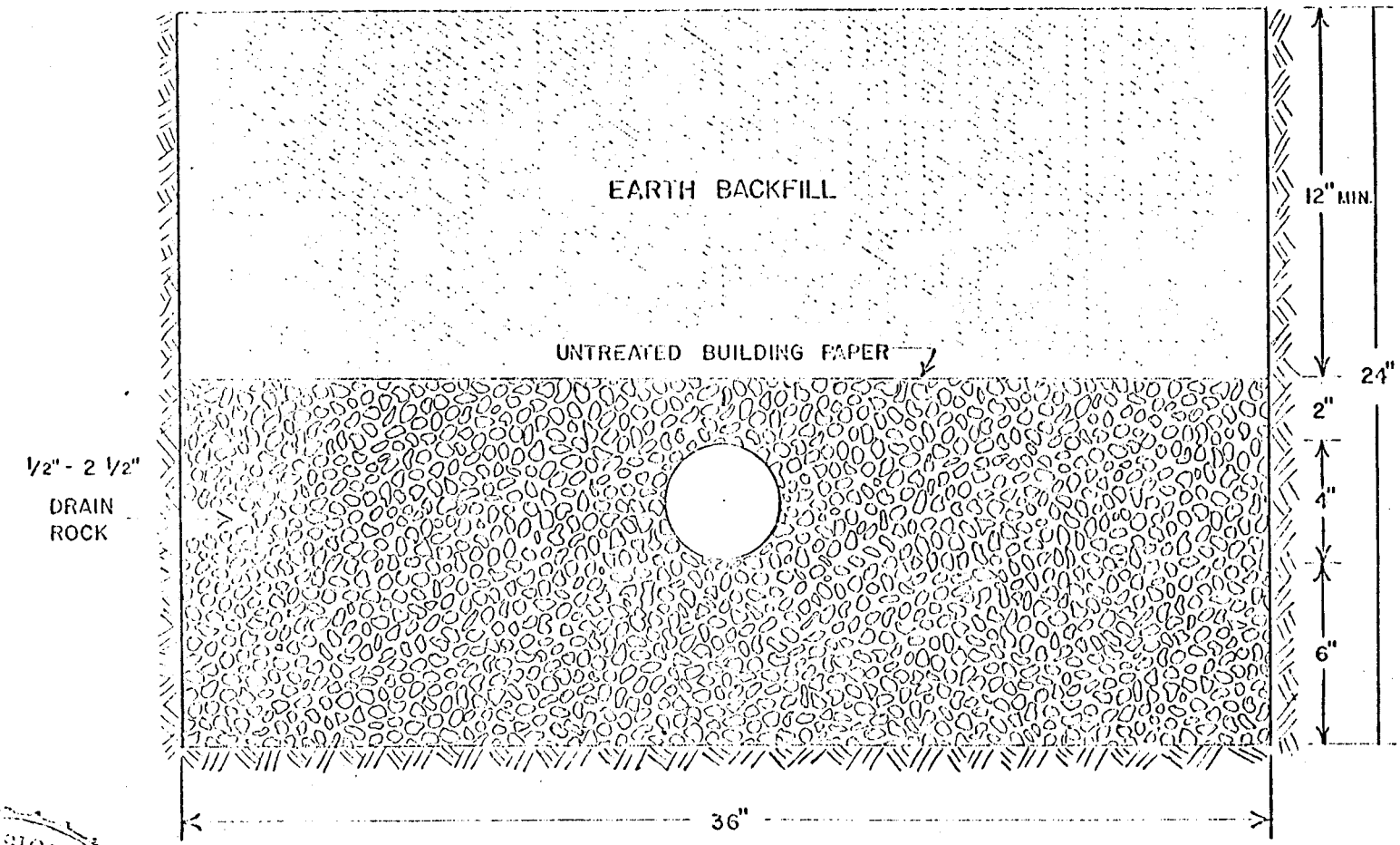
DRAWING NO.

PHONE NO. 262-1140

TOWER RESOURCES, INC.

PRICE, UTAH

PINNACLE MINE



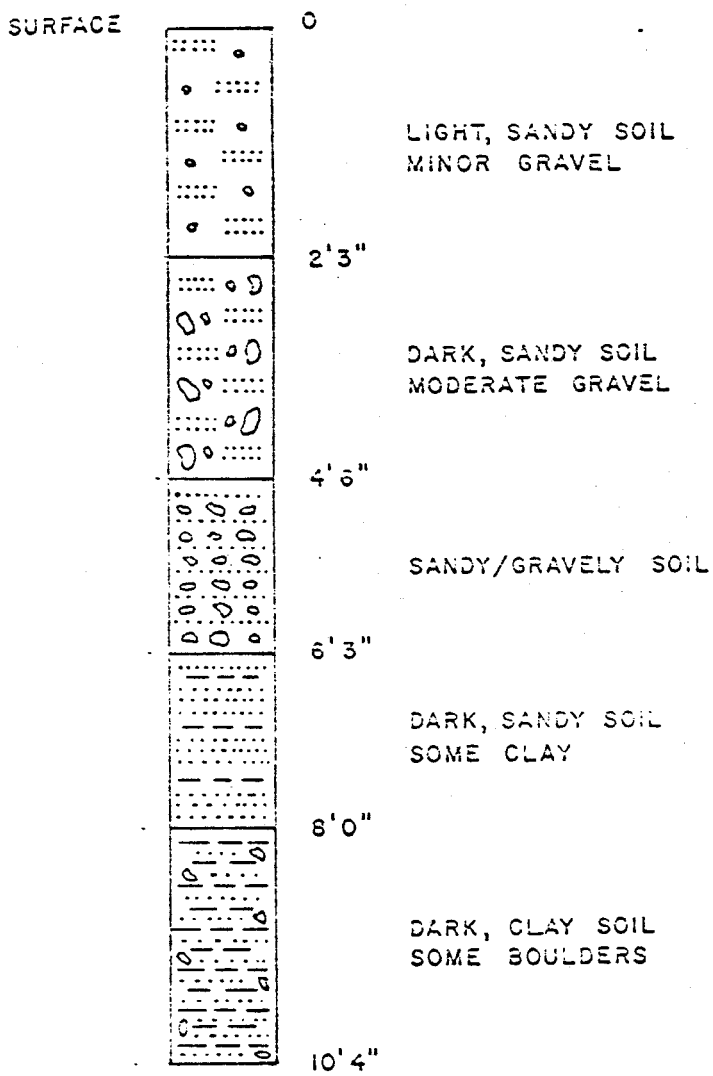
TRENCH DETAIL

SCALE 1" = 6"
DATE 4-7-80

REGISTERED PROFESSIONAL ENGINEER
No. 4548
JOHN W.
LILY

TOWER RESOURCES, INC.

TEST HOLE
AT
DRAINFIELD SITE
PINNACLE MINE
OFFICE BUILDING



WASTEWATER DISPOSAL SYSTEM

FOR THE

PINNACLE MINE

PREPARED FOR:

TOWER RESOURCES, INC.

BY

DAN W. GUY

REGISTERED PROFESSIONAL ENGINEER

STATE OF UTAH NO. 4548

REGISTERED PROFESSIONAL ENGINEER
No. 4548
DAN W. GUY
4/9/86
STATE OF UTAH

PLAN FOR CONSTRUCTION AND MAINTENANCE
OF
WASTEWATER DISPOSAL SYSTEM

General Description

The Pinnacle Mine is to be located in the Right Fork of Deadman Canyon, in Carbon County, some 10 miles northeast of Price, Utah. Due to the remote location, no existing sewage disposal facilities are available; therefore, this submittal encompasses a complete design for wastewater disposal on site.

Pinnacle Mine

Wastewater Disposal System Specifications

Criteria

The following criteria have been used in the design of this system:

1) Bathhouse facilities, complete with showers, toilets and drinking fountains will be available.
2) Facilities designed for 45 men/day.
3) Disposal system designed for 35 gallon/day/man. (Based on average of factory use in Table V-2, of Part V, Small Underground Wastewater Disposal Systems).
4) Percolation rate of 17 minutes/inch.
5) Design is based to comply with standards set forth in the Utah State Division of Health, Code of Waste Disposal Regulations, Part V, Small Underground Wastewater Disposal Systems.
6) Design is certified by a registered professional engineer, State of Utah.

Design

The system herein proposed is a septic tank/drainfield type, using proven and approved materials and techniques. It will consist of a wastewater discharge line, a septic tank, and an absorption field.

Location and Installation

Location and installation of the system shall be such that, with reasonable maintenance, it will function in a sanitary manner and will not create a nuisance, health hazard or endanger the quality of any waters of the state. The proposed location of the system is shown on the attached map.

Construction Materials

All materials used in the construction of the system shall be durable, sound and not unduly subject to corrosion. Pipe, pipe fittings and similar materials shall comply with the requirements of the Utah Plumbing Code.

Wastewater Drainage Line

This line will convey wastewater from the bathhouse to the septic tank. The following criteria will be followed in the installation of this line:

1) It shall be of suitable, approved material and will have watertight and root-proof joints.
2) It will have an inside diameter of 4 inches, and will be laid on a minimum grade of 15 inches per 100 feet.
3) Cleanouts will be installed every 50 feet and at all changes in direction. Cleanouts will consist of 2-45° bends with cleanout.
4) Lines will not be closer than 10 feet horizontally to any water service pipes.

Wastewater Quantity Estimate

Since no actual figures are available for this operation, discharge quantity has been estimated from discussions with Mr. Gerald Story. This discussion determined an estimated usage of 35 gallons per day per person. Using the projected manning of 45 people, the estimated daily wastewater will be:

45 men x 35 gallon/man/day = 1,575 gallons/day.

Septic Tank

The septic tank shall be constructed of durable material designed to withstand expected physical loads and corrosive forces. It shall be designed to provide settling of solids, accumulation of sludge and scum, and access for cleaning.

The septic tank herein proposed is a standard, approved concrete type, sold commercially under the name of Duracrete. This tank will meet all requirements of Parts V-13 through V-20 of Part V, Small Underground Wastewater Disposal Systems. A detailed drawing of this proposed tank is attached.

Septic tank sizing is based on the following formula: V=1,125 + 75%Q. Since Q is expected to be 1,575 gallons per day, V=1,125 + 0.75 (1,575) or 2,306.25 gallons. The proposed tank is therefore sized at a 2,500 gallon capacity to allow for an added safety factor.

Discharge Line

The effluent from the septic tank will be conducted to the absorption field, through a watertight line meeting the requirements for house sewers. Outlet inverts will be at least 1 inch below the inlet invert.

Absorption Field

1) Soil Exploration: The attached drawing shows a 10' deep soil exploration test in the proposed drainfield area. This test assures at least 4' of soil between the base of the proposed absorption system and bedrock.

2) Installation: The field is proposed to be placed level, with all trenches interconnected.

3) Sizing: The percolation rate for this area is found to be 17 minutes per inch. A copy of the percolation test report is attached. Based on this rate, an allowable rate of application to the field will be 1.2 gallons per square foot per day, requiring a minimum of 1,312.5 square feet of absorption area for the expected wastewater discharge of 1,575 gallons per day. The proposed field will consist of 4-100' long x 36" wide trenches, separated by a minimum of 7.5' of undisturbed earth (wall to wall). This will provide an absorption area of 1,335 square feet, including side trenches, slightly more than

required.

4) Criteria: The absorption field will consist of gravel filled trenches provided with perforated pipes to distribute septic tank effluent in the gravel fill, from which it will percolate through the trench walls and bottom into the surrounding sub-surface soil.

a) The portion of the trenches below the distribution lines shall be in natural or acceptably stabilized earth.

b) The proposed system will be level, with all trench bottoms constructed at the same elevation. Distribution lines and trenches will be level and interconnected.

c) Effluent distribution lines shall be 4" diameter, perforated pipe of suitable material.

d) The gravel fill in the trench shall be of ½" to 2½" drain rock, and will completely encase the distribution pipe. The gravel will be covered with untreated building paper or straw prior to backfill.

e) Heavy equipment will not be driven over the trenches during backfilling or after completion of the absorption field.

Percolation Test

for

Pinnacle Mine

The following percolation test was run at 2 points within the proposed drainfield site for Tower Resources' Pinnacle Mine on May 2, 1980. The test was performed by Mr. Mike Glasson, under the direction of Dan W. Guy, a registered professional engineer, State of Utah.

The test was performed as follows:

1) 2 holes were dug in the area of the proposed absorption field. Each hole was 6 inches in diameter, with vertical sides, and dug to the depth of the bottom of the proposed field. Hole locations are shown on the enclosed map.
2) The sides and bottom of each hole was roughened, and all loose materials were removed. Two inches of coarse sand were placed in the bottom of each hole to prevent scouring.
3) The holes were filled with water greater than 12 inches above the sand, and each hole was kept filled for 4 hours.
4) The water level was adjusted to 6 inches over the sand. The drop in water level was then measured from a fixed reference point, at 30 minute intervals for a period of 4 hours. The

water level was brought back to a depth of 6 inches after each measurement.

5) The drop during the final 30 minute period was used to calculate the percolation rate.

6) The following table is a tabulation of all measurements:

NORTH HOLE

Measurement No.	Time (start 11:42)	Water Level Drop
1	12:12	3-7/8"
2	12:42	3-1/4"
3	1:12	2-7/8"
4	1:42	2-3/8"
5	2:12	1-7/8"
6	2:42	1-3/4"
7	3:12	1-3/4"
8	3:42	1-3/4"

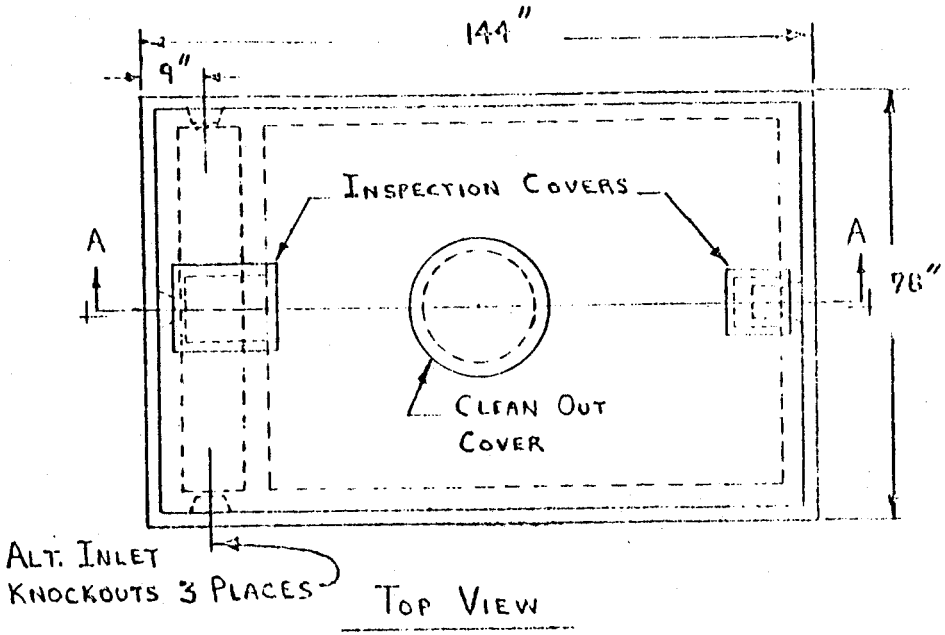
SOUTH HOLE

Measurement No.	Time (start 11:50)	Water Level Drop
1	12:20	3-1/8"
2	12:50	2-5/8"
3	1:20	2-1/4"
4	1:50	2 "
5	2:20	1-3/4"
6	2:50	1-3/4"
7	3:20	1-3/4"
8	3:50	1-3/4"

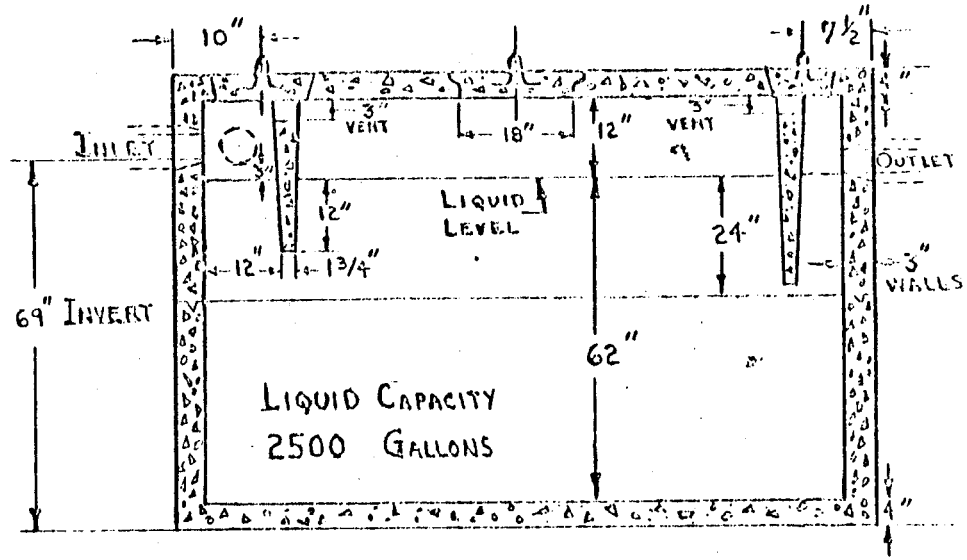
The preceding table of readings shows a percolation rate of 1.75" per 30 minute period, or a rate of 17.14 minutes per inch. Using the table (Figure V-1) on page 12 of "Small Underground Wastewater Disposal Systems", the allowable rate of application is 1.2 gallons per square foot per day.

The percolation test was run under the direction of a registered professional engineer, and is hereby certified to be a true and accurate representation of the percolation capabilities of the sites herein described.

REGISTERED PROFESSIONAL ENGINEER
No. 4548
DAN W. GUY
STATE OF UTAH



TOP VIEW

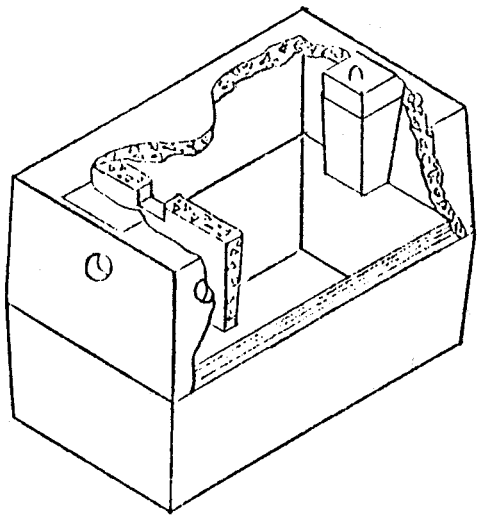


SECTION A-A

NOTE:

CAPACITY – 2500 GALLONS
WEIGHT – 28000 POUNDS
EXCAVATION DIMENSIONS – 9'X 15'
FLOW LINE – 5'-9"

SEALED WITH ASPHALT ROPE AND REINFORCED WITH 4"X 4" - 4 X 4 WELDED FABRIC



CUTAWAY ISOMETRIC

2500 GALLON - TWO PEICE SEPTIC TANK

SCALE: NONE	APPROVED BY:	DRAWN BY
DATE: 4-29-74		REVISED

DURA - CRETE, INC.

1495 W. 3500 S. SALT LAKE CITY, UT

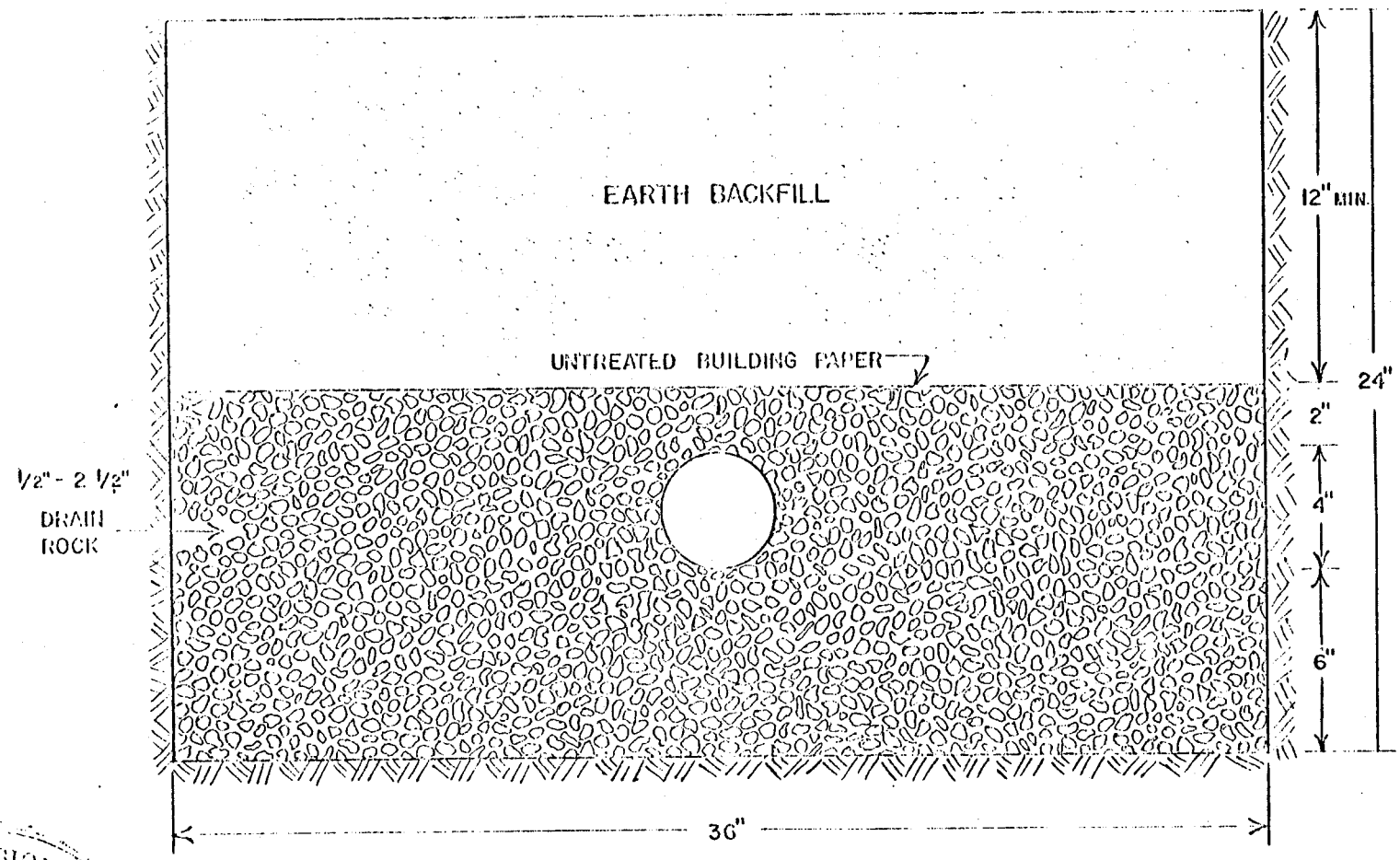
DRAWING NUMBER

PHONE NO. 262-1140

TOWER RESOURCES, INC.

PRICE, UTAH

PINNACLE MINE



TRENCH DETAIL

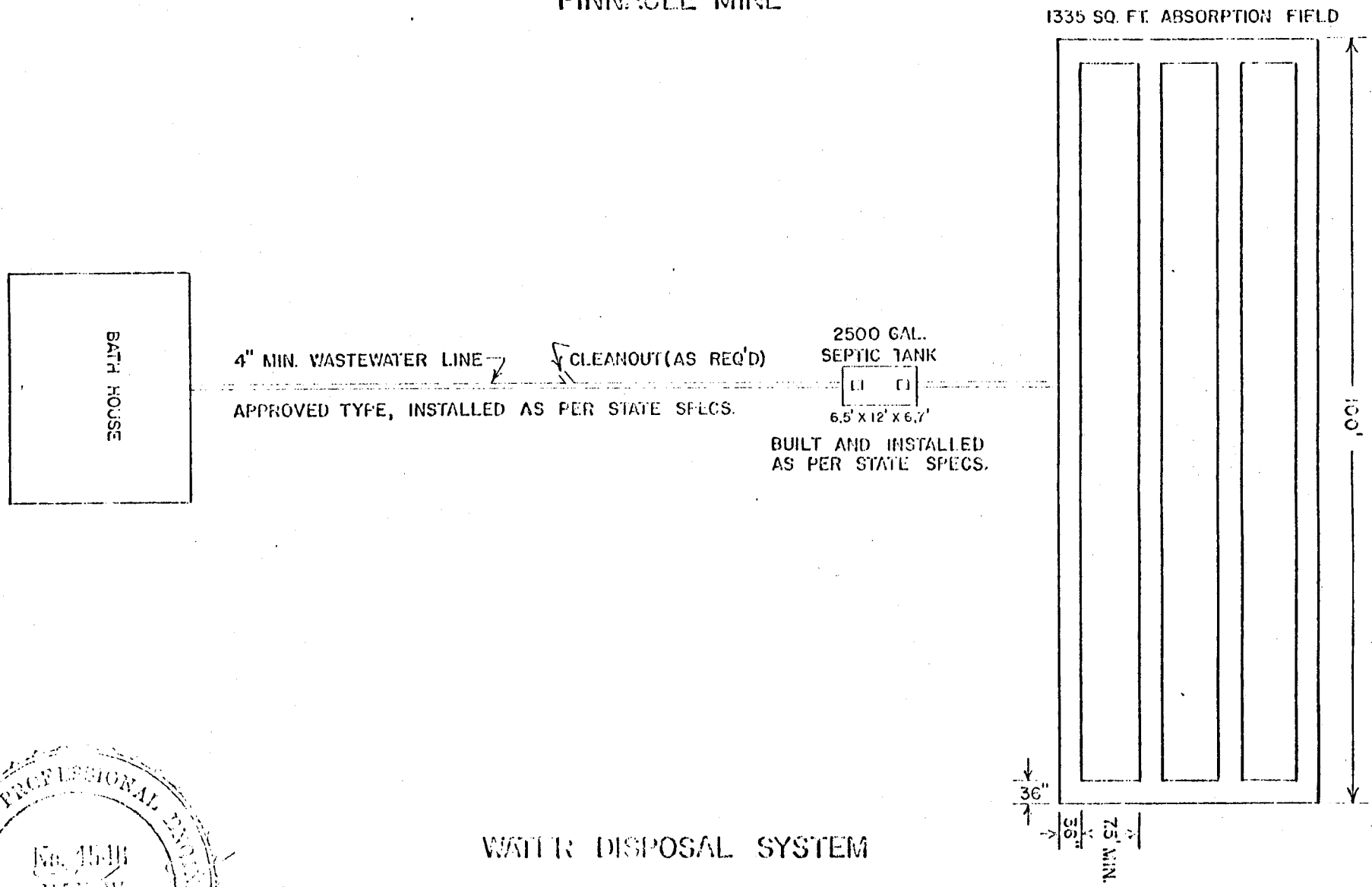
SCALE 1" = 6"
DATE 4-7-80

REGISTERED PROFESSIONAL ENGINEER
No. 4548
UTAH

TOWER RESOURCES, INC.

PRICE, UTAH

PINNACLE MINE



WATER DISPOSAL SYSTEM

DATE: 4-6-80

SCALE AS SHOWN

EXHIBIT III-E

EMISSION INVENTORY

Emission Inventory

Table 1 shows all of Tower's potential Point & Non-fugitive and Fugitive particulate emission sources. These sources were arrived at using EPA's Region VIII interim policy paper. Some of the emission sources described in that paper do not apply to Tower's operation since this inventory is for those surface sources relating to underground mining rather than sources resulting from surface mining operations. Unrelated sources include blasting, overburden & topsoil removal, drilling, overburden & topsoil shaping and topsoil & overburden stockpile erosion.

Sources which relate to Tower's underground mining facility can be controlled to a large degree. Some methods of control which are pointed out in the interim policy paper are: spray systems, enclosures, and minimizing drop distances. This control can be accomplished by maintaining a stockpile which effectively minimizes the drop distance. These controls have efficiencies of anywhere from 25 to 90%.

Table 2 shows the worst case emission sources, the EPA formula used to calculate emissions, the control methods to be used and the control efficiency where:

s = silt content of all weather gravel surface (17%) or, silt content of coal (8%)

S = average speed traveled over roads (40 mph)

W = wet days per year $\geq$0.01 ppt (37.25)

U = average wind speed (4.13 meters/sec., 9.2 mph)

A = rock & gravel or clay factor (0.025)

I = 38 tpy (rock & gravel), 47 tpy (clay) } 42.5 tpy

K = 1.0

C = 0.5

L' = 1.0

V' = 1.0

W = vehicle weight in tons, pick up (2.5)

d = dry days per year (327.75)

Y = loader, truck, or railcar capacity (10, 41, 148 yd^3 respectively)

M = moisture content of coal (10%)

Table 3 shows average wind speeds and precipitation for this area, based on U.S. Weather Bureau statistics, gathered at the Price Area Bureau of Land Management Office.

Table 4 shows the potential versus controlled emissions for Tower's 1.5 million tpy mine. Following Table 4 are calculations showing the emission source, the EPA formula used and the potential emissions given in tons per year, lbs. per hour and lbs. per day.

TABLE 1

Emission Inventory

The emissions as related to Tower's underground mining can be subdivided into four major categories, as follows:

A. Coal Handling, Processing and Transportation

1. Fugitive

a. Haul Roads
b. Paved Roads

2. Point and Non-fugitive

a. Conveyor Belts
b. Crushing
c. Truck Loading
d. Truck Dumping
e. Coal drop (transfer)
f. Railcar Loading
g. Screening

B. Wind Erosion

1. Fugitive

a. Coal Storage Piles
b. Disturbed Areas

C. Personnel and Support Access

1. Fugitive

a. Access Roads

D. Road Maintanence

1. Fugitive

a. Haul Roads
b. Access Roads

TABLE 2

Worst Case Emission Rates

Emission Source	EPA Formula	Control	Control Efficiency
1. Point & Non-fugitive			
A. Coal Handling			
1. Conveyors	0.05 lbs./ton	10% mine run moisture content	40%
2. Transfers	0.15 lbs./ton		
3. Truck Loading	$0.0018 \frac{(s/5)\ (U/5)}{(M/2)^2 (Y/6)}$		
4. Truck Dumping			
5. Rail Car Loading			
B. Coal Processing			
1. Crushing			
a. Primary	0.05 lbs./ton	covered (enclosed)	90%
b. Secondary	0.15 lbs./ton		
2. Screening	0.15 lbs./ton	water spray	50%

TABLE 2, Continued

Worst Case Emission Rates

Emission Source	EPA Formula	Control	Control Efficiency
2. Fugitive Dust			
A. Haul Roads	$0.81\ s\ (S/30)\ \frac{(365-W)}{(365)}$ lbs./VMT	Watering @ shift changes	50%
B. Paved Roads	0.01345 lbs./VMT		
C. Wind Erosion			
1. Storage Piles	1.6 u lbs./acre-hr.	Chemical stabilization on dead storage	25%
2. Disturbed Areas	AIKCL'V' tons/acre/year		
D. Access Roads	$5.9\ (s/12)(S/30)(W/3)^{.8}$ (d/365) lbs./VMT	Restrict speed, water @ shift	60%
E. Haul & Access Road Maintenance	32 lbs./hr. grader use	Post maintenance watering	40%

TABLE 3

Precipitation - (days per year with > 0.01")

	1974	1975	1976	1977
Jan.	7	5	0	1
Feb.	1	4	2	2
March	0	4	1	0
April	1	0	3	3
May	0	4	4	9
June	0	9	1	3
July	7	6	4	7
Aug.	2	2	3	6
Sept.	1	4	8	4
Oct.	8	2	2	3
Nov.	2	3	0	2
Dec.	3	1	0	5
	32	44	28	45

avg. = 37.25 (yearly)

Wind Speed (mph)

Jan.	7.2
Feb.	8.2
March	10.5
April	9.8
May	10.2
June	9.3
July	10.3
Aug.	9.3
Sept.	10.6
Oct.	8.4
Nov.	8.7
Dec.	8.3

Avg. = 9.2 mph = 4.13 meters/sec.

Source: U.S. Weather Bureau

TABLE

Summary of Potential and Controlled Emissions

1.5 Million Ton per Year

Point and Non-fugitive Sources

"Worst Case"

Point & Non-fugitive Sources	Potential TPY	Potential lbs/day	Potential lbs/hr	Control (%)	Controlled TPY	Controlled lbs/day	Controlled lbs/hr
A. Coal Handling							
1. Conveyors	37.5	205.5	8.6	40	22.5	123.3	5.16
2. Transfer	112.5	616.4	25.7	40	67.5	369.84	15.42
3. Truck Loading	0.3	1.6	0.1	---	0.3	1.6	0.1
4. Truck Dumping	0.02	0.1	0.01	--	0.02	0.1	0.01
5. Railcar Loading	0.006	0.04	0.001	---	0.006	0.04	0.001
B. Coal Processing							
1. Crushing							
a. Primary	37.5	205.5	8.6	90	3.75	20.55	.86
b. Secondary	112.5	616.4	25.7	90	11.25	61.64	2.57
2. Screening	112.5	616.4	25.7	50	56.25	308.2	12.85
Totals:	412.83	2261.50	94.4	64	161.58	885.27	36.97

TABLE 4, Continued

"Worst Case"

Fugitive Sources	Potential TPY	Potential lbs/day	Potential lbs/hr	Control (%)	Controlled TPY	Controlled lbs/day	Controlled lbs/hr
A. Coal Transportation							
1. Haul Roads	70.0	583.6	24.3	50	35.0	291.8	12.2
2. Paved Roads	2.1	17.5	0.7	--	2.1	17.5	0.7
B. Wind Erosion							
1. Storage Piles							
a. Minesite	6.1	33.3	1.4	25	4.6	25.0	1.1
b. Railroad Loadout	16.5	90.4	3.8	25	12.4	67.8	2.9
2. Disturbed Areas							
a. Minesite	1.2	6.8	0.3	--	1.2	6.8	0.3
b. Railroad Loadout	3.7	20.3	0.8	--	3.7	20.3	0.8
C. Personel & Support Access							
1. Access Roads	13.1	72.0	3.0	60	5.2	28.8	1.2
D. Road Maintanence							
1. Haul & Access Roads	6.7	36.5	1.5	40	4.0	21.9	0.9
Totals:	119.4	860.4	35.8	43	68.2	479.9	20.1

CALCULATIONS

POINT AND NON-FUGITIVE SOURCES

1.5 MILLION TONS PER YEAR

A. Coal Handling

1. Conveyors

EF = 0.05 lbs./ton x 1.5 million tons/year

EF = 75,000 lbs./year ÷ 2,000 lbs./ton

EF = 37.5 tons/year ÷ 365 days/year

EF = .10 tons/day x 2,000 lbs./ton

EF = 205.5 lbs./day ÷ 24 hrs./day

EF = 8.6 lbs./hr.

2. Coal Transfer

EF = 0.15 lbs./ton x 1.5 million tons/year

EF = 225,000 lbs./year ÷ 2,000 lbs./ton

EF = 112.5 tons/year ÷ 365 days/year

EF = .31 tons/day x 2,000 lbs./ton

EF = 616 lbs./day ÷ 24 hrs./day

EF = 25.7 lbs./hr.

3. Truck Loading (3 locations)

$$EF = .0018 \frac{(s/5)(U/5)}{(M/2)^2(Y/6)} \text{ lbs./ton}$$

Where: $s = 8\%$

$U = 9.2$ mph

$M = 10\%$

$Y = 10\ yd^3$ (loader)

$$\therefore EF = .0018 \frac{(8/5)(9.2/5)}{(10/2)^2(10/6)} \text{ lbs./ton}$$

EF = .0001 lbs./ton x 3 locations

EF = .0004 lbs./ton x 1.5 million tons/year

EF = 572 lbs./year ÷ 2,000 lbs./ton

EF = <u>0.3 tons/year</u> ÷ 365 days/year

EF = .0008 tons/day x 2,000 lbs./ton

EF = <u>1.6 lbs./day</u> ÷ 24 hrs./day

EF = <u>0.1 lbs./hr.</u>

4. Truck Dumping (1 location)

$$EF = .0018 \frac{(s/5)(U/5)}{(M/2)^2(Y/6)} \text{ lbs./ton}$$

Where $Y = 41\ yd^3$ (28 ton truck)

$$\therefore EF = .0018 \frac{(8/5)(9.2/5)}{(10/2)^2(41/6)} \text{ lbs./ton}$$

EF = .00003 lbs./ton x 1.5 million ton/year

EF = 47 lbs./year ÷ 2,000 lbs./ton

EF = <u>0.02 tons/year</u> ÷ 365 days/year

EF = .0001 tons/day x 2,000 lbs./ton

EF = <u>0.1 lbs./day</u> ÷ 24 hrs./day

EF = <u>0.01 lbs./hr.</u>

5. Railcar Loading (1 location)

$$EF = .0018 \frac{(s/5)(U/5)}{(M/2)^2(Y/6)} \text{ lbs./ton}$$

Where $Y = 148\ yd^3$ (100 ton railcar)

$$\therefore EF = .0018 \frac{(8/5)(9.2/5)}{(10/2)^2(148/6)} \text{ lbs./ton}$$

EF = .000009 lbs/ton x 1.5 million tons/year

EF = 12.9 lbs./year ÷ 2,000 lbs./ton

EF = <u>0.006 tons/year</u> ÷ 365 days/year

EF = 0.00002 tons/day x 2,000 lbs./ton

EF = <u>0.04 lbs./day</u> ÷ 24 hrs./day

EF = <u>.001 lbs./hr.</u>

Total Coal Handling (uncontrolled): <u>150.33 Tons/year</u>
<u>823.2 lbs./day</u>
<u>34.4 lbs./hr.</u>

B. Coal Processing

1. Coal Crushing

a. Primary

EF = 0.05 lbs./ton x 1.5 million tons/year

EF = 75,000 lbs./year ÷ 2,000 lbs./ton

EF = 37.5 tons/year ÷ 365 days/year

EF = .1 tons/day x 2,000 lbs./ton

EF = 205.5 lbs./day ÷ 24 hrs./day

EF = 8.6 lbs./hr.

b. Secondary

EF = 0.15 lbs./ton x 1.5 million tons/year

EF = 225,000 lbs./year ÷ 2,000 lbs./ton

EF = 112.5 tons/year ÷ 365 days/year

EF = .3 tons/day x 2,000 lbs./ton

EF = 616.4 lbs./day ÷ 24 hrs./day

EF = 25.7 lbs./hr.

2. Coal Screening

EF = 0.15 lbs./ton x 1.5 million tons/year

EF = 225,000 lbs./year ÷ 2,000 lbs./ton

EF = 112.5 tons/year ÷ 365 days/year

EF = .3 tons/day x 2,000 lbs./ton

EF = 616.4 lbs./day ÷ 24 hrs./day

EF = 25.7 lbs./hr.

Total Coal Processing (uncontrolled): 262.5 tons/year
1438.3 lbs./day
60.0 lbs./hr.

B. Coal Processing

1. Coal Crushing

a. Primary

EF = 0.05 lbs./ton x 1.5 million tons/year

EF = 75,000 lbs./year ÷ 2,000 lbs./ton

EF = 37.5 tons/year ÷ 365 days/year

EF = .1 tons/day x 2,000 lbs./ton

EF = 205.5 lbs./day ÷ 24 hrs./day

EF = 8.6 lbs./hr.

b. Secondary

EF = 0.15 lbs./ton x 1.5 million tons/year

EF = 225,000 lbs./year ÷ 2,000 lbs./ton

EF = 112.5 tons/year ÷ 365 days/year

EF = .3 tons/day x 2,000 lbs./ton

EF = 616.4 lbs./day ÷ 24 hrs./day

EF = 25.7 lbs./hr.

2. Coal Screening

EF = 0.15 lbs./ton x 1.5 million tons/year

EF = 225,000 lbs./year ÷ 2,000 lbs./ton

EF = 112.5 tons/year ÷ 365 days/year

EF = .3 tons/day x 2,000 lbs./ton

EF = 616.4 lbs./day ÷ 24 hrs./day

EF = 25.7 lbs./hr.

Total Coal Processing (uncontrolled): 262.5 tons/year
1438.3 lbs./day
60.0 lbs./hr.

Grand Total Non-fugitive (uncontrolled): 412.8 tons/year

2261.5 lbs./day

94.4 lbs./hr.

FUGITIVE SOURCES

1.5 MILLION TONS PER YEAR

A. Coal Transportation

1. Haul Roads

$$EF = 0.81\ s\ (S/30)\ \frac{(365 - W)}{(\ 365\ )}\ \text{lbs./VMT}$$

Where: s = 0.17

S = 40 mph

W = 37.25

VMT = vehicle miles travelled

∴ EF = 0.165 lbs./VMT

@ 8.51 miles and 208 round trips/day

= 3540.16 miles/day

∴ 0.165 lbs./VMT,

EF = 70.0 tons/year

EF = 583.6 lbs./day

EF = 24.3 lbs./hr.

2. Paved Roads

EF = 0.01345 lbs./VMT

@ 6.26 miles and 208 round trips/day

= 1302.08 miles/day

∴ @ 0.01345 lbs./VMT

EF = 2.1 tons/year

EF = 17.5 lbs./day

EF = 0.7 lbs./hr.

Total Coal Transportation (uncontrolled): 72.1 tons/year

601.1 lbs./day

25.0 lbs./hr.

B. Wind Erosion

1. Storage Piles

a. Minesite

EF = 1.6 u lbs./acre-hr.

Where u = 4.13 meters/sec.

∴ EF = 6.61 lbs./acre-hr.

@ 8760 hrs./year and .21 acres

= 1839.6 acre-year

∴ @ 6.61 lbs./acre-hr.

EF = 6.1 tons/year

EF = 33.3 lbs./day

EF = 1.4 lbs./hr.

b. Railroad Loadout

EF = 1.6 u lbs./acre-hr.

Where u = 4.13 meters/sec.

∴ EF = 6.61 lbs./acre-hr

@ 8760 hrs/year and .57 acres

= 4993.2 acre-hrs./year

∴ @ 6.61 lbs/acre-hr

EF = 16.5 tons/year

EF = 90.4 lbs./day

EF = 3.8 lbs./hr.

2. Disturbed Areas

a. Minesite

EF = AIKCL'V'

Where A = 0.025

I = 42.5

K = 1.0

C = 0.5

L'= 1.0

V'= 1.0

@ 2.35 acres

∴ EF = 0.53 tons/acre/year

EF = 1.2 tons/year

EF = 6.8 lbs./day

EF = 0.3 lbs./hr.

b. Railroad Loadout

EF = AIKCL'V'

EF = 0.53 tons/acre/year

@ 7.0 acres

∴ EF = 3.7 tons/year

EF = 20.3 lbs./day

EF = 0.8 lbs./hr.

Total Wind Erosion (uncontrolled): 27.5 tons/year

150.8 lbs./day

6.3 lbs./hr.

C. Personel & Support Access

1. Access Roads

$$EF = 5.9\ (s/12)\ (S/30)\ (W/3)^{.8}(d/365)\ \text{lbs./VMT}$$

Where s = 0.17

S = 40.0

W = 2.5

d = 327.75

@ 5.82 miles and 50 round trips/day

= 832.8 VMT/day

$\therefore$ EF = 0.09 lbs./VMT x 832.8 VMT/day

EF = <u>72.0 lbs./day</u>

EF = <u>13.1 tons/year</u>

EF = <u>3.0 lbs./hr.</u>

Total Personel & Support (uncontrolled): <u>13.1 tons/year</u>

<u>72.0 lbs./day</u>

<u>3.0 lbs./hr.</u>

D. Road Maintanence

1. Haul & Access Road Maintanence

EF = 32 lbs./hr. grader time

@ one 8 hr. shift/week and 52 weeks/year

= 416 hrs./year

$\therefore$ EF = 13,312 lbs./year ÷ 2000 lbs./ton

EF = <u>6.7 tons/year ÷ 365 days/year</u>

EF = 0.02 tons/day x 2000 lbs./ton

EF = <u>36.5 lbs./day ÷ 24 hrs./day</u>

EF = <u>1.5 lbs./hr.</u>

Total Road Maintanence (uncontrolled):	6.7 tons/year
	36.5 lbs./day
	1.5 lbs./hr.
Grand Total Fugitive (uncontrolled):	119.4 tons/year
	860.4 lbs./day
	35.8 lbs./hr.
Grand Total (uncontrolled) Fugitive & Non-fugitive:	533.1 tons/year
	3127.4 lbs./day
	130.4 lbs./hr.

APPENDIX C

(EXHIBITS IV A, B, C, AND D)

EXHIBIT IV-A

DRILL HOLE LOGS

Exhibit IV-A
Drill Logs

PROPERTY	(CENTENNIAL COAL ASSOCIATES) LARSON LEASE	D.H. NO. #6 (Page 1 of 3)
LOCATION	NW Corner of SE¼ of SW¼ Section 5, T13S, R11E, SLM Collar Elevation 8558	T.D. 2275
DATE BEGIN December 9, 1971		DATE COMPLETE March 22, 1972

LITHOLOGIC LOG

NQ Wireline
E. J. Longyear

GENERALIZED GEOLOGIC LOG OF DRILL HOLE #6

INTERVAL Depth	Thickness	DESCRIPTION
0 - 675'	675'	Rock bit. Limestone of Flagstal Formation, sandstones and shales of the North Horn Formation.
675' -1725'	1050'	Sandstones and shales interbedded, massive, typical of the North Horn, Price River, and Castlegate formations.
1725' -1756'	31'	Shale, gray to black, often carbonaceous.
1756' -1756'10"	0'10"	Coal
1756'10"-1784'	27' 2"	Sandstone, marbled gray to white, with occasional thin, shaley beds.
1784' -1784' 6"	0' 6"	Coal
1784' 6"-1798'10"	14' 4"	Shale, dark gray to black, organic.
1798'10"-1802' 9"	3'11"	Coal - LOWER SUNNYSIDE
1802' 9"-1879'	76' 3"	Sandstone, gray to marbled-gray and black, medium-grained, generally crossbedded.
1879' -1881' 2"	2' 2"	Coal - CENTENNIAL SEAM
1881' 2"-1886'11"	5' 9"	Shale, Black, carbonaceous.
1886'11"-1891' 4"	4' 5"	Shale, gray, sandy, organic.
1891' 4"-1894' 4"	3' 0"	Coal
1894' 4"-1918' 8"	24' 4"	Sandstone, marbled gray and white, fine-grained.
1918' 8"-1928'	9' 4"	Shale, gray.
1928' -1929'	1' 0"	Coal, dirty, poor quality
1929' -1937'	8' 0"	Shale, light gray to gray, sandy.
1937' -1956' 6"	19' 6"	Sandstone, marbled gray and white, fine-grained, varved.

PROPERTY	(CENTENNIAL COAL ASSOCIATES)	D.H. NO.
LARSON LEASE		#6 (Page 2 of 3)
LOCATION	NW Corner of SE¼ of SW¼ Section 5, T13S, R11E, SLM Collar Elevation 8558	T.D. 2275
DATE BEGIN December 9, 1971		DATE COMPLETE March 22, 1972

LITHOLOGIC LOG

NQ Wireline
E. J. Longyear

INTERVAL		DESCRIPTION
Depth	Thickness	
1956' 6"-1958' 6"	2' 0"	Coal
1958' 6"-1975' 6"	17' 0"	Shale, black, carbonaceous with thin coal seams and boney bands.
1975' 6"-1977'	1' 6"	Coal
1977' -1989'	12' 0"	Sandstone, white to dark gray, fine-grained, shaley.
1989 -1995	6' 0"	Shale.
1995' -1998'10"	3'10"	Coal - GILSON SEAM
1998'10"-1999' 1"	0' 3"	Shale, black, carbonaceous, boney.
99' 1"-2005'	4'11"	Shale, dark gray.
2005' -2006' 7"	1' 7"	Coal
2006' 7"-2025'	18' 5"	Shale, gray, with some carbonaceous matter.
2025' 5"-2028'10"	3' 5"	Sandstone, white, fine-grained with detrital material.
2028'10"-2029' 6"	0' 8"	Coal
2029' 6"-2031' 6"	2' 0"	Shale, gray.
2031' 6"-2042'	10' 6"	Sandstone and shale interbedded gray and white, varved.
2042' -2045'	3' 0"	Shale, gray.
2045' -2047' 6"	2' 6"	Coal, boney, poor quality.
2047' 6"-2066' 6"	19' 0"	Sandstone, white to gray, fine-grained, varved.
2066' 6"-2067' 6"	1' 0"	Coal
2067' 6"-2072' 6"	5' 0"	Shale, gray.
72' 6"-2083'	10' 6"	Sandstone, white to gray, fine-grained.
2083' -2100' 6"	17' 6"	Shale, gray to black, contains Pelecypods.

PROPERTY	(CENTENNIAL COAL ASSOCIATES) LARSON LEASE	D.H. NO. #6 (Page 3 of 3)
LOCATION	NW Corner of SE¼ of SW¼ Section 5, T13S, R11E, SLM Collar Elevation 8558	T.D. 2275
DATE BEGIN	December 9, 1971	DATE COMPLETE March 22, 1972

LITHOLOGIC LOG

NQ Wireline
E. J. Longyear

INTERVAL Depth	Thickness	DESCRIPTION
2100' 6"-2101' 6"	1' 0"	Coal
2101' 6"-2110' 6"	9' 0"	Sandstone, white to gray, fine-grained, shaley.
2110' 6"-2188'	77' 6"	Sandstone, gray, medium-grained, subrounded, crossbedded, 10-15% dark minerals. KENILWORTH SANDSTONE.
2188' -2204' 8"	16' 8"	Shale, gray, sandy.
2204' 8"-2205'11"	1' 3"	Coal
2205'11"-2207' 9"	1'10"	Boney, carbonaceous particles } UPPER ABERDEEN
2207' 9"-2211' 6"	3' 9"	Coal
2211' 6"-2252'	40' 6"	Sandstone, gray and white, very fine-grained, shaley.
2252' -2256' 3"	4' 3"	Coal - LOWER ABERDEEN SEAM
2256' 3"-2275'	18' 9"	Sandstone, gray, medium-grained, crossbedded, 5-7% dark minerals. ABERDEEN SANDSTONE.

Logged by Samuel Quigley
March 23, 1972

EXHIBIT IV-B

COAL SEAM ANALYSIS

Exhibit IV-B
Coal Seam Analysis

Tower Resources, Inc.

ABERDEEN SEAM:

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

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

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

AS RECEIVED	DRY BASIS
12,517	13,138

C. MINERAL ANALYSIS OF ASH:

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

D. PROXIMATE ANALYSIS:

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

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

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

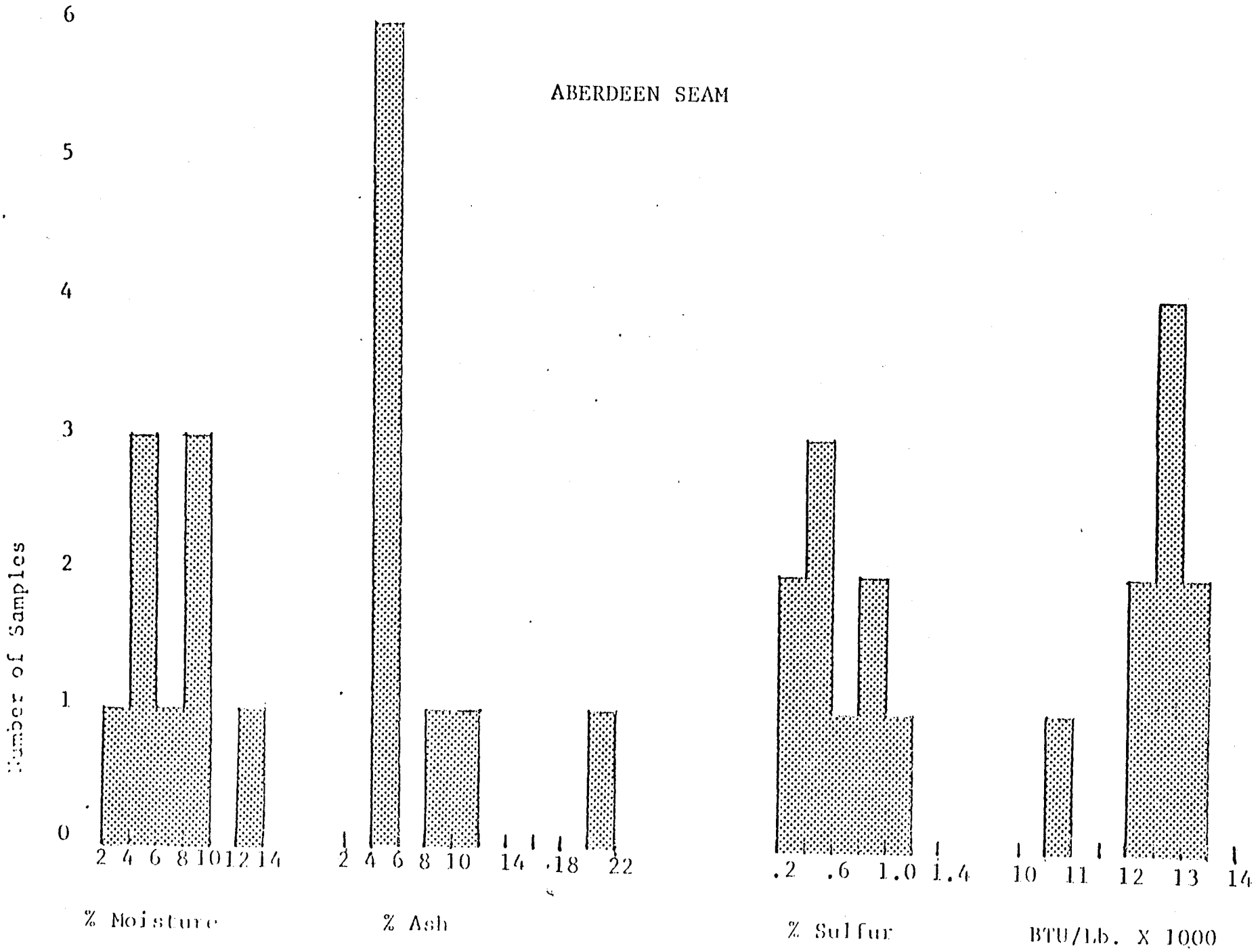
F. WATER SOLUBLE ALKALIES:
$Na_2O = 6.0 \times 10^{-5}\%$

G. ALKALI AS Na_2O OF THE ASH = 0.99%

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

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

I. GRINDABILITY (HARDGROVE INDEX) = 45.2


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

Tower Resources, Inc.

GILSON SEAM:

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

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

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

AS RECEIVED	DRY BASIS
12,124	12,777

C. MINERAL ANALYSIS OF ASH:

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

D. PROXIMATE ANALYSIS:

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

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

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

F. WATER SOLUBLE ALKALIES:

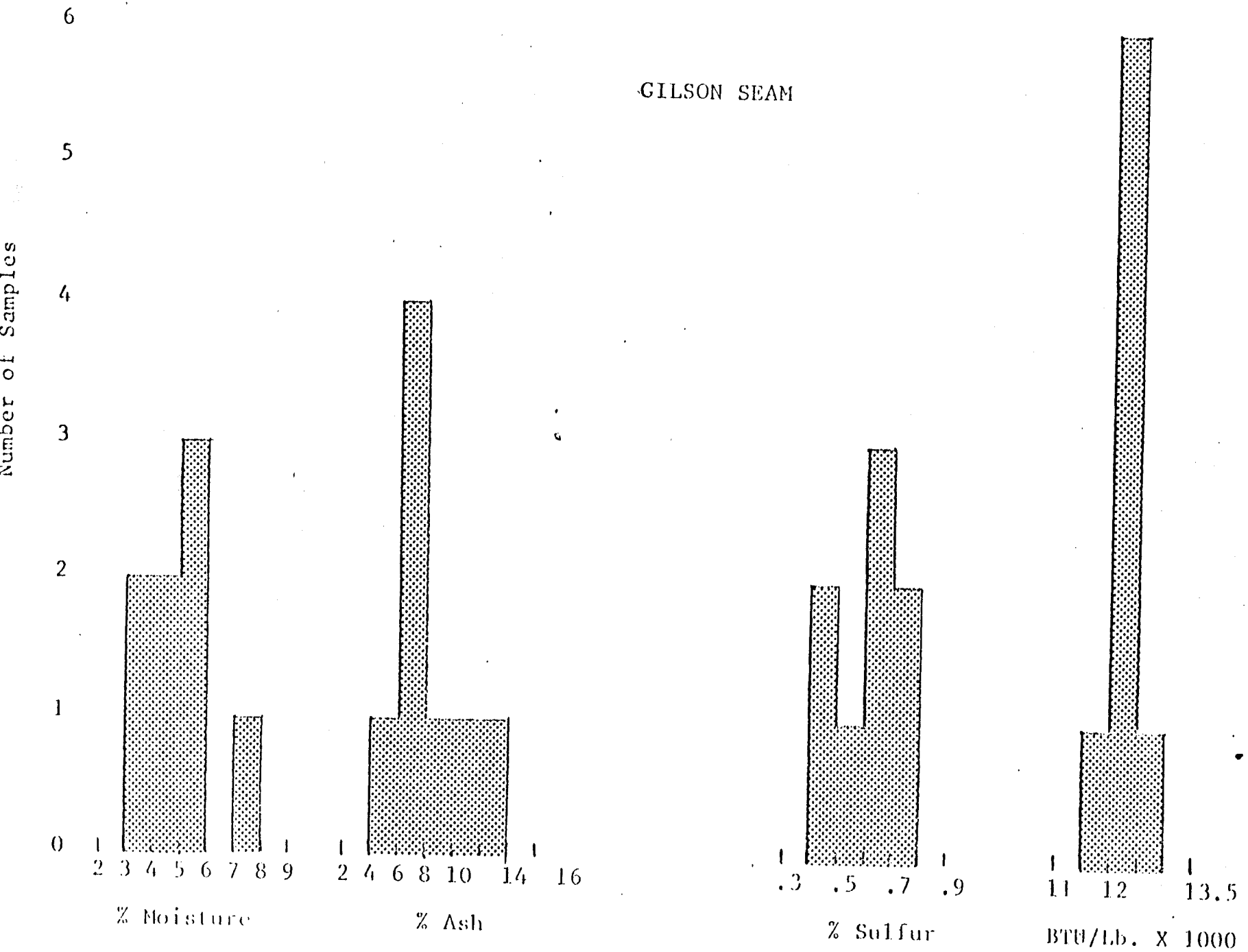
$Na_2O = 5.0 \times 10^{-5}\%$

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

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

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

I. GRINDABILITY (HARDGROVE INDEX) = 47.2


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

LOWER SUNNYSIDE SEAM:

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

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

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

AS RECEIVED	DRY BASIS
12,276	12,969

C. MINERAL ANALYSIS OF ASH:

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

D. PROXIMATE ANALYSIS:

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

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

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

F. WATER SOLUBLE ALKALIES:

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

G. ALKALI AS Na_2O OF THE ASH = 0.66%

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

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

I. GRINDABILITY (HARDGROVE INDEX) = 48.0

LOWER SUNNYSIDE SEAM

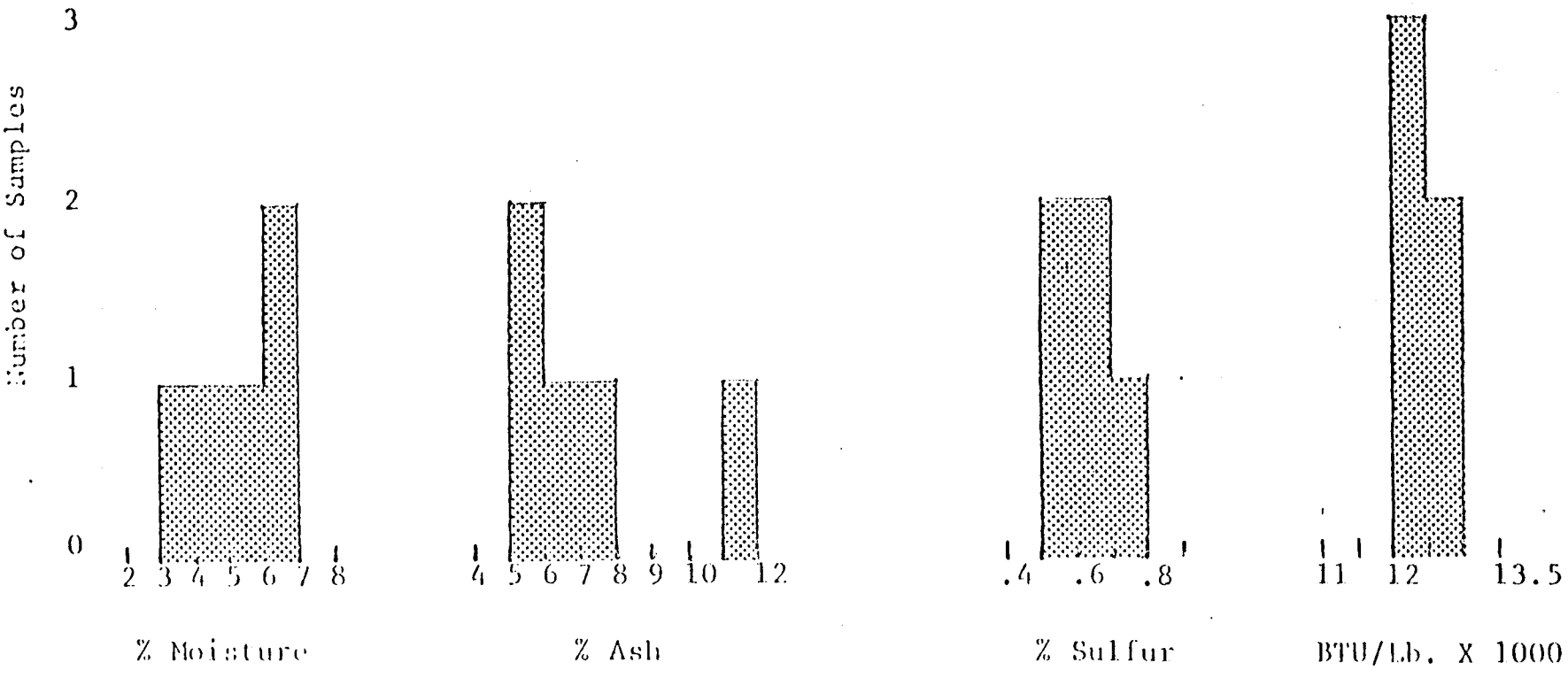


EXHIBIT IV-D

RAPTOR SURVEY

RAPTOR SURVEY OF THE RIGHT FORK
AND THE
STARPOINT FORK
OF
DEADMAN CANYON, AND STRAIGHT CANYON

FOR

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

TO

AMCA COAL LEASING
Walker Bank 2nd Floor, Room 1
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FROM

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INTRODUCTION

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

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

METHODS

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

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

HABITAT

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

FINDINGS

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

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

SPECIFIC OBSERVATIONS

April 29, 1980

Right Fork

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

Starpoint Canyon

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

April 30, 1980

Straight Canyon

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

May 9, 1980

Straight Canyon

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

May 9, 1980 (cont.)

Starpoint Canyon

1. adult Cooper's hawk flying high over canyon

May 23, 1980

Right Fork

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

Starpoint Canyon

1. American kestrel hunting near the mine area

Straight Canyon

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

June 6, 1980

Straight Canyon

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

June 6, 1980 (cont.)

Starpoint Canyon

1. kestrel in middle portion of canyon.

CONCLUSIONS, ASSESSMENT, AND RECOMMENDATIONS

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

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

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

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

LITERATURE CITED

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

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